

*Hand Book*

on

# **GENERAL AGRICULTURE**

(ICAR – JRF and Other Competitive Examinations)



**SC, ST, OBC & Minority Coaching Cell**



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## **Soil Science**

### **Introduction:**

- The term soil is derived from Latin word “Solum” means ‘Floor’ or ‘Ground’.
- Soil is the interphase between atmosphere and the mantle of rocks making up the earth’s crust called “lithosphere”.
- Regolith: All loose material above bedrock (the unconsolidated material of weathered rock and soil material).
- Soil Survey: Systematic examination, description and classification of soils.
- Pedology: Science dealing with genesis, survey, classification and laws of geographic distribution of soils as a body in nature.
- Edaphology: It is the study of soils from stand point of higher plants.

### **Rocks:**

- “Rocks” are defined as the aggregates of one (or) more minerals.  
Eg: Limestone – aggregation of calcite mineral.
- Rocks have no definite chemical, morphological composition or definite symmetrical form like minerals.
- Based on origin, rocks are classified as
  1. Igneous rocks
  2. Sedimentary rocks
  3. Metamorphic rocks.
- I. Igneous rocks:
  - These are the most abundant and makeup 95% of all the earth crust.
  - Igneous rocks are “oldest rocks” and are also known as “crystalline (or) massive (or) fire rocks.
  - These rocks mainly consist of primary minerals and more than half of the igneous rock is containing “feldspar” minerals.
  - Igneous rocks based on their mode of formation are divided into two groups.
    - a. Extrusive (or) volcanic rocks: These are formed at the surface from the volcanic magma. Eg: Basalt, diorite
    - b. Intrusive (or) plutonic rocks: These are formed by the cooling of the original magma and occur below the earth crust. Eg: Granite.
  - Igneous rocks are also classified based on their chemical composition.
    - a. Acid rocks – contain more than 65% silica – Granite.
    - b. Neutral rocks – contain 50% - 65% silica – Diorite.
    - c. Basic rocks – contain less than 50% silica – Basalt.
- II. Sedimentary rocks: These rocks are formed through the transportation and deposition of weathered sediments. The sedimentary rocks are mostly formed through the agency of water, which are called clastic, aqueous or stratified rocks. Based on origin, sedimentary rocks are classified into 4 groups.
  1. Residual sediments: These are formed from the products of weathering in situ that is at same place. Eg: Laterite, bauxite.
  2. Mechanical sediments: These are formed due to the deposition of pebbles, sand and silt. Eg: Sandstone, shale.

3. Chemical sediments: These are formed due to evaporation of water, precipitation and consequent accumulation of sediments.  
Eg: Limestone.
4. Organic sediments: These are formed due to partial decomposition of organic remains under anaerobic conditions.  
Eg: Peat

**III. Metamorphic rocks:** These are formed from the rocks by the action of heat and pressure on pre-existing igneous and / or sedimentary rocks.

Eg: Sandstone – Quartzite, Shale – Slate, Limestone – Marble, Granite – Gneiss, Basalt – Schist, Coal – Graphite.

**Minerals:** A mineral is a naturally occurring, homogenous element or inorganic compound that has a definite chemical composition and a characteristic geometric form. The minerals can be identified by many of their physical properties like colour, lustre, streak, hardness etc.

- Lustre – general appearance of mineral in reflected light.
- Fracture – property of the mineral to break along an irregular surface i.e., surface produced when the mineral breaks in direction other than cleavage plane.
- Streak – The colour of the powder of the mineral that is obtained by rubbing the mineral against the unglazed porcelain plate.

Soil forming minerals mainly belong to the group of aluminosilicates. Minerals are classified based on quantity (essential and accessory), origin (primary and secondary), specific gravity (light and heavy) and chemical composition (native elements, oxides, sulphates, sulphides, carbonates, halides, silicates).

Primary minerals – They are the original components of the rock, which have not been altered chemically. They are formed from crystallization of magma (molten mass).  
Eg: Quartz, feldspar etc.

Secondary minerals – are resulted from the decomposition and / or alteration of primary minerals. These are formed due to subsequent changes in the rocks.  
Eg: All clay minerals like kaolinite, illite except micas. Micas are primary minerals.

Minerals which form the chief constituent of rock and regarded as the characteristic components of the rock are known as “Essential Minerals”. Eg: Quartz and feldspars.

Accessory minerals : The minerals which occur in small quantity in rocks They are not concerned for naming or the nomenclature of the rocks. Such minerals are called as “accessory minerals”. Eg: Apatite, pyrite, magnetite etc. These are not required for the formation of any rock.

#### **Primary silicate minerals:**

- Quartz –  $\text{SiO}_2$ .
- Potash feldspar (Orthoclase) –  $\text{KAlSi}_3\text{O}_8$ , Soda feldspars (Albite) –  $\text{NaAlSi}_3\text{O}_8$ .

- Lime feldspar (Anorthite) –  $\text{CaAl}_2\text{Si}_2\text{O}_8$ ; Albite and anorthite combine to form plagioclase or soda lime feldspars.
- Feldspars are easily attacked by “water containing  $\text{H}_2\text{CO}_3$ ”. The weathering process is called as carbonation.
- Plagioclase weathers more rapidly than orthoclase.  
Orthoclase is commonly occurring feldspar mineral in acid igneous rocks.
- Micas are the double silicates of K and Al with or without iron. These are plate like structures.
  1. Muscovite (white mica) –  $\text{KAl}_3\text{Si}_3\text{O}_{10}(\text{OH})_2$
  2. Biotite (black mica) – occurs both in acidic and basic rocks.
  3. Phlogopite – Occurs as a primary mineral in igneous rocks.  
Biotite is easily weatherable than muscovite.
- Pyroxenes and amphiboles: These are the double silicates of Fe, Mg, Al and Ca.
- Pyroxene – Augite (dark green)
- Amphibole – Hornblende (green - black)
- Olivines are the “thin silicates of Fe and Mg”. Eg: Fayalite, forsterite.
- Sedimentary rocks have more of secondary minerals.
- Muscovite alters to “hydrous mica”.
- The insoluble residual material left behind during weathering is called as “saprolite”.
- The phenomenon of weathering of surface layer of rocks due to differential co-efficient of expansion and contraction leading to ultimate disintegration is called “exfoliation”.
- The material deposited due to melting of ice or glacier in warm regions forms a structureless mass and is termed “moraine or till”.
- Chemical weathering of feldspar produces clay mineral.
- Basalt decomposes more easily than granite.
- Ease of weathering of minerals  
Quartz > Feldspar > Micas > Olivines > Hornblende.
- Weathering is a destructive process whereas soil formation is a constructive process in nature.
- Relief: It is defined as the elevations and inequalities of a land surface considered collectively. “Topography” is similar to relief to be used on contour maps.
- The time devoted by nature to the formation of soil is known as “pedogenic time”.
- The process leading to the development of “soil profile” is called “pedogenic process”.
- “Humification” is the process of decomposition of raw O.M into humus. This process usually takes place in surface or O horizon.
- ‘Eluviation’ is the process of removal of constituents by percolation from upper layer to lower layer (wash out).
- “Illuviation” is the deposition of dissolved material in the lower layers (wash in).
- “Podzole” means ash like under. Podzolisation is humid temperate type of soil forming process. It is opposite to “calcification”.
- Laterization is the process of soil formation in tropics and sub-tropics. Laterization is the process of removal of “silica” instead of “sesquioxides” from the upper layers.
- Laterization and podzolisation form soils belonging to the group of “pedalfer”.
- “Calcification” occurs in areas where there is insufficient rainfall.
- The soils which are having high saturation of ‘Ca’ are called as “pedocals”.
- “Decalcification” is the removal of ‘Ca’ ions (or)  $\text{CaCO}_3$  by leaching.
- “Cation exchange capacity” is expressed as me/100 g of soil or  $\text{cmol (p) kg}^{-1}$  soil.

- Soil cations are sometimes called as “swarm ions” because they resemble swarm of bees around a beehive.
- The area in which the ions are moving around root (or) clay particle in soils is called “oscillation zone”.
- CEC of kaolinite increases as the pH of soil increases.

$$\% \text{ of base saturation} = \frac{\text{Total exchangeable bases (m.e/100 g.soil)}}{\text{CEC}} \times 100$$

- Arid region soils have high B.S than soils of humid region.
  - Soils which have higher B.S one dominated by 2:1 clay minerals like montmorillonite, vermiculite, chlorite, micas.
  - Anion exchange is more in soils high in 1:1 clay.
  - Acid soils are poor in available Ca and Mg.
  - Availability of ‘S’ is not affected by soil reaction as the sulphur compounds are soluble in whole pH range.
  - When pH is low, solubility of Fe, Mn, Al increases.
  - Availability of B, Cu, Zn is reduced when the pH is increased.
  - Availability of Mo is reduced in acid soils.
  - “Buffering” refers to resistance to slight change in pH.
  - The power to resist slight change in pH is called “buffer action”.
  - Horizons in a soil profile are broadly divided into 4 groups and are called A, B, C, D.
  - AB horizons are collectively called as ‘solum’. The solum together with parent material is called “soil profile”.
  - “Horizon” – A layer of soil approximately parallel to the land surface.
  - The diagnostic surface horizons are called “epipedons”.
  - When larger mineral particles dominate, soil is said to be “gravelly” (or) sandy. When the mineral colloids dominate it is “clayey”.
  - Compact soils and sandy soils have high bulk density.
  - B.D. is more in lower layers of the profile because of less O.M.
  - Addition of organic matter lowers the B. D and increases the porespace.
  - Due to leaching of Fe compounds due to high rainfall, “grey (or) grey brown” soils are formed.
  - Hue – refers to the dominant spectral colours.
  - Value – refers to the relative lightness (or) darkness of colour.
  - Chroma – relative purity of a colour.
  - “Soil consistence” is a dynamic property of soils which is expressed by the degree and kind of “cohesion and adhesion”.
  - Non – exchangeable cations in montmorillonite – Mg, illite – K.
  - The organic matter on decomposition gets modified and acquires the properties of “Colloids”.
  - “Soil survey” is the study and mapping of soils in their natural environment.
  - “Remote sensing” is the science and art of acquiring the information about objects from distance without physically going in contact with the object.
  - Pedalfers – Accumulation of iron – aluminium in soils under high rainfall.  
Pedocals – Accumulation of ‘Ca’ – in areas of low rainfall
1. Alfisols – They are characterized by clay enriched Bt horizon.

2. Vertisols – These soils are black soils – Inversion of soil occurs in the profile.
3. Aridisols – These are the soils of dry regions.
4. Mollisols – These are developed under grassland vegetation.
5. Histols – These are the organic soils developed under water saturated environment.
6. Oxisols – These are very strongly weathered mineral soil.
7. Ultisols – These are the soils of low base status.
8. Spodosols – These are the mineral soils with accumulation of humus and sesquioxides.
9. Entisols – These are recently developed mineral soils horizonisation.

- In soils, bauxite is the dominant oxide of aluminium.
- Bluish and greenish colour of soil indicate ill drained condition.
- The porosity and permeability of 1:1 clay mineral is high.
- Ca & Mg have specified role of flocculation.
- Total pore space is more in “clayey soils”.
- Many fungi are soil inhabitants living as saprophytes on dead organic matter.
- A larger proportion of plant nutrient present in the soil are in organic form.
- The CEC of inorganic colloids is less than organic colloids.
- Saline soils are dominated by chlorides and sulphates.
- The hydrogen ion concentration of soil solution is called – Active acidity.
- Limonite –  $2\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ .
- Climate and biosphere are the active factors involved in the soil formation.
- Humus theory was proposed by “von Liebig”.
- The number of textural classes in the textural triangle is 12.
- The steps involved in the development of soil structure are flocculation and aggregation.
- In the arid regions with imperfect drainage, the most preferred cation for adsorption on soil colloid is Na.
- The soil/parent material is said to be colluvial if it is formed due to gravity.

### **Soil chemistry:**

- “Soil fertility” is defined as the quality that enables a soil to provide the proper nutrient compounds in proper amounts.
- “Soil productivity” is defined as the capability of soil for producing a specified plant.
- Criteria of essentiality of elements were proposed by Arnon in 1954..
- “D.J. Nicholas” advanced the term “Functional (or) metabolic nutrient”.
  1. Deficient: when an essential element is at lower concentration that severely limits yields and produces deficient symptoms.
  2. Insufficient: When the level of an essential element is below that required for optimum yields (or) when there is an imbalance with another nutrient.
  3. Toxic: When the conc. of either essential (or) other elements is sufficiently high to reduce plant growth severely.
  4. Excessive : When the concentration of an essential plant nutrient is sufficiently high to result in corresponding shortage of another nutrient.

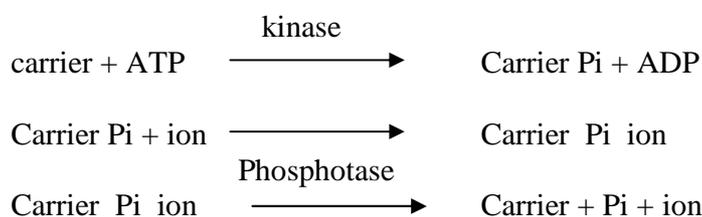
Establishment of essentiality of elements:

- Nitrogen – Theodore de Saussure; Mo – Arnon and stout,  
Na – Brownell and wood; Co-Ahmed and evans.

- Some elements like Ca and Mg counteract toxic effects of other elements – balancing function.
  - Ionic forms of nutrients absorption: Nitrogen –  $\text{NO}_3^-$ ;  $\text{NH}_4^+$ ; Mo –  $\text{MoO}_4^{2-}$ ; P –  $\text{H}_2\text{PO}_4^-$ ,  $\text{HPO}_4^{2-}$ ; C –  $\text{CO}_3^{2-}$ ;  $\text{HCO}_3^-$ ; S –  $\text{SO}_4^{2-}$ , B –  $\text{BO}_3^{3-}$ ,  $\text{HB}_4\text{O}_7^-$ .
  - Absorbed nutrients (exchangeable ions) are always in equilibrium with dissolved fraction.
  - Hydrogen ions are leased to the medium in exchange for metal cations and  $\text{OH}^-$  (or)  $\text{HCO}_3^-$  are released in exchange for anions.
  - In passive absorption ions move into a cell along their electrochemical potential gradient without expenditure of energy by the cell.
1. Mass flow hypothesis – Eg:  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ , Ca and Mg which occur in sufficient quantity in soil solution.
  2. Diffusion: Along concentration gradient – Mulder. Eg: P, K, Zn, Cu, the concentration of which is low in soil solution.
  3. Ion exchange:
    - a. Carbonic acid theory:  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{++}$ .
    - b. Contact exchange hypothesis – Jenny and Over Street. It takes place between plant root and clay surface due to overlapping of oscillation volumes around the adsorption site.
  4. Donnon equilibrium theory: When a different ion of similar charge is present in the external medium there will be no exchange.

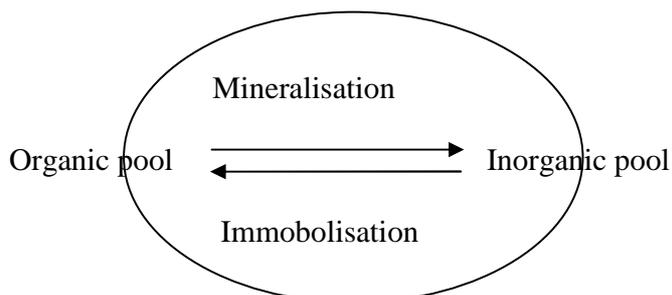
Active absorption mechanisms:

1. Lundegardh's hypothesis: Uptake of salt dependent of "anion" respiration. Transport of anions occurs through "cytochrome system".
2. Carrier hypothesis: Requires ATP.



Nitrogen:

- Soil organic matter = organic carbon X 1.724.
- Surface soil has higher 'N' content than deeper soils.
- Organic fraction of soil nitrogen is 98%.



**Mineralisation :**

1. Aminisation: Hydrolytic decomposition of proteins results in the release of amines and amino acids.
2. Ammonification: The amines and amino acids released are converted to ammonium compounds.
3. Nitrification : Biological oxidation of ammonium ions to  $\text{NO}_3^-$  is known as nitrification.
  - Aminisation, ammonification – Heterotropic bacteria.
  - Nitrification – autotrophic bacteria;  $\text{NH}_4^+ \longrightarrow \text{NO}_2^-$  *Nitrosomonas, nitrococcus*
  - $\text{NO}_2^- \longrightarrow \text{NO}_3^-$  Nitro bacter.
  - The *nitrosomonas, nitrobacter* are usually referred to as the “nitrobacteria”.
  - High C:N ratio prevents the release of ammonia. If the ammonia is present in too high concentration, it constrains the nitrification.
  - Nitrification will be appreciable at field capacity of soil moisture content and takes place even at (or) below the wilting coefficient.
  - Nitrification takes place at a pH 5.5 to 10.
  - If C:N ratio is more than 30:1 favours immobilisation and less than 30:1 favours mineralization.
  - Several clay minerals with 2:1 type structure have the capacity to fix ammonium and K ions. “Vermiculite” has the highest CEC and hence high fixing capacity.
  - Ammonium fixation by clay mineral is greatest in subsoil than the top soil because of higher clay content of subsoil.
  - Leaching losses of  $\text{NO}_3^-$  is low in unirrigated, arid, and semi - arid region and high in humid areas where irrigation is practiced.
  - $\text{NO}_3^-$  ions are reduced to  $\text{N}_2$  in poorly drained and low in aeration soils by denitrification. Eg: *Thiobacillus denitrificans; Pseudomonas denitrificans*.
  - Volatilization: Application of ammonium containing fertilizers (or) urea which hydrolyses to  $\text{NH}_3$  gas. The escape of ammonia gas into atmosphere is called volatilization. .
  - The BNF in different organisms is brought about by enzyme “nitrogenase” enzyme.

Group	Rhizopium sps
Alfalfa	<i>Rhizobium militoti</i>
Clover	<i>R. trifoli</i>
Soyabean	<i>R. japonicum</i>
Lupini	<i>R. lupine</i>
Bean	<i>R. phaseoli</i>
Peas & vetch	<i>R. leguminosorum</i>

- $\text{N}_2$  fixation by symbiosis with non - legumes.  
Casuarinaceae – Casuarina; Betulaceae – Alnus  
Actinomycetes – Frankia.
- Rhizobium – symbiont, Azotobacter – free living  
Azospirillum – associate symbiont in maize, sorghum, bajra, ragi crops.  
BGA – Irrigated rice – Freelifving  
Azolla fern BGA – Rice fields.  
Mycorrhizae (symbiosis) – Plant root fungus – all crops.
- The major loss of N from most soils is that removed by “crop plants”.
- In plants the total N content ranges from 0.2 to 4.0%,

- Nitrogen imparts dark colour to plants.

### Phosphorus: -

- Phosphorus has been considered “key to life”.
- P containing Ca minerals in soils are mostly apatites –  $\text{Ca}_{10}(\text{PO}_4)_6$ .
- Fluorapatite –  $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$ , Carbonate apatite –  $3\text{Ca}(\text{PO}_4)_2 \cdot \text{CaCO}_3$ .
- Hydroxyapatite –  $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{Ca}(\text{OH})_2$ , Oxyapatite –  $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaO}$ .
- Tricalcium phosphate (TCP) –  $\text{Ca}_3(\text{PO}_4)_2$  OCP –  $\text{Ca}_8\text{H}_2(\text{PO}_4)_6 \cdot 5\text{H}_2\text{O}$ .
- Dicalcium phosphate –  $\text{CaHPO}_4 \cdot 2\text{H}_2\text{O}$  MCP –  $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot \text{H}_2\text{O}$
- Of all the above, the readily available for plant are mono calcium phosphates.
- The apatite minerals are the most insoluble and unavailable of the group.
- Phytin is a calcium – magnesium salt of “phytic acid”. Phytin is the most abundant of the known organic ‘P’ compound.
- Monovalent forms are preferred by plant than divalent (or) trivalent.
- $\text{H}_2\text{PO}_4^-$  proportion is high at pH 5.0,  $\text{HPO}_4^{2-}$  is high at pH 9.0 (very alkaline soil).
- 6.5 to 7.5 pH is considered to be best for optimum availability of ‘P’.
- Phosphate fixation is more in 1:1 type of clay minerals.
- Gibbsite –  $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ , Goethite –  $\text{Fe}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$ .
- The concentration of ‘P’ in the soil solution is the measure of “intensity factor” (I) of ‘P’ nutrition.
- The source of soil solution P replenishment is known as the quantity factor (Q) of P nutrition.
- ‘P’ compounds in soils are categorised in three major groups
  1. Readily available – soil solution P
  2. Slowly available – labile P
  3. Very slowly available – non – labile P.
- Tropical clay soils high in Fe and Al need a high level of Q to assure a given I level. Potential buffering capacity (PB C) =  $Q/I$ .
- Total P content in plant ranges from 0.03 to 0.3%; In seeds upto – 1.5%.
- Excess of P causes trace element deficiency particularly Fe and Zn.
- Deficiency of P causes bronzing of leaf margins in cereals.

### K

Orthoclase –  $\text{KAlSi}_3\text{O}_8$  – K Feldspar.

- 1:1 type minerals like ‘kaolinite’ do not fix ‘potassium’.
- Illite fixes – K ions.  $\text{Al}^{+3}$  cations will occupy the K selective binding sites.
- All K above the optimum level is considered as a luxury . Luxury consumption becomes particularly wasteful.
- K regulates water movement within plant cell.
- ‘K’ deficiency leads to “leaf scorching” (or) popularly known as “tip burning”.
- Reduced crop yields without the appearance of definite symptoms is called “hidden hunger”.
- The function of K is catalytic in nature.

Secondary nutrients include Ca, Mg & S.

**Ca: -**

- Ca is mostly present as primary minerals such as “basic plagioclase”.
- Ca is the most dominant cation in all soils. Calcite –  $\text{CaCO}_3$ .
- Light textured soils suffer greater loss of Ca than heavy soils.
- Ca is essential for formation of cell wall.
- Deficiency symptoms:
  1. Failure of terminal bud development.
  2. In fruit trees “dieback”.
  3. In guava cold leaves are chlorotic with red brown spots.
  4. Severe loss of colour in young leaves of “brassica sps”.

**Mg:** If large qualitative of Mg salts are added to soils containing montmorillonite, the minerals are altered to vermiculites.

- It is low in acid soils.
- Dolomite limestone is the richest source of Mg.
- Mg is constituent of chlorophyll and maintains dark green colour.
- In sandy soils too much ‘Mg’ may create ‘K’ deficiency.

**S :-**

- ‘S’ behaves like nitrogen in many respects
- Sulphates are present in subsoils that contain 1:1 clays.
- ‘S’ is present in the oils of plants of mustard and onion families.
- Sulphide production in paddy soils causes a disease known as “Akhiochi” (or)  $\text{H}_2\text{S}$  injury.
- Due to  $\text{H}_2\text{S}$  injury, bubbles will be coming out from the affected areas. Soil colour will be black.
- “Akhiochi” disease occurs in soils that are lacking ‘iron’.

**Micronutrients:** Viets classification (1962).

Pool A : Water soluble ions. It is usually non existent for Cu and Zn, very small for Fe & Mn. Low redox potential and low pH increase Mn & Fe but not Cu and Zn.

Pool B: Cations exchangeable by  $\text{NH}_4$ . It is small for Cu and Zn.

Pool C: Cations exchangeable only by strong chelating agents like EDTA, DTPA.

Pool D: Micro – nutrient cations held in secondary clay minerals.

Pool E: Cations held in primary minerals.

- Chlorides occur mostly in Pool A and Pool E. Borates – Pool E.
- Molybdates – Occur in all the pools.
- Mo – Ultra basic rocks; Cu – basic rocks.
- Micronutrients are more concentrated on the surface soil.
- Presence of moisture reduces availability of Cu & Zn and increases Fe & Mn.

- Low Si/Mg ratio – Leads to fixation of Zn in soils.
- More of  $\text{CaCO}_3$  percent in soil, leads to the less availability of Fe, Mn, Zn, Cu and increases the Mo availability.
- Boron is available in more amounts in coarse soils.
- 'B' deficiency is commonly associated with dry areas.
- Antagonism effect: Most of the micro nutrients are not available due to the antagonism effect shown by them.  
Mn vs Fe, Fe vs Zn, Cu vs Mo.

**B:-** It is the only non - metal among the micronutrients.

- 'Tourmaline' is the main boron containing mineral found in most soils.
- Boron fixation is more in fine textured soils.
- Borax –  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ .
- 'B' indicator plants – sunflower, cabbage, cauliflower, sugarbeet.
- B deficiency causes heart rot/crown rot of sugarbeet.  
topsickness of tobacco.

**Cu:-** Chalcopyrite –  $\text{CuFeS}_2$  Chalcocite –  $\text{Cu}_2\text{S}$

- 'Cu' deficiency leads to 'exanthema', die back in citrus.
- In wheat, glumes are empty.

**Fe :-** Pyrite –  $\text{FeS}_2$ , Siderite –  $\text{FeCO}_3$ , Hematite –  $\text{Fe}_2\text{O}_3$ .

- It is structural constituents of pigments in micro - organism
- Black pigment – Clalics – Contain iron.
- Fe – EDTA – Ethylene diamine tetra acetate – for acid soils.  
Fe – HEDTA – Hydroxy ethylene diamine tetra acetate – for alkali soils.  
Fe – DTPA – Diethylene triamine pentaacetate – for alkaline soils.  
Fe – EDDHA – Ethylene diamine dihydroxy acetate – for calcareous soils.
- Deficiency causes white foliage in nurseries.

**Mn:-** Legumes show 'Mn' deficiency.

- Red soils contain more 'Mn'.
- It is constituent of nitrite – reductase and hydroxylamine reductase.
- It involves in 'Hill reaction and Calvin cycle'.
- Deficiency symptom: "Pahala blight" of sugarcane.  
"Grey speck" of oat
- Paddy is more susceptible for Mn deficiency. Symptoms develop early on 3<sup>rd</sup> emerging leaf.
- Mn toxicity is very common on acid soils.

**MO:** Molybdenite –  $\text{MoS}_2$  Wulfenite –  $\text{PbMoO}_4$  Powellite –  $\text{CaMoO}_4$ .

- It is a constituent of "nitrate reductase".
- Deficiency causes "whip tail" in cauliflower.
- The toxicity of molybdenum on animal health was "teartness" (molybdenosis).

**Zn :-** the retention of Zn in soils to other cations  $\text{H} > \text{Zn} > \text{Cu} > \text{Mg} > \text{K}$ . Sphaelarite – Zns

- It requires for the synthesis of 'tryptophan'.
- It is a constituent of alcohol dehydrogenase and galactose oxidase enzymes.
- Deficiency in rice – 'khaira'.
- 'Zn' deficiency is cotton – little leaf:                      Maize – white bud.
- Critical pH range for availability of Zn is 5.5 to 6.5.

**Problem soils:**

- Leaching is problem in humid regions and salt accumulation is a problem in arid and semi - arid regions.
- Soil becomes "Saline" in areas where annual evaporation exceeds annual precipitation.
- Beans are damaged by chloride in the soil solution at equal osmotic pressure, which sulphates do not harm the crops.
- Grasses are more tolerant to chlorides than sulphates at equal O.P.
- At very high O.P, magnesium is more toxic than 'Ca' than Na.
- A soil which does not permit the normal growth of plant is a "Problem soil".
- 1. Acid soils: Two types in AP..
  - a. Laterite soils - These are open textured with "massive structure".
  - b. Ferruginous red soils – derived from crystalline metamorphic rocks.
- Humus is a final product of organic matter decomposition.
- Lime as a reclaiming agent: calcite limestone – CaCO<sub>3</sub>, dolomite limestone – CaCO<sub>3</sub> MgCO<sub>3</sub>. Quick lime – CaO, Blast furnace slage – CaSiO<sub>3</sub> (by product of iron industry).
- Due to high soil acidity, Al, Mn, Fe, become highly solubilized and available in toxic amounts.
- In acid soils activity of bacteria and actinomycetes is adversely affected. Fungi are active in acid pH.
- All the micronutrients (Fe, Mn, Cu, Zn, Co) except Mo are available in the acid pH. Mo deficiency has been identified in leguminous crops.
- In saline soils increasing osmotic pressure result in decreasing water availability to plants.
- In alkali soils high exchangeable Na depress the availability of Ca & Mg.
- Reclamation of saline soils – By using good quality irrigation water

$$\text{leaching requirement} = \frac{\text{Depth of drainage water}}{\text{Depth of irrigation water}} = \frac{Ddw}{Diw}$$

- Reclamation of alkali soils- use of gypsum; use of pyrites and molasses.
- Reclamation of saline alkali soils – use of good quality irrigation water.
- Salt tolerant varieties.  
Rice – CSR 1, 2, 3, Wheat : Kalyana sona, Groundnut – TMV - 10, Kadiri.  
Ragi – Godavari, Sarada, Pea – P163, Sunflower – EC 68413, 68414, 68415.
- High seed rate and closer spacing have been tried under saline conditions as compared to normal conditions.
- Ammonium sulphate and CAN are superior to urea in alkali soils.
- Confusion of leaf hopper damage with boron deficiency in alfalfa.

- Yellowing (or) chlorosis is caused by deficiency of [N, Mg, Fe & Mn]. Deficiency of N & Mg are seen in the older leaves while Fe, Mn deficiency are seen in the younger leaves. Mo deficiency often look like mild N deficiency in legumes.
- Phosphate – Bray’s modified test  
K – Sodium cobaltinitrite test  
Indicator plants:-  
N – Cauliflower, cabbage  
K- Potato  
Mg – Sorghum (CSH – 1)  
Mn – Rice (IR – 8)  
Mo – Tomato, Cauliflower  
P – Rape seed  
Ca – Cauliflower  
Zn – Hybrid maize  
Cu – Wheat  
B – Hybrid maize, sunflower.
- Sunflower pot cultural technique for boron.
- Sackett and Stewart technique (*Azotobactor* test for P & K).
- The Mulder’s *Aspergillus niger* test for Cu & Mg.
- Mehlich technique for available K<sub>2</sub>O.
- Mehlich – Cunninghamella plague method for ‘P’.
- The fertility gradient approach of “Rammorthy”.

Nutrient estimated	Method
Available N	Alkaline KMnO <sub>4</sub>
Available P <sub>2</sub> O <sub>5</sub>	Olsen’s method – 0.5M NaHCO <sub>3</sub>
Available K <sub>2</sub> O	Neutral – N ammonium acetate
Readily oxidizable organic carbon	Walkley and Black’s rapid titration method.

- In case of typical black soils % extractable P = 100 – Clay %.
- “Gross tetany in cattle” is caused by eating forages deficient in Mg.
- Summer drought aggravates Fe deficiency in many plants.
- Salt tolerant fruit crop – Datepalm; coconut.
- Number of salinity classes in the USDA classification of irrigation water are 4.
- Cell sap producing dark blue colour with “diphenylamine” indicates “High NO<sub>3</sub>- N”.
- The number of sites on soil colloids at which exchangeable “K” held are 3.
- Use of fertilizer containing high sulphates adversely effect utilization of micronutrient Mo.
- Water containing B more than 2.0 ppm is unsuitable for irrigation.
- Ideal Ca & Mg ratio for maximum availability of Mg in the soil is 7:1.
- The less soluble compound of ‘B’ good for application on sandy soils to correct ‘B’ deficiency is colomonite.
- Soil dispersion is caused due to presence Na of in excess amount.
- Crop which needs more Ca – Soyabean.
- Elements required for nitrifying bacteria are Ca & P.
- Ferns require ‘Al’ in their nutrition; green algae – *Scenedesmus* requires vanadium.
- Anion fixation is more in kaolinite.
- Phosphorus mineralization occurs when CP ratio of organic residue is < 200:1.

- Nutrient which impart vigour and disease resistance in plant is K.
- 'A-value' technique is used to study availability of nutrients in soils.
- In case of immobile nutrients, the deficiency symptoms first appear on young leaves.
- Application of O.M. to soil reduces 'P' fixation.
- In Jenny's pot culture test, the crop grown for assessing the fertility status of soils is lettuce.
- Divalent form of Mn exists in acid soils.
- Metallic ion capable of forming into an anion in alkaline pH is Zn.
- Zn application particularly increase crop yields in saline sodic soils

### **Manures and fertilizers:**

- Manuring: It is the process of improving productive capacity of the soil by adding more plant nutrients to the soil in different forms.
- Fertilisers are inorganic salts except "urea and calcium cyanamide".
- Decomposition of manures is allowed to reduce the wide C:N ratio to about 25:1.
- The N fraction of FVM is mainly given by "Urine".
- Old and sick animals produce FYM rich in nutrients.
- "Byre system of collection" is followed in government farms and in advanced countries to collect FYM.
- Composting: Converting organic materials into manure in a short time by accelerating fermentative process under controlled conditions.
- Composting earthworm – *Eisenia foetida*.
- In ADCO method compost is similar to FYM and hence also called 'synthetic FYM'.
- The starter in ADCO method – ADCO accelerate –  $(\text{NH}_4)_2\text{SO}_4$ . The compost was called 'ADCO complete'. ADCO process was developed by 'Hutchison and Richards'.
- "Activated compost process" is a never ending composting process developed by Fowler and his associates
- "Bangalore method" was developed by 'Dr. C.N. Acharya'. It is a cheaper method. In this method decomposition of O.M is not so well but N and O.M. are conserved very well.
- In rural composting over the organic wastes dung water is sprinkled as a starter.
- In urban composting starter is "night soil".
- " $\text{CuSO}_4$ " powder is added to reduced the offensive odour which is due to the foul smelling organic compounds called "mercaptans".
- Sewage: Drainage water that is taken out of the cities and towns through underground drainage pipe system including night soil.
- Sewerage: The pipe system laidout in municipalities and cities to take the drainage water out of the cities.
- Sullage: Refers to the drainage water takenout of the municipalities through open channels. Does not contain night soil.
- Effluent: The supernatant liquid that floats over the drainage water is allowed to settle in the tank.
- Sludge: The solid portion of drainage that settles at the bottom of the tank.
- Activated sludge: The settlement of the solid material is made fast by pumping air into the tanks.
- In activated sludge salts like  $\text{FeCl}_2$ ;  $\text{FeSO}_4$  are added to activate certain bacteria called "Iron bacteria".
- The optimum time of incorporation of the green manure crop in the soil is during flowering.
- Tisdell & Oodes have given 3 binding agents.

1. Transient binding agents – like gums & mucilage.
  2. Temporary binding agents – Fine roots of the plants as well as the “fungal hyphae”.
  3. Persistent binding agents – Microbial secretions.
- Persistent binding agents along with inorganic substances like Fe & Al oxides act as permanent binding agent.
  - “Daincha” is grown to open the hard deep layers of the soil. It is not a fodder crop and is suitable for “sodic soils” (or) “alkali soils”.
  - Poudrette – form of night soil.
  - Biggest compost plant – Tel Aviv (Israel)
  - Bone meal is effective in soils with more Fe & Al.
  - If inorganic fertilizers are added to the soil year after year it leads to salinity resulting in “exosmosis”. This can be avoided by adding of B.M.
  - Blood meal:
    1. Red product: Got by drying blood in super heated steam.
    2. Black product: Got by drying blood on a sand bath.
  - “Guano” is a product obtained from sea birds.
  - Guano is treated with  $H_2SO_4$  in order to allow hydrolysis and convert the organic nutrients into inorganic nutrients. This is called “artificial guano”.
  - Lessen the oil content greater the decomposition.
  - Chile saltpeter –  $NaNO_3$  – rich deposit of  $NO_3$ .
  - To get 1 kg of ‘N’ in the form of fertilizer about 40,000 kilo joules of energy is needed.
  - In “Haber – Bosch” process N is made to combine with  $H_2$  under optimum conditions of  $550^{\circ}C$  temp; 200atm pressure and activated iron oxide” as a catalyst.
  - The source for  $N_2$  is the ‘atmospheric N’
  - $H_2O$  is used as a source of  $H_2$  in countries where electricity is cheap.
  - “National fertilizers Ltd” at Nangal (Punjab) uses water as a source.
  - About 64% of ammonia produced in the world use “natural gas” as a source of  $H_2$ .  
Eg: Nagarjuna fertilizers.
  - “Naptha” is a light distillation fraction of petrol (or) crude oil. About 75% of nitrogenous fertilizers produced in India use ‘naptha’. Naptha is essentially a mixture of “hydrocarbons”.
  - The heavy distillate fraction of crude oil is called fuel oil.
  - ‘Ramagundam’ plant used coal as a source  $H_2$ .
  - Coal also can be used as a source of  $N_2$ .
  - In steel industries lot of coal is burnt to melt iron and “Coke oven” gas is get as by -product.
  - $NH_3$  contain 82% N.
  - $NH_3$  is soluble in water to an extent of 30% by wt. This is called “liquor ammonia” (or) “aqua  $NH_3$ ”.
  - $NH_3$  is a cheapest source of N fertilizer.
  - 1 kg  $NH_3$  needs 1.8 kg lime to neutralize acidity developed.
  - Ammonium sulphate is manufactured by the
    1. Coke oven gas process – Bituminous coal is subjected to destructive distillation. It contains 10%  $NH_3$  by volume.
    2. 85% of  $(NH_4)_2 SO_4$  manufactured in India is by “Gypsum process”.
  - $(NH_4)_2 SO_4$  is white crystalline salt, but commercially vary from yellow to gray due to impurities like ferric cyanide, arsenous sulphides (or) traces of tar
  - “Thiocyanates” present are toxic to plants. So the  $(NH_4)_2 SO_4$  are periodically checked.
  - 110 kg of  $CaCO_3$  is needed to neutralize the acidity created by 100 kg of  $(NH_4)_2 SO_4$ .
  - 1kg of N applied as ammonium sulphate requires 5.1kg of lime for neutralization.

- $\text{NH}_4\text{Cl}$  is very popular in Japan and S.E. Asia. It is prepared by
  1. Direct neutralization process.
  2. Dual salt (or) modified Solvay process. Here  $\text{NH}_4\text{Cl}$  is salted out by  $\text{NaCl}$  using the principle of “common ion effect”.
- CAN is a mixture of  $\text{NH}_4\text{NO}_3$  and  $\text{CaCO}_3$ .
- Fine granules of CAN are coated with soap stone powder i.e.  $\text{MgSiO}_3$  which improves the free flowing character of the fertilizer and it acts as a conditioner.
- “Urea (or) carbamide” has N in organic form, non-ionic form (or) amide form.
- 82% of N requirement of the crops in India is by urea.
- When temperature exceeds  $100^\circ\text{C}$ , urea produces a toxic product called “biuret”. Biuret has less amount of ‘N’.  
 $\text{NH}_2 - \text{CO} - \text{NH} - \text{CO} - \text{NH}_2$ .
- The amount of biuret content in urea should not exceed 1.5%; when urea is being used as a feed to cattle the biuret content should be less than 0.5%.
- When soil is acidic, ammonical fertilizers should not be recommended as they increase acidity.
- For paddy ammonical fertilizers are preferable as paddy takes N in the form of  $\text{NH}_4^+$
- $\text{PO}_4^{3-}$  which is unavailable form after being added to soils.  $\text{H}_2\text{PO}_4^-$  &  $\text{HPO}_4^{2-}$  are available forms.
- Rock phosphate formed from primary minerals is “magmatic origin” and that formed due to teeth and bones is called “organogenic origin”.
- “Morocco” occupies first place in deposits of P. The rock phosphate here is of organogenic origin.
- The rock Phosphate of N. Africa is very soft and finely crystalline and is called “Galsa phosphate”.
- In USA rock phosphate is present in the form of “pebbles”.
- In USSR rock phosphate is very hard and called “Kolaphosphats”.
- “Rock phosphate” is the basic raw material for manufacturing any phosphatic fertilizer.
- Rock phosphate when treated with  $\text{H}_2\text{SO}_4$  give SSP; when treated with  $\text{H}_3\text{PO}_4$  gives ‘TSP’.
- $\text{H}_3\text{PO}_4$  can directly used as a liquid fertilizer.
- “Soft earth” of R.P is best for acidic soils, for grasslands, pastures and orchards where the ‘P’ requirement is needed over a long period of time.
- “Mussoire R.P” is the raw material used for manufacture of P fertilizers in India.
- “River pebble phosphate (or) waste pond phosphate” is colloidal phosphates mineral phosphate, calphos.
- The fine powder of R.P is called “float”.
- SSP is produced by two process.
  1. Dean process
  2. Continuous rock acidulation process.
- The toxic compounds like ‘F’ present in R.P are eliminated as HF.
- SSP contains  $\frac{2}{5}$  of  $\text{Ca}(\text{H}_2\text{PO}_4)_2$  &  $\frac{3}{5}$  of gypsum by wt.
- There are 2 grades of SSP available in India.
  1. 14%  $\text{P}_2\text{O}_5$
  2. 16%  $\text{P}_2\text{O}_5$  (i.e. 7%P) [ $\text{PX}2.29 = \text{P}_2\text{O}_5$ ].
- ‘TSP’ does not have gypsum so it is completely soluble in water.
- “Basic slag” is a by product of steel industry (in open hearth process) and is called “Thomas slag”.

- $P_2O_5$  content in basic slag is being enriched by treating with R.P. and the resultant mixture is being marketed under the trade name “Pelophos”.
- Carnalite –  $KCl MgCl_2 \cdot 6H_2O$ , Kainite –  $KCl MgSO_4 \cdot 3H_2O$ .
- Schoenite –  $K_2SO_4 MgSO_4$  Sylvite –  $KCl$ .
- Sylvinite –  $KCl NaCl$  Langbeinite –  $K_2SO_4 \cdot 2MgSO_4$
- Removal of clay particle from sylvinite is called “Desliming” slurry is coated with starch to prevent remaining clay to combine with floating reagents.
- Most of the  $KCl$  is prepared by “Floatation process”.
- For  $K_2SO_4$  preparation, raw materials are langbeinite and sylvite (in Mannheim process).
- Any fertilizer containing 3 nutrients it is a “complete fertilizer”. If there are 2, It is called “multi nutrient fertilizer”.
- Complex fertilizers are homogenous, mixed fertilizers are heterogenous among commonly used complete fertilizer.
- Ammonium phosphate – Factammophos; nitrophosphate – Suphala.
- When straight fertilizers are mixed in large quantities it is called as bulk blended fertilizer (BBF).
- All the properties of fertilizer which affect the flow of fertilizers through distribution equipment are collectively called “drillability”.
- Granular fertilizers are more easily drillable compared to pulverized fertilizers.
- Cracking in fertilizer mixture can be reduced by adding conditioners.
- Crystal knitting is a process of formation of new compounds due to crystallization with a change in temperature and moisture of the fertilizer when the fertilizer is under pressure.
- Double decomposition occurs between two compounds that do not have a common ion.
- Unit cost of N in urea is cheapest among all.
  1.  $NO_3^-$  fertilizers are recommended in acid soils with a pH of 5.0.
  2. Both forms ( $NH_4^+$  &  $NO_3^-$ ) for pH 5-7.
  3.  $NH_4^+$  is effective in neutral and slightly alkaline soils of pH 7.0-7.5.
  4.  $NH_4^+$  fertilizers are inferior in highly alkaline soils as  $NH_4^+$  reacts with  $OH^-$  forming  $H_2O$  &  $NH_3$ .  $NH_3$  is lost as a gas.
- The part of fertilizer available to succeeding crop other than for which it is applied is called “residual effect”.
- $NH_4$  fertilizer should be avoided in highly acidic soils.
- $NO_3^-$  fertilizer should be avoided in “coarse soils” as more leaching is there.
- $KCl$  has more salt index than  $K_2SO_4$ .
- Salt index is defined as the ratio of the increase in osmotic pressure produced by the given fertilizer to that produced by the same weight of  $NaNO_3$ . Salt index of  $NaNO_3$  is given as “100”.
- Ca & Mg deficiency is seen in only acid soils & ‘S’ in alkaline soils.
- Ca is needed in large quantities for root development. Hence, called root developer.
- In delta areas silt is added to the soil indirectly called “wrapping” through letting into the fields with proper bunds of the silt laden flood waters.

## **AGRICULTURE/AGRONOMY**

- Agriculture - Latin word: Agronomy - Greek word.
- Community development programme - 1952.
- Sharbati Sonara obtained from Sonara - 64 with gamma rays.
- Jaganath (Rice) obtained from T - 141 with X - rays.
- Aruna (Castor) obtained from HC - 8 with thermal fast neutrons.
- Intensive Area Development Programme (IADP) also known as “Package Programme” (1960).
- 1875 - Indian Meteorological Department (IMD) - Pune.
- 1880 - First report of Famine Commission.
- 1898 - Second report of Famine Commission.
- 1901 - Third report of Famine Commission.
- 1903 - Imperial Agricultural Research Institute, Pusa, Bihar.
- 1928 - Royal Commission on Agriculture.
- 1929 - ICAR
- 1936 - IARI shifted to Delhi.
- 1966 - HYVP
- 1967 - Multiple Cropping Programme (MCP).
- 1969 - National Demonstration Programme (NDP).
- 1972 - ICRISAT.
- Central Plantation Crops Research Institute - Kasargad.
- ICARDA - Syria; CIMMYT - Mexico; IRRI - Manila; IPRI - Peru; ICTA - Cali, Columbia; IITA - Ibadan, Nigeria.
- Meteorology - Greek word.
- Meteorology - Science of atmosphere;
- Weather - State (or) condition of the atmosphere at a instant time.
- Climate - Summation of weather conditions over a longer period.

### **Structure of atmosphere**

1. Troposphere - Thicker at equator and thinner at poles and most stable.
2. Tropopause - Present between troposphere and stratosphere.
3. Stratosphere - Includes ozone layer (or) ozonosphere.
  - a. It is the seat of all photochemical reactions in the air.

Solid portion of earth - Lithosphere.

- Ionosphere is the most unstable layer in the atmosphere.
- The upper part of the atmosphere is called as “Magnetosphere”.
- Altitude - Height; Latitude - Imaginary line horizontally connecting the East and west.
- Longitude - Imaginary line connecting the North & South poles. It is useful for calculating of “Local mean time” (LMT).
- For calculating Greenwich mean time (GMT) -  $0^{\circ}$  longitude.
- For IST -  $82.5^{\circ}$ E ;

### **Albedo = Reflected radiation /Insulation radiation**

- Source of heat to the plants - Infra red rays.
- 42% insulation returned to the space. 58% usable insulation.

- The average amount of energy available at the outer limits of the atmosphere is known as “Solar Constant”. Value of I.C. is  $1.94 \text{ ca/cm}^2/\text{min}$ .
- Short day plants —————> Maize, Soyabean, Tobacco.
- Long day plants —————> Sugarbeet, Wheat, Barley.
- Day neutral plants —————>Sunflower, Cotton.
- In temperate regions the Southern Slopes show better growth of crops than northern slopes due to the direction of light.
- Solar radiation - Pyranometer (or) Pyrhelimeter -  $\text{Ca}_1/\text{Cm}_2/\text{min}$ .
- Duration of light - Campbell Stokes sunshine recorder - hours/day.
- Intensity of light - Lux meter - LUX.
- Wave length absorbed in PS Violet - blue & Orange - red.
- The most harmful effect of high light intensity is the “Solarisation” because of photo oxidation.
- Radiation - Transmission of heat without medium.
- Convection is the most effective for heat transfer in atmosphere.
- The condition in which the abrupt rise instead of fall in temperature occurs in the air is known as “Inversion”.
- Maximum temperature 1.00 - 4.00 PM, Minimum temperature 1.00 - 6.00 AM
- The end of July - highest temperature. The end of January - Lowest temperature
- $C = (F - 32) * 5/9$ ;  $F = (9C/5) + 32$
- Six’s Thermometer records both Max. and Min. temperature.
- Thermograph - Continuous recording of air temperature.
- Dry bulb thermometer - current air temperature.
- Isotherms - are the lines connecting the places that have equal temperature.
- The decrease in temperature with increase in altitude in the air is known as “Vertical Temperature gradient”. It is expressed as “Lapse rate”.
- The rate at which temperature decreases with increase in altitude of air is known as “Lapse rate”.
- The value of LR is  $3.5^{\circ}\text{F}$  per 1000 feet (or)  $6.5^{\circ}\text{C}$  per Km.
- The rate at which temperature changes due to change of pressure is called as “adiabatic lapse rate”. The value is  $5.5^{\circ}\text{F}/1000$  (or)  $10^{\circ}\text{C}$  per Km.
- The plant goes to “Starvation” due to high respiration rate.
- Suffocation - Ice in contact with plant roots inhibit the diffusion of  $\text{CO}_2$  and respiratory products.
- Heaving - Injury to plant is caused by lifting upward of the plant along with soil from its normal position.
- Vertically moving air columns are called as “Currents”.
- Winds are mainly caused due to “pressure gradient”.
- The difference in pressure between two places at the same elevation is called “Horizontal pressure gradient”.
- The direction from which wind blows is called “Windward”.
- Clock wise direction of wind movement - Veering wind; Anticlock wise direction of wind movement - Backing wind.
- Wind direction - Wind vane, Speed Robinson cup anemometer  
Anemograph - Both direction and Speed.
- The lines connecting the points having equal wind speed are called - “Isotechs”.

- Trade winds - It is the movement of air in lower layer of atmosphere. The winds that are flowing from horse latitudes to towards doldrums (Equator) in both the hemisphere are called trade winds.
- Antitrade winds Movement of air in the upper layer of atmosphere from equator to towards North and South poles.
- Trade winds change their direction (or) track are call as “Monsoon winds”.

<b>Sea breeze</b>	<b>Land breeze</b>
1. Occurs during day time	1. Occurs during night time.
2. Cool and dense air moves from Sea to land surface.	2. From land to sea.
3. also called ‘On shore wind’.	3. off shore wind.

<b>Valley breeze</b>	<b>Mountain breeze</b>
1. Occurs during day time.	1. Night time.
2. Flow of air from valley to the mountain.	2. From mountains to the valley

Warm air contain more water vapour than cool air.

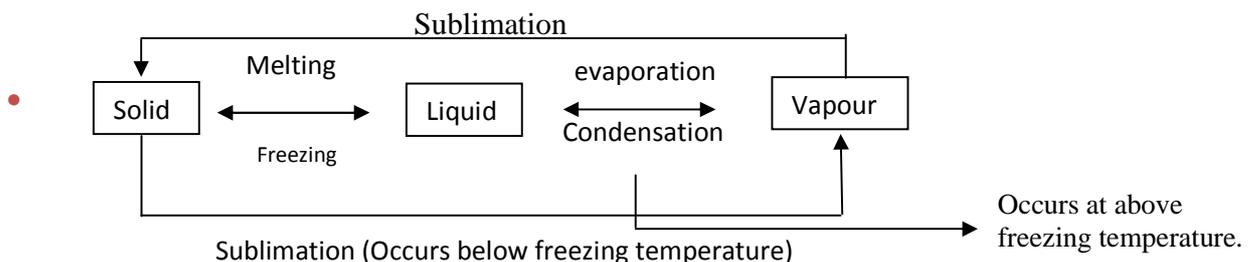
$$\text{Absolute humidity} = \frac{\text{Weight of water vapour}}{\text{Unit volume of air}} \text{ g/m}^3.$$

It is change with temperature.

$$\text{Specific humidity} = \frac{\text{Weight of water vapour}}{\text{Unit Weight of air including water vapour}} \text{ g/m}^3$$

$$\text{R.H} = \frac{\text{Water vapour present in the air}}{\text{Water vapour required for saturation}} \times 100$$

- Instrument used for measurement of R.H. are called “Psychron (or) Hygrometer.
- Wet & dry bulb thermometer - R.H. in field.
- Hair hygrometer - Inside room.
- Hydrologic cycle → It is the continuous circulation of water between atmosphere, lithosphere, hydrosphere.
- Rate of evaporation expressed as mm/day.
- Under equivalent conditions ocean water will evaporate 5% more slowly than fresh water.
- Measurement of evaporation - USWB Class A open pan evaporation. In free water surface.
- Sunken screen evaporimeter → In a cropped field.



- Hygroscopic particles can act as nuclei for condensation.
- Most important hygroscopic nuclei in the atmosphere are sea salt (NaCl) nitric oxide.
- Dew point: The temperature at which saturation occurs or condensation temperature.
- Dew: Deposition of liquid water droplets on the surface of cooled objects.
- Fog: Aggregation of minute droplets of water suspended in the air near the surface of earth. It is also called as “Low Cloud”.
- Haze: Smoke and dust mixed with fog.
- Frost: Same as dew but in dew condensation above freezing point. But in frost condensation below freezing point.
- Cloud: Same as fog. But in higher altitudes.
- There are 3 basic clouds forms.
  1. Cirrus (Fibrous (or) Feathery)
  2. Cumulus (Heaped manner) - resembles like cauliflower.
  3. Stratus (Layers).
- It a basic cloud from above its normal height then the cloud will be thin prefix “Alto”.
- If any cloud is associated with precipitated prefix or suffix “Nimbus”.
- High clouds → Cirrus, Cirro cumulus (Sea shores), Cirro Stratus.
- Middle clouds → Alto cumulus, Alto Stratus (typically water).
- Low clouds → Stratus, Nimbo Stratus and Strato cumulus.
- Clouds with vertical development → Cumulus, Cumulo nimbus.
- Sky cover expression : clear -  $<1/10$ ; Scattered -  $1/10$  to  $6/10$ ; Broken -  $6/10$  to  $9/10$ ; Over cast -  $9/10$ .
- Obscured → Sky and Clouds are completely covered with Fog and Smoke.
- Southwest monsoon → 7<sup>th</sup> June to 26<sup>th</sup> September.
- Northeast monsoon → 27<sup>th</sup> September to 31<sup>st</sup> January
- Hot weather period → 1<sup>st</sup> February to 6<sup>th</sup> June
- **Precipitation in the form of liquid :-**
  1. Rain → droplets between 0.5 mm to 4mm Rain  $> 0.5$ mm
  2. Drizzle → Rain droplets  $< 0.5$ mm -light rains.
  3. Mist → Rain droplets completely evaporates before reaching the ground.
  4. Glaze → Rainfall on objects into a sheet (or) coating of ice.
  5. Rime → Freezing fog.
  6. Snow → White crystals of frozen water.
  7. Sleet → Frozen (or) partly frozen rain.
  - 8. Holi → Icepieces.
- Isohyets → The imaginary lines connecting the places receiving same amount of rain.
- **Measurement of rainfall – Rainguage**
  1. Coastal Andhra : Punasa - Early kharif  
Peddapanta - Late kharif  
Pyrus - Rabi
  2. Rayalaseema : Mungari - kharif  
Hingari - Rabi
  3. Telangana : Abi - kharif  
Tabi - Rabi

- In coastal districts paddy growing season from June to November is called as “Sarva” while paddy growing from October to March is called “Dalwa”.
- Low pressure areas are called “Depressions”.
- Tropical cyclones are violent storms. These storms in West Indian water are known as “Hurricanes”. In the East Indian and Japanese water are known as “Typhoons” and in the Indian ocean they are called “Cyclones”.
- Prediction of the weather for the next few days to follow is known as “Weather forecasting”.
- Brief report on weather conditions in coded form is known as “Synoptic report”.

**Tillage:** It is the manipulation of the soil with tools and implements for loosening the surface crust and bringing about conditions favourable for germination.

**Tilth:** It is the physical condition of the soil in relation to plant growth.

- Buck scraper (or) levelling plank - major leveling of field.
- Percentage of soil volume occupied by porespace is called “Porosity”.
- Crumb and granular structure is the good soil structure.
- Bulk density - It is the mass per unit volume of dry soil.
- Mechanical manipulation of soil at high moisture content is known as “Puddling”.
- Peddamadaka → Heavy plough, used for deep ploughing in black cotton soils.
- Levelling implement → Buck scraper.
- Layout of seed bed → Broad bed furrow former; ridges plough bund former.
- Star weeder → used in groundnut for control of weeds.
- Japanese rotary weeder → used in low land rice.
- Seed drill = gorru, Blade harrow = Guntaka.
- Levelling of puddled soil is done by the implement called “Pallamanu”.
- Humus is the end (or) final product of organic matter decomposition. The right time for incorporation of green manure is at crop flowering stage.  
Depth of sowing depends on seed size.
- It is not possible to build up high organic matter in Indian soils because of high temperature.
- It is not advisable to broadcast fertilizer when there is dew on leaves.

Green manure crop used for reclamation of saline and alkaline soils is *Diancha*.

- The method of sowing in which all plants get uniform spacing is drilling, seeding behind country plough.
- Earth rotates from west to east.
- The response of living organisms to regular change in temperature either day (or) night is known as “Thermoperiodism”.
- **Hydrometers - forms of precipitation.**
- Orographic rains - Rains caused by mountains.

- Solistice → It is the maximum distance between sun and earth. It occurs twice - once each in South and North of celestial equation during the annual path of earth around the sun.
  - June - 21<sup>st</sup>
  - Dec - 22<sup>nd</sup>
- **Equinox** : The astronomical day at which light and night are equal, which occurs when the sun is directly over head of equator.
  - March - 21<sup>st</sup>
  - September - 22<sup>nd</sup>
- Emmission of surface other than a perfect black body is always less than one.
  - Albedo values are highest in winter and sunrise, sunset

S.No.	Surface	% of albedo
1.	Fresh snow	75 - 95%
2.	Dry Sand duke	35-45 %
3.	Clay Soil	20-35%
4.	Wet sand	20-30%
5.	Deciduous forests	10-20%
6.	Human Skin bloude	43-45%
7.	Dark soil	5-15%

- Heat capacity in the range of 0.3 - 0.6 cal/cm<sup>3</sup>
- Specific heat : Minerals - 0.18 - 0.20 cal/gm.  
Humus - 0 - 45 cal/gm
- The “Grant Anicut” across the river Cauvery in TN was constructed by “Chola King”.
- Large number of tanks are seen in South India, Inundation canals are common in North India.
- First irrigation commission - 1901.
- Total geographical area - 328 m ha  
Average Rainfall - 1200 mm
- Total Precipitation - 400 m ha
- Major source of irrigation in Andhra Pradesh is Canals.
- Anicut - Embankment across a river.
- Ayacut - Irrigation area under a project.
- A structure less soil allows water to percolate too rapidly (or) too slowly.
- Suitable resorting system of water distribution among farmers is “Warabandi”.
- 2/3 of capillary water is available to growing plants in India.
- Musi Project - Nalgonda, Kaddem - Adilabad, Yerralakawa - East Godavari Rayalabanda diversion scheme - Mahaboobnagar, Vamsadara - Srikakullum and Gajuladinne - Kurnool.
- Soil texture determines the amount of water a soil can hold.
- A platy structure can impede downward movement of water.
- Particle density - 2.65 g/cc, Bulk density - 1.25 to 1.70 g/cc.  
Porasity = [(1-B.D/P.D) X 100]
- When all the pores, large and small are filled, the soil is said to be saturated and it at its “Maximum retentive capacity”.
- Water in large pores move downwards - Gravitational water (or) free water.

- Water in the small pores move because of capillary force and is called “Capillary water”. It moves more freely than free water. It can move in any direction, but always in the direction of “Increasing tension”.
- Thin film around soil particles that cannot be used by plants is called “Hygroscopic water”.
- Capillary movement is by adhesive and cohesive forces.
- Water moves from saturated soil to unsaturated layers.
- In moist soils water movement is more uniform than in dry soils.
- At saturation, capillary movement is most rapid in sandy soils and slowest in clay soils. But in unsaturated, capillary movement is rapid in clay and slow in sandy soils.
- Adhesion - attraction of soil particle and water.
- Cohesion - between water molecule.
- Soil moisture tension is a measure of the tenacity with which water is retained in the soil and shows the force per unit area that must be exerted to remove water from the soil. It is usually expressed in atmosphere.
- Soil moisture tension does not indicate the amount of water. To show the amount of moisture a given soil holds at various tension.
- “Moisture extraction curves” (Soil moisture characteristic curves) must be developed.
- PF is defined as the logarithm of height in a column of water. Pf value of saturated soil is ‘0’.
- At Field capacity pF 2.54; P.W.P - 4.2 soil moisture tension - 15 bars.
- Movement of irrigation water from the surface into the soil through the soil is called “Water intake = Percolation + Infiltration”.
- Infiltration is the downward flow of water from the surface into the soil.
- Percolation is the movement of water through soil profile.
- Percolation rate is governed by the permeability (or) Hydraulic conductivity of the soil.
- Permeability is the quality of soil that enables it to transmit air and water.
- Hydraulic conductivity is the co-efficient ‘K’ (Proportionality factor).
- Darcy’s law =  $V = Ki$   
V = Effective flow velocity  
i = Hydraulic gradient  
‘K’ depends on the properties of fluid as well as the soil.
  
- Seepage is the lateral movement of water in the soil.
- Leaching is removal of soluble salts by passage of water through soil.
- Field capacity is the amount of water a well drained soil held after free water had drains against held gravity.
- Available water = F.C - PWP
- 1/3 atmospheric tension is usually taken as field capacity of the soil
- Permanent wilting point is the soil moisture to meet transpiration requirements.
- Ultimate wilting point - At this point the plant will die even after providing water.
- A higher water table limits root growth and a raised water table may kill roots.
- The usual water extraction pattern 40% moisture from the upper quarter 30% from second quarter, 20% from III, 10% from IV quarter.
- Effective root zone depth is the soil depth from which the crop extracts most of the water needed for “evapo transpiration”.
- Safflower - very deep root system, cotton - deep root system
- Soil crusting reduces infiltration.

- Certain stages in the crop growth period are made sensitive to soil moisture stress compared with others. These are known as “Moisture sensitive” or “Critical periods”.

<u>Crop</u>	-	<u>Moisture sensitive period</u>
Rice, Finger millet	-	Primordia development, heading, flowering
Sorghum	-	Booting, Blooming
Maize	-	Tasseling, Silking
Wheat	-	Crown-root initiation
Groundnut	-	Peg penetration, flowering
Sunflower	-	Two weeks before flowering to 2 WAF
Safflower	-	From rosette to flowering
Cotton	-	Flowering, boll development
Tobacco	-	Tapping stage
Potato	-	Tuber initiation to tuber maturity
Onion	-	Bulb formation

The periods in days during which irrigation water is supplied to the crop is termed as “Base period”.

- Irrigation project constructed during British period Godavari delta system
- Consumptive use is the amount of water needed for transpiration + evaporation + used by vegetation for metabolic activities.
- Measurement of soil moisture:
  - Direct method measures direct water content.
  - Indirect method measures water potential.
- Gravimetric method is a standard method.
- Spirit burning method is rapid and suitable for field.
- In Neutron moisture meter - A probe and a scaler (or) counter are present. The probe consists of a source of fast neutron (mixture of Radium - Barium). It is not suitable for measuring moisture content very near to the soil surface.
- Tensiometer is useful in sandy soils.
- Resistance affected by a change in moisture content is the principle used in the gypsum blocks. Resistance to flow of electricity is proportional to moisture content in the medium.
- Soil moisture characteristics in the laboratory can be determined by using “Pressure plate and pressure membrane apparatus”.
- Water requirement = consumptive use + application losses + water needed for special operations.
- Irrigation requirement = (W.R) - (ER + GW)
  - ER = Effective rainfall - Measured by ‘Randas’ method
  - GW = Ground water

$$\text{Net irrigation requirement} = \frac{\text{Moisture content at F.C} - \text{Moisture content before irrigation}}{100} \times \text{B. density} \times \text{Root zone depth}$$

$$\text{Gross irrigation requirement} = \frac{\text{Net irrigation water to be applied at each irrigation}}{\text{Irrigation application efficiency}}$$

Irrigation period is not greater than the irrigation frequency.

- Duty of water - It is the relationship between the irrigation water and the area of crop that matures fully with the given amount of water.
  1. In canal irrigation duty is usually expressed as the “area per unit rate of flow”. It is expressed in  $\text{ha/m}^3/\text{sec}$ .
  2. Duty is also expressed in terms of depth of water and is referred to “Delta”. Delta is the total depth of water required for the entire crop period and expressed in “cm”.
  3. Volume in terms of depth over unit area -  $\text{ha.cm}$ . represent the total quantity of water needed for a crop per unit area.
  4. In case of tank irrigation, duty may be expressed as the in terms of “Stored water” expressed as  $\text{ha/million/m}^3$ .
- Drainage in light soils leads to leaching loss of Nitrogen.
- Furrow irrigation is the most common method for maize and cotton.
- Irrigations are scheduled based on “depletion of available soil moisture”. For many crops irrigation at 20% DASM at moisture sensitive stage. At other stages irrigations at 50% DASM.
- Soil moisture tension (Tensiometer) used for irrigating orchards especially in “Coarse texture” soils.
- Potential evapotranspiration can be estimated by “Lysimeter method”.
- Visual plant symptoms :
  - Leaf colour - Cotton, Groundnut, Bean.
  - Plant movement - Jowar, Bean; Exudation - Cut of stem - Cotton
  - Indicator plant - Sunflower.
- Check basin method is used for Groundnut, Fingermillet, Sorghum and Vegetables.
- Basin method is used for irrigating orchards.
- Border strip method is used for close growing crops like Wheat, Barley and Groundnut. In the surface methods, most efficient use of water is seen in “Furrow method”.
- In Kerala subsurface irrigation method is practiced
- Over head irrigation - Sprinkler irrigation (Sandy Soils)
- Drip irrigation - Trickle irrigation - water is released from “Nozzles”.
- In drip irrigation the discharge from nozzles is 2 to 10 liters per hour.
- Water conveyance efficiency: It indicates the losses that occur while water is conveyed from the source to the point of utilization.
- The Water application efficiency gives an indication of the quantity of water that is stored in the root zone of soil out of the quantity that is delivered.

- Water distribution efficiency is a measure of the uniformity of water distribution with in the field.
- Overall efficiency of a particular project in terms of water use is Project efficiency.
- Spiles are convenient in furrow irrigation
- Waterlogging - When the water table comes near the surface “Parallel field drain system” is the effective method of surface drainage and is well suited both for irrigated and rainfed areas.
- “Parallel field drain system” is required for both surface and subsurface drainage.
- Drainage coefficient : It is defined as the depth of water in cm. to be removed in 24 hours period from the entire drainage area.
- The random (or) natural system is used for draining isolated patches.
- Classification of irrigation water by US Salinity laboratory (USSL) based on EC and SAR (Sodium absorption ratio).
- Highest WUE crops - Ragi, Lowest - Rice.
- The State having maximum per cent of irrigated area is Punjab.

$$\text{Water application efficiency} = \frac{\text{Water stored in the root zone}}{\text{Water delivered to the field}} \times 100$$

- The total amount of water used in ET by a crop in its growing season is known as “Seasonal Consumptive use”.
- Free energy status of pure water is “Zero”.
- The major type of water loss in lowland rice cultivation is in the form of Deep percolation.
- The main objective of puddling in rice field is to reduce the weeds.
- Every living organism is a product of its biological heridity and its environment.
- Ley farming - Inclusion of fodders (or) grasses in cropping system. Cropping index -The number of crops grown/annum X 100
- Sequence cropping: growing two or more crops in sequence on the same field per year.
- Relay cropping - Before harvesting one crop the seeds of other crop are sown.
- Catch cropping - growing one extra crop between two main crops due to availability of time.
- Multi storeyed cropping: Growing different heights of crops due to availability of time.
- Alley cropping: Crops are grown in alleys formed by trees and shrubs mainly to hasten the soil fertility.
- Ideotype : It is defined as a biological model which is expected to perform in a predictable manner with in a defined environment.
- Incase of Rice “Dee Geo Woo Gene” and in Wheat “Norin - 10” stocks are responsible for dwarfness.

### **1. Rice :-**

- Breeding varieties which can effectively photosynthesize even under low light intensity.
- Traditional varieties raised in tropics are called “Indicas” (Long in duration).
- “Japonicas” are the varieties of temperate zone.
- “Javoanicas” are called bulk rice.
- In kharif, dry nursery gives higher yields compared to wet nursery.
- Dapog nursery: Raising the seedlings without their roots coming into contact with soil.

### **2. Wheat :-**

- Wheat contains more proteins than others and the protein is ‘gluten’.  
T. dicoccum - (Emmer wheat)
- When seed is dropped in furrows by hand it is called “Kera”. Implement attached to plough is “Pora”.
- At the “Jointing stage”, the stem becomes visible with distinct nodes.
- Wheat crop is highly sensitive to temperature.

### **3. Maize:- (Queen of cereals) - C<sub>4</sub> Plant**

- Maize Protein - ‘Zein’. It is deficient in essential amino acids – Lysin and Tryptophan.
- Dent corn – *Zea mays indentata* - The depression (or) dent in the crown of the seed.
- Flint corn - Mainly grown in India.
- Pop corn - Human consumption - Hard starch.
- Waxy corn - waxy appearance because of “amylopectin”.
- Grand growth stage knee high stage male inflorescence - Tassel, female -cob.
- In Dehradun valley “Zing” terracing is practiced - 75% maize in Rice slope - 25%.

### **4. Sorghum:**

- Tolerate high temperature better than any other crop and a short day plant. It can also tolerate water logging better than other crops like Rice.
- Toxic substance – Dhurrin (HCN).
- Maghi jowar – Khammam
- Dibbling is practiced in dry lands.
- Growth stage – 1; Vegetative period; GS<sub>2</sub> – Critical stage  
GS<sub>3</sub> – grain filling period.
- CSH – 1 is the best for rationing.
- Sorghum toxic effect is removed by Indigo (or) wild Indigo / green manuring.

### **5. Ragi:- *Eleusine coracana* (Birds foot millet)**

- It is a major millet. It is a very rich source of “Ca”.
- Heaven of millet – Africa.
- Punasa – AKP – 2.  
Pedda panta – VZM – 2, Sarada, Kalyani.  
Puru – VZM – 2.
- It is the only crop which can thrive under warm temperature and cool temperature prevailing in hilly regions.
- Sowing in shallow furrows – Karnataka

### **6. Bajra :- *Pennisetum americanum* (cat tail millet, Bull rusk millet, Spiked millet)**

### **7. Korra :- *Selaria italica* (Dry land good crop) (Fox tail millet)**

- It is a mixed crop with cotton in Rayalaseema.

**Variga:-** *Panicum miliaceum* – Proso millet.

**Sama :-** *Panicum miliare* – Little millet.

**Arika :-** *Paspalum scrobiculatum* – Kodo millet (Nivas – 1 varieties)

### **Fodder :-**

**1. Lucerne :** *Medicago sativa*, also known as alfalfa Queen of fodder.

- Excess of feeding of Lucerne develops bloat (or) tympanitis (gas accumulation in stomach).
- Dodder is a parasite on Lucerne plant.

**2. Berseem :-** *Trifolium alexandrinum*

Egyptian clover (or) King of fodder crop.

- Excess feeding causes bloat (or) tympanitis.
- Pusa gaint variety is treated with calchicine for good germination.
- The most important weed in berseem is chicory.

**3. Stylo :-** *Styloxanthus sp S. hamata*

**4. Su babul:-** *Leucaena leucocephala* – Perennial fodder

- Toxic substance – “Mimosine”. It is drought and salt tolerant fodder.
- “Hay” is the dry form of forage crop that is cut before it is dead ripe and dried for storage without any appreciable loss of nutrients value.
- The principle grasses for hay making are *Cynodon dactylom*.
- Silage: - It is the product which is formed when the forage plant material is put in a place when it can ferment in the absence of the air.
- Ensiling – It is the process of making silage.
- Haylage –The portions of the forage material that remain after making hay is generally known as haylage which is used for feeding the cattle.
- The best stage for harvesting of fodder Maize is “dough stage”.
- If wheat sowing is delayed “Shallow depth of sowing” is practiced.
- Rainfed rice is very common in ‘Assam’.
- Mid season drainage in rice crop discourages the development of late tillers.
- “Butyric acid” gives bad odour to silage.
- Grain straw ratio in new plant types is 1:1.
- State first in Sorghum production is Maharastra.
- Resistance to pests and diseases is after provided by the mineral.
- Double gene dwarf wheat variety is Kalyanasona, Triple gene dwarf is Hira.
- White grained finger millet is Hamsa.
- Resistant rice variety for drought is MTU – 17.
- Preservative used in silage making is Sodium metabisulphate. Acid in preservation is Lactic acid.

**1. Red gram** :- *Cajanus cajan* – First important Pulse crop of South India.

PDM – 1 variety Andhra region.

**2. Green gram**:- *Vigna radiata*.

**3. Black gram**:- *Vigna mungo*

**4. Bengal gram** :- *Cicer arietinum*

- Seeds are recommended to cure “Scurvy”.
- Malic and oxalic acids collected from green leaves.
- There are two types
  1. Desi type – Small size seed and the rough seed coat is colored.
  2. Kabuli type – Large size seed and white seed coat.
- “Jyothi” suitable for all districts in the state.

**5. Cowpea**:- “*Vigna sinensis*” (or) *V. unguiculata*

- Cowpea withstand heat and heavy rains. It is highly drought resistant.
- Cowpea is a cover crop and soil conservation crop.
- “Russian gaint” useful for fodder purpose.

**6. Horse gram**:- *Macrotylomia uniflorus* – Test crop for drought.

**7. Soy bean** :- *Glycine max*

- The best time of planting was found to be June, 1.
- Intermediate varieties were found to yield higher than determinate varieties.

**8. Groundnut** : - *Arachis hypogaeae*

- The highest yield in “Zimbambway”.
- ‘Sandy loam’ are best suited for cultivation.
- Deficiency of ‘Ca’ leads to “Pops”. ‘S’ is required for the thiomine of oil.
- Pegging and pod development are the moisture sensitive stages.
- Pigeon pea is intercropped with Ground nut in the ratio of 1:5 (or) 1:7.

**9. Gingelly**:- *Sesamum indicum*

- Oil % = 46-52% In India – U.P. (1<sup>st</sup>)  
A.P. – Karimnagar.
- White seeded varieties are grown in Telangana region. White seeded have high oil than black seeded varieties.
- ANGRAU released gingelly variety is “Madhavi”.
- Sesamum + Red gram in 5:1 ratio.
- Oldest oil seed crop is gingelly.

**10. Castor** :- *Recinus communis*

- Important industrial oil seed crop.
- Castor oil contains a very high percentage of hydroxyl fatty acid known as “Recinoleic acid”.
- Castor oil is used as a purgative. In dyeing industries, it is used for the preparation of “Turkey red”.
- It is not used as cattle feed because of toxic behavior of rice “(an albumin) and ricenine” (an alkaloid)”.
- Brazil – first. India first in area and second in production .  
Andhra Pradesh first in area. ‘Nalgonda’ first in Andhra Pradesh.
- Aruna – mutant of HC – 8; ‘Sowbhagya’ – long duration variety.
- Spacing for Aruna castor is 60 X 30 cm, Aruna (nipped) – 45 X 30cm.

- Nipping of axillary buds is practiced when castor is grown for seed production. Yield increased by 30% due to was observed.

**11. Sunflower:-** *Helianthus annuus*

- Origin – Peru (or) Mexico.
- It is short duration, Photo insensitive crop.
- It is a rich source of “Linoleic acid” – 64%.
- “Sunrise selection” is a Canadian variety.

**12. Safflower:-** *Carthamus tinctorius*

- Linoleic acid – 78%
- Unsaturated fatty acids of safflower lowers the “Serum Cholesterol”.
- Oil is used in the preparation of “Roghan” which is used in the preservation of leather and the production of water proof cloth.
- In India, the crop is mainly grown in Maharashtra.

**13. Niger :-** *Guizotia abyssinica*

- Oil – 37-43%
- India is the chief niger producing country. It is mainly grown in M.P.
- “Oodacamund” – 120 – 130 days.

**14. Linseed :-** *Linum usitatissimum* Var. Kiran

- It is a dual purpose crop grown for oil as well as fibre; oil – 33 – 47%.
- Linseed oil is very excellent drying oil.  
M.P. - first
- Linseed is susceptible to weed competition through out its growth period.

**15. Mustard and Rapeseed :-** (*Brassica* sp)

- Rapeseed and mustard are the major Rabi oil seed crops of India.
- It is grown as oil seed crop as well as condiment.
- In the tanning industry, mustard oil is used for softening of leather.
- Refined oil called Colza is used in Europe.
- China is the largest producer of these crops  
India – second, U.P. – First.
- Mustard – *Brassica juncea*  
Rapeseed – *B. campestris* F: Cruciferae.
- Sarson – India colza; Toria – Rape, Rai – Mustard.
- These crops neither tolerant to drought nor water logging.
- Toria is the earliest brassica oil seed crop to be harvested.

**Sugarcane:-**

- India is said to be the original home of Sugarcane.
  1. Noble cane (or) garden cane – *Saccharum officinarum*
  2. Chinese cane – *S. sinensis*
  3. North India cane – *S. barbans*
  4. Wild canes of Asia – *S. spontaneum*
  5. Wild canes of Gunea – *S. robustum*
- An implement known as “Ridge mar” has been designed to work a tractor without initial ploughing of the fields and prepare deep trenches.
- “Three budded setts” are the most widely practiced method of planting.
- Method of planting in Anakapalli region – ‘Trench planting’.

Wrapping – It is the process of twisting the bottom leaves a round the cane.

Propping – The Sugarcane is supported by bamboos to prevent the plant from lodging.

- If the brix recorded by hand refractometer is 18% (or) more the cane is said to be mature.
- For recording the brix “Hand refractometer” is used and jar extraction of juice “Pouch piercer” is used.
- “Lime sucrate” is one of the clarificant used for neutralising the juice and flocculation of collidal particles in the juice.

**Sugar beet:-** *Beta vulgaris*

- F.C Achard is father of the sugar beet industry.
- 40% of world sugar stoma sugar beet, 60% of world sugar is from Sugar cane.
- Sugar recovery in Sugar beet is 15-16%; in Sugar cane 8 – 10%.

**Tobacco :** - *Nicotiana tobacum*

- *N. rustica* is used for hookah, chewing and snuff.
- CTRI – Rajahmundry
- The removal of the flower bud along (or) along with some of the top leaves of the plant is known as “Topping”.
- After topping the axillary buds grows and the removal of buds is known as “desuckering”.
- Pit curing is followed for chewing and hookah tobacco.

**Cotton:-**

- *Gossypium hirsutum* (50%) *G. barbadense* (negligible area)
- *G. arboreum* (29%) *G. herbaceum* (21%) – Chro. No.13
- Temperature for germination 15<sup>0</sup>C, during the period of floral bud initiation 21<sup>0</sup>C.
- Seed cotton – ‘Kapas’. Topping is also done.
- Ginning % - It is the out – turn of lint to seed cotton
- Sample quality – Expressed in counts. A count is the number hanks (840 yards each) found in the one pound of yarn.
- Neppiness – the defect in yarn. Due to the fibres, tiny knots are formed in the yarn.  
Varalakshmi – Hybrid cotton.  
Saraswathi – Desi cotton

**Mesta:-** “*Hibiscus cannabinus*”. *H. subdariffa* F: Malvaceae

- A.P. first in production
- Mesta Research Station – Amudalavalasa – Srikakulum.
- Ideal stage for harvesting is flowering stage.
- 16% fibre – by weight of dry stalks  
40% fibre – by weight of fresh stalks.

**Sunhemp:-** Bambay hemp (or) Banaras hemp – *Crotalaria juncea*.

- Proper stage of harvest – ‘Pod formation’.
- A common weed associated with sun hemp is ipormeia sp.

**Agave:-** *Agave sisalina* – Creamy white fibre

- It serve as hedge cum fibre plant.
- Propagation through “Suckers and Bulbis”.
- Flowering in case of Agave is called “Poling”.

**Jute:-** *Corchorus capsulari*; *C. olitorius*, F: Tiliaceae

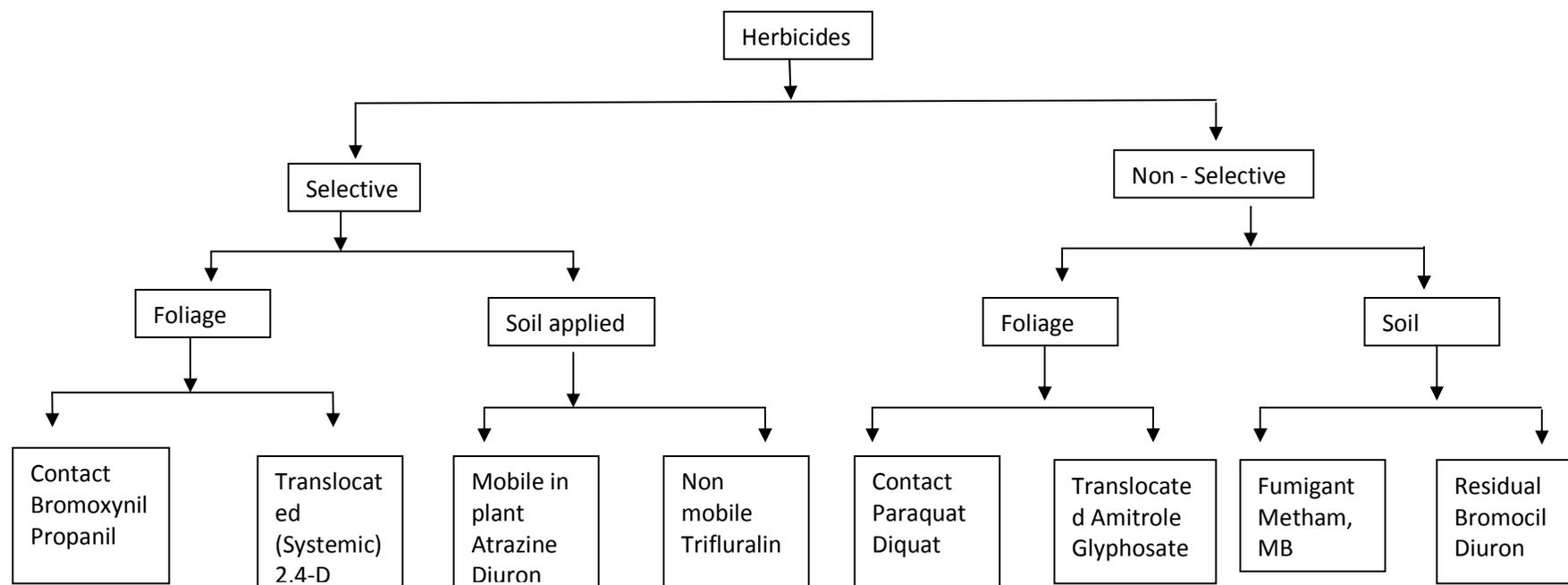
- Retting : It is the biological process by which the fibre of the bark gets loosen and separated easily from the woody stalk due to removal of pectins, gums, and other mucilaginous substance.
- Retting is due to combined action of water and microorganisms.

**Bits:**

- U.S.A produce largest oil seeds in the world.
- Superior quality Jaggary is obtained from the Sugar cane variety is CO – 7706.
- In tobacco, burning quality is positively related to ‘K’ content of leaf.
- The long keeping quality of gingelly oil is due to the presence of antioxidant ‘Sesemolin’.
- Sesamum is highly sensitive to frost.
- In Groundnut, oil content is positively related with temperature.
- The short fibres covering the cotton seed are termed as “Fuzz”.
- A pulse crop without root nodules – “Rajmah”.

- A weed is a plant growing where it is not desired.
- Burmudo grass/star grass – *Cynodon dactylon* – Forage grass  
Quack grass - *Agropyron repens* – Soil binding grass.
- *Eichornia crassipes* – Weed for fisher man (Water hyacinth)
- Weeds as green manure – *Croton sparsiflorus*.
- Source of a protein – *Chlorella pyrenoids*.
- Weeds used in crop breeding – *Saccharum spontaneum*
- Weeds used as pollution indicators.  
NO<sub>2</sub> gas – Wild mustard  
SO<sub>2</sub> – Chick weed.
- Medicinal plant – *Leucas aspera* - snake bite/malaria.
- Reclaim alkali soils – *Argemone mexicana* (Mexican poppy)
- Prickly weed – wild safflower.
- Canada thistle – *Cirsium arvense*; Bund weed – *Convalulus arvensis*.
- In tea the presence of “Loranthus” leaves impair its quality.
- Congress/Municipal/Carrot grass – *Parthenium hysterophorus*.
- Water lettuce – *Pistia lanceolata*.
- Nut grass – *Cyperus rotandus*.
- Fail to regrow when they are cut close to the ground level - simple annuals.
- The woody weeds include shrubs and undershrubs are collectively called “Brush” weeds.
- Summer perennial weed – *Sorghum halopens* (Jhusow grass).
- Winter perennial weed – *Cirsium arvense*.
- Migrated weeds (or) introduced weeds are called as *Anthrophytes*.
- Poisonous weed – *Datura fastuosa*.
- Facultative weeds are also called apophytes – but often escape from cultivated fields.
- An objectionable weed is a noxious weed whose seed is difficult to separate once mixed with crop seeds.
- In quack grass rhizomes sometimes called “Sobolobes”.  
Runners – Bermuda grass  
Bulb – Wild onion, wild garlic.
- In *Hydrilla verticillata* the bulbils originate in leaf axils and called “Turions”.
  1. Pappus → It is a parachute like modification of persistent calyx into hairs.  
Eg. Compositae family
  2. Comole → Weed seeds are covered with hairs partially (or)
  3. Baloon → It is a modified pappery calyx.  
Eg: *Physalis minima*.
- Wind swings the intact plant → Censor mechanism Eg: Mexican poppy.
- Dispersal of weeds through digestion mechanism (animals) is a “endozoochori”.
- Those with the same size and shape as the grain are extreme difficult to separation. Such weeds are called “Satellite”.
- “Neutrophiles” serve as indicator plants.
- Thatch grass – *Imperata cylindrica*.
- Wild ant (*Avena jatva*) seeds exhibit 3 types of dormancy.  
i.e. Enforced, Innate, Induced dormancy.
  - a. Enforced dormancy: It is due to the placement of seed in the lower layer of soil, It is caused by the absence of “red light”.
  - b. Innate dormancy : Genetically controlled character. It is due to the presence of hard seed coat and immature embryos.

- c. Induced dormancy: due to some sudden physiological changes.
- Agril. ecotype – Continued adoption of an agril. Practice can lead to the development of adoptive ecotypes.
  - In summer, furrow planting of crops is a very useful method for reducing weed problem.
  - Flooding is a common crop husbandry method of controlling weeds in rice field.
  - Bio – agent is a living organism employed to control of pest.
  - “*Lantana camera*” was controlled by *Crociosema lanotana* – moth borer.
  - Carp fish used to control aquatic weeds.
  - Spider mite was found to useful in controlling prickly pear (*Opuntia stricta*).
  - Starvation test is a good safeguard against an introduced bio agent becoming a pest of some economic crop plant.
  - Bio herbicides: In *Phytophthora palmivora* – De-vine.  
*Colletotrichum gleoispories* – Collego.
  - When hand pulling is aided by a forked sharp blade (or) tip of a sickle, it is called “Spudding”.
  - Mowing is cutting of a uniform growth of weeds from entire area at ground level.
  - Dredging and chaining is used to control aquatic weed.
  - Repeated light application of flame to plant shoots can destroy even roots of deep perennial weeds. This process is called “searing”.
  - When selective herbicides are applied at higher rate they act as non – selective herbicides. Eg. Diuron.
  - Atrazine is a trans locate herbicide when absorbed from soil but a contact herbicide when sprayed on plant shoots.
  - For perennial weeds translocated herberbicides are used.
  - Pre plant dessication is applied to destroy existing vegetation.



- Pre plant incorporation: herbicides are mixed with weed free seed beds to obtain residual control.  
Eg. Paraquat, Fluchoralin (especially in pulse crops)
- Pre emergence – Atrazine, Diuron.  
Post emergence – Paraquat and Diquat.

**Adjuvant:-** are also called as additives.

1. Surfactants / wetting agents/surface active agents.  
Eg. Soap, Uphar, Tea.
2. Stabilizing agents include emulsifier and dispersants
  - An emulsifier causes an emulsion concentrate to disperse spontaneously into small stable droplets.
  - Dispersants stabilize suspension.
3. Solvents/coupling agents / co-solvents.
  - 2, 4 – D is almost insoluble in water, but it can be dissolved in “Poly ethylene glycol (PEG)” to make it water soluble.
4. Humicants/Hygroscopic agents: Humicants prevent rapid drying of herbicides.  
Eg: Glycerol.
5. Stickers/filming agents/deposit builders.
6. Compatibility agents – like “Compex” are used to mix fertilizers and pesticides.
7. Activators/synergists: “Ammonium thiocyanate” is a widely used activator of amitrole and the combination is designated as Dmitrole – T.
8. Drift control agents
  - Triazines:- The inhibition of photosynthesis is a characteristic effect of triazines. Their specific action is on the photolysis on the hill reaction.
  - Uracil: These are strong inhibitors of photosynthesis.
  - Ureas: Produce abnormal meiotic cells in root tips.
  - Nitriles – Bromoxynil  
Most sensitive site of action is uncoupling of oxidative and P.S. Phosphorylation.
  - Bipyridilium – inhibit the reduction of NADP to NADPH.
  - Eichlobenil induces dormancy in weed seeds.
  - In organic copper or serial herbicides inhibit “Pyruvate dehydrogenase” activity during “glycolysis”.
  - Carbamates – These are mitotic poisons.
  - Thiocarbamates – Inhibits shoot and root growth of grass weeds.
  - Dinitroanilines – Nucleic acid inhibition is the primary mechanism.
  - Phenoxy alkanic acid – 2,4-D, 2,4,5-T cause epinasty, swelling twisting.
  - Troazpes – Amibole – development of albino leaves and shoots.
  - Selectivity of molinate between *Oryza sativa* and *Echinochloa colonum* was chiefly due to differences in the “crown root initiation” levels.
  - Activated charcoal has been found a strong absorbant of herbicides 2,4-D.
  - In intermediate metabolism the intermediate chemical structure prove more phytotoxic than the parent compound.
  - The reverse metabolism of 2, 4-DB and MCPB was by an enzyme of “ $\beta$  - oxidation process”.

- Selectivity of propanil between resistant rice and susceptible *Echinochloa colonum* was found to be due to differences in the “aryl acylamine amidohydrolase” (AAAH) enzyme content of their leaves.
  - 2, 4-D for killing broad leaved weeds in monocot crops.
  - 2, 4-DB and MCPB are employed for controlling broad leaved weeds MCPA – Methaxone, 2, 4-D (Na salt) – Fernoxone, Nitrofen – TOK – E- 25, Paraquat – Gramaxone; Fluchloralin – Basalin pendimethalin – stomp; Glyphosate – Round – up; Butachlor – Machete Benthocarb – Saturn.
  - Additive effect: It is defined as the total effect of combination is equal to the sum of the effects of the components.
  - Synergistic effect: The total effect of a combination is greater (or) more prolonged than the sum of the effects of the two taken independent.
  - Antagonistic effect: The total effect of a combination is smaller/lower than the sum of the effect.
  - Independent effect: The total effect a combination is equal to the effect of the most active compound.
  - Enhancement effect: Response is greater in herbicides when added with adjuvant.
  - Amitrole was phytotoxic to groundnut in the presence of high ‘P’ levels.
  - Application of herbicides in suspension fertilizers is becoming popular.
  - Boron reduces rapid microbial detoxification of 2,4-D.
  - Barnyard grass – *Echinochloa crusgalli* is most common in rice.  
Jungle rice – *E. colonum* – Upland rice.  
Water jern – *Salvinia molesta*.
  - Alachlor and metalochlor effective against grasses but weak against broad leaves.
  - Acrolein – used for destroying submerged weeds (aquatic).
  - *Cyperus rotendus* – Purple nut sedge; *C. esculentus* – yellow notes.
  - Canary grass – *Phalaris minor*.
  - Witch weed – *Striga asiatica*.
  - Discovery of natural stimulant of striga germination from cotton roots gives the trivial name “*Strigol*”.
  - For controlling striga growing resistant varieties like N – 13 is recommended.
  - Parthenin is the main toxicant present in the parthenium.
  - Johnson’s grass – *Sorghum halopens*.
  - Atrazine for maize, Sugar cane.
  - Trap crop for striga – cowpea.
  - *Opuntia delloni* was controlled by *Dactylopius tomentosus*.
  - Granular formation pre requisite – moisture pressure.
  - In Sugarcane, weeding starts with “Blind hoeing”.
  - Best herbicides for rice – “Anilophos”.
1. Triazines —————> Atrazine, atratap
  2. Triazoles —————> Amitrole, Amitrole – T
  3. Phenoxy acid —————> 2,4-D, 2,4,5-T, MCPA
  4. Diphenyl ether —————> Nitrofen
  5. Nitrites —————> Bromoxynil
  6. Thiocarbamate —————> Benthocarb

7. Bipyridilium —→ Paraquat, diquat.
8. Dinitroanilines —→ Fluchloralin
9. Substituted urea —→ Diuron
10. Amides & Acetamides —→ Alachlor

**C.P. 202:**

1. Reasons for low yields of rice in India is cloudyness.
2. Wheat variety brought from Mexico and formed the basis for green revolution is Sonara – 64, Lermaeroja.
3. The crop most sensitive to excess moisture at early stages of its growth – Maize.
4. Number of ground nut plants/m<sup>2</sup> in kharif are 33 and in Rabi are 44.
5. In wheat : single dwarf gene variety is Sonalika  
Double is Kalyansona  
Triple is Hira, Malavika.

## GENETICS AND PLANT BREEDING

- From the radical a seminal root originates, produces two lateral roots referred to as “Seminal root system”.
- Stem – Culm.
- Ligule – Membranous hairy structure present at the junction of leaf sheath and leaf blade.
- Auricles – Ear like appendages on either side of the ligule.
- Panicle – Spikelets may be pedicellate (or) sessile.
- Spike – Spikelets are sessile only.
- Perianth – represented by 2 lodicules which are hygroscopic, helping for pollination.
- Sub family Graminae:
  - Pooideae – basal floret perfect a while upper florets imperfect – Spikelets are laterally compressed.
  - Panicoideae – basal floret imperfect upper florets perfect – dorsally compressed.
- Sugarcane, Sorghum tribe – Andropogonae
 

Maize	– Maydeae	}	Panicoideae
Wheat	– Hordeae	}	
Ragi tribe	- Chlorideae	}	Pooideae

### 1. Paddy:

- Some spikelet glumes may be elongated nearly half to the length of the spikelet. Such spikelet is described as “Winged Spikelet”.
- The mid vein of lemma is prolonged into “awn”.
- The tip of lemma and palea are together projected and known is as “apiculus”.
- Fruit is described as “Caryopsis”.
- Paddy is “Protandrous”.

### 2. Sorghum:

- *Sorghum verticillium* – Higher content of HCN (Dhurrin).
- Fibrous roots along with stilt roots.
- Auricle absent.
- Lodicules 2, Fleshy, truncate, ciliate.
- Sessile floret is grain forming.
- Peduncle may be erect” (or) bending downwards - “goose necked”.
- *Sorghum cerneum* – Tellajonna; *S. roxburghi* – Konda jonna.

### 3. Maize : Zea mays varieties evertq – pop corn

- Inflorescence monoecious and open panicle.
- Style – a single long thread like structure known as “Silk”, divided into two (or) bifid stigma, Protein – Zein,

### 4. Wheat : Inflorescence – Spike of spikelet. $2n = 6 \times 7 = 42$ .

- Peduncle is zig zag rachis.

- In fruit longitudinal groove on the ventral side is known as “Crease”. On either side of it the elevated regions are known as “Cheeks” and on the stigmatic side small hairs are present known as “brush”.

**5. Bajra:** *Pennisetum americanum*

*P. purpureum* – Napier grass.

- Because of the short lateral branches, minute pedicels, the inflorescence may give a false appearance as a spike (Spiciform).
- On the tip of the anther lobes minute, unicellular hairs are present in the form of pencil cone. So it is described as “Penicellate anthers”. Which helps in anthers flush from bisexual flowers.
- Styles 2 but fused to one known as connate style. It is helped in emergence of stigmas from the bisexual floret.
- This crop is highly “Protogynous”, cross pollinated.

**6. Korra:** Fox tail millet; Italian millet; *Setaria italica*.

- The bristles are considered as reduced (or) modified “Spikelets”.

**7. Arika:** - Kodo millet; *Paspalum scrobiculatum*.

- Winged rachis is present.
- Immature plants, grains with husk are harmful to cattle with more HCN content.
- Dehusked grains is known as “Chicco”.
- Cleistogamous” pollination (S.F in unopened flower condition).
- *Echinochloa colonum* – “Oodalu” – Barnyard millet.
- Cleistogamy is seen in Arika, Bengalgram.

**8. Ragi:** - *Eleusine coracana*

- Leaves give whorled appearance.
- Inflorescence “terminal dilate whorl of spike”.
- One (or) two finger occur little below to the terminal whorl known as the “Thumb”.
- Paleas bikeeled (or) double boat shaped.
- Fruit – Utricle.

**9. Pulses:-**

- Papilionaceous corolla is responsible for the zygomorphic nature.
- Aestivation – The arrangement of sepals and petals in relation to the adjacent ones in bud condition.

**Tribe**

Hydecereae

Eienistlea

Vicieae

Phaseoleae

**Example**

Arachis – leaves, Paripinnate.

Sunhemp – leaves simple.

Pea, Bengalgram – Imparipinnate leaves

Redgram – Pinnate

**10. Bengal gram:-** Chick pea – *Cicer arietinum* (or) Gram

- Surface of the plant shows small glandular hairs containing “Oxalic and malic acids”.
- Persistent calyx (Sepals) is present, Jointed peduncle seen.

- Fruit legume (or) pod with persistent calyx and styles described as “beaked”.
- Cleistogamy is seen.
- Hilum – Place of attachment of seeds to pericarp.

**11. Cowpea:-** *Vigna catgung* (or) Indian pea. Known as vegetable meat.

- Fruit has longest pod among all the pulses.
- More number of seeds per pod of all the pulse crops.

**12. Glycine max:-** Soybean

- Below the stigma small hairs are present. Described as “bearded”.
- Used as minor pulse and mostly as a source of oil edible.

**13. Pea:-** *Pisum sativum*

- Fruit – a much swollen pod.

**14. Redgram:-** *Cajanus cajan*

- Long peduncles and flowers are seen as clusters at the tip of the peduncle.
- Among all the pulse crops flowering continuous for long period in the variety Prabhat, Puragati.

**15. Horse gram:-** *Dolichos biflorus* (or) *Macrotylomia uniflorus*

- Inflorescence; raceme – group of 2-3 pedicellate flowers (or) sessile flowers in the axil of bract.
- Sepals campanulate (cup shape).
- Use horse gram without splitting.
- Fruit “Sickle shaped pod”.

**16. Garden bean:-** *Dolichos lablab* var. *Typicus* – seeds are parallel to the pericarp.

- Field bean: *Dolichos lablab* var. *Lignosus* – seeds are right angle to the pericarp.

**Oil seed crops:-**

- Fatty (or) fixed – do not volatile (or) evaporate when exposed to atmosphere.
- Essential oil – Volatile (or) evaporate when exposed to atmosphere.
- All oils are in liquid form consisting of linoleic and oleic acids.
- Tuberous roots – “Dhalia”.
- In ray florets and disc florets calyx generally as “Pappus”.
- Syngenesious - the another lobes are united while the filaments are free. In compositae – fruit – cypsela (with persistent pappus).
- Safflower oil is best for heart patients because of high “Linoleic acid” content.

**17. Ground nut:-** Origin – Brazil

- Sepals united forming a long calyx tube represented as “Pseudopedicel”.
- Androecium “Monadelphous”. Androecium present at the rim of the calyx tube, antherlobes dimorphic (Morphologically dissimilar).
- This crop show longest flowering period.

- From the proteins of the cotyledons a synthetic fibre is synthesized used in textile industry known as “ardil”.

**17. Gingelly:-** F: Pedaliaceae

- “Bilabiate” corolla (two posterial petals upper lip; 3 arterial petals lower lip)
- Androecium “Didynamous” (2 stamens with short filament and 2 with long filament)

**18. Coconut:-**

Long – *Cocos nucifera* var. typical  
Dwarf – *cocas nusifera* var. nana

**19. Castor:-**

- Waxy coating – bloom
- Male flowers at the base – arranged in “irregular cymes”.
- Female flowers at the top – arranged in “recemose”.
- Branched stamens are present.
- The tip of stigmas covered with prominent bright red hairs, hence stigmas are “Papillose”.
- Fruit: A warty schizocarpic Regma (each bit coccus).
- Spongy out growth of outer seed coat – “Carunile”. Carunile (or) Eloisomes.
- Thick endosperm which is the source of oil – capions.
- The endosperm encloses thin “Leaf like cotyledons”.

**Fibre crops:-**

1. Lignified fibres – Schlerenchymatous cells. Flax fibre = Linseed fibre.  
eg: sun hemp, Deccan hemp, manila hemp.
2. Cellulose fibre – Cotton, flax.
  - Bast fibre – Sunhemp, flase, manila hemp.
  - Wood fibre - obtained from the xylem. Eg: Bamboo
1. Cotton:
  - Single bundle completely enriches the ovary and style of the gynecioum and forming “Staminal colums”.
  - Aborted avotes which are known as “Motes”.
2. Hibiscus cannabinus: Bhimilipatnam jute, Deccan hemp, Mestafibre  
H.sabdriffa – Roselle
  - Each sepal is showing a prominentelivated midrib at the centre of which a prominent involucral gland is present.
3. *Corchorus capsularis*: C. olitorius – Bengal jute F: Teliaceae
  - Fibres are extracted by Retting process. It is mricrobial process by clostridium.
  - *C. Olilorius* – Fossajute.
  - Also known as ‘Goldenfibre’ – JRF - 2012

**Sugarcane:**

- Small longitudinal slits present in the epidermis are known as “Corky cracks” (or) “ivory marks”.
- The bud is protected by two lateral outgrowths known as “Flangens”.

- In the bud groove region, small horizontal cracks are known as “Knife cuts”.
- At the ligule region the inner surface of the leaf sheath is known as “throat” outer surface is known as “Collar”.
- Inflorescence – Arrow (or) open panicle.

**Tobacco:-**

- Many minute ovules as swollen axile – placenta.

**Chilli : - *Capsium annum***

- Inflorescence – extraxillary formed by the terminal bud
- Alkaloid – Capsacin, Red colour: Capsanthin
- Variety – Jwala.
- In sugar beet economic part – modified tap root.
- In Sago (*Metroxylon sago*) economic part is the central pith region of the trunk.
- In saffron – style and stigmas are the economic plant parts.
- Alkaloid in arecanut – “Arekalin”.
- Maize cobs, the nodes and internodes are very much condensed and the basal portion is called “Shank”.
- Safflower dye – “Carthamin”.
- Tobacco is the golden leaf of India.
- In Safflower, calyx is absent. It is cross pollinated crop. Often cross pollinated.
- Chilli is very rich in Vitamin “C”.
- In cool temperature “Linoleic acid” content increases in sunflower.
- Six staminal cereal – Rice
- Seed cotton is called – Kapas.
- The walls of pericarp in cotton is collectively called ‘Vue’.
- A bast fibre yielding crop belonging to the family – Malvaceae
- Bark oil – *Cinnamomum xylanicum*.
- Barkspice – “Chakka” in Telugu.
- Pinnately trifoliate leaf – Redgram.
- A berry with leathery pericarp – Capsicum.
- Tubular florets – Disc florets; Ray florets – ligulate.
- Epicalyx – Cotton
- In bajra “lodicules are absent”.
- Ciliate lodicules – Sorghum, Wheat.
- Sessile stigma – coconut.
- Bajra composite – Balaji, Maize synthetic – Amber leaf blight resistant cotton – Varalakshmi.
- Induced mutant in Groundnut – MC – 4, resistant to tikka leaf spot – Ab – 45.
- Turmeric variety released through clonal selection – Kasthuri Kesari.
- Rice variety resistant to stem borer – Ratna: TKM – 1.  
Gall midge - Siam 29.
- In the segregating population when the progenies fall beyond the reach of the parents it is known as “Transgressive segregation”.

- Inbreeding depression is not observed in self pollinated crops. Mutation breeding is commonly used in self pollinated crops. Inbreeding depression is common in “Crosspollinated” crops.
  - Natural selection plays an important role in “Bulk method”.
  - Double stranded RNA – Reovirus.
  - Double stranded DNA is – Cauliflower mosaic virus.
  - Primary cell walls of adjacent cells are connected by “Middle lamella” which is made up of pectin.
  - Cell wall is not present in animal cells.
  - Primary cell wall appears in the form of strands under electron microscope these are called “Micro fibrils”.
  - Lignin is generally a component of secondary cell wall.
  - Pinocytosis is ingestion of liquid food material.
  - Phagocytosis is ingestion of solid substances.
  - Plant cells are connected to one another by “Plasmodesmata”.
  - Cisternae – long flattened channels. It is the common form Vesicles – oval membrane.
  - Smooth ER is also known as “Sarcoplasmic reticulum”.
  - In plant cells and in lower invertebrates golgi complex is referred as “Dictyosomes”.
  - Golgi complex helps to form the cell wall in plants.
  - Primary lysosomes - Storage granules, secondary lysosomes – digestive vacuoles.
  - Digestion of the own cellular organelles – Autolysis.
  - Power house of cell is Mitochondria.
  - Ribosomes are classified based on their “Sedimentation coefficient” expressed as “Svedberg units”.
  - Peroxisomes are involved in photorespiration and in the metabolism of H<sub>2</sub>O<sub>2</sub>.
  - Glyoxysomes are abundant in germinating seeds.
  - Spherosomes are involved in lipid synthesis.
  - Micro filaments help in the cleavage of cytoplasm during cell division and form the contractile machinery of the cell.
  - In animals polynucleate cells are known as “Syncytial” and in plants they are known as “Coenocytic”.
  - Nucleolus helps for biogenesis of ribosomes.
  - Synthesis of DNA itself is called “Autocatalytic function”.
  - DNA directs the synthesis of chemical molecule other than itself “Hetero catalytic function”.
1. Cistron – The portion of DNA specifying a single polypeptide chain is termed as cistron.
  2. Muton – As unit of mutation.
  3. Recon – Smallest unit of DNA; capable of recombination.
- Synthesis of mRNA from DNA as a complementary strand is “Transcription”.
  - tRNA bring one amino acid each for a triplet codon as anticodes and thus is known as “translation” (Protein synthesis).
  - “Trillium” is having the longest chromosome.
  - Chromosomes without centromere are acentric.
  - The short segment of the nucleolar organizer chromosome, distal to the secondary constriction is called “Satellite”.

- The two distal ends of the chromosome maintains “polarity” are known as “Telomere”.
- The stained body of the chromosomes shows differential staining capacity at different parts is known as “Heteropiconosis”.
- 1. Euchromation – Light stained, genetically active.
- 2. Hetero chromatin – Dark stained, genetically in active.
- When the chromosomes are arranged according to size, shape and structure, it is called “Karyotype”.
- When these are represented by a diagram then such diagrams are called “Idiograms”.
- Endomitosis is resulting due to “Polytene chromosomes” present in salivary glands of “Drosophila”.
- Outer enlargement of polytene chromosomes are called as “Puffs”.
- Lampbrush chromosomes. Loops are present.
- Isochromosomes – They are metacentric chromosomes having similar genetic constitution in both arms.
- Interphase is the first stage of mitosis.
  1. G1 phase : growth; S phase – doubling of nuclear components.  
G2 phase: doubling of cytoplasmic components, chromatin is reduced.Karyokinesis – division of nucleus; cytokinesis – division of cytoplasm.
- Longest phase of mitosis – Prophase.
- Most of the Karyotypic studies are done from metaphase to anaphase.
- The sister chromatids begin to move towards opposite side – “Segregation”.
- The ‘Phragmoplast’ with deposition of pectin forms the middle lamella separating the daughter nuclei.
- In meiosis prophase I is the longest of all the stages.
- In Zygotene, chromosomes begin to pair and the pairing is known as “Synapsis”.
- The point of interchange of the genetic material is called “Chiasma” it takes place in pachytene.
- Anaphase – I is the root cause for hereditary variance because of segregation.
- Locus – location of a gene which is fixed on chromosome.
- One, two (or) more alternative forms of a gene are called “alleles”.
- Monohybrid – law of segregation (or) law of purity of gametes.
- Dihybrid – law of independent assortment.
- Phenotypic classes and gametes –  $2^n$ ; minimum population –  $4^n$ , genotypic classes –  $3^n$ .
- Paramutations are exceptions to the law of purity of gametes
- Linkage is an exception to Mendel’s law of independent assortment
- A gene influencing more than one character – Pleiotropic gene and such phenomena is called “Pleiotropism”.
- Genes which cause a deviation from the normal development lethal gene – ratio – 2:1.
- Pseudoalleles – Structurally different, but functionally similar. The effect produced by them is known as “cis trans effect”. Alleles occupy same loci.
- Multiple alleles – alleles occur in several alternative forms for particular character.
- Over dominance – When the heterozygotes have more extreme phenotype than either of the corresponding “homozygotes”.
- Co-dominance – Lack of dominant and recessive relationship and the ratio is (1:2:1).
- Incomplete dominance – blending inheritance – 1:2:1. (in mono hybrids).

- Incomplete dominance in dihybrids – 3:6:3:1:2:1. Eg: *Mirabilis jalapa*.
- 1. Complementary factors (Duplicate recessive epistasis) 9:7, Test cross ratio 1:3. Two separate factors governed the same character.
- 2. Supplementary factors (Recessive epistasis) – 9:3:4, Test cross ratio 1:1:2.
- 3. Epistatic factor (dominant epistasis) – 12:3:1. Test cross ratio 2:1:1.  
The gene which suppresses the effect of other is known as “Epistatic gene” and other gene which was suppressed in its effect is known as a “Hypostatic”.
- 4. Inhibitory factor – 13:3, Test cross ratio 3:1.
- 5. Duplicate factor (duplicate epistasis) 15:1.
- 6. Additive factor – 9:6:1; Test cross ratio – 1:2:1.
- The ability of gene (or) gene combination to be expressed phenotypically to any degree is called “Penetrance”.
- The degree of effect produced by a penetrant genotype is called – expressivity.
- Quasi quantitative traits – The quantitative expression of certain qualitative character.
- 2 or more genes situated on the same chromosome to remain together in inheritance is known as “linkage”.
- The degree (or) intensity with which two independent genes are linked together is called the “linkage value”.
- The total percentage of recombined types indicates the percentage of cross over. It is a measure of “linkage”.
- Qualitative character genes linked with quantitative character gene. Such factor is called as “Marker gene”.
- Homologous chromosomes twist around each other in synapsis, then each of the two pairing chromosomes, itself become spirally wound up. This is called “Spiralisation”.
- The movement of chiasmata is called “Terminalisation”. It takes in “diplotene” stage.
- Cytological proof of crossing over – Stern’s experiment.
- The tendency of one cross over to suppress the other in neighbourhood is known as “Interference”.
- “Coincidence” is the chance of crossing over as expected  
Coincidence + Interference = 1
- Ca, Cobalt reduces crossover
- Irradiation and colchicine reduces the crossing over
- $$1 \text{ cross over } \% = \frac{\text{Total recombinations}}{\text{Total progeny}} \times 100$$

The two point test cross give only distance between genes; but three point test cross give distance and order of genes.

- Progametic and Syngamic: Sex is determined before and at the time of fertilization.  
Male heterogametic:
  1. XO – XX mechanism Eg: Vallisnaria, Cockroaches
  2. XY – XX Mechanism Eg: Man, Rumex sp, Drosophila.

Female heterogametic:

1. ZZ – ZO Mechanism – Chicken, moths, butterflies.
  2. ZZ – ZW Mechanism – Some fishes, some birds.
- Neurospora, Asparagus and maize are having genes influenced by sex.
  - When twin zygotes are formed with male and female genotypes the hormones of male embryo make the female embryo as sterile (or) with non functional sex organ known as “Free martin”. Eg: OX.
  - Sex chromosomes are also called as “heterochromosomes”.
  - Ratio X/A  $1/3$  – Supermale,  $1/2$  - Normal male,  $2/3$  – intersex (or) sterile  
 $2/2$  – Normal female,  $3/2$  – super female.
  - Inheritance of X- linked genes – Colour blindness, Haemophilia.
  - Inheritance of Y- linked genes – Hypertrichosis (Presence of hair on ears).
  - Sex influenced – Baldness X Pattern Baldness.
  - Sex limited – Secondary sexual characters, Beard development, breast development.
  - Genes located in the sex chromosomes – “Sex linked”
  - Sudden heritable changes – “Mutations”.
  - Occurrence of genetically different tissues in the same organisms are known as “Chimeras”. These are of 3 types.
    1. Sectorial – ‘V’ Shape (or) pie shape.
    2. Mericlinal – In epidermis mutation.
    3. Periclinal – In deeper region.
  - Agents which cause mutations are referred to as “Mutagens”.
  - High frequency mutations result by “Mustard gas”.
  - Induced sex linked lethal recessive mutation – CIB technique.
  - Individual hereditary factor known in chromosomal inheritance as “genes” but in extra chromosomal inheritance as “Plasmagenes”.
  - Plasmagenes are also called as “Kappa particles” (Paramoecium).
  - Deletions survive in Heterozygous but lethal in homozygous condition.
  - Non lethal deletion (or) deficiency leads to “Pseudodominance”.
  - If a repeated segment is present besides normal segment and has the same gene order it is known as a “Tandom duplication”.
  - Besides normal segment but have a reversed gene order – Reverse tandom.
  - If the repeated segment is present on a non – homologous chromosome it is known as a “Displaced duplication.
  - Reversal of the linear arrangement of genes in a segment without change in the total gene content, it is termed as Inversion”.
  - Pericentric inversions produce unbalanced gametes and inviable zygotes.
  - The transfer of a section of chromosome to a homologous chromosome is known as “translocation”.
  - Haploid set of chromosomes – genome (term coined by Wrinkler).
  - Haploid simply denotes the total number of chromosomes contained in a gamete of any sporophyte.
  - Autopolyploids – A polyploid possessing similar (or) identical genome.
  - Allo polyploids – A polyploid possessing dissimilar genomes.

- Aneuploidy (Un even) ; The lowest haploid chromosome number is genome.  
Nullisomics  $2n - 2$ , Trisomic  $2n+1$   
Monosomic  $2n-1$ , Tetrasomic  $2n+2$ .

**Bits:**

- A series of genetic disturbances which ultimately lead to male sterility in plants are due to the presence of Accessory (or) B chromosome.
- Centromeres of bivalents are arranged on either side of equator – co orientation (in metaphase – 1)
- Animals having no sex hormones but with distinct areas of body showing male and female tissues is known as “Gynandromorphs”.
- Single stranded RNA in plant virus TMV.
- When the inverted segment of chromosome includes no centromere then such inversion is known as “Paracentric inversions”.
- The diploid chromosome number in Rice is 24.
- Crossing over takes place between non sister chromatids of homologous chromosomes.
- ‘N’ base containing single ring of atoms in their molecule – pyrimidine; double ring – purine.
- Expression of recessive gene in hemizygous condition – “Pseudodominance”.
- Genes at a given locus – multiple allele,
- Gene at different loci – Multiple factor.
- Both the sexes are well developed in one body but cannot function as either sex – “Pseudohermaphrodites”.
- When an allele is absent from the homologous chromosome, it is termed as Hemizygous condition.
- The most accepted type of DNA replication is by “Semi conservative method”.
- Crossing over does not occur in the females of silkworm and in males of ‘Drosophila’.
- Genes present in Y- Chromosome, transmitted only from male to male are called as “Holandric”.
- The immediate effect of foreign pollen on the embryo and endosperm character is termed as xenia.
- Maximum frequency of crossing over between two genes regardless of multiple crossover is 50%.
- Quantitative traits are governed by “Polygenes”.
- Crossing of  $F_1$  with homozygous recessive – Test cross.
- Gene exchange in bacteria by viruses – Transduction.
- An example of man made allopolyploid – Triticale.
- Raphano brassica – *Raphanus sativus* x *Brassica oleraces*.
- Cytoplasmically inherited characters are inherited through the maternal parent.
- Spindle fibres are formed by the polymerization of “Microtubules”.
- Autotriploid- Banana; Grape, seedless water melon.
- Autotetraploid – Potato, Autohexaploid – Sweet potato,
- Allotetraploid – Cotton, Allopolyploid – Triticale, Raphanobrassica.
- Man made autotriploid – Sugarbeet.

- Non sister chromatids break by “Endonuclease enzyme”.
- The tendency of one dominant gene and recessive gene to remain together on a chromosome is called “Repulsion phase”.
- Cells which undergo meiosis are called Meocyte.
- The entire genetic constitution of an individual is called – genotype.
- Exception for cell theory – Virus.
- Lysosomes are tiny bags filled with “hydrolytic digestive enzyme”.
- Cell undergoes meiosis when the ratio of RNA and DNA is low.
- Non localized chromosomes are present in *Luzula*. i.e. Diffused Centromere.
- Telomeres showing active mobility is called Neocentric.
- Oil seed crop varieties developed by mutation breeding is castor.
- Amino acids are attached to the RNA at “Anticodon end”.
- Polygenic expression will be greatly influenced by environment.
- Chemical mutagen – Ethyl methane sulphonate (EMS).
- One allele mutagenic together – Paramutation.
- Barr eye character in *Drosophila* is due to “duplication”.
- The number of tRNA kinds – 21.
- The end of tRNA which recognize “aminoacyl synthetases” is CCA.
- Starting codon on mRNA – AUG.
- Translocation heterozygotes produce viable gametes by “Alternative segregation”.
- Haploid – diploid sex determination is present in honeybee.
- Colchicine can depolymerise Microtubules.
- Chromatin = DNA + Nucleoprotein.
- Location of genes on chromosomes – is done by aneuploids.

- Striga resistant variety – N-13 of Sorghum.
- Paleolithic (or) early stone age – No domestication of plants and animals.
- Neolithic (or) late stone age – Domestication of plants occurred.
- Historical period – Domestication of industrial plants.
- Modern period – Domestication of industrial plants and drug plants.
- Introgression – Absorption of germplasm from one species by the other without impairing its taxonomical identity is known as “introgression”
- Corn has borrowed most of the characters from its wild relatives “Teosinte and Tripsacum”.
- Large proportion of cultivated crops originated through “allopolyploid”.
- According to Mendel variations in the population is created because of “Natural hybridization”.
- Natural selection – Darwin.
- Vavilov noted the existence of parallelism in variability among the related species and he called it as “Law of homologous series”.
- Largest and oldest independent centre of origin – The China centre of origin.
- Secondary crops – plants which are derived from weeds that grow among the primary crop plants.
- Bulbils – Modified flowers that develops into plants directly without formation of seed. Eg. Garlic.
- Somatic hybridization (Protoplasts of two different species may be fused with the help of poly ethylene glycol (PEG).
- Apomixis:- It is a form of asexual reproduction in which seed is produced but the embryo develop without fusion of male and female gametes.
- When sexual reproduction occurs besides apomixes, the apomixes is termed as “Facultative apomixes”.
- Apospory - Some vegetative cells of the ovule develop into unreduced embryo seed without meiosis.
- Apogamy – Synergids (or) antipodal cells develop into embryo.
- Pseudogamy – Development of apomictic seed by the stimulus of pollination and pollen tube growth without fertilization.
- Parthenogenesis – Development of a embryo without fertilization.
- Parthenocarpy – Development of fruit without seed.
- Monogamy – Both male and female flowers mature at the same time.
- Chasmogamy – Flowers open only after pollination.
- Dichogamy – Male and female flowers mature at different times.
- Heterostyly – Flowers are bisexual but stamens and styles are of different lengths.
- In often cross pollinated crops cross pollination exceeds 5%.
- NBPGR – National Bureau of Plant Genetic Resources.
- The part of plant used in the propagation of the species is known as “Propagule”.

**Introduction of Pests and diseases:** Potato tuber moth from Italy; Woolly aphids of apple and fluted scales of citrus from Australia.

- False smut of Wheat – Australia; Coffee rust and Bunchy top of banana – Sri Lanka.

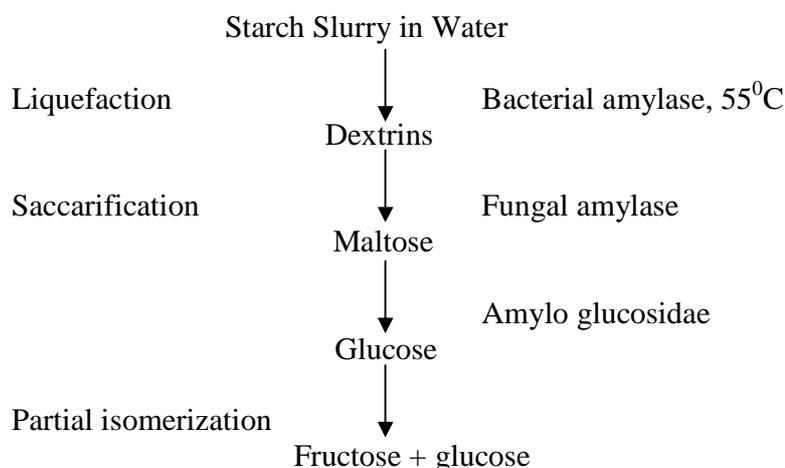
- Adoption of a variety to a new environment is known as “acclimatization”.
- All dwarf wheat varieties are derived from crosses with “Mexican dwarf wheat”.
- The gradual loss of variability in the cultivated forms and in their wild relatives is referred to as “Genetic erosion”.
- Gene sanctuaries – May be defined as an area of diversity protected from interference from man.
- “Exploration” are trips for the purpose of collection of various forms of crop plants and their related species.
- The fundamental steps of any breeding programme, are
  1. Creation of variation
  2. Selection.
- The two basic requirements of selection to operate are
  1. Variation must be present in the population.
  2. The variation must be heritable.
- The ratio of genetic variance to the total variance i.e., phenotypic variance is known as “heritability”.
- “Genetic advance” is the difference between the mean of the progeny and mean of the population from which selection is made.
- Evaluation of the worth of the plants on the basis of performance of their progenies is known as “Progeny test”.
- A pure line is a progeny of a single homozygous plant of self-pollinated species.
- Homozygosity % =  $(2^m - 1) / 2^m$   
m = No. of generations of selfing.  
n = no. of genes segregating.
- Mating (or) crossing of two genetically dissimilar plants is known as “Hybridization”.
- The pedigree may be defined as description of the ancestors of an individual and it generally goes back to some distant ancestors.
- Isogenic lines – Which are identical in their genotype, except for one gene.
- The back cross is the only method for “inter-specific gene transfer”.
- Heterosis may be defined as the superiority of F<sub>1</sub> hybrid over both the parents.
- Maize is the crop studied against heterosis and inbreeding depression.
- If the F<sub>1</sub> is superior over the better parent, it is known as “Heterobeltosis”.  
$$\text{Heterosis} = [F_1 - ((P_1 + P_2)/2)]$$
- Mating between closely related individuals (or) self-fertilization is known as “inbreeding”. Loss of vigour and fertility due to inbreeding is known as “inbreeding depression”.
- Top cross: A cross between an inbred and an open-pollinated variety.
- Homozygous balance is characterized by lack of inbreeding depression.
- Test cross: When the top cross is made to assess the combining ability of an inbred the cross is called as “test cross”.
- Poly cross: Progeny of a line produced through random pollination by a number of selected lines.
- Varietal cross (or) population cross: A cross between two open-pollinated varieties.

- If ‘n’ lines are to be tested in all possible single cross combinations there would be  $n(n-1)/2$  single crosses without reciprocals and if reciprocals are also included it would be  $n(n-1)$ .
- The concept of combining ability was proposed by Sprague and Tatum.
- The ability of an inbred to transmit the desirable character to its hybrid progenies in combination with another inbred line is known as “combining ability”.
- The average performance of inbred in series of hybrid combinations is known as its “General combining ability”. This is obtained by “top cross test”.
- Specific combining ability: is a deviation from performance predicted on the basis of GCA estimated by “Diallel crossing”.
- Heterosis is mainly due to SCA.
- Number of double cross combinations –  $n(n-1)(n-2)(n-3)/8$ .
- Synthetics are important in cross pollinated crops.
- A “Synthetic” may be defined as an advanced generation of open pollinated seed mixture of a number of inbred lines among them.
- Synthetics only exploit GCA; but hybrids exploit both GCA and SCA.
- $Syn_2 = Syn_1 - (Syn_1 - Syn_0)/n$ .  
n = no. of parental lines.
- A “Composite” variety is produced by mixing seeds of several phenotypically outstanding lines and allowing them to open pollinate in all possible combinations.
- Germplasm complexes are produced by mixing seed from several lines (or) populations of diverse genetic origin.
- Recurrent selection: Method which involves “reselection” generation after generation with interbreeding of selects to provide genetic recombination”.
- In recurrent selection for GCA tester is “open pollinated variety” (broad genetic base).
- In recurrent selection for SCA tester is an “inbred”. (narrow genetic base).
- If dominance is in complete, Recurrent selection for GCA & reciprocal recurrent selection are equal but both are superior to R.S for SCA.  
If dominance is complete three methods are equal.  
If over dominance is present, Reciprocal recurrent selection and recurrent selection and recurrent selection and recurrent selection for SCA both equally superior to recurrent selection and recurrent selection for GCA.
- Male sterility is the condition in which non functional pollen grains are produced.
- The male sterile line may be maintained by crossing it to a heterozygous male fertile. Genetic male sterility is governed by a single recessive gene.
- Male sterile  $Srr$  X male fertile  $Frr$  → Male sterile  $Srr$ .
- Maintainer line is recessive fertile –  $Frr$ .
- Incompatability : Heteromorphic – accompany florel. Morphological differences.  
Homomorphic : do not accompany any floral morphological differences.
  - Gametophytic
  - Sporophytic
- Long styles, Short stamens – pin type flowers .  
Short styles, long stamens – Thrum type.

- In gametophytic incompatibility incompatible reaction depends upon the genetic constitution of the pollen itself.
- Fully incompatible –  $S_1S_2 \times S_1S_2$
- Partial compatible –  $S_1S_2 \times S_2S_3$ .
- Fully compatible –  $S_1S_2 \times S_3S_4$ .
- By each generation of selfing in Cross Pollinated crops the homozygosity is increased by 50%, while heterozygosity reduced by 50%.
- Term ‘Heterosis’ was coined by “Shull”.
- An auto tetraploid which contains all recessive alleles is termed as “Nulliplex”.
- A “Clone” is a group of plants produced through asexual reproduction from a single plant.
- A sexually propagated crops are invariably cross pollinated.
- Pathogenicity - Ability of a pathogen to infect a host strain.
- Virulence – Capacity of a pathogen to incite a disease.
- When the host does not show the symptoms of disease it is known as “Immune reaction”.
- Phytoalexins are produced by a host in response to infection of the pathogen. Phytoalexins are either “fungicidal (or) fungistatic”.
- Oligogenic resistance is synonymous to “vertical resistance” (resistance to only one race).
- Vertifolia effect: Epidemic development in “Ono” variety carrying vertical resistance genes.
- In horizontal resistance reproduction rate is not zero but it is less than one.
- Pedigree method is quite suitable for horizontal resistance.
- All three (Yellow, Black & Brown) rusts resistant wheat variety – sparrow.
- Oligophagy – live on one taxonomical unit only. Eg: Hessian fly (flesian fly).  
Seasonal oligophagy – Insects may live on many sps. In one part of the year and on few in another part of the year. Eg. Aphids.
- The detrimental effect of the plant on the biology of the insect is known as “Antibiosis”.
- Leafhopper resistance – Vijaya (in rice).
- Accumulation of proline (amino acid) content in drought resistance.
- Screening tests are normally conducted in  $F_3$  generations of segregating material.
- First induced mutation variety – Charina – F (tobacco).
- Induced mutations commonly pleiotropy often due to mutations in closely linked genes.
- Gene mutations – gamma rays.
- Alpha rays – Chromosomal aberrations, Beta rays, X – Rays → Chromosomal and gene mutations.
- Non – ionizing agents use is confined to ‘pollen grains’.
- Polyploids contain generally low dry matter content than diploids.
- Mainly allopolyploids are “Apomictic”.



## BIOTECHNOLOGY

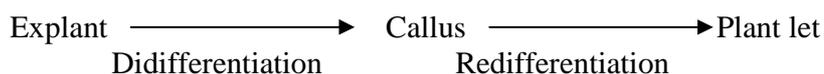


- Variation created in tissue culture is called “Somaclonal variation”.
  - The specialized cells (B – cells) in the spleen and lymph glands release antibodies.
  - Monoclonal antibodies is applied to a group of identical antibodies recognizing the same antigen.
  - Callus – A tissue arising from disorganized proliferation of cells.
  - Subculture – A septic transfer of a part of a culture to fresh medium.
  - Passage time - The time interval between two successive sub cultures.
  - Suspension culture – Cells (or) cell aggregates culture in liquid medium.
  - Batch culture – Cell suspension grown in a fixed volume of liquid medium.
  - Explant – A plant organ (or) piece of tissue used to initiate culture.
  - Excise – To remove a piece of tissue (or) an organ from its parent source.
  - Meristemoid – Cluster of meristematic cells with in Mcallus with a potential to form primordia.
  - Embryoid – Non zygote embryo formed in culture.
  - In vitro – “In glass”; In vivo – “In life”.
  - Parasexual hybridization (or) somatic hybridization – Hybridisation by non sexual methods.
- Eg: Potoplast fusion.
- Heterokaryon – A cell in which 2 (or) more nuclei of unlike genetic make up are present.
  - Synkaryon – Hybrid cell produced by the fusion of nuclei in homokaryon.

**Bits:** In mass selection genotype of selected plants is not known since progeny test is not done.

- During plant introduction the introduced material should be accompanied by a “Phytosanitary” certificate.
- Allotraploid otherwise termed as “Amphidiploid”.
- The homozygous lines developed by controlled selfing in cross pollinated crops are called “Inbred lines”.
- Parent to progeny relationship is known in Pedigree method.

- The difference between the mean of the original population and mean of the selected plants is termed as “Selection differential”.
- Mass selection is based on “Phenotype”.
- The percentage of plants selected from a population to be advanced to next generation is called “Selection intensity”.
- The performance of a double cross hybrid in maize can be predicted based on the performance of non parental single crosses.
- Cytoplasmic male sterility is used for production of vegetables, and ornamental plants.
- Genetic male sterility is used for hybrid production of “Castor”.
- Modified flower – Bulbils.
- The first cytoplasmic genetic male sterile line in Sorghum – CSH -7.
- Maximum amount of segregations are observed in F<sub>2</sub> generation.
- Bajra composite – Balaji, Maize synthetic – Amber.  
Leaf blight resistant cotton – Varalakshmi.
- Induced mutant in Groundnut MC -4, Resistance to tikka leaf spot – Ah – 45.
- Heteroplast – Cell containing foreign organelles.
- Genetic engineering – manipulation of the genetic architecture of the organism at DNA level (or) molecular level.



- Tissue culture techniques are being used for effective vegetative propagation of horticultural (or) agricultural crops. These techniques are called “Micropropagation”.
- Activated charcoal stimulates embryogenesis in plants.
- The most popular medium for anther culture is N<sub>6</sub> medium.
- In anther culture in rice pretreatment is done with “ethereal”.
- Iron is crucial for pollen embryo development in tobacco.
- Dry heat – metals, glassware, wet heat – paper material, liquids.
- Some media components are unstable at high temperature and must be sterilized by “Ultra filtration” at high temperature.
- Working area is generally surface sterilized with either ethanol (or) isopropanol.
- Organogenesis in tissue culture is controlled mostly by a balance between cytokinin and auxin.
- In callus of *Medicago sativa* high kinetin, 2,4 – D ratio stimulates “rhizogenesis” high 2,4 – D; Kinetin ratio – caulogenesis.
- For embryo culture MS medium and Monnier’s medium favorable.
- ‘Sucrose’ is added to embryo culture to maintain suitable osmotic pressure.
- “Casein – hydrolysate” (CH) amino acid complex increases embryonic differentiation and the size of the embryo.
- Coconut milk is referred to as “Endosperm factor”.  
Most of the responding sps to endosperm culture – Euphorbiaceae, Santalaceae, Loranthaceae.
- Cultured endosperm of coffee does synthesize – ‘Caffeine’.
- The middle lamella is dissolved by using “Pectinase”.

- Protoplast may be cultured either by “liquid drop method” (or) plating method (Common method).
- To induce protoplast fusion suitable chemical agents called “Fusogen” are used. These include PEG, Polyvinyl alcohol,  $\text{NaNO}_3$ .
- Cybrid may be defined as plant (or) cell which is a cytoplasmic hybrid produced by fusion of protoplast and Lytoplast.
- Cybrids have two different cytoplasm and one nuclei.
- Vitrification – In repeated cycles of invitro shoot multiplications often a percentage of cultures show water soaked, almost translucent leaves. Such inhibits a rate of growth.
- The heart of the biotechnology is the “bioreactor” where the biotransformation takes place.
- Fluid flow characteristics obey Newton laws of viscosity.
- The basic types of fermentation processes – Semisolid fermentation and submerged fermentation.
- “Enzyme assay” is to determine how much the enzyme of known characteristic is present in the tissue homogenate, fluid (or) partially purified extract.
- Enzymes purification follows an important step called “Extraction”.
- The crude extract is treated with absorbant gels like “ $\text{Zn(OH)}_2$  for removal of pigments.
- “Affinity Chromatography” is a very bio specific one and it is ideally suited for the separation of one protein from all other.
- “Urakinas” from human urine, used for cleaning wounds and removal of blood clots.
- Nutrients for cancer cells – A sparagine, glutamine are removed by asparaginase and glutaminase.
- Glucose oxidase for determining blood glucose.
- LDH (Lactic dehydrogenase) for lactate and pyruvate.
- A glucose oxidase – Catalase is effective in removing  $\text{O}_2$ .
- Some of the soil enzymes – Cellulase, nitrogenases, urease etc.
- Biosensors can measure sugars, proteins, hormones in body fluids pollutant in water.
- Enzyme biosensors – Alcohol Oxidase, Invertase, glucose oxidase,  
Microbial bio sensors – *Brevibacterium incto fermentum*.
- Recombinant DNA is method of transferring relatively small amount of genetic information from one cell type to the other.
- Enzymes which synthesize DNA – Terminal transferase, DNA polymerase  
Restriction endonuclease.
- Enzymes that degrade DNA – Nuclease  $\text{S}_1$ , Exonuclease III.  
Restriction Endonuclease.
- Enzymes that joins DNA sequence –  $\text{T}_4$  DNA ligase.
- Enzymes which modify the 5 terminal of DNA – Calf intestinal  
Phosphatase,  $\text{T}_4$  polynucleotide kinase.
- The sequence recognized by restriction enzymes are “Palindromes”.
- In case of mammalian cells, there is only one potential vector the “Simian virus” (SV – 40).
- Many animals “tumor virus” contain reverse transcriptase.
- A useful plasmid is “pBR 322” (resistance to tetracycline and ampicillin) it has 4322 bp.  
Transgenic organisms – These are the outcome of the recombinant DNA technology.

- Cauliflower mosaic virus (CMV) and Gemini virus have also been used as vectors for plant transformations.
- Yeast are the most popular eukaryotic cell for cloning.
- Bacteria involved in fermentation processes are “Chemo-organotrophes”.
- The first therapeutic agent produced by recombinant DNA technology using *E. coli* is “human insulin”.
- *E. coli* contain endotoxins and pyrogenic lipopolysaccharides.
- Hybridoma cells are constructed by fusing a mouse myeloma and B. Cells (skin cancer cells).
- Starch is the important - CHO currently used in fermentation process.
- Batch and fed batch fermentation – Closed system.
- All the substrate is added at the beginning of fermentation in batch but in fed batch they are added in increments throughout the process.
- Continuous fermentation – Open system in which medium is continuously added.
- Stock cultures are kept in the laboratory in freeze dried form deep frozen in liquid nitrogen.
- Some of the flocculating agents – Isin glass (a collagen type protein derived from a tropical fish) gelatin, tannic acid.
- Centrifugation may be the only practicable separation of cells from viscous media.
- Tangential flow filtration (or) cross flow filtration is an effective method for separation of cells from liquid where high value products are involved.
- Citric acids and lactic acids produced by fermentation are precipitated as their “Calcium salts”.
- The most commonly used ion-exchange celluloses are “Diethyl amino ethyl” (DEAE) and carboxy methyl, cellulose anion and cation exchanges respectively.
- The most commonly studied secondary metabolites are “Antibiotics”.
- For getting more amount of starter culture, we can use “Seed rank fermentor”.

**Bits: -**

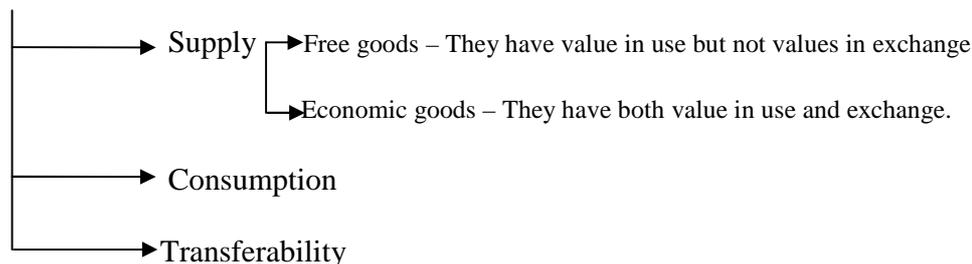
- The disadvantages with micropropagation of adult tree is browning of the medium.
- Somaclonal variation is the consequence of genetic abnormalities.
- Protoplast obtained from endosperm cells gave best results in tobacco.
- The capacity of a cell to give rise to a whole plant – “totipotency”.
- The artificial seed of carrot somatic embryo’s are coated by polyethylene oxide. (PEO).
- The filamentous fungus that is genetically engineered for production of proteins of mammalian origin is *Aspergillus niger*.
- The important yeast used in industry – *Saccharomyces cerevisiae*.
- S.I unit of enzyme – “Katal”.
- Cosmids vectors are used for cloning large fragments of DNA.
- Detergents – Proteases.
- In gel chromatography molecular wt. is the criteria for separation.
- For production of ‘SCP’ Protein: RNA ratio must be highest
- The amount of enzyme per unit wt. of protein is termed as “Turn over of the enzyme”.
- Enucleate protoplast is termed as cytoplast.

- Synthetic seeds – Somatic embryo genesis, virus free plants – shoot tip culture.  
Somatic hybrids – Protoplast fusion.
- Inter specific hybrids – Embryo culture – Rare hybrids also  
Inter generic hybrids – Protoplast culture.  
Triploids – Endosperm culture.  
Uniform diploids – Meristem culture.
- A vehicle which is used to carry other species of DNA is called vector.
- Plant oils used in industrial fermentation media are palm oil
- Human viral protein produced on large scale for medical purpose – Interferon.
- Organism used for riboflavin (B<sub>2</sub>) fermentation *Ashbyo gossypii*.
- Procem of origin of shoot, bud (or) roots from tissue (or) suspension culture organogenesis.
- Cells (or) cell aggregates culture in liquid medium is termed as suspension culture.
- The most serious objection for clonal propagation through callusing is due to genetic instability.
- Usual source for large scale production of enzymes is Microbial cells.
- Homozygous tobacco plant developed through anther culture –F.
- The pinocytosis property of protoplasts is utilized in transfer of genome of the one species to others.
- Small circular DNA found inside some bacteria is Plasmid.



## ECONOMICS

- The word economics was derived from Greek word “OIKONOMICAS” OIKOS – House hold, NOMOS – Management.
- Father of economics – “Adam Smith” (Book – Wealth of Nations).
- The early form of economics is “Political Economy”.
- The ‘subject matter’ comes under the scope of economics.
- Economics is a science in methodology and an art in its application.
- Micro economics is also known as “Price theory”.
- Macro economic is also known as “Income theory”.
- The theory of product pricing factor and economic welfare is micro economics.
- Wants – efforts – satisfaction sums up the subject matter of economics
- Dividing the money among the factors is ‘distribution’.
- Micro and Macro economic terms were coined by “Ragnar frisch”.
- Macro economics known as theory of income and employment of simply income analysis.
- Economics is primarily study of man and not of wealth.
- Theory of economics has been systematically arranged into consumption, production, exchange and distribution.
- A positive science is concerned with “What is” and normative science with “What out to be”.
- Positive science is a “Pure science” and normative science is an ‘ethical Science’.
- Deductive method come down from generals to particulars.  
Inductive method come down from generals to particulars to the general.
- Deductive method static approach and unbiased; inductive method dynamic approach & biased.
- “Economic laws” are statements of uniformities which govern human behavior concerning the utilization of limited resources for the attainioment of unlimited ends – Robbins.
- Anything that can satisfy a human want is called “Good”.
- “Services” refers to the work that a person may do
- Good based



- Based on consumption :-
  1. Consumer goods – Yield satisfaction directly. They are also called “Goods of the first order”.
  2. Producer goods – These help to produce other goods known as the “goods of the second order”.
- Good will of a business transferable.

- Utility is the power of a good to satisfy human want.
- Utility is subjective and relative.
- The term utility has no ethical and moral significance.
- Utility is measured in terms of units called “Units”.
- Economists who contend that utility is measurable are called “Cardinalists”.
- Economists who say that utility cannot be measured and who follow the approach are called “Ordinalist”.
- ‘Value’ is defined as the power of a commodity to command other things in exchange for itself.
- When value is expressed in terms of money it is called ‘Price’.
- Wealth consists of all potentially exchangeable means of satisfying human needs.
- Any thing which possesses value in exchange is “Wealth”.
  1. Social (or) Communal wealth – Parkes.
  2. National wealth – Rivers.
  3. Cosmopolitan wealth – Rivers.
  4. Negative wealth – Debts.
- All money is wealth but all wealth is not money.
- Wealth is fund and income is flow.
- Wealth is the means to an end, welfare is the end itself.
- Human wants is starting point of all economic activity and consumption is the end of all economic activity.
- Consumption is defined as destruction of utility.
- “Want” may be defined as that desire which is accompanied by the capacity and willingness to satisfy it.
- Any single want is stable leads to “law of diminishing marginal utility”.
- Wants become habits led to Engel’s law of consumption function.
- Necessaries of existence – Food, Clothing, Shelter.
- Necessaries of efficiency – Vehicle for a doctor.
- Conventional necessities – Marriage dinner.
- Defense luxuries – gold ornaments.
- Law of diminishing marginal utility: Def: The additional benefit which a person derives from a given increase of his stock (or) any thing diminishes with every increase in stock that he already has – “Alfred Marshall”.
- Marginal utility: It is the utility derived from the additional unit of a commodity consumed.

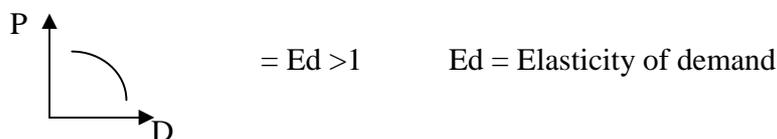
Initial utility: It is the utility of first unit.

Zero utility: number of addition to the total utility. It also implies the “point of satisfy”.
- When total utility is max, marginal utility is zero.
- Law of diminishing marginal utility does not apply in the case of money.
- Marginal utility of money for a rich man is less while it is high for a poor man.
- Price measures the marginal utility (or) marginal utility indicates the price.
- It is wrong to say that the marginal utility and price are governed by demand and supply.
- Law of equi-marginal utility also called Law of substitution, Law of Max. satisfaction.
- The law of diminishing marginal utility tells us the position of consumers, equilibrium in the case of any commodity purchase.

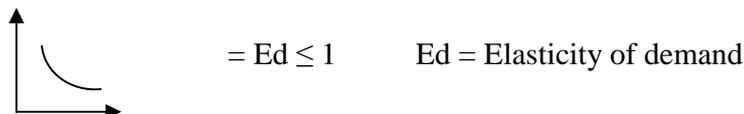
- The law of equi-marginal utility tells us the position of consumer's equilibrium in the case of more than one commodity purchase.

$$\frac{M_{ua}}{P_a} = \frac{M_{ub}}{P_b} = \frac{M_{uc}}{P_c}$$

- The excess of the price which the consumer would be willing to pay rather than go without the thing-over which he actually does pay is the economic measure of his surplus satisfaction. It may be called "Consumer's surplus". It is based on the law of diminishing marginal utility. (Alfred Marshall).
- C.S = What we are prepared to pay – what we actually pay.  
C.S = Total utility – Total amount spent.
- Fall in price will cause an increase in C.S. & rise in price, a fall in C.S.
- Standard of living of the people means the quantity and quality of consumption.
- "Demand schedule" is a list of quantities purchased (or) demanded at various prices in a given period of time. It represents functional relationship b/w the price and the amount demanded.
- Graphic representation of demand schedule is called "demand curve".
- The slope of demand curve is in accordance with the laws of diminishing marginal utility.
- In inferior goods (or) in Giffen's goods a fall in price tends to reduce and a rise in price tends to extend the demand.
- Demand is a function of price.
- Elasticity means sensitiveness (or) responsiveness of demand to the change in price.
- Elasticity of demand = % of change in demand / % of change in price.
- When a small change in price may lead to a great change in demand. The demand is elastic. Even a big change in price is followed by only a small change in demand it is said to be inelastic demand Eg: Salt
- Cross elasticity : means a change in the demand for a commodity owing to a change in the price of another commodity.
  1. Perfectly elastic demand : Demand curve is horizontal to 'X' axis  $E_d = \infty$
  2. Perfectly inelastic demand : Demand curve is vertical straightline  $E_d = 0$ .
  3. Relatively elastic demand :



4. Relatively inelastic demand:

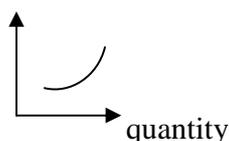


5. Unity elastic demand :  $E_d = 1$

- Production is defined as the creation of utility.

Lower segment of demand curve below the given point  
 Point =  $\frac{\text{Lower segment of demand curve below the given point}}{\text{Upper segment of d.c. above the g.p.}}$

- Production should be defined as creating (or) addition of wealth (or) valuation.
- Factor of production – Land, labour, Capital and organizations.
- Land is fixed in quantity and lacks mobility.
- Labour has no free mobility.
- Territorial division of labour: It refers to certain localities specializing in the production of some commodity. It is also called “Localisation of industries”.
- Two documents of joint stock company :-
  1. Memorandum of association.
  2. Articles of association.
- In public limited company – There is no max limit 2 min. limit is ‘Severe’.
- Private limited company – min 2; Max. 50 members.
- Co-operation means working together towards a common end. In producers co-operation – elect the board of management using the principle of “one man one vote”.
- Supply means the quantities that a seller is will in to and able to sell at different prices.
- Stocks is the total volume of a commodity which can be brought into the market for sale at short notice. Supply means the quantity which is actually brought in the market.
- Supply curve has positive slope price



- Law of supply – supply  $\propto$  price.
- The price below which the seller will refuse to sell is called the “Reserve price”.

- Elasticity of supply =  $\frac{\text{Percentage change in amount supplied}}{\text{Percentage change in price}}$

(or) Proportional change in price / Price

- Elasticity of supply co-efficient is always positive.
- Supply is said to increase when more is offered at the same price (or) the same quantity offered at a lower price.
- Supply is said to decrease when less is offered at the same price (or) the same quantity is offered at higher price.
- Exchange is the barter comparatively superfluous morethan enough for the comparatively necessary (Jevans).
- Generally acceptable medium of exchange – Money.
- Conversion of metals into coins is a function of government and is done in “mints”. There are mints at Bombay and Culcutta.

- Some cost is incurred in making coin. This charge is higher than the cost it is termed “Seigniorage” and if no charge is made and coins are minted free of cost the coinage is “gratuitous”.
- The wealth of a country depends on the labour and land.
- The total supply depends upon the strength of population and its quality.
- Malthusian theory of population: Thomas Robert Malthus wrote his essay on “Principles of Population”.
- Food increases in an arithmetical ratio, population increases in geometrical ratio.
- Population can be checked by
  1. Preventive checks : by bringing down the birth rate.
  2. Positive checks: By increasing the death rate.
- The theory of optimum population was proposed by “Edwin Cannan”. (Modern theory of population).
- Optimum population may be defined as the one at which per capita income is the highest.
- Dalton’s formula for Mal adjustment.
- Actual population deviates from optimum population. This deviation is called “Mal adjustment”.
$$M = (A - O) / O$$

A = Actual population  
O = Optimum population
- “Capital formation” is the very core of the “Economic development”.
- Murry and Nelson says “Capital formation” is called investment. The amount which a community adds to it.
- Capital formation represents the surplus of production over consumption.
- In most under developed countries, investment is only 5.8% in developed countries 15-20%.
- Taxes by the government – “Forced savings”.
- Organizing and risk taking are the two main functions of the organizer.
- Type of organizations:-
  1. Sole trade concern (or) Individual enterprisers the common form of business organisation in our country.
  2. Partnership.
  3. Joint stock company: The most important type of business organization today.
- The capital of company is divided into number of shares which are transferable and have “Limited liability”. Management is one share one vote.
- The banks are “factories of credit” as they manufacture and sell a credit.
- Exchange banks – RBI
- Industrial banks – IDBI; IFC (Industrial finance corporation).
- Central bank is the most important institution in the banking system of a country. RBI – April 1935.
- One rupee notes are issued by Government of India while all other notes are issued by RBI.

- Credit: Prof. Galbraith defined credit as the temporary transfer of assets (or) wealth from one who has to the other who has not.
- Promissory notes are popularly known as I.O.U (I owe you).
- Market – A particular place (or) building where the goods are purchased (or) sold.
- Monopolistic competition refers to competition among large number of sellers producing close but not perfect substituted products. (Heterogenous products).
- For monopolistic competition the demand curve (or) sales curve (or) average revenue curve, slope downwards to the right.
- Oligopoly: A competition is called oligopolistic when few sellers of a product are found in the market (Homogenous product).
- Interdependence is the most important feature of Oligopoly.
- Duopoly – two sellers (Homo & Hetero genous).
- Monopoly : One seller (Homogenous)
- The price at which demand and supply are equal is known as “equilibrium price”.
- Price at which the willing to buy the commodity is known as “demand price”.
- The price at which the seller is willing to offer his goods for sale is known as “Supply price”.
- The price will be settled according to the marginal utility of the consumers.
- All commodities can have “Market price”; only reproducible commodities can have “normal price” (long period price).
- Demand play active role in market price; Supply play active role in “normal price”.
- The national wealth is the source of distribution
  1. Functional distribution : Refers to the share factors of production in the form of rent, wages, interest. It is a “macro concept”.
  2. Personal distribution: refers to the gives amount of income and wealth derived by individual. It is a “micro concept”.
- General theory of distribution – Marginal productivity theory. It is based on the – “law of diminishing marginal returns”. This theory considers only demand but not supply.
- Modern theory of distribution – Considers demand and supply.
- Distribution refers to the sharing of wealth that is produced among the different factors of production.
- “Rent” refers to the remuneration that is paid for the use of the free gift of nature.
- “David Ricardo” proposed a systematic theory of rent on “deductive basis”.
- Ricardo theory based on the “law of diminishing returns”.
- Rent is not price determined but price determining.
- “Quasirent” is the surplus earned by instruments of production other than land.
- A ‘wage’ may be defined as a sum of money paid under contract by an employer to a worker for services rendered.
- The demand for labour is ‘derived demand’. (for a factor of production)
- Liquidity preference theory proposed by J.M. Keynes.

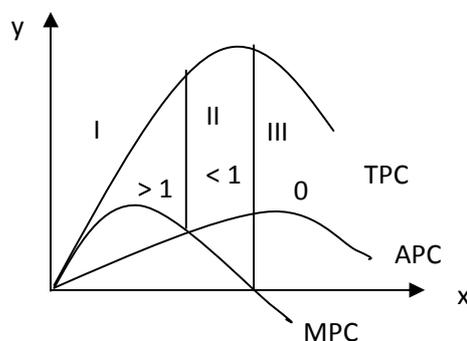
**Bits:-**

- Karl Marks defined capital as crystallized labour.
- Durable use producer goods are classified as “Fixed capital”.

- The level of 'capital formation' depends upon power to save and will to save.
- Disposable income = personal income – personal taxes.
- A consumer spend his income according to the "law of substitution in order to get maximum satisfaction.
- Produced means of production – capital.
- A tax whose impact and incidence are on the some person – Direct tax.
- Monopoly is complete negation f competition.
- The capital which is used for payment of water (or) salaries is known as 'Remunerative' capital.
- When the burden of the tax is more on the poor than the rich it is known as indirect tax.

- Agricultural economics defined by Prof. Grey.
- Problem of agriculture :
  1. Production problem
  2. Marketing problem
  3. Financing
- In earlier days production used to be “Consumption oriented” but in modern times production is “Market oriented”.
- Agricultural products are joint products.
- The demand for agricultural products are ‘inelastic’.
- Agricultural markets are not regulated.
  1. Agricultural holding: The area of a land for cultivation as single unit.
  2. Farm: Means a piece of land where crop and livestock enterprises are taken up.
  3. Operational holding: Total area held under single management excludes leased land.
  4. Technical unit: Single convenient unit in production for which technical co-efficients are calculate. Eg: acre, ha.
- Group of technical units: Plants (or) plant is a part of farm firm.
- Farm firm: It is a production unit under one management and is also known as economic unit.
- Time required for a source to be completely transformed into a product is referred to as ‘transformation period’.
- Choice indicator: It is a yard stick (or) an index (or) a criteria indicating which of two (or) more alternatives is optimum (or) will maximize a given end. Choice indicators are almost always given as “ratios”.
- The short run is that period of time during which one (or) more of the production inputs is fixed in amount and cannot be changed Long run – productive inputs can be changed.
- Cost of production: Expenses incurred per unit quantity of output of a commodity.
- “Technical efficiency” is the ratio of output to input “Economic efficiency” is the ratio of value of output to value of input.
- “Enterprise” is defined as single crop (or) livestock commodity being produced as a firm.
- Agriculture production economics – Principles of choice are applied to the use of capital, labour, land and management resources in the farming industry.
- Production economics is concerned with productivity – deals with economic efficiency.
- The scientific approach to the study of production economics involves deduction and induction approaches.
- Induction approach employ statistical modes.
  1. Product – product relationship (what to produce).
  2. Factor – factor relationship (How to produce).
  3. Factor – Product relationship (How much to produce) (law of diminishing returns employ this).
- Factor – product relationship deals with the “Production efficiency of the resources”.
- The goal of this relationship is the product maximization.
- Farm management specialists cal this relationship as “input-output relationship” an agronomist call as “fertilizer response curve”.
- “Price ratio” used as choice indicator to determine the optimum quantity of input to use.
- The relationship between inputs and outputs can be characterized as “Production function”.

1. In continuous production function inputs and outputs can be split up into small units.
  2. In discontinuous (or) discrete production function inputs and outputs cannot be broken into smaller units.  
Eg: Ploughing  
Discrete viable can be known from “Counting”.
- Linear equation of production function  $Y = a + bx$ .  
Y = dependent variable  
A = constant  
B is coefficient  
X = Independent variable
  - $Y = ax^b$  is an exponential equation (Non-linear) and is known as “Cobb – Douglas” production function.
  - Law of returns:
    1. Law of increasing returns (Increasing marginal productivity) → Curve is convex to the origin.
    2. Law of constant returns (constant marginal productivity) curve is “Concave to the origin”.
    3. Law of decreasing returns (decreasing marginal productivity) curve is “Concave to the origin”.
  - Law of diminishing returns also known as “Law of variable proportions”.
  - When  $MPP > APP$ ; App increases.  
MPP = APP; App will be maximum  
MPP < APP; App decreases.
  - Elasticity of production =  $\frac{\% \text{ of change in output}}{\% \text{ of change in input}} = \frac{MPP}{APP}$
  - The elasticity is less than one between the points of maximum average product and the maximum total product.
  - When the elasticity of production is less than zero, total product decreases at increasing rate.
  - Till the point of “inflection where MPP is maximum TPC reverse its shape from convex to concave.



- Region I & III are irrational zone of production.
- Region II rational zone of production optimum point of input use in this rational zone.

- How much input to use :

$$MR = \frac{\Delta \text{ total value product}}{\Delta \text{ input level}} = \frac{\Delta y}{\Delta x} \cdot P_y$$

- Marginal input cost (MIC) =  $\frac{\Delta \text{ total input cost}}{\Delta \text{ input level}} = \frac{\Delta x \cdot P_x}{\Delta x} \cdot P_x$  (price of input /unit)

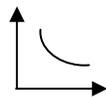
- Profit maximizing input level at the point of where MVP = MIC.

- How much output to produce:

$$MR = \frac{\Delta \text{ total revenue}}{\Delta \text{ total physical product}} = \frac{\Delta y \cdot P_y}{\Delta y}$$

$$MC = \frac{\Delta \text{ total input cost}}{\Delta \text{ total physical product}} = \frac{\Delta x \cdot P_x}{\Delta y}$$

- Profit maximizing output level at the point of MR = MC.
- Factor – factor relationship: The goal of this relationship is minimization of cost at a given level of output.
- Principle of substitution between inputs explain factor – factor relationship price ratios and substitution ratios are choice indicators.
- An isoquant is a convenient device for compressing three dimensional picture of production function into two dimensions.
- Isoquant represents all possible combinations of two inputs physically capable of producing given level of output.
- Isoquants are also known as “Isoproduct curves” (or) Equal product curves” (or) “Product indifferent curves”.
- If number of isoproduct curves are drawn on one graph the figure is known “Isoquant map”.



- Isoquant show cardinal magnitudes.
- The slope of isoquant denotes the ratio of substitution (MRTS) between two resources.

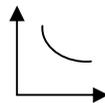
$$MRTS = \frac{\text{No. of units of replaced resources}}{\text{No. of units of added resources}}$$

MRTS of  $X_2$  for  $X_1$  denoted as  $\Delta X_1 / \Delta X_2$ ;  $X_1$  for  $X_2$  as  $\Delta X_2 / \Delta X_1$ .

- MRTS is less than zero in case of substitutes.
- When two resources are completely interchangeable they are called “Perfect substitutes”. The isoquants for perfect substitutes is negatively sloped [  straight line.
- **Complements:** The inputs which increase the output only when combined in a fixed proportion are known as “Complements”.  
Eg: Tractor worked by labour
- In case of “perfect complements” isoquants are right angle



- “Substitution at decreasing rate is more common in agriculture.
- Isoquants are convex to the origin when inputs substitutes at decreasing rate.
- Iso cost lines (equal cost line, iso outlay lines, price lines factor cost lines).

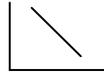


- Iso cost lines defines all possible combinations of two factors which can be purchased with a given outlay of fund.
- The slope of isocost line indicates the “ratio of factor prices”.

$$\text{Price ratio} = \frac{\text{Cost per unit of added resources}}{\text{Cost per unit of replaced resources}} = \frac{P_{X_1}}{P_{X_2}}$$

- The least cost combination is obtained when marginal ratio of substitution is equal to the inverse price ratio of the resources.  
The least cost combination will be at the point where isocost line is tangent to the isoquant.
- A line (or) curve connecting the least cost combination of inputs for all output level is known as “Isocline” of many isoclines the isocline which is considered to be most appropriate over a production period is known as “expansion path (or) scale line. At any time only one expansion path is possible.
- Ridge lines represent the points of maximum output from each input given a fixed amount of other input.
- Portion of isoquant which lie between the ridge lines are suited for economic production.
- The main objective of product – product relationship is “maximization of profits”.
- The principles of substitution and the law of equimarginal returns explain the product – product relationship.
- The production possibility curve presents all possible combinations of two products that could be produced with given amounts of inputs (or) opportunity curve (or) Iso resource curves (or) Transformation functions.
- Production possibility curve can be drawn either directly from production function (or) from total cost curve.

- Isorevenue line: All possible combinations of two products which would yield on equal revenue (or) income.



- The slope of the isorevenue line indicates the ratio of product prices.
- The optimum point of product combination” will be where the isorevenue line is tangent to the production possibility curve

$$\text{MRPS} = \frac{\text{No. of units of replaced product}}{\text{No. of units of added products}}$$

$$\text{PR} = \frac{\text{Price per unit of added product}}{\text{Price per unit of replaced product}}$$

Types of product – product relationship.

- Joints products are produced through a single production process. All agricultural products are mostly joint products.
- Complementary enterprises – If in change in one, the other at well be change.  
MRPS  $\longrightarrow$  + ve.
- Supplementary enterprises – Does not affect the production level of other product.  
MRPS is zero
- Competitive enterprises – Two products are inversely relationship.  
MRPS  $\longrightarrow$  - ve.
- When two products substitute at constant rate only one of the two products will be economical to produce depending upon their relative prices. This is a case of “Specialization”.
- The production possibility curve is concave to this origin. When products substitute at increasing.

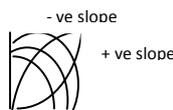


Profits are maximized by producing a combination of two products (diversification)

To. Decreasing rate of substitution.



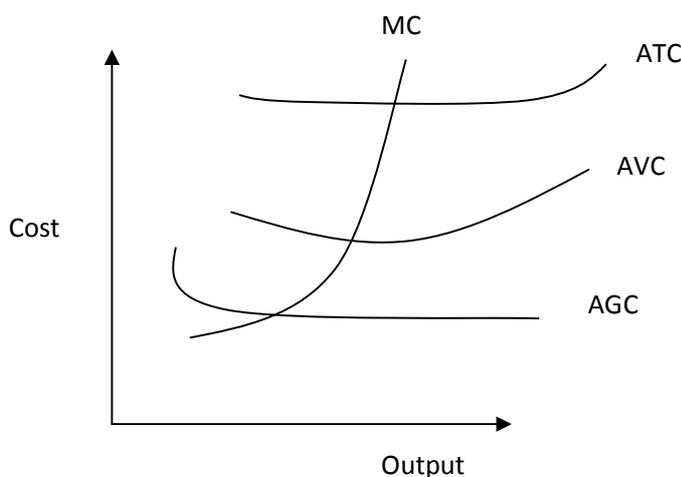
To. Ridge lines for production possibility curve.



- “Returns to scale” means the behavior of production when all productive factors are increased (or) decreased simultaneously in the same ratio.  
Returns to scale is “long run production factor”.  
Law of variable proportion – short run production function.
- Fixed costs are not under the control of the Manager in the production function.
- Fixed costs are also called as “Sunk costs”, “Overhead costs” indirect cost; supplementary costs.
- Variable costs are also known as “direct costs”, “prime costs”, short run costs.
- Export costs are paid out costs.
- Import costs are self owned and self owned self employed resources.
- 1. The shape of the TVC curve is inverse ‘S’ shape.  
2. TFC is parallel to X – axis.  
3.  $TC = TFC + TVC$ . It is inverse ‘S’ shape.  
4. Shape of the AFC is rectangular hyperbola



- 5. AVC is ‘U’ shaped
- 6. ATC is ‘V’ shaped.
- 7. Marginal cost =  $\Delta Tc / \Delta y$ . It is “U shaped curve”.
- Average cost curves:



#### Farm management:

- A farm can be compared with living cell. Farm management deals with economic efficiency.
- A farm is a “Socio economic unit”.
- Farm management may in short be called as a science of decision matiy (or) a science of choice.
- Farm management is generally considered to be “Micro economics” in its scope Micro Economics is also called as Price Theory. It deals with allocation of resources at the level of individual form.

- Alternative – macro.
- First organized study in the field of farm cost accounting in 1923 – 24 by “Punjab board economic enquiry”.
- First all India studies of costs and returns on a farmer holding was conducted by ICAR.

**Summary of cost principle:-**

Short run:

1. Expected selling price is greater than minimum ATC. A profit can be made and is maximized by producing where MR = MC.
  2. Expected selling price is less than minimum ATC but greater than minimum AVC. A loss of expected profit but the loss will be less than TFC and minimized by producing at a point where MR = MC.
  3. Expected selling price is less than minimum AVC. A loss is expected but can be minimized by not producing anything.
- Principles of equimarginal returns (or) opportunity cost principle.
  - An optimum choice of enterprises is made based on the “Principle of equimarginal returns”.
  - The opportunity cost is the return sacrificed from the next best alternative.
  - The procedure for determining future value is called compounding.
  - Present values are found using a process called “Discounting”.

$$F.V = A = P \left(1 + \frac{r}{100}\right)^n$$

$$P.V = \frac{A}{\left(1 + \frac{r}{100}\right)^n}$$

- The specialized (or) diversified farming depends largely on the “Principle of comparative advantage”.
  - The “Type of farming” refers to the nature and degree of product (or) a combination of products being produced at the farm. It is concerned with production process.
  - System of farming refers to the organizational setup under which the farm is being run.
- Under specialized type of farming, the major enterprise contributes more than to total farm income.
- In ‘diversified farming’ no single product (or) source of income equals as much as 50% of the total receipts.
- Ranching: It means practice of grazing animals on public land. Rangeland is not utilized by tilling (or) growing crops.

$$A = P \left(1 + \frac{r}{100}\right)^n$$

- If a farm is to be categorized as a “Mixed type of farming” at least 10% of its gross income must be contributed by the livestock. This contribution in no case should exceed 19%.
- Dry farming: It refers to an area which receives 20” (or) less of annual rainfall.

S. No.	Type of farming	Type of ownership	Type of operatorship
1.	Co-operative farming		
a.	Co-operative better farming	Individual	Individual
b.	C-operative joint farming	Individual	Collective
c.	Co-operative tenant farming (leased)	Collective	Individual
d.	Co-operative collective farming	Collective	Collective
2.	Collective farming	Society	Society
3.	Capitalistic farming (estates)	Individual	Individual
4.	State farming	State	Paid management
5.	Peasant farming	Individual	Individual

- “Family holding” refers to a farm which yield gross average income Rs. 1600 (or) net income Rs. 1200.
- “Cropping system” refers to sequence of crops grown on a specific piece of land over a period of time.
- “Cropping pattern” refers to adoption of particular types of crops by the farmer in a particular region.
- Income capitalization method – capitalized value  
 $V = \text{net income per year (i)} / \text{rate of interest (r)}$
- Farm accountancy – recording in books the business transaction anytime of the year.  
 Farm book keeping – History of the business transactions.
- Farm accounting the objective of farm records and accounts is to provide the control over the business and improve the management of the farm.
- Man equivalent: 2 men = 3 women; 1 man = 2 children.
- “Farm work simplification” (or Job analysis is a promising method of reducing the farm labour requirement.
- Break even point (BEP) refer, to that volume of business at which the farmer is indifferent b/n two alternatives.  
 $\text{BEP} = \text{Annual total fixed costs} + (\text{variable costs per year} \times \text{No. of acres})$
- Systems of book keeping – Double entry system; single entry system.
- Three parts of farm records :
  1. Physical farm records.
  2. Financial farm records.
  3. Supplementary farm records.
- BEP refers to that volume of business at which the farmer indifferent b/n two alternatives.  
 $\text{BEP} = \text{Annual total fixed costs} + (\text{Variable costs per year} \times \text{No. of acres})$ .
- Systems of book keeping – Double entry system; single entry system.
- Three parts of farm records –
  1. Physical farm records.
  2. Financial farm records.
  3. Supplementary farm records.
- “Farm inventory” is a list of all the physical property of a business along with their values at a specified date.

- It is the complete list of ‘farmer’s assets’.
- Assets are classified based on “liquidity and useful life”.
  1. Current assets: More liquid assets – Cash in hand.
  2. Working assets: They have useful life greater than on year – Machinery etc.
  3. Fixed assets: Land and building.
- Methods of evaluation of assets:
  1. Valuation at cost minus depreciation: for working assets.
  2. Valuation at cost (or) market price: For purchased farm supplies
  3. Net selling price – for current assets.
  4. Replacement cost minus depreciation – for long lived assets such as building.
  5. Income capitalization method  $V = I / R$ . – for building.
  6. The decline in value of capital equipment – Depreciation.

Methods of computing depreciation:

1. Straight line method : Annual depreciation

$$A.d = \frac{\text{Original cost} - \text{Junk value}}{\text{Expected life of the asset}} \text{ - most common method}$$

2. Annual revaluation method
  3. Diminishing balance method : A.D. (Book value of beginning of year) X R.
- The balance at the end of the useful life is the “Salvage value”.

$$R = \frac{100\%}{\text{useful life}}$$

- The “balance sheet” is a systematic organization of everything owned and owed by a business (or) industrial at particular point in time.
- The business is said to be solvent when the net worth (or) equity is greater than zero.
- Liquidity measures the ability to generate cash needed to meet cash obligations.

1. Net capital ratio (NCR) =  $\frac{\text{Total assets}}{\text{Total liabilities}}$
2. Working ratio (WR) =  $\frac{\text{Current assets} + \text{Intermediate assets}}{\text{Current liabilities} + \text{Intermediate liabilities}}$
3. Current ratio – It is a measure of liquidity =  $\frac{\text{Current assets}}{\text{Current liabilities}}$
4. Debit / equity ratio =  $\frac{\text{Total liabilities}}{\text{Owners equity}}$

- Farm efficiency measures:
  1. Physical efficiency measures (technical)
  2. Value efficiency measures (financial)



- **Agricultural marketing:** It is the study of all activities, agencies and policies involved in the procurement of farm inputs by the farmer and the movement of products from the farms to the consumer.
- Agricultural marketing system is a link between farm and non farm sectors.
- **Marketable surplus:-** It is the total quantity of commodity available with the producer for marketing after meeting the normal requirement for house hold consumption.
- **Marketed surplus:** It is the quantity of produces which the farmer sells in the market at a particular point of time.
- **Marketing function:** Any single activity perform in carrying the produce from the point of production to the ultimate consumer.
- **Market functionaries:**
  1. Merchant middle man: Eg: whole salers, Retailers. Who take the title of the commodity. They take the title of the product.
  2. Agent middle men: They do not take the title of the product.
  3. Speculative middle man: They take the title of the product and their main intension is to make maximum profit.
  4. Facilitating middle man: They do not take the title of the product.
- **Market margin:** It refers to the difference between the price paid and received by a specific marketing agency.
- **Marketing channel:** These are the routes through which are the commodities moves from the producer to the consumer.
- **Grading:** It is the sorting of unlike lots into homogenous lots.
  1. Fixed grading: Standards are fixed (Mandatory grading).
  2. Permissive grading: Individual choice are permitted.
- **Market intelligence:** It gives the information regarding prices, demand and supply.
- **Market finance:** It is the finance given to the farmer during a time period from harvesting and disposal of the commodity at a remunerative price. Distress sales can be avoided –
- In 1. Village market transaction between buyers and sellers.
  2. Primary wholesale market between farmers and traders.
  3. Secondary whole sale market between (1) . Whole sellers, and 2. Wholesellers.
  4. Terminal market – assembled for export Eg: For wheat, exchange market in Hapur”
  5. The exports will be bring the produce into the “Sea board market”.
- The ultimate objective of all marketing effort is to place the goods in the hands of consumer.
- **Equalization:** It occurs between the process of assembling and dispersion. Equalisation consists of adjustment of supply and demand. It is the task of distribution system to match available supplies to the consumers demand.
- Transportation costs goes nearly for about 50% of marketing cost.
- Grading taken up at producer level is known as “Katcha” grading and at traders level is known as “Pacca” grading.
- 10% of total produce last in the process of storage due to damage by rodents, storage pests and excessive moisture.
- **Processing:** Change in the farm of the commodity.
- **Market information:** It ensures smooth and efficient operation of marketing system.
- **Market news:** Current information about prices arrival and changes in market condition.

- **Price spread:** The difference between price paid by the consumer and the price received by the producer for an equivalent quantity of produce.
- **Market margin:** It refers to the difference between price paid and received by a specific market agency.
- Producers share in consumer's rupee  

$$PS = (PF / Pr) \times 100.$$

PF = Producers price  
Pr = retail price
- **Marketing cost:** It is the actual expenses required in bringing goods and services from the producer to consumer.
- Cotton and grain market act (Berar cotton market act) – 1891,
- Hyderabad Agricultural act (Market) – 1930 – Board of management constituted with 12 members.  
Madras commercial crop markets – 1933 – 18 members.
- In Andhra Pradesh – 556 market committees.
- Agricultural produce (development and ware housing) corporation act – 1956.  
Central ware housing corporation – 2<sup>nd</sup> March, 1957.  
National cooperative development corporation (NCDC) act  
} 1962  
Ware housing corporation act
- Ware house receipt is “negotiable instrument” which serves as a “Collateral security” for the purpose of obtaining credit.
- First state ware house was set in Bihar in 1956.
- Co-operative marketing society act – 1912. Association of producers  
AIRCSC – 1951 Gorwala  
Mirdha committee – 1965.  
Dantwala committee – 1956.  
NCA – 1976  
NAFED – 1958 oct.,  
FCI – 1965.
- Largest government agency to procure food grains in the country.
- Protein rich food in mid – meal for school children – Balahar.
- AGMARK – Agriculture produce grading and marketing – 1937.
- First grading station – Kodur in 1938 for ‘Satgudi dange’.  
Ghee grading laboratory – Guntur – 1956.
- Central AGMARK laboratory – Nagpur.  
ISI - 1947
- NCAER – National council of applied economic research.
- Procurement price – Government purchase price.
- **Agricultural finance:** Agricultural finance is an economic study of financing the agriculture. It is concerned with macro finance and micro finance.
- “Wicksell” defined capital as a single coherent, mass of save up labour and saved up land in course of time.
- Capital goods are the products of human labour.
- The basis for credit transaction is ‘confidence’.

- Short term loans are also called as SAO (Seasonal agricultural operation).
- Under Indian conditions no credit for purchasing of land.
- Credit when properly used is a “Powerful tool”.
- “Financial ruin” when used improperly.
- Two aspects are to be taken into consideration while choosing the agency.
  1. Cost of credit.
  2. Timeliness of supply
- 1. Investment loans – Both medium and long term loans.
- 2. Consumption loans – Short term in nature. These are not usually extended by the institutions in our country.
- Collateral security: LIC policies fixed deposit bonds, ware house receipt.
- Equitable mortgage: Only documents will be mortgaged and loan is taken. This is done only when the property is self-acquired.
- Simple mortgage: When the property is an “ancestrall” pledging movables, movable property such as gold.
- Key loans: The produce (or) goods will be kept under the seal of financing agency and the loan is given.
- Open loans: The adv. Of this type of loan is stoks can be sold and replacement is made.

3 R’s of credit:

1. Returns from the proposal investment.
2. Repayment capacity
  - Liquidity loans
  - Non liquidity loans.
3. Risk bearing ability – Ability to withstand unexpected losses.
  - Repayment capacity = Gross income – [working expenses including SAO loan + family living expenditure + taxes + other loans due].
  - The repayment schedule should coincide with “income generation time”.
  - The risk in business increases as the owner’s equity in the business decreases.

$$\% \text{ of equity} = \frac{\text{Owned funds}}{\text{Owened funds} + \text{borrowed funds}} \times 100$$

- 4 C’s of credit:
  1. Character
  2. Capacity
  3. Capital
  4. Condition and common sense
- Character is one of the ‘basic’ corner stone in the risk bearing ability.
- Owner equality is the ‘back bone’ of risk bearing ability.
- First co-operative credit societies act was passed in the year 1904.
- 14 major commercial banks were nationalized an 1968.
- RRB – 2<sup>nd</sup> Oct., 1975, RBI act – 1934.

- 6 commercial banks nationalized – 15<sup>th</sup> April, 1980.
- Lead bank scheme – 1969 by the Reserve bank of India (Area approach).
- National credit council /Chairmanship – Prof. G.R.Gadgil.
- Important function of lead bank is in each district to prepare the District credit plant (DCP).
- First District credit plant – 1980.
- To review the flow of institutional credit especially in the weaken sections of rural committee under the chairmanship of “M. Narasimham” (RRB).
- The main objective of RRB is to develop “Rural economy”.
- Crop loan system – Kharif, 1966.
- The intention of crop loan system is that the entire credit system should be production based and market oriented.
- Scale of finance defined as the quantum of loan amount extended for a crop (or) for an activity.
- The scale of finance for any crop will be fixed up taking into consideration two aspects.
  1. Gross returns.
  2. Cost of cultivation

Scale of finance not exceed 50% of gross returns.

66% (or) 2/3% of cost of cultivation should be fixed up.

- The rate of interest is fixed by R.B.I.
- NABARD – National bank for agriculture and rural development by B. Sivaraman (CRAFECARD).
- Co-operation as self help made effective by organization.
- F. Nicholson slogan Find Raiffeisen”
  1. Straight – end repayment (or) lump sum payment  $I = PTR/100$ .
  2. Partial repayment : The cost installment is called as ‘Baloon payment”.
  3. Amrotization plants – Killing by degrees.
    - a. amortized decreasing repayment – Principal amount constant
    - b. Amortized even repayment – Installment constant.

$$I = B \cdot \frac{i}{1 - (1+i)^{-n}}$$

I = Installment

B = Principal amount

i = Rate of interest

n = number of years

- Gratis : It is a thing borrowed freely.
- Liability: It is the debt (or) obligation owed to some one else.
- Issued capital: It is the actual amount that the share holders subscribe towards the share capital.
- Paid up capital: It is the capital that is been paid by share holders.

- Liquidation: It is the act of termination (or) winding up of the business losses.
  1. Self liquidating loans – liquidated in the same year.
  2. Non – liquidating loans – not liquidate in the same year.
- Gestation period: The period required for the investment in a project to producer visible returns.

**Bits: -**

- ‘Area approach’ was given greater importance under lead bank scheme.
- The loans extended by financing institutions should be properly secured is emphasized in the principle of protection.
- Ware housing scheme in public sector was started based on the recommendation of AIRCSC.
- The agency which advises the central government to announce support price for agricultural commodities is CACP – commission on agricultural costs and prices – 1985.
- Buying activity in marketing creates – Possession utility.
- Most of the risks taken by ‘Middle men’.
- Land improvement loans act of 1883 for providing long term loans.
- Scale of finance for different crops in a particular district are fixed by “District consultative committee”.
- RRB’s for small and marginal farmers.
- Net worth = Total assets – Total liabilities.
- Co-operative credit societies in India are formed on the lines of “Raiffisen” model.
- Co-operative credit socie movement birth place – England.
- Spot market – cash market.
- Metric act – 1956.
- Differential rate interest DRT scheme chargable interest – 4%.
- The market very nearer to the consumer are Retail market.
- The appointment of paid secretaries in PACS was recommended by AIRCSC committee.
- The comprehensive crop insurance scheme was introduced in the year – 1985.
- The paid up share capital of each RRB is subs aided by sponsor bank sate government and government of India of India in the ratio of 35:15:50.

## **Agricultural Engineering**

- “Counter poise lift” is commonly used to lift water from shallow wells.
- “Rope and bucket lift” is the most common water lift in India to draw water from deep wells.
- Centrifugal pump mainly consists of two parts.
  1. Impeller (or) rotor: Which add energy to the water in the form of increased velocity and pressure.
  2. Casing: Which guides the water from the impeller.
- Classification of centrifugal pumps.
  1. Depending upon energy conversion.
    - a. Volute    b. Diffuser
  2. Plane of rotation of the impeller.
    - a. Vertical                      b. Horizontal
  3. Type of impeller
    - a. Open    b. Semiopen    c. Closed            d. Non clog.
  4. Number of stages
    - a) Single stage                      (b) Multi stage.
  5. Section
    - a. Single                      b. Double
  6. Method of drive
    - a. Direct driven                      b. Belt driven
- In diffuser pump velocity head converted to pressure head.
- In ‘vertical centrifugal pump’ the suction lift of the pump should not exceed 4.5 to 6.0M.
- Where the shaft leaves the casing, there is a gland (or) stuffing box to prevent leakage of air.
- ‘Bed plates’ – For mounting the pumps and to fix properly on the foundation for avoiding vibrations.
- Foot valve – The main purpose to retain water in the pump.
- Priming – The process of removing air from pump casing and suction pipe.
- The interrelationship of capacity, head, power and efficiency are best shown by graphically and these curves are called “Characteristic curves of the pump”.
- When the speed is kept constant ‘Capacity decreases’.
- ‘Sluice valve’ is provided to have smooth flow.
- Pump capacity  $Q = 28 AD / EH$   
Q = discharge in lit/sec’  
A = Area in ha.  
D = Gross depth of irrigation in cm.  
E = Number of days for irrigation  
H = Number of hours of operation
- Static head” is the vertical distance between the water surface at the source and at the outlet.
- ‘Static suction head” is the vertical distance between the water level and the centre line of the pump.
- Static discharge head: Is the vertical distance between the centre line of the pump and the point of free delivery of water.

- Static head = Static suction head + Static discharge head.
- Friction head = is the head required to overcome the resistance of the pipeline and fitting.

$$h_f = \frac{4flv^2}{2gd}$$

f = Co-efficient of friction

l = Length of pipe in 'm'

d = diameter of pipe

g = 9.81 m<sup>2</sup>/s

- Velocity head: Velocity head is the distance through which the liquid must fall to acquire a given velocity.

$$h = \frac{v^2}{2g}$$

- Total head = Static head + Friction head + Velocity head.

- Water house power (WHP) = 
$$\frac{\text{Discharge in (lit/ sec.) X total head in (meter)}}{75}$$

$$= \frac{\text{Discharge in (m}^3\text{/ sec.) X total head in (meter)}}{273}$$

$$\text{Shaft HP (SHP)} = \frac{\text{WHP}}{\text{Pump efficiency}}$$

$$\text{Brake HP (BHP)} = \frac{\text{WHP}}{\text{Pump efficiency X drive efficiency}}$$

$$\text{Input HP} = \frac{\text{WHP}}{\text{Motor efficiency}}$$

Overall efficiency = Pump efficiency X drive efficiency.

- Reciprocating and centrifugal pumps are the examples of shallow well pumps.
- The principal advantage of the submerisable pump is that it can be used in a 'very deep tube wells'. These are adopted to tube wells of 10 cm diameter.
- Submerisable pump has no working part above the ground.
- Wetted perimeter: Sum of the lengths of sides of channel which are in contact with water.
- Hydraulic radius: It is the ratio between cross sectional area of the stream and the wetted perimeter. 
$$R = \frac{A}{P}$$

- Free board: Is the expected vertical distance between highest water level and the top of the retaining banks. It is provided to prevent over topping of structures because of “Wave actions”. Generally 20% of the designed depth is taken as free-board.

- Open channel velocity  $V = \frac{R^{2/3} S^{1/2}}{n}$  (Manning’s Formula)

S = Hydraulic slope  
 R = Hydraulic radius  
 n = roughness coefficient  
 A= Cross sectional area  
 Discharge capacity

$$Q = A.V.$$

- The best hydraulic section of a trapezoidal channel under favorable structural condition  
 $b = 2d \tan \theta/2$   
 b = bed width  
 d = depth of flow of water  
 $\theta$  = angle b/n side and the horizontal

- Lining material – Concrete; LDPE sheets.
- Underground pipes:-  
 P<sub>1</sub> pipe – up to 8m head ; P<sub>2</sub> pipe – up to 8m – 20m  
 P<sub>3</sub> pipe - >20m head.
- ‘If sulphates are high’ concrete pipes should be avoided.
- ‘Plastic pipes’ are specially suitable in the smaller diameter for about 6 kg/cm<sup>2</sup> high pressure.
- Irrigation piper are tested
  1. For water absorption.
  2. For strength
- To test the water absorption samples of the pipe are boiled for about 5 hours and gain in weight by moisture absorption is notes.
- The standard irrigation pipe should not exceed 8% of the original dry weight.
- The discharge through a pipe line can be determined by applying the Darcy’s equation.

$$V = \sqrt{\frac{Hdg}{2fl}}$$

f = Darcy’s roughness coefficient.

- Spacing of the pipes – Closer spacing’s are suitable for sandy soils and farther spacing for heavy clay soils.
- To prevent damage of pipelines, they must be kept at least 45cm below the ground. The width of the trench should be 70cm for working convenience.
- The minimum diameter of the ‘Pump stand’ should kept not less than 60 Cm.

- “Current meter” is an instrument which records number of revolutions corresponding to velocity.
- A weir is a notch of regular form through which water may flow.
- The bottom edge of weir notch is termed as the “Weir crest”.
- 1. Rectangular weir:
  - a. Suppressed rectangular weir: It has crest length equal to the width of the channel. The discharge  $Q = 0.0184 LH^{3/2}$ .
  - b. Contracted Weir: It has crest length less than width of the channel.  
 $Q = 0.0184 (L - 0.1nH) H^{3/2}$   
 $n$  = Number of end contractions
- Sharp crested weirs are preferred over “broad crested weirs”  
 Trapezoidal weir (cipolletic weir) ;  $Q = 0.0186 LH^{3/2}$   
 Triangular weir  $Q = 0.0138 H^{3/2}$  (To measure low discharges)
- The depth of flow over the crest should not be less than 5cms.  
 $Orifice = 0.61 \times 10^{-3} A\sqrt{2gh}$  (MKS units)
- Parshal flume – It is having 3 sections.
  1. Converging (or) Contracting section – leveled
  2. Constricted (or) throat section – Down ward
  3. Diverging (or) expanding section – Slope upward.
- The size of the parshal flume is expressed by the width of the “throat”.
- Sandy soils and Sandy loam with high infiltration will have smaller basins and clay soils with low infiltration large basins.
- Check basin method is suitable to most soils except to sandy soils.
- All row crops included grains, Vegetables and various cash crops are adopted to ‘contour furrows’ method. Contour furrows are not advisable in sandy soils and soils that crack.
- “Sprinkler irrigation” is not suitable in very fine textured soil where the infiltration rate is less than 4 mm/hour.
- The capacity of the sprinkler irrigation
 
$$Q = \frac{2780AD}{FHE}$$

A = Area, d = depth of water in cms; f = number of days of irrigation; H = operating hrs/day; E = water application efficiency.
- Drip irrigation method is accomplished by using small diameter plastic lateral lines with devices called “Emitters (or) Drippers”. In drip irrigation the capacity = 2 -10 lit/hour.
- “Plastics” is an organic substance and it consists of natural (or) synthetic binders (or) resins with (or) without moulding components.
- Elastomers: These plastics are soft and elastic materials with a low modulus of elasticity. They deform considerably in tension and the deformation disappears rapidly at room temperatures.
- Indathene: is the trade name of various grades of LDPE manufacture and marketed by IPCL (Indian petro chemicals corporation limited).
- Water erosion is of four types
  1. Sheet erosion
  2. Rill erosion – This is advanced stage of sheet erosion.

3. Gully erosion – Gully erosion is the removal of soil by running water with formation of channels, that cannot be smoothed out completely by natural condition cultivation. Gully erosion is an advanced stage of “Rill erosion”.
4. Stream channel erosion – Transportation of soil along the banks of stream.

Sheet → Rill → Gully → Stream channel

- The rational method is commonly used in predicting peak-run off rate of small water sheds. (< 1300 ha.).  
 $Q = 0.0276 CIA$ .  
 $Q$  = Peak – runoff in cum./sec.  
 $C$  = Run off coefficient  
 $I$  = Rainfall intensity in cm/h  
 $A$  = Watershed area in ha.
- “Bench terracing” is one of the oldest mechanical (or) engineering method of erosion control. This will be useful in soils with slopes more than 15%.
- Types of bench terraces.
  1. Level and table: They are suitable for areas receiving medium rainfall which is evenly distributed and which have highly permeable and deep soils.
  2. Sloping outwards: They are used in low rainfall areas with permeable of medium depth.
  3. Sloping inwards: They are used in heavy rainfall areas.
- Broad base terracing: Classified into
  1. Graded terrace – Useful on poorly drained soils with slopes less than 4%.
  2. Level terrace – on slope of <2%.
- From functional aspects, graded terraces are classified as “interception”.
- Terraces are further classified in to
  1. Channel type 2. Ridge type.
- Channel type is mostly used on soils where controlled removal of water is of prime importance. It is built from one side.
- Ridge types are usually used where the water holding capacity is principal function. It is built from both sides.
- Surveying is a process of determining the position of points in a horizontal plane.
- “Leveling” is the art of determining and representing the relative heights.
- In “geodetic survey” curvature of the earth is taken into consideration.
- “Plane survey” – taken for smaller areas.
- Radian is the unit of plane angle
 
$$1 \text{ degree} = \frac{\pi}{180} \text{ radians} = 60 \text{ minute}$$
- In approximate results, distance may be determined by “Pacing” (average length of pace – 80cm).
- In ‘Computative method’ distances are obtained “Calculation”.
- Swivel joints are provided at the end of the chain to turn round without twisting.
- For work of highest precisions “Invar tape” is generally used.
- In ‘Optical square’ H & I mirrors are placed at an angle of  $45^{\circ}$ .

- The mirror H called horizon glass is half silvered. The mirror 'I' known as 'index glass' is whole silvered.
  1. If both ends are visible from intermediate points "Direct ranging" is practiced.
  2. If both ends are not visible from intermediate points "Indirect ranging" (or) "Reciprocal ranging".
- The principle of chain survey is 'triangulation'.
- A number of subsidiary lines called "Tie lines".
- The longest of the chain line – "Base line".
- Joining the apex of triangle – "Check line".
- The positions of boundaries, building, fences – "offsets".
- The preliminary inspection of area to be surveyed is called "Reconnaissance" survey. During this survey prepare a neat sketch called "Index sketch".
- Reference sketch: are necessary to find the positions of stations.
- Type of impellers in turbine pump – Closed and semi open.
- The most accurate method of finding areas between chain line and curved boundary is "Simpson's rule".
- The first reading – back sight, Last reading – Foresight, In between reading – Intermediate sight.
- Silting takes place if the channel slope is less than 0.05%.

### **Farm Power and Machinery:**

- Manual power – 0.1 HP; Animal power – 1.0 HP.
- The average force (or) draft animal can exert is nearly  $1/10^{\text{th}}$  of its body weight.
- If the wind velocity is more than 32 km/hr. wind mills can be used for lifting water.
- The unit power available for crop production in India is 1.54 hP/ha.
- "Heat engine" is an equipment which generates thermal energy and transforms it into mechanical energy.
- "External combustion engine" Eg: Steam engine.
- Internal combustion engine. Eg: Diesel & Petrol engine.
- IC engines classified as otto cycle, diesel cycle, Semi diesel cycle based on the type of working cycle.
- Tractors are mostly equipped with high speed engines running at about "1500RPM".
- A pin called "Gudgeon pin (or) wrist pin" is provided for connecting the piston and the connecting rod. The end of the connecting rod which fits over the crankpin is called "Big end of the connecting rod".
- A fly wheel is provided at the end of the crank shaft for smoothening the uneven torque produced by the engine.
- When the cycle is completed in two revolutions it is called four stroke, in one revolution – two stroke cycle engine.
- The movement of piston from BDC to TDC (or) TDC to BDC is called "Stroke".
  1. Suction stroke: Piston – moves downward; Inlet valve – Opened.  
Exhaust valve- Closed.
  2. Compression stroke: Piston – moves upward; Inlet valve – closed, exhaust – closed.
  3. Power stroke: Piston – moves down; Inlet and Outlet – Closed.

4. Exhaust stroke: Piston – moves up; Inlet – closed; outlet – open.
- In two stroke engine three holes are provided known as Inlet port, transfer port and exhaust port. This piston is usually of the type is known as “Deflector piston”.
  - “Scavenging” – The process of removal of burnt (or) exhaust gases from the engine cylinder.
  - Thermal efficiency of diesel engine 32-38%. Petrol – 25-32%.
  - Compression ratio of diesel engine 14:1 to 22:1; Petrol – 5:1 to 8:1.
  - Compression pressure of diesel engine 35-45kg/cm<sup>2</sup>, Petrol 6-10kg/cm<sup>2</sup>.
  - Compression temperature of diesel engine – 500<sup>0</sup>C; Petrol – 260<sup>0</sup>C.
  - The most common type of valve is called “Poppet valve”.
  - The sequence in which the power stroke in these cylinder of an engine occurs is called “firing orders” for four cylinder, four stroke engine the most commonly used firing order is 1-3-4-2, 1-2-4-3.
  - The top of the piston is known as “Crown”. Sealing part is known as “Head”. The lower portion (guiding part) is called “Skirt” skirt diameter > Head diameter.
  - Compression rings are usually plain, single piece oil rings are grooved.
  - “Crank shaft” is the back bone of the engine.
  - The space that supports the crankshaft in the cylinder block is called. “Main journal” where as the part to which connecting rod is attached is known as “Crank journal”
  - The crankpin along with two crank arms form “throw”.
  - The portion which joins big end pin and main journal is called “web”.
  - Cam shaft gear is bigger in size than that of the crankshaft gear and it has twice as many teeth as that of the crankshaft gear.
  - The lower portion of the crank case is commonly called “Oil pan”. Two types of crank case are
    1. Split block type
    2. Mono block type
  - Cylinder is made up by high grade cast iron (fly wheel, crankcase also).
  - Piston pin, connecting rod, crankshaft, cam shaft, forged steel.
  - Gaskets – Cork (or) Copper is asbestos.
  - Bore – It is the diameter of the engine cylinder.
  - For tractor engines the stroke bore ratio is 1:25.
  - Swept volume – piston displacement volume.
  - Clearance volume – It is the space which holds the charge at TDC.

- Compression ratio = 
$$\frac{\text{Total cylinder volume}}{\text{Clearance volume}} = \frac{\text{Swept vol.} + \text{Clearance Vol.}}{\text{Clearance volume}}$$

- 1 metric HP = 75 kg.m/sec.

- Indicated horse power (1 HP). It is the power generated by all cylinders and receive by the piston. It is measured by a device called “Indicator”.

$$\text{IHP} = \frac{\text{PLAN} \times x}{4500 \times 2} \quad \text{---(4 - Stroke);} \quad \frac{\text{PLAN}}{4500} \times x \times (2 - \text{Stroke}).$$

Where x = number of cylinders

- Break horse power (BHP) : It is the horse power delivered by the engine at the end of the pull loads crankshaft.
- Drawbar horse power (DBHP): It is the power which is used to pull loads.
- Frictional horse power (FHP) : It is the power required to run the engine at a given speed without producing any useful work.

$$\text{FHP} = \text{IHP} - \text{BHP}.$$

- Mechanical efficiency  $\mu = \frac{\text{BHP}}{\text{IHP}} \times 100$
- Power is measured by “Dynamometer”. DBHP is measured by “Hydraulic dynamometer”.
- Fuel supply system of diesel engine.
  1. Gravity feed system: Diesel tank is placed above the level of fuel injection pump.
  2. Forced feed system: Fuel is fed to the injection pump by a “lift pump (or) transfer pump”.
- Primary filters removes water and coarse particles of dirt form the fuel. Secondary filters removes “fine sediments”.
- Air cleaner is two types : 1. Dry type                      2. Oil bath type
- Pre cleaner functions on the centrifugal principle.
- “Fuel lift pump” is a single acting (or) double acting plunger type pump. It is driven by a camshaft of the engine.
- Fuel injection pump” should pump equal quantity of fuel to all cylinders.
- It creates pressure varying from 120-300 kg/cm<sup>2</sup>.
- In fuel injection pump “Delivery valve” prevents the reverse flow of fuel.
- “Governor” maintain constant speed of the engine under different load conditions. It protect the engine and the attached equipment against high speeds when the load is reduced (or) removed.
- There are two systems of governors in IC engine
  1. Hit and Miss system – Power stroke of the engine are regulated.
  2. Throttle system – Suction stroke will be regulated.
- Distributor is made of bakelite (or) similar non conducting material.
- “Spark plug” is used for igniting highly compressed change in the combustion chamber.
- Electrolyte – 35% H<sub>2</sub>SO<sub>4</sub> + 65% distilled water with a specific gravity of 1.28 in fully charged condition 1.15 (or) less when fully discharged condition. The specific gravity is measured by “Hydrometer”.
- Capacity of the battery is measured in “Ampere hour”.
- Mineral lubricant – Grease, SAE 40.

- Fluid lubricant – oils, semi fluid lubricant – Grease, solid – Graphite, mica.
- High temperature lower the “Volumetric efficiency of the engine”.
- Too much removal of heat lower “thermal efficiency of the engine”.
- In “forced circulation method” centrifugal pump to circulate the water through out the water jacket.
- Radiators of two types 1. Tubular type            2. Cellular (Honey comb) type.
- Thermostat valves are of two types. 1. Bellow type            2. Bimetallic type
- Clutch: It is a device used to connect and disconnect the tractor engine from the transmission gears. It transmits power by means of friction between driving members and driven members.
- Clutches are 3 types
  1. Friction clutch – used in 4 wheel tractors.
  2. Dog clutch – In power tillers.
  3. Fluid coupling clutch – 4 wheel tractor.
- Complete path from engine to wheel – power train.

$$HP = \frac{2\pi NT}{4500}$$

T = torque in kg.m.

- Gears are usually made of alloy steel. SAE 90 oil is generally recommended for gear box.
- Gears are of two types
  1. Selective sliding type
  2. Constant mesh type
- Each “half shaft” terminates in a small gear which meshes with a large gear called “Bull gear”.
- The device for final speed reduction suitable for tractor rear wheel is known as “final drive mechanism”.
- Depreciation – loss of value of machine  
 $D = (C-S) / LH$

$$\text{Interest} = \frac{(C+S)}{2} \times \frac{i}{H}$$

- Crawler tractor (track type (or) chain type) – Power tiller – walking type.
- “Row crop tractor” have more ground clearance.
- Central region farm machinery training and testing institute – Budni (MP).  
Northern region – Hissar, Southern – Garladinne.
- At 200-250 engine working hours drain oil from oil sump.
- At every 480 – 500 working hours interchange tyres.
- Tillage is a mechanical manipulation of soil to provide favorable conditions for growing crops.
- Tractor drawn tillage implements.

1. Trailed implement: attached by a pin joint. The main body is supported on the ground but its weight is not supported by the tractor. The implement is pulled and guided from “Single hitch point”.
2. Semi mounted implement: It has rear wheel to support part of its weight.
  - Mounted implement: It is attached to the tractor as an integral part.
  - The combined unit of share, mould board, land side and frog is called “Plough bottom”.
  - The forward end of the cutting edge – Share point.
  - The front edge of the share which makes horizontal weight cutting edge of the share.
  - The outer edge of the cutting edge of the share – wing of the share.
  - The vertical face of the share which slides along the furrow wall is called “Gunnel”.
  - Joint between mould board and share – Cleavage edge of the share.
  - Share mostly used by the farmers “Slip share”.
  - “Mould board” is that part of plough which receives the furrow slice from the share.
  - Stubble type mould board” is adopted for ploughing on old ground “Sod (or) Breaker” type is used in sticky soils.
  - “Frog” is that part of the plough bottom to which share, mould board and landside are attached rigidly.
  - “Jointer” is a small irregular piece of metal having a shape similar to an ordinary plough bottom. It looks like a miniature plough.
  - “Coulter” is a device used to cut the furrow slice vertically.
  - Vertical suction (vertical clearance) : It is the maximum clearance under the land side and the horizontal surface when the plough is resting on a horizontal surface. It helps to the plough to penetrate into the soil to a proper depth.
  - Horizontal suction: It is the maximum clearance between landside and a horizontal plane touching point of a share. It helps the plough to cut the proper width of a furrow slice.
  - Throat clearance: it is perpendicular distance between point of share and the lever portion of the beam of a plough.
  - Centre of resistance: It is a point where all the horizontal and vertical forces meet. It lies at a distance equal to 3/4<sup>th</sup> size of the plough from share wing.
  - Line of pull: It is the line passing through the centre of pull, point of hitch and the centre of resistance.
  - ‘Two – way (or) Reversible plough’ is suitable for terraced land of hilly tracts.
  - Disc angle: It is the angle at which the plane of cutting edge of the disc is inclined to the direction of travel. It is usually between 42<sup>0</sup> – 45<sup>0</sup>.
  - Tilt angle: It is the angle at which the plane of cutting edge of the disc is inclined to a vertical line. It is usually varies from 15<sup>0</sup>-25<sup>0</sup>.
  - For 60 cm diameter disc – 8 cm concavity.  
95 cm diameter disc – 16 cm concavity.
  - Scrapper: It is the device to remove soil that tend to stick to the working surface of a disc. It prevents the discs from “Clogging”.

Item	M.B. Plough	Disc plough
Plough bottom consists of	Share, M.B, landside, frog	Only circular concave steel disc
action of plough bottom	Sliding type	Rolling type
penetration of plough	Due to suction	Due to weight

- Depending upon the arrangement of disc. Disc harrows are divided into three classes
  1. Single action: Consists of two gangs of discs.
  2. Double action: 4 gangs of disc.
  3. Offset : It is used in near trees in orchard. The line of pull is not in the middle.
- Gang: Each set of discs which are mounted on a common shaft is called gang.
- To prevent the lateral movement of the disc on the shaft is called “Spacer (or) Spool”. It is a device for keeping the discs at equal spacing on the gang bolt. It is generally made of cast iron.
- “Spike tooth harrow” – comes under “drag type”.
- Unbroken strip of soil left in between two gangs of harrow distributed by “Middle type breaker”.
- In a sickle, forged end of the blade fitted into the handle is called “Tang”.
- Ledger plate: It is a hard end metal inserted in a guard (finger) over which knife sections move to give to a scissor like cutting action.
- Wearing plate: It is a hardened steel plate attached to the finger bar to form a bearing surface at the back of the knife.
- “Pitman” transmits reciprocating motion to a knife head.
- Alignment of a mover – cutter bar is set at about  $88^{\circ}$  to the direction of motion i.e. inward lead of  $2^{\circ}$ .
- In knapsack sprayer the tank is filled  $3/4^{\text{th}}$  full.
- In hand compression sprayer the tank is filled  $2/3$  of its capacity.

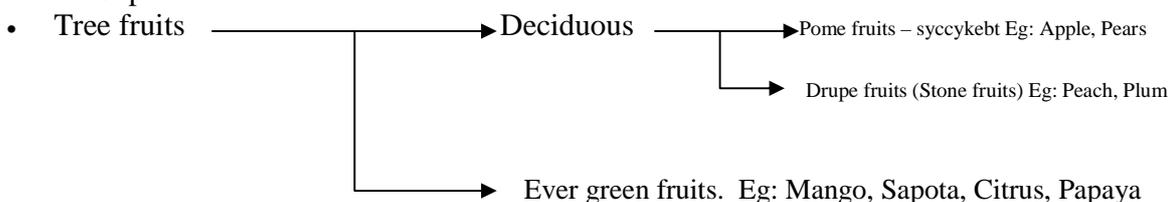
**Bits:-**

- Device used to engage and disengage the tractor engine from the rest of the transmission is clutch.
- A gear reduction unit is the power train between the differential and drive wheel is called final drive (Increasing torque).
- Vertical disc plough is used for shallow ploughing.
- The procedure of testing the seed drill for correct seed rate is called calibration of seed drill.
- In dusters the hopper should be filled with dust about of its capacity  $1/2$  to  $2/3$ .
- The opening and closing of the inlet and exhaust valves are controlled by the cam shaft.
- Gauge wheel helps to maintain uniformity in respect of depth of ploughing in different soil conditions.
- APAU drill – cup and cone mechanism.
- A mower knife is said to be in proper registration when the knife section stops in the centre of its guard on every stroke.
- The blade angle of the APAU puddler is  $10^{\circ}$ .
- Concavity is the depth measured at the centre of the disc by placing its concave side on a flat surface.
- “Vertical disc plough” is also called as “Harrow plough”.
- The disc plough is less in draft than M.B.
- In splash lubrication system a dipper is provided at the lower end of the connecting rod”.

- Gradual application of the load of the vehicle on the engine when the vehicle starts from the rest is achieved by Clutch.
- The rear bottom of the land side is known as “Heel of land side”.
- The side pressure on the mould board is transmitted to the furrow wall by the “Land side”.
- Spacing between the row to row and plant to plant is same in “Check row method”.
- The parts of the seed drill which receive seed in longitudinal grooves and pass on to the seed tubes “Fluted roller”.
- The principle that “hot water being lighter rises up and the cold water being heavier goes down is used in “Thermosiphon” type of cooling system.
- With hand sprayer, spray pressure can reach about 1-7 kg/cm<sup>2</sup>.
- To obtain complete inversion of soil the mould board used is sod (or) beaker type.
- In APAU puddler the axle is made of “Galvanised iron” (G.I) pipe.
- The detachable portion of an engine which covers the cylinder and includes combustion chamber, spark plug and valves is known as “Cylinder head”.

## HORTICULTURE

- Fruits and vegetables are also recognized as protective foods.
- Loss of sensitivity of skin, paralysis, enlargement of heart, loss of appetite – Vitamin B<sub>2</sub> (Thiamine).
- Vitamin B<sub>2</sub> (Riboflavin) required for growth and health of the skin abundantly present in pomegranate.
- Deficiency of phosphorus leads to bleeding of gums.
- Fruits and vegetables which contain, CHO's are called 'Energy Foods'.
- Fruits and Vegetables also supply roughages (Cellulose and pectin's) – prevents constipation.



- Small fruits – Eg: Grape, raspberry, black berry.
- Nut fruits – Eg: Coconut, almond.
- Vine crops – Cucumber, pumpkin, squash.
- Cole crops – Cabbage, Cauliflower.
- Salads – Lettuce, Coriander.
- Perinnials – Asparagus, drumstick.
- Greens – Spinach, Palak.
- Arboriculture – Raising of perennial trees for shade (or) avenue.  
Eg: Encalyptus, Casuarina.
- Fruit technology – Processing and preservation of fruits.
- High temperature in tomato wilt result in blossom end rot; in lettuce tip – burn and “Bolting of onion”.
- More common form of killing by freezing – Intracellular ice formation.
- Root injury when the soil temperature drops below – 10<sup>0</sup>C to – 15<sup>0</sup>C.
- Immaturity of the tissues is the chief factor associate with early winter injury.
- Plant which are unable to stand low temperature even for a single night are called “Tender plants”.
- Rest period – Unfavorable conditions with in the plant.
- Dormant period – Unfavorable conditions in environment.
- The influence of light intensity is due largely to its effects on “Photosynthesis”.
- Blue light – Normal leaves and stem stunted growth.
- Blue + Red – Photosynthesis.
- Red – elongation of plant parts.
- Length of the day controls the time when “Protein synthesis” takes place.
- Fruits that mature during rainy season contain less Sugar and more acid.
- Citrus suffered in black cotton soils from ‘die-back disease’ in Vodlapudi orange.
- Sandy loam soils of Telangana – Chalka soils.

- Peaty soils are suited for growing spices and plantation crops.
- The beneficial effect of wind break is felt a distance equal to three times its height.
- There should be a spacing of 12 m between the row of windbreak and the first orchard row.
- The angle branches make with the main trunk is known as “Crotch”.
- Planting should be preferably in the afternoon rather than in the morning.
- Arrangement of plants in the orchard is known as “Layout”.
- Trees grown at the centre of the square – Filler tree.
- Hexagonal (or) Septuple system is based on the “equilateral triangles” his system accommodate about 15% more plants per unit area than the square system.

Cultivation is possible in three directions =  $2 \times \sqrt{\frac{3}{4}} a^2$

- In quincunx X system double the number of plants of square system.
- The perpetuation of plants is called “Propagation”.
- Viviparous seed – Chow – Chow.
- The period of rest during which certain favorable physiological changes occur in seed after harvest to the embryo to germinate is called “After ripening”.
- Seed coats impermeable to water – Clover, alfa alfa.
- Seed coats impermeable to oxygen – Xanthium.
- Stratification – Moist chilling, temperature – 0 – 10<sup>0</sup>C.
- Nucellar embryony – Citrus.
- Polyembryony – Jamun, Mango.
- Graftage – The art of joining two plant parts – roots and stem.
  - a. Grafting – A piece of stem with more than one bud.
  - b. Budding – A single bud is used.
- Swollen base of stem – corm. Eg: Colocasia, Banana.
- Shoot suckers – Banana, Pineapple, Suckers – lateral branch that develop.
- Root suckers – Guava, Curryleaf from the underground portion of the stem.
- Seed coats impermeable to water – Clover, alfalfa.
- Stolon – An aerial horizontally growing shoot which on contact with the soil strike roots. Eg: Jasmine, Cynodon dactylon.
- Runner – Strawgerry, Oxalis.
- Offset – Agave, Pineapple, Waterhyacinth.
- Crowns – Pineapple
- Bulbils – Liliun – Acrial stem bulblets.
- Slips – Stem pieces with 3-4 nodes. Eg: Chrysanthemum slips.
- Rootage: In cuttage the roots are induced in the detached portion of plants where as in layer age roots are induced on plants parts when they are intact with the parent plants.
- A layered stem is known as “layer”.
  1. Tip layering – Eg: Strawberries.
  2. Simple layering – Jasmine
  3. Compound layering – Phelodendron – branch is alternately covered and exposed along with its length.

4. Mound layering – Mango, Guava.

- The best season to take cutting is from middle of July to middle of February.
- In graftage the upper part is termed as “Scion” and the lower part is termed as “root stock”. The new plant obtained as a result is called “Stion”.
- The root stock is selected on the basis of the influence on the ‘Scion’.
- The shoots of mother tree from which the buds are used as scion material is known as ‘bud wood’.
- Top working is the practice of grafting on established trees which involves the removal of most of their branch system. To re - juvenate old unproductive tree.
- A scion is grafted over the already grafted shoot. This is known as “Double” working. Double working is done to temper the influence of the rootstock.
- “Bridge grafting” is a form of repair grafting and is used in cases in which the root system of the tree has not been damaged but where there is injury to the bark of the trunk.
- The influence of root stock is more in magnitude as compared to the influence of scion as stock.
- Precocity: from planting to flowering period – early bearing nature.
- Effect of root stock on the vigour of the scion on precocity on productivity and yield.
- The major influence of the scion on the rootstock is on the vigour of the stock.
- Graft incompatibility Eg: Apple on pear; Sweet orange on wood apple.
  1. Trans located incompatibility: This due to the movement of toxic materials through phloem. This is can not be overcome even by inserting an intermediate stock.
  2. Localised incompatibility: This may be due to repulsive action of stock and scion. This can be overcome by inserting an intermediate stock.
- “Training” is a treatment given to the young plants to get a suitable (or) desirable shape and a strong frame work systems of training.
  1. Close centered system – Strong crotches.
  2. Open centre system – Weak crotches.
  3. Modified leader system – practiced in citrus. It is the best system.  
In training branches should arise on the main trunk alternately at intervals of at least 15cm.
- Removal of unwanted, surplus annual growth, dead, dried and diseased wood of the plants is “Pruning”.
- Fruits born an current flush. Eg: Ber, phalsa and grapes.  
Method of pruning:
  1. Thinning out: When a shoot is removed entirely from the jinception.
  2. Heading back: When a branch is cut almost to the base, leaving a few inches at stump, carrying few buds, it is referred as “Heading back”.
  3. Pollarding – Mere cutting back of the shoots to reduce in the height of the tree is “Pollarding”.
  4. Training – Cutting the growth of the twig.
  5. Pinching (Tipping) – Removal of the tip of the shoot. This is practiced in marigold and chillies at the time of transplanting.
  6. Disbudding – Nipping (or) rubbing.
  7. Deblossoming – Removal of surplus flowers practiced in alternate bearers take Mango, Apple etc.
- In deciduous trees pruning can be done before the termination of dormancy.

- In evergreen, pruning should be carried out just before the start of active growth (or) after the harvest of the crops.
- Trees on light soils flower earlier than those on heavy soils.
- An accumulation of carbohydrates is essential for flower formation.
- Bahar treatment is given to produce flowers. This is mainly practiced in citrus (Santra) in Nagpur area.
- Ringing: The bark is removed in the form of a ring from small branches. Ringing is practiced in grape and deciduous fruits in Europe.
- Smudging: Un oxidized hydrocarbons like acetylene and ethylene often induce flower bud formation. Smudging is a practice based on this principle.
- Rumani prefers Himayuddin polles
- Waves of fruit drop
  - I. wave (post – setting drop) – This drop is natural and beneficial to the plant. It is a necessary evil.
  - II. Wave (Summer (or) June drop) – due to high temperature shedding (thinning) helps the remaining fruits on the tree of increase in size.
  - III. Wave (Pre-harvest drop) – Cause heavy losses.
- Late rains may prolong the vegetative growth and delay (or) reduce flowering as in Mango. It can be remedied by drying out the soil by deep ploughing and probably by artificial inhibition of growth by growth inhibitors (Cycocel B<sub>9</sub>).
- The phenomenon in which an asexual reproduction process occur in place of the normal sexual reproduction – Apomixis.
- A narrow croatch can be widened by pruning the branch to an outer bud.
- Light intensity refers to the concentration of light waves.
- The quality of the light refers to the length of wave.
- For cold storage mature fruits while for waxing ripening and immature fruits are harvested for smoke ripening.
- Colour of seeds is a guide of maturity in pears and in certain apples.
- “Penetrometer” measure firmness as an index of maturity.
- Acidity and as tringency gradually disappear during ripening.
- Aroma and taste together constitutes the favour. The aroma is cause by the formation of ester.
- During the time of ripening the rate of respiration reaches a peak and then decline. This peak is referred as “Climteric”.  
Eg: Banana, Mango.
- ‘Avocado’ ripen only after harvest and also ‘Panchavarnam’ Mango variety.
- Ca carbide pellets placed for uniform yellow colour development also causes loss brightness of colour.
- “Ethrel” is the ripening hormone most commonly employed for artificial ripening of fruits.
- Pre cooling is done to make the fruits to acclimatize for the low in cold storage chamber.
- Brown heart: When CO<sub>2</sub> increases in the storage atmosphere.
- Hot dry winds at blossoming time prevents “Pollen germination”.
- The fruits of sweet orange are juicy and thin skinned if sour orange is used as a root stock.

- Exposing of fruits to gamma ray – Irradiation.
- Toughening of the skin in citrus fruits for loss susceptibility to injury is called as “Qualiting”.
- The storage malady that occurs when immature fruits are stored in “Browning”.
- In Bryophyllum propagation through “leaf cutting”.
- pH for horticultural crop – 6 – 7.
- The plant with slender and succulent stems to support in erect position are vines.

Krishna is the leading district in Mango production in Andhra Pradesh.

Mango: *Mangifera indica*                      F: Anacardiaceae                      2n = 40

- Ripe mango is rich source of vitamin A and C.
- Baneshan – leading commercial variety – Susceptible to mango hoppers.  
Rumani – Attractive commercial table variety.  
Neelum – Suitable for long distant transport  
Alphonso – Leading commercial variety of Maharashtra.
- Cherakurasam – Suitable for cultivation in drylands.
- Polyembryonic varieties – Bappakai, Goa, Bellary, Salem, Nilexwar dwarf.  
Neelaeshan – Neelum X Baneshan.  
Neeludin – Neelum X Himauddin  
Neelgoa – Neelum X Yerramulgoa
- Swarna – Jahangir – Chinnasuvarna rekha X Jahangir  
A.U. Rumani – Mulgoa X Rumani  
Mallika – Neelum X Dashahari – by IARI.
- Table and juicy variety – Chinnasuvarna rekha  
Early variety – Rajamani,  
Late variety – Mulgoa.  
Off season variety – Neelum., Banglora.  
Pickle variety – Acharpasand, Tellagulabi.  
Variety for preservation Baneshan, Bangalore.
- Mulgoa is monoembryonic in India and is poly embryonic in “Florida” (USA).
- Sufficient heat during the ripening of the fruit.
- In “Kanyakumari” mango fruits are obtained all round the year.
- In arching of approach grafting is the principle method of propagation followed by “Vineer grafting”.
- “Kalepadi” variety is dwarfing stock and wild mango variety called “Ulima” (Ceylon) a prolific root stock.
- Spreading variety – Peter.
- Mango can withstand deficiency of “Phosphorus” but not “Potash”.
- “Dashahari” produce high percentage of perfect flowers.
- Neelum and Bangalore are regular varieties.
- Malformation affects the vegetative shoot is called “Bunchy top”.
- “Bhadran” variety of Uttar Pradesh is resistant and free from the Malformation.

Banana: *Musa paradisiaca* F: Musaceae  
Adams fig, Apple of paradise.

- Heart – male bud.
- Fruits are called “Fingers”.
- Poovan (Chekkarakeli) – good keeping quality.
- Amruthapani – best table variety.
- Tella Chakkarakeli – best of banana in circars.
- Basrai – Immune to panama wilt but suffer from bunchy top of disease.
- Nendran – It is a dual purpose variety of great importance in Kerala.
- Hill bananas : 1. Virupakashi – Perennial bananas  
2. Srumalai
- Banana is propagated vegetatively through suckers and Rhizomes.
- Removal of dry leaves is called “Trashing”.
- Banana fruits develop “parthenocarpically” (seedless fruits).
- Removal of male bud of the inflorescence give 15% increase in yield.
- Cutting of the pseudostem on a little above the ground “Muttocking”.
- Basrai – Immune to panama wilt and good.
- Poovan - Resistant to panama wilt and good keeping quality.

Citrus: F: Rutaceae

- The special feature of citrus fruits is the presence of “juice sacks”.
- Three generas: 1. Citrus 2. Fortunella 3. Poncirus.  
Sweet orange – citrus sinensis; Acid lime – C. aurentifolia  
Lemon – C. limon; Mandarinina - C. reticulata.  
Rough lemon – C. jambheri; Vadlapudi orange (kichilli) – C. maodras patna.  
Trifoliate orange – Poncirus trifoliate; grape fruit – C. paradisi.
- USA biggest produce of citrus.
- Florida produces 90% of the grape fruit in the world.
- Oranges grown in different parts of India are of two species.
  1. Sweet orange
  2. Mandarin orange.
- Varieties of sweet orange – Sathgudi, Mosambi, Batavian.
- The mandarin group includes all types of loose Jacket oranges commonly called “Santhra”.
  1. Sathgudi – Known as Chini.
  2. Batavion – Yellow and green stripes due to “basketting” – pumello is the only monoembryonic.
- Exotic variety – Valencia late – Late variety – prolific bearer.

## **II. Mandarins:-**

1. Nagpur santhra: Finest of all mandarins.
2. Agency kamala: Variety from grown in Andhra Pradesh.  
Exotic variety Kinnow – a hybrid resistant to sun burn with richer juice.

- The only variety grown lime is called “Kagzi lime”.
- Tahiti – lime is seedless.
- Rangpur lime is a hybrid between Mandarin and rough lemon.
- Seedless variety of lemon – Melta, Lucknow; Italian.
- Acid lime can stand heavy rains and resistant to high water level.
- Vegetative propagation is shield budding (or) T. budding.
- “Mandarins” are largely propagated by seed all over the country except Nagpur santhra which is the only budded variety.
- The most commonly used stocks for sweet orange and mandarins are Jamberi (Rough lemon) and Karna Khatta.
- Karna Khatta is satisfactory root stock for grape fruit, Trifoliate orange – hardest root stock – dwarfing rootstock for sweet orange.  
Rangapur lime used as stock for mosambi in Bombay region.
- For “Napur santhra” sweet lime is satisfactory stock.
- Acid lime is commonly propagated by seed all over the country because the seeds exhibit a high percentage of polyembryony.
- Cultivation of solanaceous vegetables as inter crop may be avoided as this may encourage the development of nematodes which may cause root damage.
  1. Angam season – September – February 80% of total annual yield.
  2. Gairangam – July – September 15% of total yield.
  3. Edagaru – March – May

**Grape:-** Vitis vinifera F: vitaceae

- Largest produced fruit of the world.
- “Raisins” varieties are better dried and preserved.
- \_\_\_\_\_ - Delphinidin
- Bangalore blue is a hybrid between V. labrusca X V. vinifera  
(American grape) (European grapes)
- Commercial classes of grapes :

1. Table grapes ↳ Arab – E – Shahi ↳ Selection No.-7	2. Rasin grapes ↳ Thompson seedless ↳ Kishmish	3. Wine grapes ↳ Carigune ↳ Gross column	4. Sweet juice grapes ↳ Bangalore blue ↳ “Gulabi”
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- Canning group – Thomspson seedless. Canner.
- Grape is commercially propagated through ‘hardwood cutting’.
- To avoid aphid problem it is propagated through ‘budding’.

Region	Training Method
1. Bombay – Deccan region	Single stake system
2. Punjab and Haryana	Kniffin system
3. Bangalore region Madhurai region Hyderabad	Pandal over head system arbour system



- CO-1 – Selection made in Coimbatore. Good for papain collection.
- Solo: It produces plants with only female and perfect flowers.
- Propagated through seeds.
- One male plant for a group of 10 female plants (1:10).
- CO-2 is an improved. Strain from Coimbatore exclusively for “Papain”.
- Selection – 7 produced on

**Pine apple**:- Ananas casmosus                      F: Bromeliaceae

3 types 1. Cayenne group : Kew, Gaint kew.

2. Queen group : Queen – High suckers bearing ability.

3. Spanish group : Red Mauritius, yellow Mauritius.

- Crops can tolerate partial shade.
- “Kew” is the leading commercial variety.
- Mauritius is a mid season variety
- Propagations through suckers, slips (or) crowns.

**Pomegranate**:- Punica granatum                      F: Punicaceae

- The juice is useful for patients suffering from “leprosy”.
- The edible part of pomegranate is the juicy out growth of the seed called the “Aril”.

Variety

- Alandi (Hard seeded variety); Dholka – Westindies.  
In South India – Papershell, Masket red.
- Seed propagation is common also through hard wood stem cuttings.
- Boron deficiency cause cracking of fruits.
- The Mrig bahar crop is more susceptible to fruit cracking.
- Tree begins fruiting in the fourth year.

Fig: - Ficus carica                      F: Moraceae

- They stimulate blood production and are useful for preventing acute anemia.
- At the apex of the fig is a small opening known as “eye”.

Varieties:

1. Caprifig (Wild fig) – both male and female flowers. Short style female flowers are adopted for the laying of egg by fig wasp (Blastopl age).
  2. Smyrna fig.
  3. Common fig – Capable of developing without pollination.
- Poona – The variety belong to common fig (or) Adriatic fig type. It is bell shaped variety.
  - Propagated by hard wood stem cutting.

**Phalsa**: Grewia subinaequalis (Bush phalsa)                      F: Tiliaceae

G. asiatica (Tree phalsa)

- Phalsa is grown mostly from seeds.
- **Ber:** Ziziphus jujube F: Rhamnaceae
- Propagation of superior varieties by “Shield budding”.
- “Dodhia and Banarsi” varieties are commonly cultivated in Rayalaseema.
- Dodhia variety is said to be resistant to fruitfly attack.

**Jack fruit** : - Artocarpus heterophyllus F: Moraceae O: India

- It gives the largest fruit, which are borne on leafless stalks arising from the trunk.
- Male and female flowers of jack are borne in separate drooping “catkins”.
- Variety: Rudrakshi, Singapore (or) Ceylonjack.
- Carambola: Averhoa carambola F: Oxalidaceae.
- Some fruits the fruit is used as a substitute for tamarind in cooking.
- Passian fruit : Passiflora edulis F: passifloraceae
- Variety : yellow variety, Purple variety.

**Amla** : Anola, Indian gooseberry: phyllanthus emblica (or)  
Emblica officinalis  
F : Euphorbiaceae

**Jamun:** Indian black berry : syzygium cumini F: Myrtaceae

**Apple:** Malus sylvertsis F: rosaceae

- Variety 1. Diploids – (self fruitful) - Red delicious, Yellow delicious, Jonathan.  
2. Triploids – (self unfruitful) – Baldwin, Beauty of both, Cox’s orange pippin.
- “Ambri Kashmiri” is indigenous to Kashmir valley.
- The presence of lime in the soil is good for apple cultivation.
- Generally propagated by budding (or) grafting.
- “Malling ix” dwarfing root stock in popular.
- The tree should be trained to modified leader system.
- Some apple trees bear fruit on short crooked growth called as “Spurs”.

**Pear:** Pyrus communis (French pea) (or) European pear – persistent calyx.

F : Rosaceae. P. pyrifolia oriental pear.

- Most of variety are self unfruitful.
- Variety : 1. Bagu gosha – Excellent canning variety.  
2. Gost baghu – Better keeping quality – Longest variety in Kashmir.
- Nashpati – self fruitful.
- Propagation by “Shield budding”.
- To produce dwarf pear, trees. Quince ‘C’ rootstock is used.

- Intermediate root stock – old home.

**Peach:** prunus persica                      F: Rosaceae

- All variety are self fruitful, except the variety “J.H. Hale” which is male sterile.
  1. Elberta – wider climatic adoptability.
  2. Alexander.
- Propagated by “Shield budding” plum is the better rootstock.

**Plum:** Prunus domestica (European plum)  
P. Salicina (Japanese plum)                      F: rosaceae

- Variety : Santarosa, Victoria.
- Propagation by shield budding.
- Wild apricot (Zardalu) is better root stock.

**Apricot:** Prunus armeniace                      F: Rosaceae

- The wild apricot called “Zardalu”.

**Cherry:** Prunus avium                      F: Rosaceae

- Sweet cherry used as desert.
- Sour cherry – P. Cerasus used for cooking and canning.

Bits: -

- Hydrophilic colloids are derive from proteins.
- Non climacteric fruit – citrus, apple.
- A mild injury caused to the vessels to stimulate resting buds – Notching.
- Two (or) more buds if developed of the same node of a fruit trees the buds are called “accessory” buds.
- While planting cutting in the nursery bed root polarity has to be maintained.
- Pollen supply – polliniser.
- It is very important with root cutting to maintain polarity.

- **Tomato** : Lycopersicon esculentum F: Solanaceae O: Mexican regions of tropical America.
- Determinate type terminate in a flower bud and called 'self topping' (or) self pruning.  
Eg: Pusa early dwarf; CO – 1.
- Indeterminate types terminates in a vegetative bud and often requires staking.  
Eg: Pusa ruby, Best of all Sioux.
- Intermediate – Semi dwarf.  
Eg: S – 120, Roma.  
Small fruited Tomato – L. pimpinellifolium
- Tomato has a yellow pigment – “carotene” and red pigment “Lycopene”.
- Varieties by IARI.
- Pusa ruby – Sioux X Improved meeruti X Red cloud.
- SL – 120 : A nematode resistant variety.
- Pusa red plum – esculentum X Pimpinellifolium
- Roma – for processing.
- F<sub>1</sub> hybrids – Pusa ruby X Best of all.
- Boron – to prevent fruit cracking; Zinc for higher ascorbic acid content.
- A period of drought followed by a sudden heavy watering during the fruiting period may cause “cracking of fruits”. Boron deficiency also cause “cracking of fruits”.
- Extraction of seeds.
  1. Fermentation method.
  2. Acid (or) alkali method – Avoid discolouration – Acid method is quick and more commonly used.
- Intermediate deficiency of soil moisture and deficiency of calcium may cause “blossom end rot”.
- “Sioux” is resistant to growth cracks.
- “Catface” is an advanced stage of “blossom end rot”.
- Root – knot nematode is a common problem in “light red loams”.
- CO-3 (Maruthum) is a mutant variety.

**Brinjal:** Solanum melongene F: Solanaceae O: India

- “White brinjal” is said to be good for “diabetic patients”.
- Based on the length of the style four types of flowers.
  1. Long style
  2. Medium style.
  3. Pseudo style.
  4. True (or) short style.
- Long and Medium – Swollen ovary – fertile.  
Pseudo and short – rudimentary ovary – do not set into fruits.
- S. auriculatum was found immune to little leaf virus.

Variety:

Pusa purple long – Ratooning variety.

Pusa purple round – Rest to shoot borer

Pusa purple cluster – Rest to bacterial wilt.

- Bagyamathi – A.P.A.U. variety.

Akra kusumakar; Arka nauaneeth – Hybrid = IHR22-1-2-1 X supreme.  
Pusa purple long X Hyderpur – Pusa anmol – F<sub>1</sub> hybrid.

**Chilli:** - Capsicum annum

Bellpeper: C. fruitscens                      O: Peru

- Alkaloid – Capsicin; Red pigment – Capsathin.
- Variety: Sindhuri, N.P. 46A, Pusa jwala – root to mosaic and leaf curl.  
Kiran – Rest. To thrips.
- Male sterility was observed in G<sub>2</sub> – strain at lam; Guntur.

**Bhendi (Okra):** Abelmeschus esculentus                      F: Malvaceae                      O: South Africa

- The extract obtained from the plant by seeking in water is used as a clarifier in the manufacture of jaggery.
- Fibre formation in the pod from 5<sup>th</sup> to 6<sup>th</sup> day of formation and a sudden increase in fibre content may be seen from 9<sup>th</sup> day.
- Variety: Selection – 1 – 1; highly rest. To yellow vein mosaic virus (YMV)  
Pusa – Sawani: Tolerant to YVMV  
Pusa – Makhmeli: Sus. To YVMV
- Abelmoschus manihot – wild species immune to YVMV.
- I.H.R.20-31 retain its tenderness upto 10<sup>th</sup> day.

Cucurbits: Summer vegetable, Monoecious,                      F: Cucurbitaceae.

- Dioecious cucurbits: Coccinia and pointed gourd.
- Fruit is “pepo”.
- Bitter principle – cucurbitacin (Mono glycoside).
- Gibberellic acid induces maleness.

Cucumber: cucumis sativus                      O: India

- Variety : Japanese long green; Straight eight, Chine – IARI.  
I.I.H.R.: Gemini excellent for salads.
- IARI recommended F<sub>1</sub> hybrid – ‘Pusa samyog’.
- The fruit maturity in cucumber is judged by the size but not the age of the fruit.
- Lower temperature causes “blenishes”.

Pumpkin and Squashes: cucurbita moschata

- Variety: Akra suryamukhi – rest. To common pest of fruit fly Arka Chandan.
- IARI : F<sub>1</sub> hybrid – Pusa alankar.

Gourds: O: India



- Edible part – Curd.  
Early variety – Pusa kathi  
Mid season variety – Snowball, giant snow ball, patna main crop.  
Late variety – Snow ball -16.
- Cole crops at high temperature regions produce “Sinigrin” compound which gives badodour.
- Cauliflower crop often shows the deficiency of boron and Mo.
- The curd is protected against sunscorch and yellowing by covering with outer leaves which is known as “Blanching”.
- Whiptail is caused due to the deficiency of ‘Mo’ in acidic soils.
- Browning is caused by boron.
- Deficiency of nitrogen cause “buttoning” (development of small curds).
- Planting of early varieties in the late season also cause.
- Blindness is due to low temperature.
- The flowers open and develop into ‘Siliqua’.

Knol – Khol: B.O. Variety : gongylodes.

- Edible part – Knob (Enlarge stem)
- Variety : White Vienna; purple Vienna.
- Sprouting broccoli: B.O. variety: italic. Edible part – Head.
- Variety : Bronzino – A purple variety of the heading type.
- Brussels sprouts : B.O. Variety : gemmnifera  
Edible part - sprouts
- Beans and Peas: F: leguminasea
- Peas are hardy Beans, warm weather except brood bean which is hardy plant.
- French bean: Phaseolus vulgaris O: South America.
- Three types 1. Dwarf bush type – day neutral plants  
2. Semi pole (or) Runner type – Short day plants.  
3. Pole type – long day plants.

Jampa variety : littering habit.

- Variety : Pusa parvati – developed through ‘X’ ray irradiation contender; giant stringless.
- Deficiency of Ca and Mg result in lower protein content.

Cluster bean:- *Cyamopsis tetragonolobus* – warm crop.

- “Pusa mausami” variety is suitable for growing only as rainy season crop.
- Pusa sadabhar – Suitable for both summer and rainy season.
- Pusa naubahar
- Used for extraction of seed gum.

Dolichos bean: O: India.

- Variety : Pusa early prolific bean – Dolichos lab lab variety typicus bean: D.L. lignosis
- DC 1428 cross between garden bean and field bean.
- It is called “Ardhanari” in Tamil.

Cowpea: *Vigna unguiculata*

Variety : Pusa phalguni

- Pusa barsati – Suitable for rainy season.
- Winged bean: *Psophocarpus tetragonalobus* (or) fox tail bean.  
Broad bean : *vicia faba*
- Some people are allergic to the pollen of this plant.
- An illness some times fatal and known as “Favism” is caused.

**Pea:** *Pisum sativum*

- Asavgi.
- NP-29 suitable for dehydration.
- Maturity of pea is tested with help of “Tenderometer”.

Bulb crops: F: *Amaryllidaceae* – winter vegetables.

Onion: *Allium cepa*      O: N.W. India.

- Flowering shoot – scape.
- It has pungency due to the presence of “Allyl propyl disulphide”.
- Red colour is due to the presence of pigment – “Anthocyanin” and yellow colour in same variety due to the presence of another.
- Pigment – ‘quercetin’.
- Variety: Pusa red – fairly resistant to onion thrips – IARI.
- Bellary bia, Bellary red, Poona red, Potna red – Local variety.  
IIHR – Arka Kalyan; Arka Nikatan: Arka pragathi.
- Physiological problem – Bolting.  
Seed production: Bulb to seed method: seed to seed method for nucleus and foundation seed production

- Garlic: *Allium sativum*
- Smaller bulbs known as cloves.
- The typical flavor of garlic is due to the presence of chemical “Allicin” plus “Diallyl disulphide”.
- The local strains that are commonly grown are 1. Jawari gaddi      2. Rajella gaddi
- Leek: *Allium porrum*
- Leek is an bulb forming member of the onion family.
- Variety: “London flag and American flag”.

**Tuber crops:**

- Potato: *Solanum tuberosum* F: Solanaceae O: South America.
- More than 50% from Uttar Pradesh.
- It is a ‘treasure house of carbohydrates’.
- It has the underground stem know as “Stolon”.
- Variety : CPRI – Simla.
  1. Kufri chandramukhi – suitable for making chips.
  2. Kufri Alankar
  3. Kufri Jyothi – resistant to late blight.
    - Kufri Muthu – Immune to late blight and wart disease.
    - Kufri sheetman – frost resistant.
    - Kufri Chamalkar – Rest to early blight.
    - Kufri sindhuri – Rest to late blight and frost.
- Potatoes stored at less than 0<sup>0</sup>C suffer from interval breakdown of tissues known as “Black heart”.
- Root tuber: Sweet potato. *Ipomea batatus* F: Convolvulaceae.
- Sweet potato is grown from “Sprouts”.
- Vine cutting are generally used as propagation material.
- It is one of the most drought resistant vegetable.
- Variety: Pusa Saffaid; Pusa lal, Pusa Sunhari – IARI. Rich in carotene.
- Local variety: Bhadrakali, Sanrat.

**Colocasia esculenta :** F: Araceae O: India

- Acridity is due to the presence of needle like crystals of “calcium oxalate”.
- Elephant foot yarm: *Amorphophallus compenulrtus*. F: Araceae.
- “Gajendra” is important variety.
- It is grown from small tuberous out growths on corm called as “Cormels”.

Tapioca (Cassava): *Manihot esculenta* F: Euphorbiaceae

- ‘H’ – Series, Srivisaka, Srisahya.
- Propagated by stem cutting.
- Yam (or) Dioscorea: *Dioscorea alata* F: Dioscoreaceae
- Its extract is used for treatment of “arthities”.

Raddish	Carrot	Turnip	Beetroot
<i>Raphanus Sativus</i>	<i>Dacus carota</i>	<i>Brassica rapa</i>	<i>Beta vulgaris</i>
F: Cruciferae	Umbellifeceae	Cruciferae	Chenopodiaceae
Var: Rapid ret white, Pusa desi, Pusa Reshmi	Pusa Kesar	Golden ball Show ball	Calyx continues to grow after becomes corky and completely, Covers the seeds. Third form of seed called as “Glom Rule” Var: Crimson globe

• **Leaf Vegetables: -**

- Amaranthus sp. F: Amaranthaceae.  
A. tricolor; A. blitum (growing in summer season)
- Indian spinach (Batchali) – Basella alba F: Basellaceae.
- Mint (Podina) – Mentha viridis F: Labiateae
- Chukkakura (Sorrel) – Rumex vesicarnis F: polygonaceae
- Gogu (or) Rosella – Hibiscus Cannabinus F: Malvaceae
- Fenugreek (Mentikura) – Trigonella foenum graceum F: leguminaceae.  
Variety: 1. The common menthi.  
2. Kasthuri (or) Chama menthi – Pods are stickle shaped.
- Palak (Beet leaf) – Beta vulgaris variety: Bengalensis F: chenopodiaceae  
Variety : Pusa Jyothi, All sreen.

**Salad crops: -**

- The vegetables the are consumed uncooked are known as “Salad crop”.
- Letuce: Lactuca sativa F: Compositae.  
Seed : Achene.
- High temperature cause ‘tipburns’.  
Variety: 1. Great lakes – Rest. To tip burn.
- Cellery: Apium graveolens F: umbelliferae  
Variety : Standard bearer.

**Ornamental gardening: -**

- Plants can be grouped together in various way to give an aesthetic effect. Each such grouping is called as ‘feature’.
- Fence is the outermost boundary.  
Eg: Prosopis julifera, Casuarina equisetifolia.
- Hedges are useful to divide the garden into section to line the drives so as to direct the visitor to a central object.  
Eg: Lantana camera
- Edges are grown along the paths and around the flower beds.  
Eg: Alternanthera sp., Eupatorium cannabinum.
- The path should be slightly raised over the ground level. It may be laid with gravel (or) brick which are carefully painted when it is called a “paved path” covered with broken slabs when it is known as ‘crozy path’.
- Lawn forms the background colour in the garden.  
Eg: Cyanodon dactylon
- When plants are grown in a row, but not trimmed the feature is called a border.
- Borders are planted to different sps; while hedges are generally planted a single sps.
- The shrub borders may be grown along wall (or) in front of fence of tree, but are not in a row the feature is known as “Shrubery”.  
Eg: Croton.
- “Festuce” is quick growing and the finest of lawn grasses.
- A flower bed should be behind the lawn (or) in middle.
- Plants of different colour foliage – Carpet beds.

- Topiaries – Plants which can stand severe and constant pruning trimmed into globes, Ovals, animals, furniture etc.  
Eg: Casuarina equisetifolia
- Creepers trailed arches – Arch.
- When a path is covered by a creeper trailed on the arbour it is known as pergola.  
Eg: Bouganvillea
- Shades having plants are grown in a structure called the “fern house” (or) fernery”.
- Glass structures are called conservatories (or) glass houses.
- Orchids are humid tropical and subtropical plants loving shade.
- Terrestrial orchids grown in soil. Epiphytic orchids grown on branches of trees. Most orchids develop “Pseudo bulbs” for storage of water.
- Pot galleries – on the steps of which ‘potted plants’ are arranged.
- Aquatic plants are grown in lilly pools.  
Eg: Pistia, Water hyacinth.
- Rocking. Eg: Opuntia, Agave.
- Avenue trees and background trees: Trees are tallest features in the garden.
- Avenue trees help to guide the visitors to an object.  
Eg: Yellow gulmohar, Neem tree.
- Parks are the lungs of the city.
- Gardens of 10 acres for every 1000 population.
- Gardens are said to be the “Yard sticks of culture”.
- Styles in planning:
  1. Formal (or) artificial
  2. Informal (or) natural
  3. Free – style gardening.
- In the formal gardens there is bilateral symmetry of features.  
Eg: Mughul garden
- Informal garden – Imitates nature.  
Eg: Japanese garden

Rose: Rosa indica F: Rosaceae  
Queen of flowers.

- Bloom only in the spring and summer therefore called summer roses – Rosa gigantean.
- Autumn rose – R. indica – Flowers throughout the year.
  1. Hybrid teas – Crosses between Tea roses and hybrid perpetual.
  2. Floribundas – Crosses between polyanthes roses and hybrid roses.
  3. Grandiflora – Crosses between floribundas and hybrid teas.
  4. Polyanthes – Suitable for edging.
- Rose may be propagated by seed, layering, cutting, budding and grafting.
- Seed propagation is done only in cold regions for production of new varieties. Most common method of propagation is by “Cutting”.
- For the plains “Edward” is the best root stocks and for hills R. multiflora is preferred.
- The time of blooming can be suitably adjusted according to the date of pruning. This is called “Staggered pruning”.

- The solvent “Benzene” is used for extraction of rose oil.
- Rose gultmand is preferred for making “rose water”.

Jasmine : Jasminum sps. F: Oleaceae

J. auricultum – Mullai

J. grandiflorum – Jathimalli (or) Jaji malli – It is grown for its. Highly fragrant flowers.

J. Sambac – Gundu malli – commercially cultivated (or) ‘Arabian jasmine’.

- Jasmines are propagated through cutting (or) by layering.
- The essential oil of Jasmine is known in commerce as “Jasmine concrete”.
- The oil is extracted from Jasmine flowers by the solvent extraction process. “Petroleum ether” is used as the solvent.
- Jasmine concrete is purified by alcohol by means vacuum distillation to produce “Jasmine absolute”.

Crossandra : Crossandra infundibuliformis

- Propagated by seeds. They lack sepals.
- Chrysanthemum: Chrysanthemum sp. F: Compositae
- “Autumn queen” in USA.
- National flower of Japan.
- Anemone – Flowers with a tubular central disc.
- Pompon – Very small flowers without any visible centers.
- For decoration and flower shows incured “Chrysanthemum” are used.
- Rooting is practiced.

**Marigold:** Tagetes creeta – African marigold (grown commercially for cut flowers)

I. Putula – French marigold – Variety: Gypsy.

- Roots and leaves have insecticidal properties.
- F<sub>1</sub> hybrid – ‘Climase’.
- Single signet (T. tenuifolia) ideal for edgings and rock gardening.

**Tuberose :** Polyanthus tuberosa F: Amaryllidaceae

- Single flowered varieties are most fragrant and are used for commercial cultivation.
- Dhavanam (Artemisia) – Artemisia pollens.
- All vegetables belong to “Angiosperms”.

**Bits:**

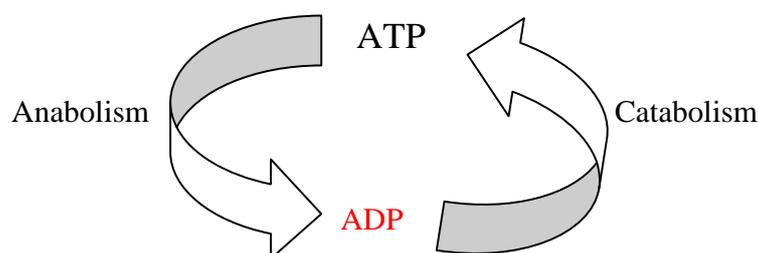
- Vegetable forcing garden concerned with the production of vegetables out of their normal season.
- Bitterground – mimordica charantia; Musk melon – cucumis melo.

- The ray florets are curved backwards and downwards in reflexed type of chrysanthemum.
- The inflorescence of tube rose – Spike, Propagated by Bulbs.
- Edible part of muskmelon – epicarp.
- The variety of Ashgard released by APAU – Shakti.
- Non – pungent chillies are commonly known as “Sweet pepper”.
- In peas wrinkled seeded varieties are more suitable for processing.
- Vegetable rich in protein – Peas.
- Oleri culture literally means “Pot herbs”.
- Floating vegetable gardens are seen in “Dal” lake of Kashmir valley.
- For drying chillies are harvested at red ripe stage.
- Semi double type of Jasmine – Dontharamalli.
- Exhaustion of carbohydrates results in irregular bearing in Mango crop.
- Bud fertility in grape is determined by dissecting the buds under microscope to assess the presence (or) absence of cluster primordia.
- ‘K’ element tends to reduce fruit cracking in Banana.
- “Pumello” is a monoembryonic citrus fruit.
- Sitaphal plant is not eaten by goats due to the presence of “Anonains”.
- Atemoya – Anonus squamosa X A. Cherimoya  
Amrapali – Dashari X Neelum (opposite to mallika) – For high density planting.  
Manjeera – Neelum X Rumari.  
Arkavathi – Black champa X Thompson seedless.  
Arka kanctan – Arab – E –Shai X Queen of vine gourds.  
Seed dormancy in sithaphal cause stone fruit formation.  
Citrus sps. Resistant to frost – Trifoliate orange.
- Best planting material in pine apple – ‘Slips’.
- For earliest fruit grown by man is said to the Datepalm.
- The fruit set in mango carried to maturity – 0.1%.
- Thanges variety recommended for high density percentage – Amrapali.
- Wood apple – Feronia elephant.



## BIOCHEMISTRY

- Enzymes discovered by Eduard Buchner – 1897.
- Protein nature of enzymes discovered by J. Sumner.
- ATP structure – Fiske and Subba Rao.
- Photo synthetic system and aerobic heterotrophic system feed each other and called “Syntropy” (between Carbon & energy cycle).
- The exchange of O<sub>2</sub> between photosynthetic system and heterotrophic system accompanies “Carbon cycle”.
- In living system ‘S’ is present mainly in the form of “Mercapto” groups in S – containing amino acids.



- Smooth E.R – Lipid synthesis.
- Plasmalemma – Responsible for the uptake and elimination of water maintains homeostasis.
- Cytosol: Site of glyconeogenesis; hydrolysis of fats to glycerol and fatty acids. Cellwall – Shape and rigidity.
- Endomembrane system: Membrane bound enzymes.
- Origin of cellular energy – Solar energy.
- A typical example of double helix – DNA and Amylase.  
Triple helix – Collagen.  
Single helix - RNA
- In animals nitrogen is not stored as ammonia; it is excreted as urine.
- All the biosynthetic reactions commence with one (or) another of a small group of molecules called “Key precursor metabolites” numbering of 12 – 75 building blocks.
- Assymmetric carbon atom “Chiral” in nature.
- Free energy  $\Delta G = \Delta H - \Delta TS$ .  
H = molar heat energy (or) enthalpy  
T = Temperature; S = Entropy.
- If  $\Delta G = -Ve$  exergonic;  $\Delta G = +Ve$  – endergonic  
 $\Delta G = \Delta G^0 + RT \ln Keq$ .  
 $\Delta G$  = Standard free energy.  
R = Gas constant = 8.31 J/mol/K.  
T = Absolute Temperature  
Ln = Natural logarithm  
Keq = equilibrium constant.
- The tendency of any particular atom ion (or) molecule to loose one.  
Electron – Red – OX potential.

$$\Delta G_0^1 + - nF \Delta E_0^1$$

N = number of e<sup>-</sup> transferred.

F = Faradays constant = 96230 J/requivalent.

$\Delta E_0^1$  = Change in redox potential.

- If  $\Delta E_0^1$  is -ve act as reducing pair; +Ve – oxidizing pair.
- An example of active transport is sulphate uptake by plant roots from the soil.
- The uptake of glucose by erythrocytes is passive uptake.
- PGA is transported as DHAP across the chloroplast membrane.
- Hydrophilic molecules move across the membrane as “Hydrophobic tail”.
- In animals sugars transport as ‘glucose’.
  - Plants – Sucrose
  - Insects – Trehalase.
- Storage – animals – glycogen; Plants – Starch.
- High energy compounds are those which release energy after hydelysis (or) phosphate bond energy compounds.
- Non – phosphory lated high energy compounds. – Acetyl COA – Thiolester.
- “ketoenol toutomerism” cause high energy in “Enolphosphates”.
- Type of bond in ATP, ADP – pyrophosphate.
  - Acetal COA – Thiol ester
  - Glucose 6 P – 1P – Phosphate ester.
  - 1, 3 diphosphoglycerate – Acyl phosphate.
- Phosphocreatine and phosphor argentine” serve as storage reservoir of chemical energy in muscle. Hydroxyl apetite basic material in bone.
- At C<sub>4</sub> – right side OH Glucose; Left side OH galactose.
  - C<sub>2</sub> – right side OH Glucose; Left side OH mannase
  - C<sub>5</sub> – right side OH R - sugar; Left side OH – S - Sugar
- Heteropoly saccharide – heparin – Small molecular weight polysaccharide.
  - Large molecular weight – Hyaluronic acid.
- 5 ring structure – furan; 6 ring – Pyran.
- “Hemiketals” are formed if the sugar contains a “Ketone group” in place of aldehyde.
- “Chair” form is more stable than the boat form.
- When monosaccharides react with concentration acid like H<sub>2</sub>SO<sub>4</sub> “furfural” (or) its derivaties are formed.
- When glucose oxidize with bromine water + KMnO<sub>4</sub> it give gluconic acid with strong oxidizing agent like concentration HNO<sub>3</sub> it gives “glucuronic acid”.
- Galactose give – Mucid acid.
  - Alkali
- Glucose =  $\xrightarrow{\text{Alkali}}$  Fructose and Mannose.
  - Through “Enediol”
- Change in specific rotation is called – Muta rotation.
  - $\alpha$  and  $\beta$  glucose in the proportion of 33% and 66%.
- Maltose -  $\alpha$  1- 4 linkage – in germinated cereals – 2 glucose molecules.
- Isomaltose -  $\alpha$  -1-6 linkage; Lactose -  $\beta$ ,  $\alpha$  (1-4) linkage.
- Sucrose -  $\alpha\beta$  (1-2) Cellobiose - $\beta$ , 1-4 linkage.

- Insulin is found in the roots of “Dahlia”.
- Main construction of supporting tissue – Cellulose.
- Skeleton of insects – Chitin, It is a polymer of N-acetyl glucose, 2-amine,  $\beta$  - 1-4 linkage.
- Protons which take up are located towards “Stroma”; Which release are located towards “laminar” side.
- Most abundant enzyme in nature – RUBISCO – RUBP carboxylase.
- Cereal husk – Hemicellulase.
- “Heparin” is the powerful inhibitor of blood clotting.
- Summer crystallized the enzyme “Urease” from Jack bean meal.
- Many reactions which are energetically favourable do not always proceed rapidly due to energy barrier.
- Isozymes – These are the multiple molecular forms of an enzyme and may differ in physical and chemical properties.
- Glycolytic enzymes of the Cytosol are also organized as one unit – “Metaboli”.
- Allosteric refers to another space.
- Michaelis – Menten’s equation

$$V_0 = \frac{V_{max}}{1 + \frac{K_m}{S}} \text{ or } \frac{V_{max}(S)}{K_m + [S]}$$

- Much more accurate determination of  $V_{max}$  and valuable information of enzyme inhibitor – “Eadie – Hof stee plat”.
- Competitive inhibitor increases the apparent  $K_m$  for the substrate without effect on  $V_{max}$ .
- Inhibition of succinic dehydrogenase by Malonic acid which is a structural analogue of ‘Succinic acid’ example of competitive inhibitor.
- Non-competitive inhibitor reduces the  $V_{max}$ .
- Enzyme activity double for every  $10^{\circ}\text{C}$  raise.
- Enzyme activity unit S.I. – Katal.

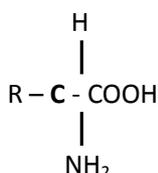
### Enzyme classification:-

- 1<sup>st</sup> class – II & III type of reaction IV – individual number of enzyme.
- Non-hydrolytic removal of a group enzyme – lyases.
- Formation of C-C; C-O; C-N; C-S bonds – ligases.
- Clarifying agent – Papain.
- Enzyme = Protein (Apoenzyme) + Non-Protein (Co-enzyme).
- Vitamins are structural components of Co-enzyme.
- Co-enzyme – A – Panthothenic acid (Vitamin); Biocytin – Biotin.
- Flavin nucleotides – Riboflavin ( $B_2$ ); TPP – Thiamine ( $B_1$ ).
- Co-enzyme  $B_{12}$  – Cyanocobalamine ( $B_{12}$ ); (Thaimine pyrophosphate  $B_1$ )

- Pyridine nucleotide – Nicotinic acid.
- “Avidin” a protein from egg white binds Biotin.
- Cobalamine occurs only in animals.

Vitamin	Function
β - Carotene (Provit of Vitamin A)	Vision
Chele colciferol (Provit – Vitamin D)	Binding of “Ca”.
Tocopherols (Provit – E)	Antioxidant.
Phylloquinone (Vitamin – K)	Blood clotting.

- The amins acids reacts directly with a prosthetic group to form “Schiff’s” base.
- Ascorbic acid utilized mostly in “Hydroxylation reactions”.
- Non – protein amino acids – L.α amino acids.
- Biocytin is the prosthetic group of “Carboxylating enzymes”.
- “Ferridoxin” is the electron donor in NH<sub>3</sub> formation.
- 24 molecules of ATP are required for one molecule of nitrogen fixed.
- Nitrogen fixing gene – “nif gene”.
- Water is ultimate source of electrons in Nitrate reduction.
- “Sirahaem” an iron porphyrin which is embedded in the enzyme protein is involved in electron transfer.
- Amino acids general formula



- ‘S’ containing A.A – Cystine; Cystine, methgonine.
- Succinic acid on transamination gives Aspartic acid, Phenyl alanine,
- Aromatic A.A. – Phenyl alanine.
- Hetero cyclic A.A. – Tryptophan, Histidine.
- Tryptophan contain an Imidole ring and Histidine contain Imidazole ring.
- Imino acids – Proline; Hydroxy proline.
- Dicarboxylic A.A.- Aspartic acid; glutamic acid.
- Amino acid action with benzaldehyde produces “Schiff’s base”.
- “Ninhydrin” is a powerful oxidizing agent it causes oxidative decarboxylation.
- The pH at which the AA has a net charges of zero is called “Iso electric point”.
- At this pH the AA has the least water solubility.
- At this pH the AA acquires a special form called “Zwitter ion” (or) “Inner salt form”.
- A molecule than cannot superimposed on its mirror image is called “Chiral molecule”.
- The aromatic amino acids are formed in “Shikimate pathway”.
- The biological activity of protein depend on the maintenance of “folded structure”.
- Secondary structure of proteins in the form of α - Helix and β - pleated.

- Contractile protein – Myosin, Transport protein – Haemoglobin.  
Structural protein – Collagens, Hormones – Insulin.  
Toxin – Ricin, Protective proteins – Antibodies.  
Enzyme – Hexokinase.
- Solubility of proteins is increased by addition of salts like NaCl is salting in.
- There is tendency of denatured proteins to come together and form a large precipitation, which comes out of the solution and this is called “Coagulation”.  
Eg: blood clotting.

### **Lipids:**

- Lipids are stored in animals in ‘adipose tissues’.
- Complex lipids contain fatty acids; simple lipids do not contain fatty acids.
- Fatty acids are the fundamental building blocks of stored fats. Many structural units are straight chain “aliphatic monocarboxylic acid”.
- In plants triacyl glycerols are stored in the oil bodies as “Spherosomes” of seeds. In animals fats are stored in the “Adipose tissue”.
- Deficiency of essential fatty acids cause disease called “phrynoderma”.
- All double bonds are “Cis type”.
- The alcohol of acyl lipids is “Sphingosine” (or) its derivatives.
- Cutin and suberin (Waxes) are the polymers of “Hydroxy fatty acids”.
- Major lipids of gram +ve bacteria are phosphatidyl glycerol and ‘Phosphatidyl ethanolamine’.
- Starting material for fatty acid synthesis – Acetyl CoA.
- Fatty acid synthesis is in “Cytosol” in animals and in “Plastids” in plants.
- All the enzymes employed in the synthesis of “triacyl glycerol” are present in E.R.
- “Phosphatidic acid” is the precursor for all acyl glycerol.
- Any phenols are formed from the amino acid “Phenyl alanine”.
- Colourless anthocyanins of fruits – “Flavonoids”.
- Tannins are astringent phenols.
- Toxic substance “Bona” is present in the Lankapappu (or) Kesari pappu.  
Toxic effect of Bona – Lathyrus.
- Catabolic pathways are generally regulated by “Feed back inhibition”.
- In animals  $\beta$  oxidation occurs in Mitochondria and in plants is glyoxysomes.

### **Bits:-**

- The monomer composition of the protein polymer constitutes the primary structure.
- In the  $\beta$  - pleated sheet the H-bonding is perpendicular to the axis of the chain.
- Sickle cell anaemia is due to the substitution of glutamic acid in the  $\beta$ - chain of haemoglobin by – Valine.
- Number of double bonds in steric acid – 0; oleic acid -1; Linoleic -2, Linolenic acid -3.
- The ‘N’ base in Lecithin is – Choline.
- The co enzyme pyridoxal phosphate is involved during catabolism of amino acids and for transamination.

- The source of protein nitrogen in ruminants is urea.
- Type of bond in triacyl glycerol – labile bond.
- The major components of the total energy of system which can do work under isothermal condition is known as “Enthalpy”.
- The major components of cutin and suberin are the products of the omega oxidation.
- The chemical substance involved in the transmission of nerve impulses is “Acetyl choline”.
- The metabolism of foreign compounds – Xenobiotic metabolism.
- In the fatty acid biosynthesis plants add further double bonds between the existing double bond and the methyl end in animals Hydroxyl group.
- Isoprenoids, the polymers of C-5 units are synthesized by Mevalonate pathway.
- Chemical which interfere with chlorophyll formation are used as Laser herbicides.
- AA’s are joined by a peptide bond with the elimination of water molecule.
- The reactions which do not proceed of their own and require an external source of energy are called “Coupled reactions”.
- Non-reducing sugar – Sucrose.
- The double bonds in fatty acids are separated by Methylene group.
- The building block of terpene is IPP.
- A typical example of non-nucleic acid caffeine.
- Tryptophan synthetase – Gibberellin.

## **MICROBIOLOGY**

- Exo microbiology – Exploration of life in outer space.
- Antony – van – Leewan hooke – animal cules (or) little animals.
- Microbes arise from non living material – spontaneous generation (or) abiogenesis.
- “Grancis Appert” developed a technique of preserving food by cooling the tins and boiling. This process is known as “Appertisation”.
- Louis Pasteur – father of microbiology – developed narrow goose necked flasks Fermentation Pasteurization.
- John tyndall – Heat resistant phase and heat labile phase Tyndalization, Dust free chamber.
- The process of discontinuous boiling is called “Tyndalisation”.
- Heating ferment half an hour at 62.8<sup>0</sup>C gives good products. This process is known as “Pasteurisation”.
- Von plenciz: proposed that the germs are responsible for disease (Germ theory of disease).
- “Etiology” is the study dealing with disease.
- O. Brefeld – Isolated a single cell of fungus for pure culture voing a solid medium “Gelatin”.
- Edward Jenner: use cowpox vaccine to immunize people against small pox.
- The culture which is kept long for many days it is said to be attenuated culture. These attenuated cultures as “Vaccines”.
- Alexander fleming – Pencillin (1929).
- Pure culture structure – Culture of a Micro Organism without any contamination.
- DNA can be altered by introducing a piece of new DNA by a process called “Recombination”.
- “E.V. Haeckel” proposed a separate kingdom called “Protista”.
- “Mesosomes” are present in prokaryotes absent in Eukaryotes.
- In prokaryotes cell wall chains Peptidoglycan layer.
  1. Streptococci – Attached in Chains.
  2. Staphylo cocci – Cells divide in any plane and are grouped in bunches.
  3. Sarcinae – Divided in 3 plains and have cuboidal structure.
- Some bacteria contain multinucleate filaments – mycelium.
- Half curved (or) comma shaped – Vibroid.
- Bacteria which have more than one turn – Helical.
- “Flagellum” useful for the movement of bacterium.
- Protein of filament is “flagellin”.
- Bacteria move according to external stimuli are called “Tactic movement”.
- F pilus (Sex pilus) helps in the movement of genetic material from one bacterium to another bacterium.
- More number of cells are embedded in that coat, that coat is called “Slime”.
- Bacteria which require extreme conditions are grouped in “archebacteria”.
- Cell wall of eubacteria is made up of poly saccharides and lipids.
- After staining Gram +Ve appear deep violet; Gram –Ve – red colour.
- Site for synthesis of ATP – “Plasmalemma (or) Cytoplasmic membrane”.

- Cytoplasmic membrane appears to be infolded more than one point these infolding are called “mesosomes” – involve in binary fission.
- The spores are enclosed in Sac called “Sporangiospores”. If they are not enclosed they are called “Conidiospores”.
- “Strain” indicates the group of individuals derived from the initial pure culture.
- Clones: are derived from a single cell.
- Type strain: Is a strain, in which characters are fully studied and becomes a permanent example for that Sps.
- In DNA homology expts: if the “Heteroduplexes” are formed they will be considered that they are similar at the Sps. level. If no heteroduplexes are formed they are not similar at the Sps. Level.
- Sidero capsaceae: Bacteria of this family are generally found in iron containing water.
- Typoid – *Salmonella typhosa / typhi*
- Kingdom of prokaryote.
  1. Gracilicutes – thin cell wall gram –Ve type.
  2. Firmicutes – thick cell wall gram +Ve type.
  3. Tenericutes – that have no cell wall – Mycoplasma.
  4. Mendosicutes – Archeobacteria.
- Constituent of Co-enzyme A – Sulphur.
- If the source of carbon is CO<sub>2</sub> the microbe is called an “autotroph”.
- If the source of carbon is organic compound it is called “heterotroph”.
- If the organism can grow on a single carbon source without the requirement of growth factory additional organic compounds the organism is called “Phototroph”.
- If as organism requires additional organic compounds or growth factors for their growth the growth is called “auxotroph”.
- “Chemoautotrophs” – utilizes CO<sub>2</sub> in the presence of reduced inorganic compounds such as NH<sub>3</sub>, H<sub>2</sub>, H<sub>2</sub>S.
- Chemoheterotrophs – This group of bacteria uses organic compound as carbon and energy sources.
- Optimum pH of bacteria – 6.7 to 7.0.
- Facultative anerobic bacteria – They can grow either in the presence (or) absence of O<sub>2</sub>.
- Micro aerophilic bacteria – They require low levels of O<sub>2</sub> concentration.
- Certain yeasts and moulds require higher concentration of sugars these are called “Osmophiles”.
- Certain bacteria require high concentration of salts for their growth and these are called “Halophites”.
- Most common method of multiplication in bacteria “Transverse binary fission”.
  1. Lag phase – There will not be any cell multiplication.
  2. Log phase – Cell multiply in an exponential manner. Primary metabolites produced.
  3. Stationary phase – Because of limiting nutrient concentration and other factors the cells cannot continuously multiply. Secondary Metabolites
  4. Death phase – During this phase some of the cells will be die and some cells will be active but will not multiply.
- For studying various physiological and metabolic activites, cells present in log phase are to be taken into consideration.

- Maintaining the culture continuously in log phase is known as “Coninurs culture”.
- Maintaining culture so that all the cells will divide at only one time called “Synchronus culture”.
- When all metabolites are synthesized at the relatively equal rates the growth is called “Balanced growth”.
- If a strain is supplied with two organic compounds it will exhibit a growth called “Diauxic growth”. Diauxic growth will have ‘two lag phases’ by J. Monod.
- Microscopic method of counting cells is usually done by using Petroff – Hauser counting chamber.
- Indirect method – Plate count methods.
- The principle in plate count method is that each viable cell will give rise to a single colony.
- Membrane filter counting method: useful in a large volume of water (or) air.
- In turbidometric method the number of cells can be determined using a “Calorimeter”.
- In aerobic organisms  $O_2$  is terminal electron acceptor where as in anaerobic organisms Nitrate, Sulphate (or)  $CO_2$  will be electron acceptor.
- Under anaerobic condition pyruvate reduced to “lactic acid”.
- Pentose phosphate pathway also known as “Shunt glycolysis”.
- In this process only reduced NADP molecules can be produced and there is not production of ATP.
- Entner – Doudoroff (or) off pathway present in both aerobic and anaerobic prokaryotes. This is absent in Eukaryotes.
- Fermentation is anaerobic oxidation of organic compounds by micro organisms. It does not involve  $O_2$  (or) electron transport chain.
- “Glyoxylate pathway” is undertaken by organisms where “acetate” is the major source of the organic carbon (or) where acetyl COA is produced without formation of “pyruvic acid”.
- In this cycle “Isocitrate lyase” and malate synthase” are specific enzymes for this cycle.
- Hill and Bendall proposed “Z-Scheme” in which the components of photosynthetic units are arranged as per the redox potential.
- Viruses cause disease during replication in host cell.
- Viruses multiply inside host cells and released by the process of “lysis” – Lytic phage.
- The fully structurally matured virus capable of infecting the host is called virion.
- Bacteriophages become the tool for the viral and genetic research.
  1. Lytic phase: When lytic phase infect, bacteria will immediately respond.
  2. Temperate phase: Bacteria response is not immediately shown.
- The Nucleic acid of the bacteriophage is covered with a protein coat called “Capsid”.
- Capsid is made up of number of sub units called “Capsomeres”.
- Types of Bacteriophages:
  - A – type – Hexagonal head, rigid tail with tail fibres.
  - B – type – Hexagonal head and a flexible tail.
  - C – type – Hexagonal head and a short tail.
  - D – type – Hexagonal head without tail. The capsomeres are large in size.
  - E – type – Hexagonal head without tail. The capsomeres are small in size.
  - F – type – They are filamentous (rod shaped).

- The phages A, B and C are unique to bacteriophages.  
D, E – are unique for animals and few plants.  
F – is mostly present in plants.  
A,B, C – contain double stranded DNA.  
D,F – Contain single stranded DNA.  
E – Contain single stranded RNA.
- Stanley – crystallized virus particles.
- Iwanowski – virus as filterable agent.
- Beijerinck – named virus as TMV.
- Virioids – They are smallest and infectious agents of plants and cause number of diseases to plants.
- Adaptation: The phenotypic changes that result due to variation in environment condition is called “adaptation”.
- Type of mutations:
  1. Point mutation
  2. Frame shift mutation
- Point mutation : This mutation results due to substitution of one nucleotide for another if the purine is substituted for another purine (or) called “Transition type of mutation”.
- If purine is substituted by pyrimidine (or) vice versa it is called “Transversion” pyrimidine for pyrimidine it is type of mutation.
- Frame shift mutation – The change in the sequence of nucleotides may result in the production of mRNA which results in the synthesis of non-functional protein.
- The addition (or) deletion of nucleotide sequence is called Insertion (or) deletion mutations.
- **Types of chemical mutagens:**
  1. Which react with DNA – Eg: Nitrous acid
  2. Base analogs – 2 – amino purine.
  3. Intercalating agents – Nitrogen mustard, Bromouracil, Acridine orange.
- Three types of gene transfer.
  1. Conjugation – Transfer of genes between the cells when they are in physical contact with each other.
  2. Transduction – Transfer of genes between the cells due to bacteriophages.
  3. Transformation – Transfer of naked DNA to the receptor cell.
- Plasmid is circular and gets integrated with bacterial chromosome and it is known as “Episome”.
- Prophage: The bacteriophage which is capable of integrating with the bacterial chromosome.
- Lysogenic bacteria: The bacteria carrying the prophage.
- “Induction” is a process where the substrate is required for the synthesis of enzymes.
- Structural genes are responsible for the determination of amino acid sequence of the enzymes.
- The regulatory genes control the rate of synthesis of enzymes.
- “Operon” consists of both the structural genes and the regulatory genes.

## PLANT PHYSIOLOGY

- Two regions of the spectrum is effective photocybernetically blue to U.V. and red to near infrared.
- Phytochrome is photoconvertible that is it occurs in two forms i.e. P-660 and P-730.

<b>Heliophytes</b>	<b>Sciophytes</b>
Grow best in full sunlight.	At lower sunlight.
Leaves vertical	Horizontal
Leaves are good reflectors of light transmit only 15% of light.	Leaves are good absorbers of light transmit about 98% of incident light.
Stomata smaller and closer usually on the lower surfaces.	Stomata larger and present on both the surfaces.
Palisade tissue well developed	Poorly developed
Spongy tissue weakly developed	Well developed
Chloroplast few and smaller	Numerous and larger
Photosynthetic rate low	High
Respiration rate high	Low
Transpiration rate high	Lower
Early flowering	Delayed
Osmotic pressure high	Lower
Light compensation point 4200 lux.	27 lux.

- Based on the photoperiodic responses Garner and Allard have classified the plants into 3 categories.
  1. Short day
  2. Long day
  3. Day Neutral.
- Long day plants form only a compact rosette of leaves when grown on short days.
- Garner and Allard found that the amount of Vegetative growth is proportional to the duration of day light.
- Day light at the equator – 12 hrs.

### Temperature:-

- The tendency of substance to give up heat is called “Temperature”.
- Temperature is a qualitative term while heat is a quantitative term of radiant energy.
- The hottest spots on earth inhabited by living organisms are called “Geysers”.
- Heat exchange between the plant and environment takes place in three ways.
  1. Conduction and Convection (Sensible heat exchange).
  2. Evaporation and condensation of water (Latent heat exchange).
  3. Direct radiation.
- The difference between solar (incoming) radiation and terrestrial (outgoing) radiation is called “Net radiation”.
- The process influenced most strongly by temperature include

- i. Chemical reactions.
- ii. Gas solubility.
- iii. Mineral absorption.
- iv. water uptake.
- The Viscosity of water doubles as temperature drops from 25<sup>0</sup>C to 0<sup>0</sup>C.
- Optimum absorption of water takes places above 30<sup>0</sup>C.
- Each crop plant requires a certain number of effective heat units before it can mature called as “Thermal constant”.
- Thermal constant for Maize – 1600 – 1800 units.  
Cotton – 1900 units.
- Plant zero for spring Wheat 2.80C.  
Corn 12.8<sup>0</sup>C.  
Cotton 16.8<sup>0</sup>C
- When temperature rise above the maximum for growth a plant enters a “Quiscent State”.  
When plant drop below the minimum for growth a plant enters “Dormant”.
- Classification based on heat resistant :
  1. Heat sensitive – Tomato wilt virus (TWV).
  2. Heat tolerant eukaryotes – Plants of sunny and dry habitats.
  3. Heat tolerant prokaryotes – Bacteria, B.G.A.
- Classification based on cold – resistant.
  1. Chilling sensitive – Rice, Cotton, Cowpea.
  2. Freezing sensitive – Valancia, Peanuts.
  3. Freezing tolerant – Certain fresh water algae.
- 73% of earth’s surface is covered with water.
- According to Hutchinson world precipitation amounts to about 4.46 X 10<sup>20</sup> ga. Falls on land, 3.47 X 10<sup>20</sup> ga falls on ocean.
- White crystals of frozen water – snow.
- A special type of precipitation during the summer season in the from of small ice pieces Hail.
- Frozen (or) partly frozen rain is called “Sleet”.
- Visibles vapor content of the atmosphere – Fog & Mist.
- The moisture condensed upon the surfaces of cool bodies like grasses, usually at night is called “Dew”. It is the main source of “Ephemeral plants”.
- Based on the rainfall India is divided into 4 climatic regions.
  1. Wet zone – rainfall exceeding 200 cm.  
Natural vegetation – Evergreen and Semi evergreen forests.
  2. Intermediate zone – 100 – 200 cm NV – Deciduous forests
  3. Dry zone – 50 -100 cm NV - Thorny dry deciders and Semi desert.
  4. Arid zone - < 50 cm N.V. – Thorny forests with large areas of desert and semi desert.
- Based on the adaptation of plants to water factor warming.
- Proposed 3 ecological groups viz., Hydrophytes, Mesophyte, Xerophytes.
- In hydrophytes extensive development of “aeren chyma”.
- Mesophytes Exhibit temporary willing at noon time.
- Homihydric plants : Large central vacuole. Eg: Most of Angiospern.
- Water balance – water absorption – Transpiration.

- Classification of plants based on water balance.
  1. Hydrostable – Water balance remaining near zero.  
Eg: Trees, some grasses.
  2. Hydrolabile – Larger losses of water and greater increases in cell sap concentration.  
Eg: Many herbs of sunny habitats.
- In the terminology of Levitt.  
Drought resistance = Drought avoidance + Drought tolerance.
- All flowering plants can withstand severe deficits in the “dormant seed stage”.
- Water use efficiency (WUE) = Dry matter produced (DM) / Evapotranspiration (ET).
- Units of WUE gm/kg.
- WUE of C<sub>4</sub> species is twice that of C<sub>3</sub> species.
- Blossom – end rot of tomato fruits is the classic example of a drought related fruit disorder (due to ‘Ca’ deficiency).

### Wind:

- Air in motion is called “Wind”.
- Wind speed is measured by an “anemometer”.
- The term “leeward” refers to the direction toward which the wind blows.
- Composition of atmospheric air (% by volume).  
N<sub>2</sub> – 78.09; O<sub>2</sub> – 20.93, Argon – 0.93, CO<sub>2</sub> – 0.03, Misc – 0.02%
- For every gram of glucose formed 1.47 g of CO<sub>2</sub> are required and the volume of air from which this amount can be withdrawn amounts is about 2500 litres.
- When CO<sub>2</sub> content of the air is artificially raised to 0.1 and 0.3% by volume, C<sub>3</sub> plants are able to bind 2-3 times and C<sub>4</sub> plants 1-5 times.
- O<sub>2</sub> concentration in the soil is lower than in the open air.
- BGA in rice fields produces 50 – 70 kg N ha<sup>-1</sup> yr<sup>-1</sup>.
- The most important symbiotic N – fixation organisms are of the genus Rhizobium.
- Rhizobium fix 200 kg N per ha. per season.
- Actinomyces form root nodules in Casuarina.
- Study of soil formation, composition and classification of soil known as Pedology.
  1. Oxylophytes – plants growing on acid soil. Eg: Pinaceae.
  2. Halophytes – on Saline soils.
  3. Psammophytes – on sandy soils.
  4. Lithophytes – on rocks. Eg. Lichens, Selaginella.
  5. Chasmophytes – On rock crevices. Eg: Equisetum.
- Mangrove plants exhibit vivipary, vast net work of roots, negatively geotropic Pneumatophores a specialized organs for respiration.
- Altitude refers to the position of the land surface to the mean sea level (MSL).
- “Epiphytes” are small herbaceous plants that grow on higher plant. In Epiphytes aerial roots are covered with greenish white tissue called “Velamen”.
- Total parasite “Orbanche cernua – on the roots of brinjal and Tobacco.  
Striga asiatica – on roots of Sorghum and Sugarcane.  
Cuscuta reflexa – On the stem of many herbs.



- The values of dry matter have been calculated per different latitudes of the globe by “Devent”.
- Production potential by Sinha and Swaminathan  $P_n = R \times DI \times 0.32 \text{ gm}^{-2}$ . Dry matter =  $0.65 \times P_n$ .
- Hydrology and physiography are most fundamental constraints of agriculture use of low lands.
  1. Crop water use efficiency (or) consumptive use efficiency.  
 $= Y/G + T + E_s$   
Y = Yield  
G = Amount of water required for growth.  
T = Transpired through foliage.  
 $E_s$  = Evaporated from the soil surface
  2. Field water use efficiency =  $Q/G + T + E_s + D$ .  
D = Deep percolation
- WUE inverse relationship with R.H.
- WUE of  $C_4$  species is twice that of  $C_3$  species.
- The crop if it is having an LAI of 4-6 the light interception in the crop canopy will be good.
- Mulches economizing water use by the plant to the extension of 10-15%.
- Black mulches increase the temperature by  $5-8^{\circ}\text{C}$ .
- Marimar classified the xerophytic plants into two distinct groups of drought avoiders.
  1. Water Savers.
  2. Water spenders.
- Water savers lose as little as 1/4300 of their dry weight per hour. Thus water spenders may be water as much as 5 lakhs times rapidly as water savers.
- Stomata can act as humidity sensors.
- Cuticular to stomatal ratio for mesophytes higher (1/2 to 1/5).
- While lesser in xerophytes (1/5 to 1/80).
- At the time of rains special type of roots develop in peripheral region called as “Rain roots”.
- Metabolic water Eg: Cactus.
- Non succulent plants that follow CAM mechanism.  
Eg: Prosopis juliflora
- Succulent type – Pine apple
- Plants capable of reaching water table are called “Phractophytes”.
- Deep absorption members of the family Chinopodiacea.
- The high rate of transpiration of xeromorphic leaves caused by larger amounts of palisade tissue.
- Chlorenchia is of mainly two types.
  1. It may be deficit (or) water
  2. Excess water.

- Same seeds avoid the effect of water stress by secretion of mucilage which effectively increase their contact with the soil.  
Eg: Mustard
- ABA increases under water deficit.

Growth Analysis:

- Growth analysis first studied by “Blackmann”.

$$\text{CGR} = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{1}{P} \text{ g m}^{-2} \text{ wk}^{-1}$$

$$\text{Relative growth rate (RGR)} = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1} \text{ g. g}^{-1} \text{ wk}^{-1}$$

It is also called as “efficiency index”.

$$\text{Net assimilation rate (NAR)} = \frac{W_2 - W_1}{t_2 - t_1} \times \frac{\log_e A_2 - \log_e A_1}{A_2 - A_1} \text{ g. m}^{-2} \text{ wk}^{-1}$$

This is also called as “unit leaf rate”.

- Leaf area ratio (LAR) = RGR / NAR.

Growth parameters	Symbol
1. CGR	C
2. RGR	R
3. NAR	E
4. LAR	F
5. LAI	L
6. LAD (leaf area duration)	D

1. CGR = NAR X LAI.
2. RGR = NAR X LAR
3. LAR = LWR X SLA  
LWR = leaf weight ratio  
SLA = Specific leaf area.

- Generally light has a positive effect on NAR and negative effect on LAR (-ve).
- “Hydroponics” is the method of growing plants in nutrient solution.
- Term Allelopathy was coined by “Mulish”.
- Parthenium hysterophorus was controlled successfully by introducing Casia Uniflora.

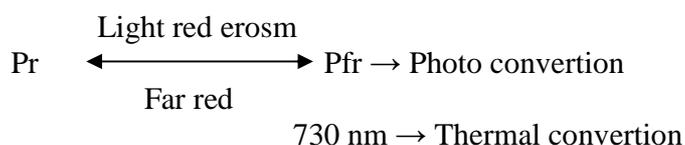
- Biogeography is the study of present and past geographical distribution of organisms on the earth.
- Energy transformation are one way.
- The movement of chemical elements in the ecosystem between the organisms and environment are known as “Biogeochemical cycles”.
- Cellular endosperm – Each nuclear division is accompanied by cell wall formation.
- Helobial endosperm – between nuclear and cellular.
- In coffee and pig weed endosperm is absent; perisperm (2n) act a storage structure.  
Endospermic seeds – legume – Fenugreek; dicots – castor.  
Non endospermic monocots – Orchids.  
Dicots – Peas, beans, grams.
- Living cells of outer most layer of endosperm – Aleuron layers.
- In a ditoped seed the surface of the coat shows a scar like structure at the place of it detachment from funicular and the structure is called – “Hilum”.
- The state at which seed reaches its maximum dry weight viability is, “Physiological maturity”.
- Physiological maturity 30-40 DA anthesis in Sorghum.
- Viability means the capacity of a seed to germinate and produce a natural seedling.
- The potential with which the seeds produce healthy seedling – Vigour.
- Tetrazolium test (for Viability) is usually based on measuring the activity of “denitrogenase enzyme”, 2, 3, 5 triphenyl tetrazolium chloride red colour strain based on relative rates of respiration. It is also called “Quick test”.
- Mathematically speed of germination is expressed as “Coefficient of germination” (Vigour).
- “Exhaustive test” is used in cereals (Vigour test).
- “Lupin” seeds have largest period of viability – 10,000 yr.
- Haserington rules for storage: 1% moisture ↓ double life ↑

5 – 6<sup>0</sup>C ↓ Double life ↑

- The arithmetic sum of the storage temperature in degrees and percent relative humidity should not exceed 100.
- 8 – 10% moisture is favourable for better storage.
- Thohar CO<sub>2</sub> can nitrogen gas increase the longevity of seed to onion and Wheat.
- Dimeasery in Epnul – Errbryes, Sunflower – seed coat.
- Failure of seeds to germinate for want of a particular environment factor is called “Quiscence”.
- Monoculture – Continous cropping of same crop species in the same piece of land.
- Poly culture – cultivation of different species.
- Individuals of Sps in which invitro – specific competition is dominant may show better growth in poly culture where as species more sensitive to inter – specific competition will show their best growth in monoculture.
- Physical (or) Chemical change produced by stress is called strain.
- Cobalt is used for drought hardening in sunflower crop 1% CaCl<sub>2</sub> – Groundnut.
- Accumulation of pesticide in an organism – Bioconcentration.

- A resource out of place – “Pollutant”.
- Allelopathic agent identified in Sorghum – Chlorogenic acid.
- Methane gas is mainly released from – Rice fields.
- World’s largest carbonate deposit were discovered at “Mississippi”.
- Artificial rainfall – AgI.
- The transpiration/assimilation ratio is higher in C<sub>3</sub> plants.
- Amino acid increases under water deficit – Proline.
- In case of grasses and fodder LAI – 6 – 11.
- Succinic acid for drought hardening in tomato.
- Plant that absorb dew very efficiently – Horse gram.
- Kaolinite – Reflective type of antitranspirant.
- Controlled burning to burn humus in acid soils.
- Allelochemical “Parthenin” present in leaves of parthinum Sps.
- Example of plant that converts from C<sub>3</sub> to C<sub>4</sub> photosynthesis is Rice.
- In monocotyledon is referred as “Scutellum”.
- Embryo and embryonic axis are the life of a new plant.
- Shoot of the cotyledon – Coleoptile.
- Base of the hypocotyls – Coleothiza.
- Nuclear endosperm – free nuclei – Eg: Wheat.
- Primary dormancy – Innate dormancy.
- Secondary dormancy – Induced dormancy.
- Failure of germination of mustard seed exposed to high concentration of CO<sub>2</sub>.
- Immature embryo – Physiological dormancy. Eg: Apple, Pear.
- Breaking of dormancy with H<sub>2</sub>SO<sub>4</sub> – Cotton.
- Senescence is ageing process.
- Heat stress – senescence interfere with Ca translocation.
- Antisenescence hormone – Cytokinins.
- Panicle senescence can be retarded by maintaining “Succinic dehydrogenase (SDH), ‘N’ application at booting stage.
- During senescence increase in activity of hydrolyzing enzymes.
- Downward movements takesplace in the sieve elements of phloem (Sugar).
- The process of sugar movement in the sieve tube – Translocation water and minerals – Xylem cells.
- The quantity of sugar translocated per unit cross sectional per unit time is called “Specific mass transfer”.
- Before reaching the sieve elements the sugars produced in green cells through layers of parenchyma cells. This process is called “phloem loading” or Vein loading. The translocated sugars leaving the elements is known as “phloem unloading”. Both loading and unloading takes place in “Parechyma cells”.
- Source – Sink (Sugar).
- Auxins cause apical dominance – cell elongation.  
Initial flowering in long day plants – GA.
- Bolting (Production of floral axis) – GA promote bolting – stem elongation GA shows inhibitory effect on germination of rice seeds,

- Cell division – cytokinins.
- Richmand long effect – Cytokinins delay the senescence.
- When ethylene is applied on upper part of petiole it shows swelling and dropping of leaving.
- Application of ABA initiates flowering in short day plants. Inhibits in long day plants.
- Critical day length (photoperid require to induce flowers).
- Flowering induced chemicals – Florigen.
- Cytokinins are deviation of adenine molecule.
- Phytochrome is a blue proteinaceous pigment compased of “protein” and chromophore”.



- Biological active form of phytochrome – Pfr.
- In shortday plants if Pfr/Pr ratio is high flowering inhibited, if ratio is low induced.
- In long day plants if PFr/Pr ratio is high flowering induced.
- Minimum vegetative growth (or) minimum number of leaves required for flowering is called “ripe – to – flower”.
- “Vernalisation” is defined as the method of inducing early flowering in plants by pre-treatment at their seeds at very low temperature  
Eg: Winter wheat.
- Sugar accumulated in tomato stems during a low night temperature.
- The sleeping movement of leaves and flower – “Nyctinastic” due to absence of light (photonastic) – Endogenous rythoms.
- Plants grown in darkness are called as “Etiolated plants”.
- Response of plant organs to light stimulus – Pholotropism.  
Red light has less effect and blue light has more effect as phototropism.
- Photomorphogenesis control alter growth, development and differentiatine.
- Mobility of chloroplarle along with the plane of light polarization is phototaxy.
- Chlorophyll has “Cyclic tetrapyrolic ring structure”.
- 2 ATP are synthesized during cyclic photophosphorylation (PSI).
- In Non-cyclie photophosphorylation water is electron donar and NADPT is the electron acceptor. In non-cyclic photophospharylation one ATP one. NADPH + H<sup>+</sup> are liberated.
- Photolysis of water takes place in (PSI & PSI) (700,680nm).

### Caluin cycle: C<sub>3</sub> plants

1. Carboxylation phase: first table some product in C<sub>3</sub> plants. PGA.  
During dark phase CO<sub>2</sub> is accepted by ROBP. ROBP → PGA.
2. Reduction: PGA → DPGA.
3. Regeneration phase: PGGK + DHAP  $\xrightarrow{\text{Aldalose}}$  Fructose 1, 0 diphosphate.

- One molecule of glucose is formed from  $6\text{CO}_2$  by utilizing 18 ATP;  $12 \text{NADPH} + \text{H}^+$ .
- 4 pathway (or)  $\beta$  carboxylation pathway. Eg: Maize, Sorghum.
- $\text{CO}_2$  acceptor is pep – Phosphoenol pyruvate – in mesophyll cell.
- $\text{C}_4$  plants show kranz anatomy – calvin cycle in “Bundle sheat cells”

$\text{CO}_2$

Pep  $\longrightarrow$  Oxalo acetic acid. This is stable product in  $\text{C}_4$  plants.

- $\text{C}_4$  plants are more efficient carbon fixation than  $\text{C}_3$  plants.
- CAM – Pine apple,  $\text{CO}_3$  –by PEP using night and Calvin cycle using day.
- Inhabitory effect of  $\text{O}_2$  on an photosynthesis is called “War burg effect”.
- Photosynthesis is measured by IRGA (Infra-red gas analysis).
- Glycolysis – Cytoplasm.
- At the end of glycolysis two molecules of pyruvic acid two molecules of NADAP, 2 molecules of ATP are formed (Net).

Enoalose

$2 \text{PGA} \longrightarrow 2 \text{PEP}$ .

- Kreb’s cycle @ Citric acid cycle, Tri carboxylic acid.
- Connecting link between glycolysis and Kreb’s cycle – Acetyl co-A.

Succinic acid  $\xrightarrow{\hspace{2cm}}$  Fumaric acid.



FAD	$\longrightarrow$	FADH <sub>2</sub>	
4NADH <sub>2</sub>	$\longrightarrow$	3 X 4	12 ATP
1 FADH <sub>2</sub>	$\longrightarrow$		2 ATP
1 GTP	$\longrightarrow$		1 ATP
			15 ATP

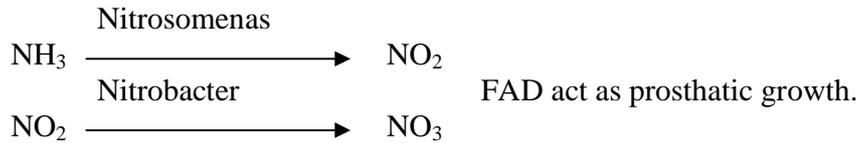
8 ATP in glycolysis %  
30 ATP in Kreb’s cycle.  
38 ATP in respiration from 1 glucose.

- Electron transport – oxidative photophosphorylation – Cristae.
- In oxidative pentose phosphate pathway (OPP) Net ATP molecule – 35 ATP.  
(or) Hexois mano phosphate pathway.

$$\text{Respiration quotient (R.Q)} = \frac{\text{Volume of CO}_2 \text{ released}}{\text{Amount of O}_2 \text{ achorbed}}$$

- R.Q. for CHO’s = 1, Fats = 0.7, Proteins = <1, Malic acid = 1.33, Araerobic respiration - /0 =  $2\alpha$ , CAM – ‘0’ in succulents.
- During the formation of root nodules curling of root hairs are caused by ‘IAA’.
- Pink pigment – leg hemoglobin.
- Bacterial dividing increases in size ant shape are termed as “Bacteids”.
- Leg haemoglobin protects “Nitrogenas enzyme”.
- Protein present in hoyumineur plant routs – “Lectins.
- Heterocysts cells are responsitile for  $\text{N}_2$  fixation in BGA.

- Fe – Synthesis of leghaemoglobin; CO – essential for legumes to fix molecular nitrogen directly.
- MO – Alternate donor and acceptor of electron in N<sub>2</sub> fixation.
- C – Electrons and 15 ATP are required for the production of two molecules of NH<sub>3</sub>.
- Reducing power for BGA – Water; for Sulphur bacteria – H<sub>2</sub>S.



- Conversion of NO<sub>3</sub> into NH<sub>3</sub> – Nitrate reduction.
- 8 e<sup>-</sup> are required for nitrate reduction.
- Nitrate reductase (MO) is called as “Inducible enzyme”.
- In Nitrate reductase – Fe/C<sub>4</sub> are electron carriers.
- NH<sub>3</sub> + 2KGA → Glutamic acid; OAB → Aspartic acid.
- N<sub>2</sub> fixation is measured by “Acetylene reduction method”.
- Mass of undifferentiated cells – Callus.
- “Umbelliferae” family has high totipotency.
- Cells have vacuole. Vacuoles retain H<sub>2</sub>O due to “Osmosis”.
- H<sub>2</sub>O is a major constituent of Protoplasm.
- Water potential is measured in “Megapascal”.
- Liquid H<sub>2</sub>O potential is “Zero”; - 1.5Mpa → growth stop; - 3Mpa → Wilting.
- Ψ<sub>w</sub> = Ψ<sub>m</sub> + Ψ<sub>s</sub> + Ψ<sub>p</sub>; Ψ<sub>w</sub> = water potential, Ψ<sub>m</sub> = matric potential, Ψ<sub>s</sub> = Solute potential, Ψ<sub>p</sub> = pressure potential.
- Matric potential is high in unvacuolated cells (or) in old cells.
- Hydrostatic pressure, damaged in vacuole the inwardly directed wall pressure – “Turgor pressure”.
- The quality and appearance of vegetables is mainly due to “turgor pressure”.
- Moist abundant Xanthophyll – 1.4 lin.
- “Beer & Lambert’s Law” – Spectrophotometer principle.
- In a ray of monochromatic light passes through absorbing medium its intensity decreases with increasing the length of the medium and concentration (Beer’s).
- Chlorophyll dissolves in “Acetone”.
- Calvin cycle “Thermosensitive”.
- Cluster grown of concentration O<sub>2</sub> acid → Casuncle.



### Practice Papers (Agronomy)

1. A soil with a pH value less than 7.0. hence having more hydrogen (H<sup>+</sup>) ions than hydroxyl (OH<sup>-</sup>) ions in the soil solution is called as  
a. Alkali soil                      b. Sodic soil                      c. Acid soil                      d. Neutral soil
2. The movement of ions and water into the plant root because of metabolic processes by the root, frequently against an electrochemical potential gradient is referred to as  
a. Acidity potential              b. Advection                      c. Active absorption              d. Active ingredient
3. An alternative renewable fuel, produced from vegetable oils or animal fats through a refinery process called trans-esterification is called as  
a. Bio-diesel                      b. Chemi-diesel                      c. Agro-diessel                      d. Ameliorant
4. In India, National Biodiversity Board is located at  
a. New Delhi                      b. Mumbai                      c. Benguluru                      d. Chennai
5. The ratio of total cropped area in different seasons to the total land area is known as  
a. Cropping intensity              b. Aridity index                      c. Competition index              d. Cropping intensity index
6. Cultivation of crops in areas where rainfall is less than 750mm per annum is known as  
a. Dry farming                      b. Rainfed farming                      c. Dryland farming                      d. Mixed farming
7. An organism that derives its energy from various chemicals and its carbon from organic molecules other than CO<sub>2</sub> i.e., glucose is called as  
a. Aeroheterotroph                      b. Chemoheterotroph                      c. Aeroautotroph                      d. Chemoautotroph
8. The chemical substance released by one species may inhibit species of plants other than one releasing it is termed as  
a. Annidation                      b. Allo-inhibition                      c. Darcy's law                      d. Auto – inhibition
9. A substance added to a soil for the improvement of its physical and chemical properties is called as  
a. Aridity index                      b. Ameliorant                      c. Active absorption                      d. Active ingredient
10. The inflorescence of sugarcane is known as  
a. Silk                      b. Tassel                      c. Arrow                      d. Spike
11. A biological model which is expected to perform or behave in a predictable manner within a defined environment is known as  
a. Pureline                      b. Prototype                      c. Ideotype                      d. Inbred
12. Gene responsible for dwarfing characters in rice is  
a. Norin 10                      b. Tift 23A                      c. Dee-Geo-Woo-Gen                      d. None
13. 'Sunflower' act as an indicator plant to diagnose the deficiency of  
a. Cadmium                      b. Nitrogen                      c. Manganese                      d. Boron
14. The scientist, who had been called as 'Father of field plot technique' is  
a. Galton                      b. Boussingault, J.B.                      c. Arnon                      d. Arnold
15. The most important potential contaminant of food produced on sewage sludge amended soils is  
a. Cadmium                      b. Nitrogen                      c. Manganese                      d. Boron
16. *Grassy stunt virus disease of rice is transmitted by*  
a. Leaf miner                      b. Gall Midge                      c. Stem Borer                      d. Brown plant hopper
17. The relationship of a crop or crop communities with its surroundings say environment is called as  
a. Farming ecology                      b. Aerable ecology                      c. Crop ecology                      d. Community ecology
18. The statistical test used to determine the goodness of fit is  
a. t test                      b. Chi-square test                      c. Z test                      d. F test



38. The Central Agricultural University is located at  
 a. Almora                      b. Sikkim                      c. Hyderabad                      d. Manipur
39. The scientist, who has been called as the Father of Natural farming' is  
 a. Ishiwata                      b. Masanobu                      c. Jetro Tull                      d. Arnold  
     Fukuoka
40. Weight of one cotton bale is equal to  
 a. 160 kg                      b. 180 kg                      c. 170 kg                      d. 178 kg
41. The Wheat and Maize Improvement Centre (CIMMYT) is located at  
 a. El Batan, Mexico                      b. Lima                      c. Manila, Philippines                      d. Rome
42. Varalaxmi is an interspecific variety of cotton evolved at  
 a. Udaipur                      b. Nagpur                      c. Dharwad                      d. Anand
43. The instrument used to measure the fineness of the fibre quality in cotton is called  
 a. Micronaire                      b. Lysimeter                      c. Macronaire                      d. Infiltrrometer
44. The System of farming on a particular farm which includes crop production, raising livestock, poultry, fisheries, bee keeping etc., to sustain and satisfy as may needs of the farmer as possible is called  
 a. Intercropping                      b. Mixed cropping                      c. Intensive cropping                      d. Mixed farming
45. The element that is very essential in the process of nitrogen fixation is  
 a. Manganese                      b. Molybdenum                      c. Sodium                      d. Zinc
46. In 1987, the first Indian, who had got the 'World food Prize' is  
 a. Dr. M.V. Rao                      b. Dr. Subramanyam                      c. Dr. M.S. Swaminathan                      d. Dr. R.S. Paroda
47. The material, which is applied on the soil surface to check evaporation and improve the soil water status is called as  
 a. Retting                      b. Spray                      c. Buffer                      d. Mulch
48. The oil content in the cotton seed ranges from  
 a. 10-15%                      b. 25-35%                      c. 15-25%                      d. 40-42%
49. The optimum seed rate for sunflower is (kg/ha.)  
 a. 8-10                      b. 18-20                      c. 10-15                      d. 30-35
50. In India, Protection of Plant Varieties and Farmers Right Authority (PPV & FRA) is located at  
 a. Chennai                      b. New Delhi                      c. Chandigarh                      d. Lucknow
51. The first wheat variety having short plant height, lodging resistance and higher grain yield is  
 a. Lok -1                      b. PBW 343                      c. Norin 10                      d. DBW 17
52. The crops that help in the nourishment of other crops by providing shade and acting as climbing sticks are called  
 a. Catch crops                      b. Mixed crops                      c. Nurse crops                      d. Cover crops
53. The condition arising due to exchange of heat between a growing crop and hot air whereby air over the crop is cooled is called as  
 a. Ecology                      b. Oasis effect                      c. Edaphology                      d. Nutrient indexing
54. Holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity is called as  
 a. Intensive agriculture                      b. Organic farming                      c. Subsistence agriculture                      d. Organic agriculture
55. Rancidity in Sunflower oil is caused by  
 a. Reduction                      b. Scarification                      c. Acidification                      d. Oxidation
56. An agricultural production system that is completely or mostly excludes the use of synthetically

- compounded fertilizers, pesticides or growth regulations is referred to as
- a. nutrient antagonism      b. Nutrient indexing      c. Organic agriculture      d. Organic farming
57. Linseed belongs to family  
a. Liliaceae      b. Tiliaceae      c. Linaceae      d. Pedaliaceae
58. The rice inflorescence is known as  
a. panicle      b. Ear      c. Spikelets      d. Siliqua
59. In 1960, soybean crop was introduced in India from  
a. USA      b. Japan      c. China      d. Indonesia
60. Name a crop that caused maximum reduction in soil alkalinity  
a. Sunflower      b. Soybean      c. Pea      d. Rice
61. The mass of the dry soil in a particular volume of the soil when all of the air spaces have been removed is termed as its  
a. Particle density      b. Soil density      c. Bulk density      d. Poro density
62. The vitamin synthesized during the sprouting process in mungbean is  
a. Vit. A      b. Vit. C      c. Vit. B      d. Vit. D
63. Arkel, Bonneville and Early December are the improved varieties of  
a. Gram      b. Lentil      c. Pea      d. Sunflower
64. IR-8 variety of rice is introduced in India from  
a. Philippines      b. Rome      c. Mexico      d. peru
65. The nutrient to be applied to increase the nitrogen fixation in soil by Rhizobium is  
a. Sodium      b. Cadmium      c. Phosphorus      d. Zinc
66. Decomposition or detoxification of herbicides by exposure to life in the soil is called as  
a. Photodecomposition      b. Photorespiration      c. Thermodecomposition      d. None of these
67. The instrument used for measuring depth of water table is known as  
a. Lysimeter      b. Parshall flume      c. Anemometer      d. Piezometer
68. The major organic cementing agent in soil aggregate formation is  
a. Vitamins      b. Minerals      c. Polysaccharides      d. Enzymes
69. Flint corn is commonly grown in India is also known as  
a. Zea mays indentata      b. Zea mays indurata      c. Zea mays everta      d. Zea mays saccharata
70. In India, the productivity of rice is highest in the state called  
a. Madhya Pradesh      b. Gujarat      c. Punjab      d. Maharashtra
71. Cultivation of crops in region where annual rainfall is more than 1150mm and having less chances of crop failure due to dry spells is called as  
a. Thinning      b. Catch cropping      c. Ratooning      d. Suckering
72. Test weight of sorghum is  
a. 70-75 grams      b. 45-50 grams      c. 55-60 grams      d. 25-30 grams
73. Echinochloa crusgalli and Ischaemum rugosum are the major weeds of which crop  
a. Rice      b. Red Gram      c. Soybean      d. Wheat
74. Important cropping system of Indo-gangetic plains is  
a. Rice – Wheat      b. Red Gram – Wheat      c. Soybean – Wheat      d. Wheat – Gram
75. Who introduced the technique of production of double cross hybrid maize  
a. East      b. Shull      c. Jones      d. Mendel
76. First hybrid maize Ganga – 1 was developed in India in  
a. 1957      b. 1967      c. 1966      d. 1961

77. The most suitable temperature for Maize growth is  
 a. 20<sup>0</sup>C                      b. 28<sup>0</sup>C                      c. 25<sup>0</sup>C                      d. 32<sup>0</sup>C
78. CO<sub>2</sub> content in soil air is  
 a. 0.03%                      b. 0.25%                      c. 0.003%                      d. 0.50%
79. The amino acid, that is richer in Opaque-2 Maize composites as compared to normal Maize is  
 a. Tryptophan                      b. Tryptophan & Lysine                      c. Lysine                      d. Protein
80. The mean yield for a crop in a region divided by the mean all India yield of the same crop and expressed in percentage is called  
 a. Relative dominance                      b. Relative yield index                      c. Relative crowding coefficient                      d. Relative yield
81. Growing two or more crops simultaneously during the part of the life cycle of each and succeeding crops planted before harvesting the preceding crop is known as  
 a. Intercropping                      b. Strip cropping                      c. Risk Cropping                      d. Relay cropping
82. The ratio of number of crops grown in a field to years of rotation and expressed in percentage is called as  
 a. Rotational intensity                      b. Resource – use indices                      c. Relative crowding coefficient                      d. Relative yield
83. Which one of the following is a non-selective herbicide  
 a. Alachlor                      b. Butachlor                      c. Paraquat                      d. Atrazine
84. The first GM potato developed at CPRI for increasing protein content in tubers consists of genes from  
 a. Chickpea                      b. field pea                      c. Pigeonpea                      d. Grain amaranthus
85. Most dominant enzyme on the earth in terms of quantity is  
 a. Rubisco                      b. Globulin                      c. Gluten                      d. Lysine
86. The percentage of the crop land actually cropped in a year is called  
 a. 'Z' value                      b. R value                      c. S value                      d. L value
87. A measure of the relative tendency of a fertilizer to increase the osmotic pressure of the soil solution as compared to the increase caused by an equal weight of sodium nitrate as a reference material is termed as  
 a. Acid balance                      b. Acid Index                      c. Salt balance                      d. Salt index
88. The ratio of maximum dose of herbicide tolerated by crop to minimum dose of herbicide required for weed control is called as  
 a. Selectivity index                      b. Acid index                      c. Salt balance                      d. Salt index
89. The horizontal flow of water in irrigation channel or canal leading to water loss is called as  
 a. Percolation                      b. Leaching                      c. Seepage                      d. Drainage
90. The herbicide that kills only the target weeds are called as  
 a. Non-selective pesticide                      b. Non-selective herbicide                      c. Selective pesticide                      d. Selective herbicides
91. The fruit of rapeseed and mustard is known as  
 a. Grain                      b. Siliqua                      c. Drupe                      d. Caryopsis
92. The inherent capacity of soil to supply plant nutrients in adequate amount and in suitable proportion is called  
 a. Soil fertility                      b. Soil erosion                      c. Soil conservation                      d. Soil capacity
93. The preservation of soil against deterioration and loss by using it within its capabilities, and applying the conservation practices needed for its protection and improvement is called  
 a. Soil fertility                      b. Soil water potential                      c. Soil conservation                      d. Soil capacity

94. The crops which are grown to harvest when they are still green and fed to livestock in stalls are called  
 a. Soiling crops                      b. Smother crops                      c. Cover crops                      d. Silage crops
95. The transgenic crop, Which has maximum cultivated area in the world is  
 a. Soybean                      b. urd bean                      c. Red gram                      d. Faba Bean
96. Delinting of cotton seed may be done with a chemical called  
 a. NaCl                      b. Hydrochloric acid                      c. Sulphuric acid                      d. Nitric acid
97. Soils of which soil order have no diagnostic horizon  
 a. Mollisols                      b. Andisols                      c. Entisols                      d. Aridisols
98. The slow growing species of legume root nodule bacteria are included in bacterial genus  
 a. Rhizobium                      b. Brady rhizobium                      c. Sino-rhizobium                      d. Azo-rhizobium
99. Substances responsible for bread making quality in Wheat is  
 a. Gluten                      b. Globulin                      c. Glycine                      d. Lysine
100. Which one of the following increases phosphate solubility  
 a. Clostridium                      b. Azatobacter                      c. Pseudomonas                      d. Nitrosomonas
101. Under drought, the sorghum plants synthesize Dhurin in  
 a. Roots                      b. Leaves                      c. Shoots                      d. All the plant parts
102. Pollen viability of wheat is related to supply of  
 a. Zinc                      b. Boron                      c. Molybdenum                      d. Magnesium
103. Khaira disease in rice is caused due to  
 a. Fungal infection                      b. Excessive application of potassium                      c. Bacterial infection                      d. Zinc deficiency
104. Immobilization of sulphur take place when the 'S' content of organic matter is less than  
 a. 0.45%                      b. 0.30%                      c. 0.60%                      d. 0.15%
105. Per cent content of sulphur in single super phosphate  
 a. 8                      b. 16                      c. 12                      d. 20
106. Concentration of which element is highest in soil  
 a. Oxygen                      b. Al                      c. Fe                      d. Si
107. Tilt is related to  
 a. Shape of the soil aggregates                      b. Size distribution of the soil aggregates                      c. Arrangement of the soil aggregates                      d. All of these
108. Soybean seeds contain  
 a. 20% oil and 20% protein                      b. 40% oil and 40% protein                      c. 40% oil and 20% protein                      d. 20% oil and 40% protein
109. The acid equivalent of ASN fertilizer is  
 a. 128                      b. 93                      c. 60                      d. 110
110. Which crop of the following has the double symbiotic relationship with nitrogen fixing bacteria  
 a. Phaseolus vulgaris                      b. Cajanus cajan                      c. Sesbania rostrata                      d. Glycine max
111. Which one of the following crops has the highest consumption of pesticides  
 a. Paddy                      b. Oil seeds                      c. Cotton                      d. Vegetables
112. For calculationg value of P,  $P_2O_5$  is multiplied by  
 a. 3.258                      b. 0.437                      c. 2.12                      d. 2.29
113. The ratio between gross and net cropped area is called as index of  
 a. Cropping intensity                      b. Multiple cropping                      c. High intensity cropping                      d. None of these

114. Black cotton soils are rich in  
 a. Montmorillonite      b. Illite      c. Kaolinite      d. Chlorite
115. Which form of nitrogen is absorbed by paddy under waterlogged conditions  
 a.  $N_2$       b.  $NO_2$  ion      c.  $NH_4$  ion      d. Nitrate ion
116. Which cation has higher aggregation capacity in soil  
 a.  $Al^{3+}$       b.  $Mg^{2+}$       c.  $Ca^{2+}$       d.  $K^+$
117. Which of the following plants does not show photorespiration  
 a. Pea      b. Rice      c. Wheat      d. Maize
118. Antisenescence polyhormone is represented by  
 a. Auxins      b. Gibberellin      c. Cytokinins      d. Ethylene
119. The carbohydrates produced in leaves cannot be trans located to different growing parts of plant in the absence of  
 a. Manganese      b. Zinc      c. Boron      d. Iron
120. The plateau with little growth rate and continuing accumulation of nutrient element in the plants can be defined as  
 a. Sufficiency range      b. Plateau range      c. Dificiency range      d. None of the above
121. 'International Centre for Agricultural Research in Dry Areas' is located in  
 a. Rome      b. Manilla      c. Syria      d. Hyderabad
122. The herbicides that move within the weed either through xylem or phloem and thus effect the whole system like photosynthesis and respirations are called  
 a. Systemic herbicide      b. contact herbicide      c. Selective herbicide      d. None of the above
123. The ploidy level of durum wheat ( $2n=28$ ) is  
 a. Tetraploid      b. Diploid      c. Monoploid      d. Hexaploid
124. **Decomposition of the organic matter in submerged soil is carried out by**  
 a. **Bacteria**      b. **Fungi**      c. **Actinomycetes**      d. **Algae**
125. Which clay mineral is rich in potash  
 a. Montmorillonite      b. illite      c. Kaolinite      d. Chloride
126. An example of companion cropping is  
 a. Sugarcane + Potato      b. Potato + Mustard      c. Potato+Radish      d. Wheat+Mustard
127. The ginning percentage in cotton can be worked out by the formula  
 a. Wt. of lint/wt. of cotton seed X 100  
 b. Wt. of cotton seed / Weight of lint X100  
 c. Wt. of lint / Wt. of seed cotton X 100  
 d. Wt. of seed cotton / weight of lint X 100
128. The optimum plant population per hectare of sorghum is  
 a. 50,000 plants      b. 1,00,000 plants      c. 1,50,000 plants      d. 2,00,000 plants
129. Which vegetable oil is good for heart patients  
 a. Groudnut      b. Soyabean      c. Mustard      d. Sunflower
130. A short duration crop in between two main seasonal crops is termed as  
 a. Cash crop      b. Companion crop      c. Inter crop      d. Catch crop
131. Which form of nitrogen is available in urea  
 a. Ammonical      b. Nitrite      c. Amide      d. Nitrate
132. Salts in the xylem ducts of the root are carried upward with  
 a. Photosynthesis      b. Guttation      c. Respiration      d. Transpiration stream
133. Application of potash in crops increases  
 a. Disease resistance      b. Water logging resistance      c. Frost resistance      d. None of these



153. The type of fertilizers, in which India is fully dependent on imports  
 a. Nitrogen                      b. Potassium                      c. Phosphorus                      d. None of the above
154. An index expressing the reduction in yield due to the presence of weeds in comparison with weed free situation is called as  
 a. Water index                      b. Crop index                      c. Weed index                      d. None of the above
155. By product produced during paneer making is known as  
 a. Mawa                      b. Malt                      c. Bran                      d. Whey
156. The element that is essential for bio-synthesis of tryptophane is  
 a. Calcium                      b. Sodium                      c. Zinc                      d. Nitrogen
157. In 1945, the scientists who had developed the first herbicide 2,4-D in world are  
 a. Watson and Crick                      b. Zimmerman and Hitchcock                      c. Arnold and Arnon                      d. Shull and John
158. First KVK in India established in Pondichery in the year  
 a. 1967                      b. 1974                      c. 1982                      d. 1972
159. Dead heart and white head damage to rice is caused by  
 a. Gall midge                      b. Leaf roller                      c. Army worm                      d. Stem borer
160. Silvery shoot or onion leaf symptom of rice tillers is caused by  
 a. Gall midge                      b. Leaf roller                      c. Rice hispa                      d. Gandhi bug
161. Idea of super rice was given by  
 a. Shull                      b. Chopra                      c. Khush                      d. Yoshida
162. Botanical name of Ragi is  
 a. Eleusine coracana                      b. Echinochloa frumentacea                      c. Panicum miliacium                      d. None of the above
163. The most serious pest of bengalgram is  
 a. Pod borer                      b. Aphid                      c. Cut worm                      d. None of these
164. According to the fertilizer control order 1957, the percentage of biuret content in urea should not exceed  
 a. 1.0                      b. 1.5                      c. 2.0                      d. 2.5
165. Fluchloralin can be used in Soybean as  
 a. Pre – emergence                      b. Pre – plant incorporation                      c. Post emergence                      d. None of these
166. In rice, the days in which the Dapog seedlings would be ready for transplanting is  
 a. 14-17 days                      b. 17-20 days                      c. 11-14 days                      d. 20-23 days
167. Most serious disease of sugarcane is  
 a. Red stripe                      b. Wilt                      c. Red rot                      d. Smut
168. Contribution of flag leaf in photosynthates in percentage is about  
 a. 52                      b. 35                      c. 40                      d. 20
169. The highest production of mustard in India is in the stage of  
 a. Rajasthan                      b. Gujarat                      c. Andhra Pradesh                      d. Tamil Nadu
170. Stomata closing can be induced by  
 a. Kaoline                      b. 2,4-D                      c. Linseed oil                      d. PMA
171. Among oil cakes, the highest nitrogen content is in  
 a. Castor cake                      b. Neem cake                      c. Groundnut cake                      d. Coconut cake
172. Maximum residual acidity is associated with the continuous soil application of  
 a. Urea                      b. Ammonium nitrate                      c. Ammonium sulphate                      d. CAN

173. UPAS 120 is a variety of  
 a. Pigeon pea                      b. Mung                      c. Sorghum                      d. Maize
174. Temperature requirement for proper grain filling in Wheat is  
 a. 23-25<sup>0</sup>C                      b. 33-45<sup>0</sup>C                      c. 10-13<sup>0</sup>C                      d. 25-35<sup>0</sup>C
175. The oil and protein content of groundnut are  
 a. 20% & 50%                      b. 45% & 26%                      c. 26% & 45%                      d. 50% & 26%
176. In a RBD experiment having 9 treatments and 4 replications, the error degree of freedom will be  
 a. 21                      b. 27                      c. 24                      d. 34
177. Which test is used for comparing two means from independent samples  
 a. F-test                      b. t-test                      c. Chi square test                      d. Z-test
178. Striga is a parasitic weed of  
 a. Sorghum                      b. Pearl millet                      c. Mustard                      d. Sunflower
179. Sprinkler system of irrigation is most suited for  
 a. Acid soils                      b. Saline soils                      c. Undulated topography                      d. Clay soils
180. The concept of zero tillage was given by  
 a. Jethro Tull                      b. Skoog                      c. Triplett                      d. Holden
181. The highest water use efficiency is obtained with irrigation method of  
 a. Flooding                      b. Check basin                      c. Corrugation                      d. Border strip
182. The interaction between legume and non-legume plants in the form of supplementation is known as  
 a. Annidation                      b. Allelopathy                      c. Supplementary                      d. Antagonistic
183. Which of the following states has the highest irrigation potential  
 a. Uttar Pradesh                      b. Punjab                      c. Maharashtra                      d. Bihar
184. Which of the following soils occupies the largest area in India  
 a. Red soils                      b. Black soils                      c. Red sandy soils                      d. Alluvial soils
185. In nutrient mobilization, the phytohormone involved is  
 a. ABA                      b. Gibberellin                      c. Cytokinin                      d. Auxin
186. Which of the following indices is also known as "Production capital"  
 a. RGR                      b. CGR                      c. LAR                      d. LAI
187. The chemical responsible for lathyrism in mammals is  
 a. BOAA                      b. HCN                      c. 2,4-DB                      d. NAA
188. Seeds failing to germinate when exposed to light are known as  
 a. Non photoblastic                      b. Positive photoblastic                      c. Negative photoblastic                      d. None of these
189. Growing poplar, pigeonpea and groundnut together is an example of  
 a. Companion cropping                      b. Multi-storey cropping                      c. Relay cropping                      d. Parallel cropping
190. SPAD meter is used for  
 a. Measuring of moisture                      b. Scheduling nitrogen fertigation                      c. Chlorophyll content                      d. Measuring canopy temperature
191. Origin of Soybean  
 a. Brazil                      b. China                      c. Mexico                      d. Peru
192. In groundnut, seed dormancy is a problem in  
 a. Bunch type                      b. Spreading type                      c. Both (a) and (b)                      d. None of the above
193. Nitrogen deficiency first occurs in  
 a. Younger leaves                      b. Older leaves                      c. Middle leaves                      d. All of the above



216. Animal and plant cells can be differentiated by  
a. Conductivity                      b. Presence or absence of cell wall                      c. Size                      d. Shape
217. One kilogram is equivalent to  
a. 2.20 pounds                      b. 2.48 pounds                      c. 1.48 pounds                      d. 1.12 pounds
218. The blood group of human beings, which was considered as universal recipient  
a. A                      b. B                      c. AB                      d. O
219. The number of pairs of chromosomes present in a human body is  
a. 28                      b. 18                      c. 23                      d. 46
220. Dangerous gas for depletion of ozone layer is  
a. Methane                      b. Ethane                      c. CFC                      d. Carbon-dioxide
221. The instrument that is used to measure the intensity/sensitiveness of pain is called as  
a. Anemometer                      b. Algometer                      c. Ammeter                      d. Glucometer
222. Foundation seed is produced from  
a. Breeder seed                      b. Nucleus seed                      c. Certified seed                      d. Registered seed
223. The condition that refers to loss or impairment of memory is called as  
a. Giddiness                      b. Amnesia                      c. Anosmia                      d. Anemia
224. The link between vertebrates and invertebrates is called as  
a. Amphioxus                      b. Reptiles                      c. Amphibians                      d. None of these
225. The study of relationship between soil properties and plant production is known as  
a. Soil science                      b. Agronomy                      c. Edaphology                      d. Pedology
226. The instrument that is used to measure the speed or force of the wind is called as  
a. Anemometer                      b. Algometer                      c. Auxanometer                      d. Glucometer
228. The cultivation of trees and shrubs is called as  
a. Horticulture                      b. Viticulture                      c. Arboriculture                      d. Agronomy
229. In which of the following crops GM varieties are mostly available for cultivation in India  
a. Mustard                      b. Cotton                      c. Soybean                      d. None of the above
230. Which test is used for comparing two means from independent samples  
a. F – test                      b. t- test                      c. Z – test                      d. Chi – square test
231. The instrument that is used to measure the pressure is called as  
a. Anemometer                      b. Algometer                      c. Auxanometer                      d. Barometer
232. Blue revolution is related with  
a. Crops                      b. Energy source                      c. Fish                      d. Oil seeds
233. The only mammal that can fly is  
a. Pigeon                      b. Bat                      c. Whale                      d. None of these
234. Photosynthetic inhibition by O<sub>2</sub> is called as  
a. Reaction                      b. Tisdal effect                      c. Warburg's effect                      d. Reynolds effect
235. Sugar beet is an indicator plant for  
a. Nitrogen                      b. Potash                      c. Sodium                      d. Zinc
236. The element that plays an important role in blood coagulation is  
a. Calcium                      b. Zinc                      c. Sodium                      d. Copper
237. Rice grain is deficient in  
a. Glycine                      b. Lysine                      c. Alanine                      d. Isoleucine
238. Mat nursery is related to  
a. Onion                      b. Chilies                      c. Tobacco                      d. Rice

239. 'ANOVA' was defined by  
 a. Pearson                      b. Howard                      c. Ebberhart                      d. Fisher
240. The middle region of the sun's atmosphere is called as  
 a. Hydrosphere                      b. Chromosphere                      c. Mixosphere                      d. Lithosphere
241. The simple measure of variability in a data set is  
 a. Mean                      b. Median                      c. Mode                      d. Range
242. The edible part in cauliflower is called as  
 a. Panicle                      b. Bolt                      c. Curd                      d. Caryopsis
243. Economic plant of Isabgol is  
 a. Husk                      b. Seed                      c. Seed and Husk                      d. Leaf
244. In human beings, glucose is stored in  
 a. Heart                      b. Liver                      c. Intestine                      d. Lungs
245. The Indian born scientist, who was awarded the Nobel prize for DNA synthesis  
 a. Har Gobind Khorana                      b. Crick                      c. Watson                      d. Bose
246. The splitting up of water molecules in plant cells in the presence of sunlight is called  
 a. Photosynthesis                      b. Photolysis                      c.                      d. Phosphorylation  
 Phytophosphorylation
247. The quantity of fate or oil is produced from one gram of glucose is  
 a. 0.28 g                      b. 0.32 g                      c. 0.45 g                      d. 0.56 g
248. The instrument that is used to measure the relative humidity of air is called  
 a. Hydrometer                      b. Anemometer                      c. Hygrometer                      d. Heliometer
249. The Japanese art of flower arrangement is commonly known as  
 a. Helsinki                      b. Bonsai                      c. Baltic                      d. Ikebana
250. Which of the following is sulphur containing amino acid  
 a. Lysine                      b. Proline                      c. Cystine                      d. Tryptophan
251. Which one of the following element is a constituent of protoplasm  
 a. Potassium                      b. Sulphur                      c. Calcium                      d. Iron
252. In a RBD experiment having 9 treatments and 4 replications, the error degree of freedom will be  
 a. 36                      b. 18                      c. 24                      d. 21
253. The scientist, who was first to isolate the enzyme is  
 a. Perkins                      b. Mendel G                      c. Bose JC                      d. Summer JB
254. The Indian state, which is the largest producer of saffron is  
 a. Maharashtra                      b. Rajasthan                      c. Jammu & Kashmir                      d. Tamilnadu
255. Four blood groups in human beings are discovered by  
 a. Perkins                      b. Landsteiner K                      c. Bose JC                      d. Summer JB
256. Zinc is required for synthesis of  
 a. Fats                      b. Tryptophan                      c. Proteins                      d. Sugars
257. Alternate form of gene at the same locus are referred to as  
 a. Plastid                      b. Episome                      c. Allel                      d. Chromosome
258. The state in which Contour system of orchard planting is generally followed is  
 a. Punjab                      b. Plateaus                      c. Hills                      d. Saline Soils
259. Cryo-preservation is done in liquid nitrogen at a temperature of  
 a. 0<sup>0</sup>C                      b. - 100<sup>0</sup>C                      c. - 10<sup>0</sup>C                      d. - 196<sup>0</sup>C
260. Which one of the following is not a legume crop  
 a. Wheat                      b. Beans                      c. Peas                      d. Groundnut

261. The edible part of jack fruit is  
 a. Hilum                                      b. Peduncle                                      c. Perianth                                      d. Endosperm
262. In temperature countries, generally sugar is obtained from which of the following crop  
 a. Sugarbeat                                      b. Sorghum                                      c. Maple                                      d. Sugarcane
263. The process through which energy is released by plants  
 a. Transpiration                                      b. Respiration                                      c. Photosynthesis                                      d. None of these
264. The instrument that is used to measure the concentration of salt water is  
 a. Hydrometer                                      b. Anemometer                                      c. Salinometer                                      d. Helimeter
265. Kalazar disease is spread by  
 a. Fruit fly                                      b. White fly                                      c. Sand fly                                      d. Mosquito
266. IGFRI is located at  
 a. Jhansi                                      b. Jodhpur                                      c. Jaipur                                      d. Jorhat
267. In plants, enzyme responsible for the synthesis of the malic acid is  
 a. Rubisco                                      b. Urease                                      c. Carboxylase                                      d. Kinase
268. Which of the following is not a bio-pesticide  
 a. Dipel                                      b. Biolap                                      c. Carbaryl                                      d. Bioneem
269. The water condensed over smoke is called as  
 a. Fog                                      b. Smog                                      c. Rain                                      d. Due
270. Green revolution is related to  
 a. Maize & Rice                                      b. Sugarcane & Cotton                                      c. Wheat & Rice                                      d. Pulses
271. Triticale is a cross between  
 a. Wheat X Rice                                      b. Wheat X Maize                                      c. Wheat X Rye                                      d. Wheat X Oat
272. Sodium carbonate is the chemical name for  
 a. Caustic soda                                      b. Salt petre                                      c. Washing soda                                      Baking soda
273. Saffron (kesar) belongs to the family  
 a. Lauraceae                                      b. Apiaceae                                      c. Orchidaceae                                      d. Iridaceae
274. The chemical name of quick lime is  
 a. Calcium hydroxide                                      b. Calcium carbonate                                      c. Calcium chloride                                      d. Calcium oxide
275. Mendel worked on  
 a. Sweet peas                                      b. Field peas                                      c. Garden peas                                      d. Beans
276. Golbal warming is attributed to increase in concentration of green house gases like  
 a. CO<sub>2</sub>                                      b. CH<sub>4</sub>                                      c. CFCs                                      d. All of these
277. The most destructive insect in the world is  
 a. Termites                                      b. Desert locusts                                      c. White flies                                      d. None of the above
278. 't test' is applicable when the number of treatments are  
 a. 4                                      b. 10                                      c. 2                                      d. 8
279. The mammal that has the longest pregnancy in the world is  
 a. Elephant                                      b. Cat                                      c. Human being                                      d. Horse
280. The minimum specific heat of water occurs at the temperature of  
 a. 0<sup>0</sup>C                                      b. 100<sup>0</sup>C                                      c. 37<sup>0</sup>C                                      d. 50<sup>0</sup>C
281. Karnal bunt s a serious disease of  
 a. Wheat                                      b. Tomato                                      c. Apple                                      d. Mango
282. The net gain of ATP during glycolysis is  
 a. 2                                      b. 6                                      c. 4                                      d. 10

Answers for the above questions:

1.	C	48	C	95	a	142	C	189	B	236	A
2.	C	49	A	96	c	143	B	190	C	237	B
3.	A	50	B	97	C	144	C	191	B	238	D
4.	D	51	C	98	B	145	C	192	B	239	D
5.	D	52	C	99	A	146	C	193	B	240	B
6.	A	53	B	100	c	147	A	194	C	241	D
7.	B	54	D	101	A	148	A	195	A	242	C
8.	B	55	D	102	B	149	C	196	D	243	C
9.	B	56	D	103	D	150	A	197	D	244	B
10.	C	57	C	104	D	151	D	198	A	245	A
11.	C	58	A	105	C	152	C	199	A	246	B
12.	C	59	A	106	A	153	B	200	A	247	C
13.	D	60	D	107	d	154	D	201	B	248	C
14.	B	61	A	108	D	155	D	202	A	249	D
15.	A	62	B	109	B	156	C	203	A	250	C
16.	D	63	C	110	C	157	B	204	A	251	C
17.	C	64	A	111	C	158	B	205	B	252	C
18.	B	65	C	112	B	159	D	206	B	253	D
19.	C	66	A	113	A	160	A	207	A	254	C
20.	B	67	D	114	A	161	C	208	C	255	B
21.	A	68	C	115	C	162	A	209	A	256	B
22.	C	69	B	116	A	163	A	210	B	257	C
23.	D	70	C	117	D	164	B	211	D	258	C
24.	D	71	A	118	B	165	B	212	A	259	D
25.	C	72	D	119	C	166	C	213	B	260	A
26.	C	73	A	120	A	167	C	214	C	261	C
27.	B	74	A	121	C	168	A	215	D	262	A
28.	B	75	C	122	A	169	A	216	B	263	B
29.	A	76	D	123	A	170	D	217	A	264	C
30.	A	77	D	124	A	171	C	218	C	265	C
31.	C	78	B	125	B	172	C	219	C	266	A
32.	A	79	C	126	A	173	A	220	C	267	A
33.	C	80	B	127	C	174	A	221	A	268	C
34.	D	81	D	128	C	175	B	222	B	269	B
35.	A	82	A	129	D	176	C	223	A	270	C
36.	B	83	C	130	D	177	B	224	C	271	C
37.	C	84	D	131	C	178	A	225	A	272	C
38.	D	85	A	132	D	179	C	226	C	273	D
39.	B	86	b	133	A	180	C	227	-	274	D
40.	C	87	d	134	B	181	C	228	C	275	C
41.	A	88	a	135	C	182	A	229	B	276	D
42.	C	89	C	136	D	183	A	230	B	277	B
43.	A	90	d	137	B	184	D	231	D	278	C
44.	D	91	b	138	D	185	D	232	C	279	A
45.	B	92	A	139	C	186	D	233	B	280	C
46.	C	93	C	140	D	187	A	234	C	281	A
47.	D	94	A	141	C	188	C	235	C	282	A



21. Different names given to the same taxon are called  
 a. Homonyms                      b. Synonyms                      c. holotypes                      d. Paratypes
22. The gladiator belongs to the insect order  
 a. Phasmida                      b. Orthoptera                      c. Grylloblattoidea                      d. Mantophasmatodea
23. The differentiation of the body into distinct functional regions is called  
 a. Morphogenesis                      b. Oogenesis                      c. Tagmosis                      d. Blastogenesis
24. In which type of head the mouthparts are in continuous series with the legs  
 a. Hypognathous                      b. Prognathous                      c. Ophisthognathous                      d. Paurometabolous
25. The Johnston's organ is present on  
 a. Scape                      b. Pedicel                      c. Coxa                      d. Trochanter
26. In silk worm, the antennae are  
 a. Clavate                      b. Capitate                      c. Pectinate                      d. Bipectinate
27. Piercing and sucking mouthparts are found in  
 a. Mosquitoes                      b. Honey bees                      c. Thrips                      d. Butterflies
28. Saltatorial legs are found in  
 a. Cockroach                      b. Praying mantid                      c. Grasshopper                      d. Mole cricket
29. The forewing of Coleoptera is called  
 a. Tegmina                      b. Elytra                      c. hemelytra                      d. halteres
30. The larva which has no legs and is very poorly sclerotized is called  
 a. Oligopod                      b. Apodous                      c. Scarabaeiform                      d. Polypod
31. Foregut is lined by  
 a. Intima                      b. Peritrophic membrane                      c. Enteric epithelium                      d. Taenidia
32. Salivary glands are also called  
 a. Mandibular glands                      b. Maxillary glands                      c. Labial glands                      d. Pharyngeal glands
33. A respiratory system in which 1 mesothoracic and 8 abdominal spiracles are functional is called  
 a. Holopneustic                      b. Perineustic                      c. Hemipneustic                      d. Oligopneustic
34. The neurons which carry impulses from the central nervous system are called  
 a. Sensory                      b. Afferent                      c. Motor                      d. Interneurons
35. The sac for storage of sperms in male insect is called  
 a. Spermatheca                      b. Seminal vesicle                      c. Median oviduct                      d. Genital chamber
36. The amount of uric acid in excreta of insects is about  
 a. 10%                      b. 25%                      c. 40%                      d. 85%
37. Due to flow of Na<sup>+</sup> inside the axon, the inner membrane becomes positively charged and other membrane becomes negatively charged, this condition is known as  
 a. Resting potential                      b. Action potential                      c. Falling phase                      d. Repolarization
38. Juvenile hormone is secreted by  
 a. Neurosecretary cells                      b. Prothoracic glands                      c. Corpora allata                      d. Corpora cardiac
39. The complete dependence of one organism over another is called  
 a. Amensalism                      b. Mutualism                      c. Protocooperation                      d. Commensalism
40. The theory of natural regulation of populations based on genetic feedback mechanism was proposed by  
 a. D. Pimentel                      b. D. Chitty                      c. A. Milne                      d. A.J. Nicholson
41. Domestic quarantines were enforced in India to prevent the spread of  
 a. Woolly apple aphid                      b. Pink bollworm                      c. Brown plant hopper                      d. San Jose scale

42. The insect which entered India before the enforcement of quarantine measures is  
 a. Cottony cushion scale    b. Cotton whitefly    c. Guava mealy bug    d. Sugarcane pyrilla
43. The prevention of Food Adulteration Act, 1954 came into force in  
 a. 1954    b. 1955    c. 1956    d. 1957
44. The recommended trap crop for IPM of diamondback moth on cabbage is  
 a. Radish    b. Carrot    c. Indian mustard    d. Cotton
45. The recommended trap crop for IPM of tomato fruit borer is  
 a. Brinjal    b. African marigold    c. Potato    d. Cucurbits
46. Clipping off the top of rice seedlings containing immature stages of insects reduces the carry over of infestation of  
 a. Rice hispa    b. Whitebacked planthopper    c. Green leaf hopper    d. Rice bug
47. Sticky bands around tree trunks provide protection against  
 a. Citrus psylla    b. Mango mealy bug    c. Mango hopper    d. Apple root borer
48. The first successful attempt to utilize biological control involved the importation of  
 a. Ladybird beetle    b. Aphelinus spp.    c. Vedalia beetle    d. Apanteles spp.
49. The All India Coordinated Research Project on Biological Control of Crop Pests and Weeds (AICRPBC) was started in  
 a. 1967    b. 1977    c. 1980    d. 1985
50. The Project Directorate of Biological Control (PDBC) came into being in  
 a. 1963    b. 1970    c. 1983    d. 1993
51. The cassava mealy bug in Africa was successfully controlled by importation and augmentation of  
 a. Cyrtorhinus lividipennis    b. Cryptolaemus montrouzieri    c. Epidinocarsis lopezi    d. Aphelinus mali
52. San Jose scale has been successfully controlled in India by the importation of  
 a. Aphelinus mali    b. Encarsis perniciosi    c. Coccinella septempunctata    d. Trichogramma chilonis
53. The beetle, *Zygogramma bicolorate*, introduced for the control of congress grass, started feeding on  
 a. Cauliflower    b. Mustard    c. Sunflower    d. Soyabean
54. A strain of *Trichogramma chilonis* has been developed in India which is resistant to  
 a. Endosulfan    b. Malthion    c. Carbaryl    d. Carbofuran
55. The green lacewing is a parasitoid of  
 a. Beetles    b. Grasshoppers    c. Aphids    d. Cockroaches
56. The first record of an insect disease caused by a fungal pathogen is that of  
 a. *Beauveria bassiana*    b. *Verticillium lecanii*    c. *Cephalosporium lecanii*    d. *Metarhizium anisopliae*
57. *Bacillus thuringiensis* was first isolated from diseased larvae of  
 a. Silkworm    b. Honey bee    c. American bollworm    d. Spruce budworm
58. *Bacillus papillae* causes milky disease in  
 a. Cockchafer beetle    b. Japanese beetle    c. Red flour beetle    d. Ber beetle
59. The commercial product "Doom" has been developed from a  
 a. Protozoan    b. Fungus    c. Virus    d. Bacterium
60. The most successful field use of a baculovirus on global scale has been made for the control of  
 a. Diamondback moth    b. Cabbage caterpillar    c. Soyabean caterpillar    d. Pink bollworm

61. The first commercial formulation of NPV was  
 a. Gypchek                      b. Elcar                      c. Virin – HS                      d. Spodopterin
62. The share of microbial pesticides in the total world pesticide market is  
 a. 1-2%                      b. 5-6%                      c. 8-10%                      d. 12-15%
63. The earliest documented case of insect resistance is against  
 a. Wheat stem sawfly                      b. Hessian fly                      c. Sorghum shoot fly                      d. screw worm fly
64. Major gene resistance is also called  
 a. Horizontal resistance                      b. Oligogenic resistance                      c. Vertical resistance                      d. Induced resistance
65. The occurrence of asparagines in minute quantities was considered to be the primary cause of resistance to brown planthopper in rice variety  
 a. ASD 7                      b. Mudgo                      c. T(N) 1                      d. Rathu Heenati
66. DIMBOA is considered to be resistance factor against European corn borer in  
 a. First generation                      b. Second generation                      c. Third generation                      d. Fourth generation
67. The number of biotypes reported in brown planthopper is  
 a. 2                      b. 3                      c. 4                      d. 5
68. A multiple insect and disease resistant variety which is grown on more than 11 million ha in the world is  
 a. IR8                      b. IR26                      c. IR36                      d. IR 72
69. Which was the first country to commercialize transgenic crops  
 a. USA                      b. China                      c. Canada                      d. Argentina
70. One of the Bt. Cotton varieties approved for commercial cultivation under north Indian conditions is  
 a. MECH 12                      b. MECH 162                      c. MECH 184                      d. MRC 6304
71. The antifeedant properties of neem were first reported in India against  
 a. Tobacco caterpillar                      b. Desert locust                      c. American bollworm                      d. Brown planthopper
72. The irreversible inversion of acetyl cholinesterase is caused by  
 a. Malathion                      b. DDT                      c. HCH                      d. Carbaryl
73. The first report of insecticide resistance in India was that of  
 a. Diamondback moth                      b. American bollworm                      c. Singhara beetle                      d. Mustard aphid
74. The maximum amount of pesticides in India is used on  
 a. rice                      b. Vegetables                      c. Plantation crops                      d. Cotton
75. The highest consumer of pesticides per unit area is  
 a. USA                      b. Taiwan                      c. Japan                      d. Korea
76. Atropine sulphate is an  
 a. Antibiotic                      b. Antifeedant                      c. Antidote                      d. Antipheromone
77. Methyl eugenol is an attract for  
 a. Oriental fruitfly                      b. Melon fruitfly                      c. Mediterranean fruitfly                      d. Paddy gall fly
78. The level at which control measures should be initiated against a pest is called  
 a. Economic injury level                      b. economic threshold level                      c. General equilibrium level                      d. None of these level
79. Whitebacked planthopper belongs to the family  
 a. Delphacidae                      b. Cicadellidae                      c. Coccidae                      d. Coreidae
80. Rice leaf – folder belongs to the family  
 a. Noctuidae                      b. Pyralidae                      c. Arctiidae                      d. Pterophoridae

81. Cotton whitefly is a vector of  
 a. Tungro virus                      b. Grassy stunt virus                      c. Leaf curl virus                      d. Leaf vein mosaic virus
82. Diamondback moth belongs to the family  
 a. Pyralidae                      b. Yponomeutidae                      c. Pieridae                      d. noctuidae
83. Red pumpkin beetle belongs to the family  
 a. Chrysomelidae                      b. Curculionidae                      c. Dermestidae                      d. Bostrychidae
84. Dengue fever is transmitted by  
 a. Anopheles spp.                      b. Culex spp.                      c. Mansonia spp.                      d. Aedes spp.
85. *Amsacta moorei* (Butler) is known as  
 a. Red hairy caterpillar                      b. Bihar hairy caterpillar                      c. Gram cutworm                      d. Grassy cutworm
86. *Epilachna vigintioctopunctata* (Fabricius) is a pest of  
 a. Cucurbits                      b. Tomato                      c. Brinjal                      d. Lady's finger
87. The Indian honey bee is technically named as  
 a. *Apis dorsata* Fabricius                      b. *Apis florae* Fabricius                      c. *Apis cerana* Fabricius                      d. *Apis mellifera* Linnaeus
88. Who was awarded Nobel Prize for discovering the language of the honey bees  
 a. Eva Crane                      b. Karl von Frisch                      c. S.F. Sakagami                      d. F. Ruttner
89. Nosema disease of the honeybee is caused by  
 a. Fungus                      b. Protozoan                      c. Virus                      d. Bacterium
90. The fully ripened honey contains the highest amount of  
 a. Glucose                      b. Fructose                      c. Sucrose                      d. Water
91. Royal jelly is the secretion of  
 a. Labial glands                      b. Neurosecretory cells                      c. Hypopharyngeal glands                      d. Mandibular glands
92. The killing of pupae of silkworm in the cocoons is called  
 a. Mounting                      b. Reeling                      c. Curing                      d. Stifling
93. Nosema bombycis causes a disease in silkworms known as  
 a. Muscardine                      b. Pebrine                      c. Flacherie                      d. Grasserie
94. The rank of India in silk production in the world is  
 a. First                      b. Second                      c. Third                      d. Fourth
95. The share of Rangeeni strain of lac insect to lac production in India is  
 a. 10-20%                      b. 30-40%                      c. 50-60%                      d. 80-90%
96. The rank of India in lac production in the world is  
 a. First                      b. Second                      c. Third                      d. Fourth
97. The Indian Lac Research Institute is situated at  
 a. Hansi                      b. Ranchi                      c. Pune                      d. Bengaluru
98. The first recipient of the World Food Prize was  
 a. N.E. Borlaug                      b. B.P. Pal                      c. R.F. Chandler                      d. M.S. Swaminathan
99. The word 'Green revolution' was coined by  
 a. William Gaud                      b. N.E. Borlaug                      c. C. Subramaniam                      d. Robert McNamara
100. The headquarter of the World Food Prize Foundation is at  
 a. Rome (Italy)                      b. Des Moines (USA)                      c. Washington (USA)                      d. Manila (Philippines)
101. The word 'evergreen revolution' was proposed by  
 a. APJ. Abdul Kalam                      b. Manmohan Singh                      c. M.S. Swaminathan                      d. G.S. Khush

102. The transgenic (Bt.) vegetable which has been approved for large-scale field trials in India is  
 a. Lady's finger                      b. Brinjal                                      c. Tomato                                      d. Potato
103. The area under transgenic crops at the global level exceeded 100 million ha for the first time in  
 a. 2004                                      b. 2000                                      c. 2006                                      d. 2005
104. *Platygaster oryzae* is the biocontrol agent of  
 a. Rice gall – midge                      b. Maize stem borer                      c. Pink bollworm                      d. Brinjal fruit borer
105. The insect which lays stalk-shaped eggs is  
 a. Fruit fly                                      b. White fly                                      c. Mealy bug                                      d. Gall midge
106. *Mayetiola destructor* is the scientific name of  
 a. Grape phylloxera                      b. Saw fly                                      c. Hessian fly                                      d. Fruit fly
107. Dr. Hans R. Herren was awarded the World Food Prize for his work on biological control of cassava mealy bugs in  
 a. 1975                                      b. 1995                                      c. 1985                                      d. 2005
108. The idea of integration of biological control and chemical control was first proposed by V.M. Stern and his colleagues in  
 a. 1959                                      b. 1969                                      c. 1970                                      d. 1975
109. The largest area of a transgenic crop at global level is under  
 a. Cotton                                      b. Soyabean                                      c. Maize                                      d. Rice
110. The largest area of a Bt. transgenic crop at global level is under  
 a. Maize                                      b. Canola                                      c. Cotton                                      d. Wheat
111. The largest area under Bt. Cotton in India is in  
 a. Andhra Pradesh                      b. Punjab                                      c. Maharashtra                      d. Gujarat
112. San Jose scale passes the winter as  
 a. Egg                                      b. Nymph                                      c. Adult                                      d. None of these
113. In which tarsal segment of the leg is present the empodium  
 a. First                                      b. Second                                      c. Third                                      d. Last
114. How many pairs of legs are present in eriophyid mites  
 a. 1                                      b. 2                                      c. 3                                      d. 4
115. Up to which age (days), royal jelly is produced by honey bee workers  
 a. 5                                      b. 10                                      c. 15                                      d. 25
116. Which of these is anti-coagulant for rats  
 a. Zinc phosphide                      b. Aluminium phosphide                      c. Strychnine hydrochloride                      d. Warfarin
117. Which of these is a molluscicide  
 a. Imidacloprid                      b. Metaldehyde                      c. Abamectin                      d. Spinosad
118. Which insect stage is parasitized by *Trichogramma*  
 a. Adult                                      b. Pupa                                      c. Larva                                      d. Egg
119. Which of these insects is a predator  
 a. *Chrysoperla carnea*                      b. *Epilachna vigintioctopunctata*                      c. *Encarsia formosa*                      d. *Aphelinus mali*
120. Which of these insects is a parasitoid  
 a. *Cryptolaemus montrouzieri*                      b. *Ostrinia nubilalis*                      c. *Bemisia tabaci*                      d. *Bracon hebetor*
121. Which of these natural enemies is a spider  
 a. *Bracon hebetor*                      b. *Lycosa pseudoannulata*                      c. *Brumoides suturalis*                      d. *Bracon hebetor*

122. Which of these natural enemies is a mite  
 a. Orius insidiosus                      b. Bracon brevicornis                      c. Tetrastichus Israeli                      d. amblyseius cucumeris
123. Which colour on the label of the container indicates the extremely toxic pesticide  
 a. yellow                                      b. Orange                                      c. Blue                                      d. Red
124. The head of an insect is composed of segments, whose number is  
 a. 2    b. 4    c. 6    d. 8
125. Which insect pest of grapes is not present in India  
 a. Grapevine beetle                      b. Grape phylloxera                      c. Grapevine girdler                      d. Grapevine thrips
126. Dual Discrimination Theory of host plant selection was proposed by  
 a. G.S. Graenkel                      b. C.T. Brues                      c. M. Kogan                      d. G.G. Kennedy and J.D. Babour
127. Retardation in lint development in cotton is caused by  
 a. Pink bollworm                      b. Spotted bollworm                      c. Cotton whitefly                      d. Dusky cotton bug
128. Destructive Insects and Pests Act was passed in  
 a. 1947                                      b. 1968                                      c. 1932                                      d. 1914
129. Bacillus thuringiensis was first isolated from silkworm in  
 a. 1902                                      b. 1912                                      c. 1932                                      d. 1942
130. Dipel is a commercial preparation based on  
 a. Fungus                                      b. Bacterium                                      Nematode                                      d. Virus
131. Staining of lint in cotton is caused by  
 a. American bollworm                      b. Cotton jassid                                      c. Red cotton bug                                      d. Cotton aphid
132. Tribolium castaneum is a pest of  
 a. Cabbage                                      b. Tomato                                      c. Okra                                      d. Stored products
133. Which is not secreted by the honey bee  
 a. Beeswax                                      b. Propolis                                      c. Royal jelly                                      d. All
134. Which of the following is a neurotransmitter  
 a. Acetylcholine                      b. Acetyl cholinesterase                      c. Acetyl                                      d. Choline
135. Moveable frame hive was first introduced by L.L. Langstroth in  
 a. 1751                                      b. 1800                                      c. 1851                                      d. 1881
136. The scientific name of mole rat is  
 a. Rattus rattus                                      b. Mus musculus                                      c. Tatera indica                                      d. Bandicota bengalensis
137. The first major accident involving pesticides in India occurred in Kerala, which killed more than 100 people due to consumption of parathion contaminated wheat flour and sugar in  
 a. 1948                                      b. 1952                                      c. 1958                                      d. 1962
138. Which of these insecticides belongs to the nicotinoid group  
 a. Nicotine sulphate                      b. Imidacloprid                                      c. Aldicarb                                      d. Dimethoate
139. Which of these insecticides is derived from actinomycetes  
 a. Spinosad                                      b. Fipronil                                      c. Pirate                                      d. Amitaz
140. Name the insecticide which is of annelid origin  
 a. Abamectin                                      b. Propoxur                                      c. Chlordimeform                                      d. nerreistoxin
141. Locust does not feed on  
 a. Shisham                                      b. Accacia                                      c. Neem                                      d. Citrus
142. Which of these microorganisms is a protozoan  
 a. Metarhizium anisopliae                      b. Nosema locustae                                      c. Bacillus popilliae                                      d. Verticillium lecanii

143. Which of these pests is a snail  
 a. *Achatina fulica*                      b. *Tylenchulus semipenetrans*                      c. *Pempherulus affinis*                      d. *Dasineurra lini*
144. Which is the vector of cauliflower mosaic  
 a. *Plutella xylostella*                      b. *Pieris brassicae*                      c. *Brevicoryne brassicae*                      d. *Thrips tabaci*
145. Which is the vector of sugarcane mosaic  
 a. *Rhopalosiphum maidis*                      b. *Pyrilla perpusilla*                      c. *Aleurolobus barodensis*                      d. *Saccharicoccus sacchari*
146. Name the vector of Banana bunchy top  
 a. *Cosmopolites sordidus*                      b. *Pentalonia nigronervosa*                      c. *Odoiporus longicollis*                      d. *Nacoleia octasema*
147. Name the vector of papaya mosaic  
 a. *Poekilocerus pictus*                      b. *Tetranychus urticae*                      c. *Drosicha mangiferae*                      d. *Aphis gossypii*
148. Which is the vector of cucumber mosaic  
 a. *Myzus persicae*                      b. *Bactrocera cucurbitae*                      c. *Aulacophora foveicollis*                      d. *Epilachna vigintioctopunctata*
149. Which is the vector of cowpea mosaic  
 a. *Clavigralla gibbosa*                      b. *Ophiomyia phaseoli*                      c. *Melanagromyza obtuse*                      d. *Earias insulana*
150. Which is the vector of okra yellow vein mosaic  
 a. *Amrasca biguttula*                      b. *Bemisia tabaci*                      c. *Oxycarenus laetus*                      d. *Earias insulana*
151. Which is the vector of tomato spotted wilt  
 a. *Bemisia tabaci*                      b. *Trialeurodes vaporariorum*                      c. *Thrips tabaci*                      d. *Nezara viridula*
152. Name the vector of grassy stunt virus  
 a. *Sogatella furcifera*                      b. *Sesamia inferens*                      c. *Orseolia oryzae*                      d. *Nilaparvata lugens*
153. Name the vector of tungro virus  
 a. *Orseolia oryzae*                      b. *Leptocorisa acuta*                      c. *Ripersia oryzae*                      d. *Nephotettix virescens*
154. Which is the vector of hoja blanca virus  
 a. *Nephotettix nigropictus*                      b. *Nilaparvata lugens*                      c. *Tagosodes orizicolus*                      d. *Sogatella furcifera*
155. Which is the vector of rice black – streaked dwarf virus  
 a. *Nilaparvata lugens*                      b. *Laodelphax striatellus*                      c. *Leptocorisa acuta*                      d. *Tagosodes orizicolus*
156. Which viral disease is transmitted by *Sogatella furcifera*  
 a. Tungro                      b. Grassy stunt                      c. Hoja blanca                      d. None
157. Which of these insects is not a vector of rice yellow dwarf  
 a. *Nephotettix virescens*                      b. *Nephotettix nigropictus*                      c. *nilaparvata lugens*                      d. *Recilia dorsalis*
158. Which of these insects is a vector of sheath blight  
 a. *Orosius albicinctus*                      b. *Acherontia styx*                      c. *Antigastra catalaunalis*                      d. *Asphondylla sesame*
159. Name the insect vector of coconut root wilt  
 a. *Opisina arenosella*                      b. *Stephanitis typical*                      c. *Aspidiotus destructor*                      d. *Oryctes rhinoceros*

160. Name the insect vector of brinjal little leaf  
 a. Cestius phycitis                      b. Urentius sentis                      c. Epilachna dodecastigma                      d. Acherontia styx
161. Which is the vector of bacterial wilt of corn  
 a. Chilo partellus                      b. Atherigona soccata                      c. Chaetocnema pulicaria                      d. Ostrinia nubilalis
162. Which is the vector of cucurbit wilt  
 a. Diabrotica vittata                      b. Bactrocera cucurbitae                      c. Aulacophora foveicollis                      d. Amrasca biguttula
163. Name the vector of potato blackleg  
 a. Phthorimaea operculella                      b. Hylemya cilicrura                      c. Myzus persicae                      d. Agrotis ipsilon
164. Name the insect vector of cotton wilt differentialis  
 a. Melanoplus                      b. Bemisia tabaci                      c. Aphis gossypii                      d. Amrasca biguttula
165. Name the insect vector of Dutch elm disease  
 a. Adoretus pallens                      b. Sthenias grisator                      c. Indarbela tetraonis                      d. Scolytus multistriatus
166. Which of these phytonematodes is a root – knot nematode  
 a. Globodera rostochiensis                      b. Rotylenchus goodeyi                      c. Meloidogyne incognita                      d. Ditylenchus angustus
167. Which of these nematodes is associated with citrus decline  
 a. Tylenchulus semipenetrans                      b. Ditylenchus dipsaco                      c. Radopholus similas                      d. Rotylenchulus reniformis
168. Which of these nematodes is associated with gall formation in wheat grains  
 a. Hirschmanniella oryzae                      b. Anguina tritici                      c. Meloidogyne javanica                      d. Heterodera schachtii
169. Which of these is not a nematicide  
 a. Phorate                      b. Carbofuran                      c. Ethylene dibromide                      d. Fenvalerate
170. Name the flying mammal among these animals  
 a. Macaca mulatta                      b. hystrix indica                      c. Pteropus giganteus                      d. Canis aureus
171. Which of these insects is the vector of bubonic plague bacterium, Pasteurella pestes  
 a. Cimex lectularius                      b. Xenopsylla cheopis                      c. Blatella germanica                      d. Musca nebulo
172. Which of these pesticides is not a miticide  
 a. Metaldehyde                      b. Dimethoate                      c. Oxydemeton methyl                      d. Phosalone
173. Chaetocnema pulicaria, which is vector of bacterial wilt of corn is a  
 a. Bug                      b. Beetle                      c. Fly                      d. Aphid
174. Melanoplus differentialis, which is a vector of cotton wilt, is  
 a. Whitefly                      b. Jassid                      c. Dragonfly                      d. Grasshopper
175. All the living organisms on earth interacting with the physical environment as a whole are referred to as the  
 a. Biosphere                      b. Biome                      c. Ecosystem                      d. Community
176. The rate of death and expectation of life at various time intervals during the life span of an insect are indicated by  
 a. Density                      b. Nataliy                      c. Life table                      d. Survivorship curve

177. A compilation of bar graphs of the ratio of one age group to another in a population is called  
 a. Age distribution      b. Age pyramid      c. Carrying capacity      d. Innate capacity
178. The specific position of a species within a community including utilization of resources both in qualitative and quantitative terms is referred to as  
 a. Niche      b. Habitat      c. Biome      d. Ecotone
179. A commensalitic relationship in which one kind of animal attaches to another and thereby gains a mode of transporation, is called  
 Philopatry      b. Phoresy      c. Amensalism      d. Migration
180. The evolutionary history of an organism or a toxonomic groups is called  
 a. Phenology      b. Biogeography      c. Geology      d. Phylogeny
181. The concept that no two species with identical ecological requirements can coexist in the same place, was proposed by  
 a. H.G. Andrewartha      b. D. Pimentel      c. G.F. Gause      d. L.C. Birch
182. The first case of insecticide resistance in India in stored grain pests was that of  
 a. Trogoderma granarium      b. Tribolium castaneum      c. Sitophilus oryzae      d. Oryzaephilus surinamensis
183. The insect which has developed resistance to maximum number of insecticides under field conditions is  
 a. Bemisia tabaci      b. Nilaparvata lugens      c. Myzus persicae      d. Plutella xylostella
184. The stage of coconut pest, *Opisina arenosella*, parasitized by *Goniozus nephantidis*, is  
 a. Egg      b. Larva      c. Pupa      d. Adult
185. Which stage of coconut pest, *Opisina arenosella*, parasitized by *Goniozus nephantidis*, is  
 a. Egg      b. Larva      c. Pupa      d. Adult
186. Which stage of the rice gall midge is parasitized by *Platygaster oryzae*  
 a. Egg      b. Larva      c. Pupa      d. Adult
187. Which stage of the rice gall midge is parasitized by *Neanastatus oryzae*  
 a. Egg      b. Larva      c. Pupa      d. Adult
188. Which stage of brown planthopper is fed upon by the mired bug predator, *Cyrtorhinus lividipennis*  
 a. Egg      b. Nymph      c. Adult      d. All stages
189. Which stage of sugarcane pyrilla is parasitized by *Tetrastichus pyrillae*  
 a. Egg      b. Nymph      c. Adult      d. All stages
190. The mite, *Aceria tulipae*, is a vector of  
 a. Wheat streak mosaic      b. Lettuce mosaic      c. Tunip yellow mosaic      d. Lettuce mosaic
191. The highest lac producing state of India is  
 a. Uttar Pradesh      b. Madhya Pradesh      c. Assam      d. Jharkhand
192. Mustard sawfly pupates in  
 a. Stem      b. Leaves      c. Soil      d. none of these
193. Yellow stem borer hibernates as  
 a. Egg      b. Larva      c. Pupa      d. None of these
194. Sorghum shoot fly overwinters in North India as  
 a. Egg      b. Larva      c. Pupa      d. None of these
195. Larvae of pink bollworm overwinter in  
 a. Seed      b. Stem      c. Soil      d. None of these
196. Cotton grey weevil passes the winter as  
 a. Egg      b. Grub      c. Pupa      d. Adult

197. Sugarcane top borer passes winter as larva in  
 a. Soil                                      b. Base of stem                      c. Top of stem                      d. None of these
198. Brinjal fruit borer hibernates as  
 a. Egg    b. Larva                                      c. Pupa                                      d. None of these
199. Brinjal hadda passes the winter as  
 a. Egg    b. Grub                                      c. Pupa                                      d. Adult
200. In classical biological control, the most successful cases of target pests belong to  
 a. Hemiptera                                  b. Hymenoptera                      c. Diptera                                      d. Coleoptera

**Answers for the above questions:**

1	B	26	D	51	C	76	B	101	A	126	D	151	C	176	C
2	C	27	A	52	B	77	A	102	B	127	A	152	D	177	B
3	D	28	C	53	C	78	B	103	C	128	D	153	D	178	A
4	A	29	B	54	A	79	A	104	A	129	A	154	C	179	B
5	A	30	B	55	C	80	B	105	B	130	B	155	B	180	D
6	B	31	A	56	D	81	C	106	C	131	C	156	D	181	C
7	C	32	C	57	A	82	B	107	B	132	D	157	C	182	B
8	B & C	33	B	58	B	83	A	108	A	133	B	158	A	183	D
9	C & D	34	C	59	D	84	D	109	B	134	A	159	B	184	B
10	B	35	B	60	C	85	A	110	A	135	C	160	A	185	A
11	C	36	D	61	B	86	C	111	C	136	D	161	C	186	B
12	A	37	B	62	A	87	C	112	B	137	C	162	A	187	C
13	B	38	C	63	B	88	B	113	D	138	B	163	B	188	D
14	A	39	B	64	C	89	B	114	B	139	A	164	A	189	A
15	C	40	A	65	B	90	B	115	C	140	D	165	D	190	A
16	D	41	D	66	A	91	C	116	D	141	C	166	C	191	D
17	C	42	A	67	D	92	D	117	B	142	B	167	A	192	C
18	D	43	B	68	C	93	B	118	D	143	A	168	B	193	B
19	D	44	C	69	B	94	B	119	A	144	C	169	D	194	C
20	C	45	B	70	D	95	D	120	D	145	A	170	C	195	A
21	B	46	A	71	B	96	A	121	B	146	B	171	B	196	D
22	D	47	B	72	A	97	B	122	D	147	D	172	A	197	C
23	C	48	C	73	C	98	D	123	D	148	A	173	B	198	B
24	A	49	B	74	D	99	A	124	C	149	D	174	D	199	D
25	B	50	D	75	B	100	B	125	B	150	B	175	A	200	A

**Match the following:**

- |     |                                    |  |
|-----|------------------------------------|--|
| 1.  | i. Setaceous                       | a. Tiger beetle                                |
|     | ii. Filiform                       | b. Silkworm                                    |
|     | iii. Bipectinate                   | c. Cockroach                                   |
|     | iv. Clavate                        | d. Butterfly                                   |
| 2.  | i. Chewing and lapping             | a. Thrips                                      |
|     | ii. Rasping and sucking            | b. Gutterflies                                 |
|     | iii. Siphoning                     | c. House fly                                   |
|     | iv. Sponging                       | d. Honeybees                                   |
| 3.  | i. Saltatorial                     | a. Grasshopper                                 |
|     | ii. Natatorial                     | b. Orthoptera                                  |
|     | iii. Cursorial                     | c. Human louse                                 |
|     | iv. Scansorial                     | d. Water bug                                   |
| 4.  | i. Tegmina                         | a. Strepsiptera                                |
|     | ii. Elytra                         | b. Orthoptera                                  |
|     | iii. Haltere                       | c. Coleoptera                                  |
|     | iv. Pseudohaltere                  | d. Diptera                                     |
| 5.  | i. Campodeiform                    | a. Lepidoptera                                 |
|     | ii. Polypod                        | b. Neuroptera                                  |
|     | iii. Acephalous                    | c. Diptera                                     |
|     | iv. Eucephalous                    | d. Nematocera                                  |
| 6.  | i. Holopneustic                    | a. 1 mesothoracic, 1 postabdominal             |
|     | ii. Peripneustic                   | b. 1 mesothoracic, 7 abdominal                 |
|     | iii. Hemipneustic                  | c. 1 mesothoracic, 8 abdominal                 |
|     | iv. Amphipneustic                  | d. 1 mesothoracic, 1 metathoracic, 8 abdominal |
| 7.  | i. Ovoviviparity                   | a. Aphididae                                   |
|     | ii. Adenotrophic viviparity        | b. Glossina                                    |
|     | iii. Haemocoelous viviparity       | c. Cimex                                       |
|     | iv. Pseudoplacental viviparity     | d. Strepsiptera                                |
| 8.  | i. Prothoracicotropic hormone      | a. <i>Corpora allata</i>                       |
|     | ii. Ecdysone                       | b. Prothoracic glands                          |
|     | iii. Juvenile hormone              | c. Neurosecretory cells                        |
|     | iv. Porphyrin                      | d. Lachrymal glands                            |
| 9.  | i. Cottony cushion scale           | a. <i>Aphelinus mali</i>                       |
|     | ii. Woolly apple aphid             | b. <i>Rodolia cardinalis</i>                   |
|     | iii. San Jose scale                | c. <i>Zygogramma bicolorata</i>                |
|     | iv. Congress grass                 | d. <i>Encarsia perniciosi</i>                  |
| 10. | i. <i>Nosema fumiferae</i>         | a. Scarabaeid beetles                          |
|     | ii. <i>Nosema locustae</i>         | b. Spruce budworm                              |
|     | iii. <i>Vairimorpha necatrix</i>   | c. Lepidoptera                                 |
|     | iv. <i>Metarrhizium anisopliae</i> | d. Grasshoppers                                |
| 11. | i. Naturalis-1                     | a. <i>Verticillium lecanii</i>                 |
|     | ii. Mycotal                        | b. <i>Beauveria bassiana</i>                   |
|     | iii. Bio-Path                      | c. <i>Fusarium sp.</i>                         |
|     | iv. TNAU Agrobiocide               | d. <i>Metarrhizium anisopliae</i>              |

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|-----------------------------|---------------------------|
| 12. i. Baculoviron          | a. Neodiprion sertifer    |
| ii. Virin-HS                | b. Lymantria dispar       |
| iii. Gypcheck               | c. Helicoverpa armigera   |
| iv. Virox                   | d. Anticarsia gemmatalis  |
| 13. i. Underhill            | a. Woolly apple aphid     |
| ii. Winter Majetin          | b. Hessian fly            |
| iii. TKM6                   | c. Brown planthopper      |
| iv. Mudgo                   | d. Stem borer             |
| 14. i. DIMBOA               | a. Greenbug               |
| ii. Gossypol                | b. Striped stem borer     |
| iii. Benzyl alcohol         | c. Pink bollworm          |
| iv. Pentadecanal            | d. European corn borer    |
| 15. i. Biotype 1            | a. Mudgo                  |
| ii. Biotype 2               | b. ASD7                   |
| iii. Biotype 3              | c. TN1                    |
| iv. Biotype 4               | d. Rathu Heenati          |
| 16. i. MECH 12              | a. South zone             |
| ii. MECH 162                | b. North Zone             |
| iii. RCH 317                | c. Central Zone           |
| iv. MRC 6301                | d. North Zone             |
| 17. i. Physical poison      | a. Formaldehyde           |
| ii. Protoplasmic poison     | b. Hydrogen cyanide       |
| iii. Respiratory poison     | c. Carbaryl               |
| iv. Nerve poison            | d. Inert dust             |
| 18. i. Karanjin             | a. Derris                 |
| ii. Annonine                | b. Pongram                |
| iii. Azadirachtin           | c. Custard apple          |
| iv. Rotenone                | d. Neem                   |
| 19. i. DDT                  | a. Kurt Alder             |
| ii. HCH                     | b. W. Finkenbrink         |
| iii. Dieldrin               | c. Paul Muller            |
| iv. Endosulfan              | d. Michael Faraday        |
| 20. i. Phosphonate          | a. Trichlorphon           |
| ii. Phosphorothionate       | b. Oxydemeton methyl      |
| iii. Phosphorothiolate      | c. Parathion              |
| iv. Phosphorodithiolate     | d. Malathion              |
| 21. i. Escherichia coli     | a. Carbaryl               |
| ii. Pseudomonas putida      | b. Malathion              |
| iii. Trichoderma viridae    | c. HCH                    |
| iv. Pseudomonas melophthora | d. DDT                    |
| 22. i. Methyl eugenol       | a. Termites               |
| ii. Trimedlure              | b. Oriental fruit fly     |
| iii. Dimethyl phthalate     | c. Mediterranean fruitfly |
| iv. Pentachlorophenol       | d. Mosquitoes             |

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|----------------------------------|--|
| 23. i. Juvenile hormone analogue | a. Precocene                           |
| ii. Antijvenile hormone agent    | b. Cuelure                             |
| iii. Chitin synthesis inhibitor  | c. Methoprene                          |
| iv. Parapheromone                | d. Diflubenzuron                       |
| 24. i. Triazene                  | a. Azadirachtin                        |
| ii. Organotin                    | b. Arprocarb                           |
| iii. Carbamate                   | c. 4 – (dimethyl triazeno) acetanilide |
| iv. Botanical                    | d. Triphenyltin acetate                |
| 25. i. Avermectins               | a. Saccharopolyspora spinosa           |
| ii. Spinosyns                    | b. Lumbriconereis heteropoda           |
| iii. Nereistoxin                 | c. Streptomyces thiolutens             |
| iv. Aureothin                    | d. Streptomyces avermitilis            |
| 26. i. Nilaparvata lugens        | a. Coreidae                            |
| ii. Nephrotettix spp.            | b. Coccidae                            |
| iii. Leptocorisa acuta           | c. Delphacidae                         |
| iv. Rippersia oryzae             | d. Cicadellidae                        |
| 27. i. Stenchaetothrips biformis | a. Pyralidae                           |
| ii. Scirpophaga incertulas       | b. Noctuidae                           |
| iii. Mythimna separate           | c. Cecidomyiidae                       |
| iv. Orseolia oryzae              | d. Thripidae                           |
| 28. i. Dicladisma armigera       | a. Acrididae                           |
| ii. Hydrellia philippina         | b. Chrysomelidae                       |
| iii. Hietoglyphus banian         | c. Ephydriidae                         |
| iv. Echinocnemus oryzae          | d. Curculionidae                       |
| 29. i. Chilo zonellus            | a. Muscidae                            |
| ii. Atherigona soccata           | b. Pyralidae                           |
| iii. Sesamia inferens            | c. Miridae                             |
| iv. Calocoris angustatus         | d. Noctuidae                           |
| 30. i. Helicoverpa armigera      | a. Noctuidae                           |
| ii. Odontotermes obesus          | b. Pterophoridae                       |
| iii. Exelastis atomosa           | c. Phycitidae                          |
| iv. Etiella zinckenella          | d. Termitidae                          |
| 31. i. Begrada hilaris           | a. Tenthredinidae                      |
| ii. Athalia lugens               | b. Scarabaeidae                        |
| iii. Stomopteryx nertaria        | c. Gelechiidae                         |
| iv. Holotrichia consanguinea     | d. Pentatomidae                        |
| 32. i. Achaea janata             | a. Sphingidae                          |
| ii. Parasa lepida                | b. Noctuidae                           |
| iii. Acherontia styx             | c. Tephritidae                         |
| iv. Acanthiophilus helianthi     | d. Limacodidae                         |
| 33. i. Bemisia tabaci            | a. Pyrrhocoridae                       |
| ii. Pectinophora gossypiella     | b. Noctuidae                           |
| iii. Earias insulana             | c. Aleyrodidae                         |
| iv. Dysdercus koenigii           | d. Gelechiidae                         |

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|---|----------------------------|
| 34. i. <i>Pyrilla perpusilla</i>        | a. Yponomeutidae           |
| ii. <i>Scirpophaga novella</i>          | b. Gelechiidae             |
| iii. <i>Plutella xylostella</i>         | c. Pyralidae               |
| iv. <i>Phthorimaea operculella</i>      | d. Lophopidae              |
| 35. i. <i>Delia antique</i>             | a. Anthomyiidae            |
| ii. <i>Ophiomyia phaseoli</i>           | b. Aphalaridae             |
| iii. <i>Rhipiphorothrips cruentatus</i> | c. Agromyzidae             |
| iv. <i>Diaphorina citri</i>             | d. Heliothripidae          |
| 36. i. <i>Idioscopus clypealis</i>      | a. Ber                     |
| ii. <i>Nacoleia octasema</i>            | b. Mango                   |
| iii. <i>Carpomyia vesuviana</i>         | c. Pomegranate             |
| iv. <i>Virachola Isocrates</i>          | d. Banana                  |
| 37. i. <i>Sternochetus mangiferae</i>   | a. Apple                   |
| ii. <i>Eriosoma lanigerum</i>           | b. Black pepper            |
| iii. <i>Scirtothrips dorsalis</i>       | c. Mango                   |
| iv. <i>Longitarsus nigripennis</i>      | d. Chillies                |
| 38. i. <i>Plocaederus ferrugineus</i>   | a. Coconut                 |
| ii. <i>Opisina arenosella</i>           | b. Coffee                  |
| iii. <i>Coccus viridis</i>              | c. Cashew                  |
| iv. <i>Helopeltis theivora</i>          | d. Khapra beetle           |
| 39. i. <i>Sitophilus oryzae</i>         | a. Rice weevil             |
| ii. <i>Trogoderma granarium</i>         | b. Lesser grain borer      |
| iii. <i>Tribolium castaneum</i>         | c. Red flour beetle        |
| iv. <i>Rhyzopertha dominica</i>         | d. Tobacco caterpillar     |
| 40. i. <i>Spilosoma oblique</i>         | a. Greasy cutworm          |
| ii. <i>Ochropleura flammata</i>         | b. Bihar hairy caterpillar |
| iii. <i>Agrotis ipsilon</i>             | c. Gram cutworm            |
| iv. <i>Spodoptera litura</i>            | d. Gram cutworm            |
| 41. i. <i>Apis indica</i>               | a. Little honeybee         |
| ii. <i>Apis florum</i>                  | b. Rock honeybee           |
| iii. <i>Apis dorsata</i>                | c. European honeybee       |
| iv. <i>Apis mellifera</i>               | d. Indian honeybee         |
| 42. i. <i>Malpighamoeba mellificae</i>  | a. European foul brood     |
| ii. <i>Acarapis woodi</i>               | b. Amoebic disease         |
| iii. <i>Bacillus larvae</i>             | c. Acarine disease         |
| iv. <i>Melissococcus pluton</i>         | d. American foul brood     |
| 43. i. <i>Bombyx mori</i>               | a. Muga silkworm           |
| ii. <i>Antheraea paphia</i>             | b. Eri silkworm            |
| iii. <i>Philosamia ricini</i>           | c. Mulberry silkworm       |
| iv. <i>Antheraea assama</i>             | d. Taser silkworm          |
| 44. i. <i>Nosema bombycis</i>           | a. Muscardine              |
| ii. <i>Beauveria bassiana</i>           | b. Grasserie               |
| iii. <i>Bacillus bambusepticus</i>      | c. Pebrine                 |
| iv. Nuclear polyhedrosis virus          | d. Flacherie               |

45. i. Tethwi a. Oct., - November  
ii. Aghani b. June – July  
iii. Katki c. January – February  
iv. Baisakhi d. June – July
46. i. Essentials of Beekeeping and Pollination a. T.N. Ananthakrishnan  
ii. General and Applied Entomology b. G.S. Dhaliwal  
iii. Integrated pest Management : Concepts and Approaches c. H.S. Pruthi  
iv. Textbook on Agricultural Entomology d. A.S. Atwal
47. i. Entomon a. Society of Pesticide Science India, Indian Agricultural Research Institute, New Delhi  
ii. Indian Journal of Entomology b. Indian Society for the Advancement of Insect Science, Punjab Agricultural University  
iii. Journal of Insect Science Agricultural Research c. Entomological Society of India, Indian Institute, New Delhi  
iv. Pesticides Research Journal Entomology University of Kerala d. Association for advancement of Trivandrum
48. i. The Insects: Structure and Function a. R. L. Metcalf  
ii. Destructive and Useful Insects b. R.F. Norris  
iii. Entomology and Pest Management c. R.F. Chapman  
iv. Concepts in Integrated Pest Management d. L.P. Pedigo
49. i. Journal of Economic Entomology a. International Centre of Insect Physiology and Ecology (ICIPE), Nairobi, Kenya  
ii. Bulletin of Entomological Research b. Annual Reviews, Palo Alto, California, UK  
iii. Annual Review of Entomology c. Entomological Society of America, Lanham, MD, USA  
iv. Insect Science and Its Application d. CAB International, Wallingford, Oxon, UK
50. i. A.S. Atwal a. Indian Agricultural Research Institute, New Delhi  
ii. S. Pradhan b. Punjab Agricultural Univeristy, Ludhiana  
iii. S. Jayaraj c. Enomology Research Institute, Loyala College, Chennai  
iv. T.N. Ananthakrishnam d. Tamil Nadu Agricultural University, Coimbatore

**Answers:**

1	i.	C	ii.	A	iii.	B	iv.	D	26	i.	C	ii.	D	iii.	A	iv.	B
2	i.	D	ii.	A	iii.	B	iv.	C	27	i.	D	ii.	A	iii.	B	iv.	C
3	i.	A	ii.	D	iii.	B	iv.	C	28	i.	B	ii.	C	iii.	A	iv.	D
4	i.	B	ii.	C	iii.	D	iv.	A	29	i.	B	ii.	A	iii.	D	iv.	C
5	i.	B	ii.	A	iii.	C	iv.	D	30	i.	A	ii.	D	iii.	B	iv.	C
6	i.	D	ii.	C	iii.	B	iv.	A	31	i.	D	ii.	A	iii.	C	iv.	B
7	i.	C	ii.	B	iii.	D	iv.	A	32	i.	B	ii.	D	iii.	A	iv.	C
8	i.	C	ii.	B	iii.	A	iv.	D	33	i.	C	ii.	D	iii.	B	iv.	A
9	i.	B	ii.	A	iii.	B	iv.	C	34	i.	D	ii.	C	iii.	A	iv.	B
10	i.	B	ii.	D	iii.	C	iv.	A	35	i.	A	ii.	C	iii.	D	iv.	B
11	i.	B	ii.	A	iii.	D	iv.	C	36	i.	B	ii.	D	iii.	A	iv.	C
12	i.	D	ii.	C	iii.	B	iv.	A	37	i.	C	ii.	D	iii.	D	iv.	B
13	i.	B	ii.	A	iii.	D	iv.	C	38	i.	D	ii.	A	iii.	B	iv.	C
14	i.	D	ii.	C	iii.	A	iv.	B	39	i.	B	ii.	A	iii.	D	iv.	C
15	i.	C	ii.	A	iii.	B	iv.	D	40	i.	C	ii.	D	iii.	B	iv.	A
16	i.	A	ii.	C	iii.	D	iv.	D	41	i.	D	ii.	A	iii.	B	iv.	C
17	i.	D	ii.	A	iii.	B	iv.	C	42	i.	B	ii.	C	iii.	D	iv.	A
18	i.	B	ii.	C	iii.	D	iv.	A	43	i.	C	ii.	D	iii.	B	iv.	A
19	i.	C	ii.	D	iii.	A	iv.	B	44	i.	C	ii.	A	iii.	D	iv.	B
20	i.	A	ii.	C	iii.	B	iv.	D	45	i.	B	ii.	C	iii.	D	iv.	A
21	i.	D	ii.	C	iii.	B	iv.	A	46	i.	D	ii.	A	iii.	B	iv.	C
22	i.	B	ii.	C	iii.	D	iv.	A	47	i.	D	ii.	C	iii.	B	iv.	A
23	i.	C	ii.	A	iii.	D	iv.	B	48	i.	C	ii.	A	iii.	D	iv.	B
24	i.	C	ii.	D	iii.	B	iv.	A	49	i.	C	ii.	D	iii.	B	iv.	A
25	i.	D	ii.	A	iii.	B	iv.	C	50	i.	B	ii.	A	iii.	D	iv.	C

**Fill in the Blanks:**

1. The study of the kinds and diversity of organisms and the relationships among them is called \_\_\_\_\_
2. \_\_\_\_\_ is the theory and practice of identifying, describing, naming and classifying organisms.
3. \_\_\_\_\_ is a group of real organisms recognized as a formal unit at any level of hierarchic classification.
4. A group of interbreeding natural populations which are reproductively isolated from other such groups constitutes the \_\_\_\_\_
5. A \_\_\_\_\_ is a tabular arrangement of species, genera, orders or other classification categories according to character and traits that serve to identify them.
7. Different names given to the same taxon are called \_\_\_\_\_
8. The insect order discovered in 2002, has been named as \_\_\_\_\_ -
9. In \_\_\_\_\_ insects, the mouthparts are projected forward along the horizontal axis of the body.
10. The \_\_\_\_\_ are the external lines or grooves in the insect skeleton indication the division of distinct parts of the body wall.
11. The terminal part of the foregut is known as \_\_\_\_\_
12. The innermost layer of chitin in the wall of the foregut is termed as \_\_\_\_\_
13. When the distal ends of the Malpighian tubules are closely attached to the rectum, this condition is known as \_\_\_\_\_ -
14. The tracheae finally break up into a number of minute branches known as \_\_\_\_\_
15. The \_\_\_\_\_ is the basic functional unit of the nervous system.
16. The portion of the ovariole which contains the developing eggs is called \_\_\_\_\_
17. The sac for storage of sperms in the female reproductive system is called \_\_\_\_\_
18. Each vas deferens becomes enlarged along its course to form a sac known as \_\_\_\_\_ in which sperms are stored.
19. Each muscle fibre has an outer cell membrane called \_\_\_\_\_
20. The thick protein filament of muscle fibres is known as \_\_\_\_\_
21. The retention of waste materials in the body in a harmless form is called \_\_\_\_\_
22. When the heart rests in the expanded condition, this phase is called \_\_\_\_\_
23. The ingestion of foreign objects and microorganisms by haemocytes is known as \_\_\_\_\_
24. \_\_\_\_\_ are specialized hydrofuge hairs which hold a permanent thin film of air on the outside of the body.
25. The formation of spermatozoa from the germ cells in the testicular follicles is called \_\_\_\_\_
26. \_\_\_\_\_ refers to the development and maturation of ova.
27. When embryonic development is completed within the body of the female, it is called \_\_\_\_\_
28. \_\_\_\_\_ refers to the mode of reproduction by the immature forms.
29. \_\_\_\_\_ denotes the production of two or more embryos from a single egg.
30. \_\_\_\_\_ refers to the mode of reproduction by the immature forms.
31. The inner surface of the midgut is lined by a thin membrane known as the \_\_\_\_\_
32. When the anterior ends of the midgut and hindgut are brought into close proximity with one another and are connective tissue sheath, this is known as the \_\_\_\_\_ -
33. \_\_\_\_\_ includes all those developmental events that occur between the formation of the zygote and eclosion.
34. \_\_\_\_\_ comprises all developmental stages that occur between formation of the zygote and emergence of adult.

35. The changes in the body shape or form during development of the insects from egg to adult are known as \_\_\_\_\_
36. \_\_\_\_\_ are the cleavage cells which remain in the yolk or return to it after reaching the periphery of the egg.
37. \_\_\_\_\_ is the process by which mesoderm and endoderm are invaginated within the ectoderm.
38. \_\_\_\_\_ denotes all displacements, rotations or revolutions of the embryo within the egg.
39. \_\_\_\_\_ refers to the formation of various tissues involved in the differentiation of organs in the fully developed embryo.
40. The production of light by living organisms is called \_\_\_\_\_
41. \_\_\_\_\_ is a state of suspended development at any stage of the life cycle under adverse environmental conditions.
42. \_\_\_\_\_ is a type of parasitism in which a parasitoid attacks another parasitoid.
43. \_\_\_\_\_ is the optimum safe concentration of the left over pesticide or its degradation products according to good agricultural practices.
44. \_\_\_\_\_ is the daily exposure to a level of pesticide residue which does not manifest into an appreciable risk during the entire life time.
45. The term \_\_\_\_\_ is generally used to describe a population capable of damaging and surviving on plants previously known to be resistant to other populations of the same species.
46. \_\_\_\_\_ are non-nutritional chemicals, produced by an organism of one species and affect the growth, health, behavior or population biology of individuals of another species.
47. \_\_\_\_\_ are chemicals that are able to modify the behavior of perceiving organisms at submicro/nanogram levels.
48. A \_\_\_\_\_ is a chemical that is released to the exterior by an organism and causes one or more specific reactions in a receiving organism of the same species.
49. \_\_\_\_\_ are chemicals which prevent feeding of insects on a treated surface.
50. \_\_\_\_\_ are the chemicals which prevent insect damage to plants or animals by rendering them unattractive, unpalatable or offensive.
51. \_\_\_\_\_ may be defined as any unit that includes all the organisms in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles within the system.
52. Any energy source that reduces the cost of internal self-maintenance of the ecosystem and thereby increases the amount of other energy that can be converted to production is called \_\_\_\_\_
53. The transfer of food energy from the source in plants through a series of organisms with repeated eating and being eaten is called \_\_\_\_\_
54. \_\_\_\_\_ is a diagram of data representing the trophic structure at each trophic level.
55. The accumulation of toxicants at different trophic levels in the food chain is called \_\_\_\_\_
56. The opposite sex of the holotype, i.e. a paratype (at the time of description) is called the \_\_\_\_\_
57. The phenomenon of number of generations per year is called \_\_\_\_\_
58. Dr. S. Pradhan developed \_\_\_\_\_ which can be used to determine the rate of development of insects.
59. The infestation of a mite in honey bee is known to cause a disease called \_\_\_\_\_
60. The disease caused by a protozoan in honey bee is called \_\_\_\_\_
61. The disease caused in honey bee by a bacterium, *Bacillus larvae*, is known as \_\_\_\_\_
62. The insects which have only one generation in a year are called \_\_\_\_\_
63. The insects which have more than one generation in a year are called \_\_\_\_\_

64. Coconut mite, *Aceria guerreronis* Keifer belongs to the family \_\_\_\_\_
65. Red spider mite, *Oligonychus coffeae* (Nietner) belongs to the family \_\_\_\_\_
66. An interaction where one of the organisms is harmed by the associated unaffected organism is called \_\_\_\_\_
67. The disease caused by a sporozoan, *Nosema bombycis*, in silkworm is called \_\_\_\_\_
68. The disease caused by fungus, *Beauveria bassiana*, in silkworm is known as \_\_\_\_\_
69. The disease caused by nuclear polyhedrosis virus in silkworm is called \_\_\_\_\_
70. The bacterial disease caused by *Bacillus bombysepticus* in silkworm is known as \_\_\_\_\_
71. Royal jelly is the secretion of \_\_\_\_\_ glands to worker honey bees.
72. A chemical released by an organism which is favourable to the emitter is called \_\_\_\_\_
73. A chemical released by an organism which is beneficial to a member of another species, but not the emitter is known as \_\_\_\_\_
74. A chemical released by an organism which benefits both the sender and the receiver is called \_\_\_\_\_
75. \_\_\_\_\_ is the endoskeleton of the head formed from invagination of the body wall.
76. Killing of the pupae of silkworm in the cocoons is called \_\_\_\_\_
77. The complete desertation of the hive by the honey bees is called \_\_\_\_\_
78. \_\_\_\_\_ is a method of reproduction in which a part of the honey bee colony migrates to a new site to make a new colony.
79. The replacement of the old queen by the new daughter queen is known as \_\_\_\_\_
80. \_\_\_\_\_ is a type of parasitism where more individuals of the same species are present in a single host that can complete development in a normal way.
81. \_\_\_\_\_ is a type of parasitism where the host is attacked by two or more species or of parasitoids.
82. \_\_\_\_\_ is the second segment of the leg, between the coxa and femur.
83. An organism capable of transmitting pathogens from one host to another is called \_\_\_\_\_
84. A phenomenon where a species is characterized by high reproductive rate and low survival rate is called \_\_\_\_\_
85. A phenomenon where a species is characterized by low reproductive rate and high survival rate is called \_\_\_\_\_
86. \_\_\_\_\_ is a phenomenon where an insect-transmitted disease of an animal species enters a human population.
87. The egg tube of the ovariole, where there are no nutritive cells differentiated from the egg cells is called \_\_\_\_\_
88. The egg tube of the ovariole, where nutritive cells are present is known as \_\_\_\_\_
89. The banana aphid, *Pentalonia nigronervosa* is a vector of \_\_\_\_\_
90. The nymphs of Odonata are known as \_\_\_\_\_
91. \_\_\_\_\_ in okra is transmitted by whitefly, *Bemisia tabaci*.
92. \_\_\_\_\_ is the relaxation phase of the heart and results from the relaxation of muscles assisted by the elastic filaments supporting the heart.
93. The name of a superfamily is suffixed by \_\_\_\_\_
94. The name of a Tribe is suffixed by \_\_\_\_\_
95. The name of a subfamily is suffixed by \_\_\_\_\_
96. An insect with strong capacity for causing a disease (highly pathogenic) is called \_\_\_\_\_
97. An insect which is carrying a virus is known as \_\_\_\_\_

98. The feeding duration necessary to acquire a sufficient titer of virus by an insect vector is called \_\_\_\_\_
99. The time that elaps from initial acquisition of the virus by the insect vector to when it becomes able to transmit the virus, is known as \_\_\_\_\_
100. The junction between two neurons or between a neuron and another cell is known as \_\_\_\_\_

**Answers:**

1	Systematics	26	Oogenesis	51	Ecosystem	76	Stifling
2	Taxonomy	27	Viviparity	52	Energy subsidy	77	Abscending
3	Taxon	28	Paedogenesis	53	Food chain	78	Swarming
4	Species	29	Polyembryony	54	Ecological pyramid	79	Supersedure
5	Key	30	Parthenogenesis	55	Biomagnification	80	Superparasitism
6	Synonyms	31	Peritrophic embrane	56	Allotype	81	Multiple parasitism
7	Mantophasmatodea	32	Filter chamber	57	Voltinism	82	Trochanter
8	Tagmosis	33	Embryogenesis	58	Biometer	83	Vector
9	Prognathous	34	Morphogenesis	59	Acarine disease	84	R-strategyst
10	Sutures	35	Metamorphosis	60	Nosema disease	85	K-strategyst
11	Proventriculus	36	Vittelophages	61	American foul brood	86	Zoonosis
12	Intima	37	Gastrulation	62	Univoltine	87	Panoistic
13	Cryptonephridial condition	38	Blastokinesis	63	Multivoltine	88	Meroistic
14	Tracheoles	39	Organogenesis	64	Eriophyidae	89	Bunchy top virus
15	Neuron	40	Bioluminescence	65	Tetranychidae	90	Naiads
16	Vitellarium	41	Diapause	66	Amenasalism	91	Yellow vein mosaic
17	Spermatheca	42	Hyperparasitism	67	Pebrine	92	Diastole
18	Seminal vesicles	43	Maximum residue limit	68	Muscardine	93	-oidea
19	Sarcolemma	44	Acceptable daily intake	69	Grasserie	94	-ini
20	Myosin	45	Biotype	70	Flacherie	95	-inae
21	Storage excretion	46	Allelochemicals	71	Hypopharyngeal	96	Virulent
22	Diastasis	47	Semiochemicals	72	Allomone	97	Viruliferous
23	Phagocytosis	48	Pheromone	73	Kairomone	98	Acquisition access period
24	Plastron	49	Antifeedants	74	Synomone	99	Latent period or incubation period
25	Spermatogenesis	50	Repellents	75	Tentorium	100	Synapse

**Mark the statements true or false:**

1. The publication of the Indian Museum Notes was started in 1789.
2. The publication of the Fauna of British India series was started in 1892
3. The author of the book some South Indian Insects is T.B. Fletcher.
4. The Indian Council of Agricultural research was established in 1939
5. Dr. Hem Singh Pruthi was the founder President of the Entomological Society of India.
6. Dr. A.S. Atwal is considered to be the father of modern beekeeping in India.
7. The Directorate of Plant Protection. Quarantine and Storage was established in 1965.
8. Of all the known species of insects, Coleoptera contains the largest number of species.
9. S.M> Manton based her theory of origin of insects on monophyletic evolutionary lines.
10. Systematics and taxonomy are synonymous terms.
11. When one name has been given to two or more different taxa, it is called homohym.
12. The tenth edition of Systema Naturae was published in 1758.
13. The pedicel is the basal part of the antenna.
14. The sponging type of mouthparts are found in butterflies.
15. The basal segment of the leg is known as coxa.
16. In exarate type of pupae, the appendages are free and are not encapsulated within a cocoon.
17. Sclerotization is a process by which the cuticle becomes dark.
18. The 'filter chamber' is present in majority of the Homoptera.
19. The labial glands are commonly known as the salivary glands.
20. The Malpighian tubules are not present in Collembola.
21. Sensory nerves carry impulses from the central nervous system.
22. A line running across the whole fibre where actin filaments are joined together is called the Y-line.
23. A major part of digestion takes place in the foregut.
24. The groups of individuals of different species occupying a given area constitute an ecosystem.
25. Biotic potential refers to the inherent capacity of an organism to reproduce and survive.
26. Hibernation is related to temperature lower than the optimum, Whereas aestivation is related to temperatures higher than the optimum.
27. Symbiosis refers to close association between two different species which may be advantageous or disadvantageous to one of the species.
28. The recent estimates put the loss due to insect pests in India to field crops and during storage to the tune of Rs. 750 billion annually.
29. The Insecticide Act, 1968 was recently amended in 2003.
30. Painter proposed three terms for various mechanisms of resistance, viz., antixenosis, antibiosis and tolerance.
31. Tolerant varieties have a higher economic threshold level than the susceptible varieties.
32. Aphids constitute about 50 per cent of the species with known biotypes.
33. The release of *Trichogramma chilonis* Ishii has provided effective control of Sugarcane stalk borer.
34. *Coccinella septempunctata* Linnaeus is an effective predator of mustard sawfly.
35. The book *Silent Spring* by Rachel Carson was published in 1972.
36. The chronic toxicity refers to the toxic effect produced by a single dose of a toxicant.

37. Pyrethrum is obtained from the seeds of *Chrysanthemum cinerariaefolium*.
38. The first photostable pyrethroid, pyrethrin was developed in 1973.
39. The number of pesticide resistant insect and mite species has increased to more than 700 species.
40. Cross resistance refers to a phenomenon whereby a strain of a species selected by an insecticide shows resistance to other insecticides to which it has been exposed.
41. The first pheromone to be isolated and identified was bombycol from the silkworm.
42. The chemosterilants do not display mutagenic and carcinogenic action in animals.
43. The most successful field use of NPV has been made for the management of soyabean caterpillar in Brazil.
44. The most outstanding success of IPM through Farmers Field Schools has been achieved in Malaysia.
45. The replacement of the old honeybee queen by the new daughter queen is called supersedure.
46. Tail-wagging dance indicated short distance.
47. The process of transfer of mature larvae of silkworm to mountages is called stifling.
48. The silvery shoot in rice plants is due to feeding by the whorl maggot.
49. The cotton flowers infested by the American bollworm give a typical rosette appearance.
50. A landmark in IPM implementation in cotton has been achieved at village Ashta in Nanded district of Maharashtra.
51. Traps are used as absolute estimates of population of insects.
52. Yellow sticky traps are used for attracting planthoppers.
53. Besides pomegranate, *Virachola Isocrates* also attacks apple, citrus and guava.
54. The foregut in insects is ectodermal in origin.
55. The hindgut in insects is endodermal in origin.
56. The midgut in insects is ectodermal in origin.
57. In Asia, first case of insecticide resistance was reported from India, when singhara beetle, *Galericella birmanica*, was found resistant to DDT and HCH.
58. Malpighian tubules originated at the junction of mid and hind gut.
59. *Holotrichia* spp. Pupate as nymphs.
60. The long slender (without nodes) petiole is present in Vespidae.
61. San Jose scale passes the winter in adult stage.
62. Peach leaf curl aphid is found at the base of the buds in egg stage.
63. Grapevine thrips hibernates as pupa in winter.
64. Banana aphid, *Pentalonia nigronervosa* is a vector of papaya mosaic.
65. The mite, *Aceria ficus* is a vector of peach mosaic.
66. Coffee green bug is ovoviviparous.
67. The desert locust lays eggs on the leaves of host plants.
68. Gram cutworm aestivates in summer as adult moth.
69. Sugarcane stalk borer, *Chilo auricilius* passes winter as larva in canes or stubble.
70. *Culex* mosquito is a vector of dengue fever.
71. Wheat grain is not attacked by bruchids.
72. *Aphelinus mali* was introduced into India for the control of San Jose scale.
73. Peach fruit fly, *Bactrocera zonata*, passes the winter in pupal stage.
74. Walnut weevil, *Alcidodes porrectirostris*, passes the winter in adult stage.
75. Almond weevil, *Mylocerus lactivirens* passes the winter in larval stage.

76. Cottony cushion scale, *Icerya purchasi* generally reproduces parthenogenetically.
77. Mango stem borer, *Batocera rufomaculata* passes the winter in pupal stage.
78. Mango fruit fly, *Bactrocera dorsalis* passes the winter in pupal stage.
79. Ber fruit fly, *Carpomyia vesuviana*, passes the winter in larval stage.
80. Early sown cucuribits are severely damaged by red pumpkin beetle, *Aulacophora foveicollis*.
81. European corn borer, *Ostrinia nubilalis* does not occur in India.
82. The eggs of rice hispa are embedded in her leaf tissue towards the tip.
83. The larvae of rice ear-cutting caterpillar, *Mythimna separate* remain encased in leaf tissue and move with the case on the leaves.
84. Brown planthopper, *Nilaparvata lugens* is a vector of tungro
85. Whitebacked planthopper, *Sogatella furcifera*, is not known to transmit any virus disease.
86. Maize borer, *Chilo partellus*, hibernates as pupa.
87. Bean fly, *Ophiomyia phaseoli*, pupates inside the stem of the host plant.
88. Painted bug, *Bagrada hilaris*, passes winter in pupal stage.
89. Whitegrub, *Holotrichia* spp., pupate in plants debris.
90. Till hawk-moth, *Acherontia styx* passes the winter soil in pupal stage
91. Red cotton bug, *Dysdercus koenigi* passes winter in the nymphal stage.
92. Red cotton bug, *Dysdercus koenigi* lays eggs on leaves of the host plants.
93. Cabbage flea-beetle, *Phyllotreta cruciferae* overwinters in pupal stage.
94. *Opius fletcheri* is a pupal parasitoid of melon fruit fly, *Bactrocera cucurbitae*.
95. *Diadrumus collaris* is a larval – pupal parasitoid of diamondback moth, *Plutella xylostella*.
96. *Encarsia perniciosi* is an introduced parasitoid of woolly apple aphid.
97. The eggs of citrus psylla are stalked and embedded in plant tissue.
98. *Tetrastichus radiates* is a parasitoid of eggs of citrus psylla.
99. The phytoseiid mite, *Phytoseiulus persimilis*, is an effective parasitoid of phytophagous mites on vegetables.
100. The parasitoid, *Goniozus nephantidis* is monophagous larval parasitoid restricting only to coconut black – headed caterpillar, *Opisina arenosella*.

**Answers**

1	False (1889)	26	True	51	False (relative estimates)	76	True
2	True	27	True	52	True	77	False (grub)
3	True	28	True	53	True	78	True
4	False (1929)	29	False (2000)	54	True	79	False (pupa)
5	False (Mian Afzal Hussain)	30	False (non preference, antibiosis and tolerance)	55	False (ectodermal)	80	True
6	True	31	True	56	False (endodermal)	81	True
7	False (1946)	32	True	57	True	82	True
8	True	33	True	58	True	83	False (rice caseworm)
9	False (Polyphyletic evolutionary lines)	34	False (Mustard aphid)	59	False (larvae)	84	False (grassy stunt)
10	False (Not synonymous)	35	False (1962)	60	True	85	True
11	True	36	False (acute toxicity)	61	False (nmph)	86	False (larva)
12	True	37	False (Flowers)	62	True	87	True
13	False (Scape)	38	True	63	True	88	False (adult)
14	False (House fly)	39	True	64	False (bunchy top virus)	89	False (soil)
15	True	40	False (not been exposed)	65	False (fig mosaic)	90	True
16	True	41	True	66	True	91	False (adult)
17	False (hard)	42	False (do display)	67	False (soil)	92	False (soil)
18	True	43	True	68	True	93	False (adult)
19	True	44	False (Indonesia)	69	True	94	True
20	True	45	True	70	False (Aedes aegypti)	95	True
21	False (to the central nervous system)	46	False (long distance)	71	True	96	False (San Jose scale)
22	False (z-line)	47	False (mounting)	72	False (Woolly apple aphid)	97	True
23	False (midgut)	48	False (gall midge)	73	True	98	False (nymphs)
24	False (Community)	49	False (pink bollworm)	74	True	99	True
25	True	50	True	75	False (pupa)	100	True

**General Agriculture – Model Test – 1**

1. Which of the following is a short day plant?  
a. Sugar cane                      b. Sugar beet                      c. Wheat                      d. Onion  
Ans. A
2. Density of water is maximum at .....  
a. 4<sup>0</sup>C                      b. 0<sup>0</sup>C                      c. 100<sup>0</sup>C                      d. Density is always one.  
Ans. A
3. Ufra disease in Rice is caused by  
a. Melaidogyne                      b. Anguina                      c. Pratylenchus                      d. Ditylenchus  
Ans. D
4. The fruit in mustard is .....  
a. Siliqua                      b. Hesperidium                      c. Lomentum                      d. Pepo  
Ans. A
5. The content of nitrogen in ammonium sulphate is .....  
a. 21%                      b. 16%                      c. 33.5%                      d. 25%  
Ans. A
6. Herbicides are not used in the dust formulation, because of .....  
a. High concentration                      b. Persistence                      c. hazardous to cattle                      d. Drift Hazard  
Ans. D
7. White ear in Rice is due to .....  
a. Stem Borer                      b. Gall midge                      c. Cut worm                      d. Gundhi bug  
Ans. A
8. The fungicide most effective against smut is .....  
a. Vitavax                      b. Plantavax                      c. Tricyclazole                      d. Ediphenphos  
Ans. A
9. The inflorescence of sugarcane is .....  
a. Panicle                      b. Spike                      c. Curd                      d. Arrow  
Ans. D
10. Pairing of homologous chromosomes during Zygotene is called .....  
a. Synapsis                      b. Chiasma                      c. Fertilization                      d. Double fertilization  
Ans. A
11. First stable product formed in C<sub>3</sub> plants is .....  
a. PGA                      b. OAA                      c. Glucose                      d. Maleic Acid  
Ans. A
12. Example of an International/Universal pest is .....  
a. Desert Locust                      b. Pectinophora                      c. Gall midge                      d. Spodoptera  
Ans. A
13. Longest Meiotic Phase is .....  
a. Prophase                      b. Metaphase                      c. Anaphase                      d. Telophase  
Ans. A
14. Example of C<sub>4</sub> plant is .....  
a. Rice                      b. Wheat                      c. Maize                      d. All  
Ans. C
15. The green house gas that is released from paddy fields is .....  
a. CO<sub>2</sub>                      b. CH<sub>4</sub>                      c. N<sub>2</sub>O                      d. NH<sub>3</sub>  
Ans. B

16. The Mango variety suitable for High density planting is .....
- a. Amrapali                      b. Sindhu                      c. Ratna                      d. Dasherri
- Ans. A
17. B.P. Pal is a variety of .....
- a. Rose                      b. Chrysanthemum                      c. Gladiolus                      d. Jasmine
- Ans. A
18. Pellagra is due to the deficiency of .....
- a. Niacin                      b. Folic Acid                      c. Biotin                      d. Pyridoxine
- Ans. A
19. Brown revolution stands for the vitalization of .....
- a. Horticulture                      b. Oil seeds                      c. Agro-food processing                      d. Forest-wood
- Ans. C
20. The most abundant element in the living systems is .....
- a. Oxygen                      b. Nitrogen                      c. Hydrogen                      d. Carbon
- Ans. A
21. The Union Government differed decision on allowing the cultivation of genetically modified .....
- a. Cotton                      b. Maize                      c. Rice                      d. Bringal
- Ans. B
22. The colour of golden rice is due to .....
- a. Carotene                      b. Xanthophyll                      c. Loss of Chlorophyll                      d. None
- Ans. A
23. The food grain production in India during 2012-2013 is estimated at .....
- a. 212 MT                      b. 196 MT                      c. 187 MT                      d. 183 MT
- Ans. D
24. The state, leading in the coffee production is .....
- a. Kerala                      b. Assam                      c. Tamilnadu                      d. Karnataka
- Ans. D
25. How many National Bureaus working under ICAR ?
- a. 4                      b. 5                      c. 3                      d. 2
- Ans. B
26. Over the years the per cent contribution of agriculture to GDP is .....
- a. Decreasing                      b. Increasing                      c. Fluctuating                      d. Stable
- Ans. A
27. Boroa leaved weeds are controlled by .....
- a. Paraquat                      b. Dioxin                      c. 2,4-D                      d. Dutachlor
- Ans. C
28. Khaira in Rice is due to the deficiency of .....
- a. Mn                      b. Zn                      c. Fe                      d. Cu
- Ans. B
29. Saltation is type of .....
- a. Water erosion                      b. Salanization process                      c. Wind transport of soil                      d. None
- Ans. C
30. Most abundant protein in the world is .....
- a. Albumin                      b. Rubisco                      c. Caesin                      d. OAA
- Ans. B

**General Agriculture – Model Test – 2**

1. Indian cotton is .....
- a. Gossypium herbaceum      b. Gossypium arboreum      c. Gossypium hirsutum      d. Gossypium barbadens
- Ans. B
2. Example of a saline tolerant crop is .....
- a. Wheat      b. Rice      c. Barley      d. Maize
- Ans. C
3. ICAR is a .....
- a. Deemed University      b. Autonomous Institution      c. Educational Institution      d. Registered Society
- Ans. D
4. Highest CEC is found in .....
- a. Vermiculite      b. Montmorillonite      c. Illite      d. Kaolinite
- Ans. A
5. SSP has P content of .....
- a. 6.5-7.5%      b. 46-48%      c. 16-18%      d. 25.2%
- Ans. A
6. Nutrient helpful for the transport of sugar is .....
- a. K      b. Ca      c. P      d. Mg
- Ans. A
7. Muriate of potash is .....
- a.  $K_2SO_4$       b. KCl      c.  $KNO_3$       d.  $K_2HPO_4$
- Ans. B
8. Country leading in rice production is .....
- a. India      b. Indonesia      c. USA      d. None
- Ans. D
9. Triticale is a cross between .....
- a. Barley X Wheat      b. Rye X Wheat      c. Wheat X Rye      d. Wheat X Barley
- Ans. D
10. E.S.P. of normal soils is .....
- a. < 15%      b. >15%      c. < 4%      d. >4%
- Ans. A
11. The state leading in total oil seeds production is .....
- a. M.P.      b. U.P.      c. A.P.      d. Maharastra
- Ans. A
12. Production of seedless grape require .....
- a. Gibberellins      b. NAA      c. Ethylene      d. IAA
- Ans. A
13. Black heart of potato is due to .....
- a. Alternaria sps      b. Iron deficiency      c. Poorly drained soil      d. None.
- Ans. C
14. Sugar turn-out from cane in India is .....
- a. 8-10%      b. 19-20%      c. 14-15%      d. 23-25%
- Ans. A
15. The curve of normal distribution is .....

- a. Bell shaped                      b. Parabolic                      c. Sigmoid.                      d. Irregular but upwards
- Ans. A
16. Permanent wilting point is observed at .....
- a. - 15 bar                      b. -0.33 bar                      c. 0 bar                      d. 1 bar
- Ans. A
17. Mango can be propagated through .....
- a. Veneer grafting                      b. T-budding                      c. Inarching                      d. All
- Ans. D
18. Micro organism associated with the symbiotic N<sub>2</sub> fixation in non-legumes .....
- a. Frankia                      b. Azolla                      c. Clostridium                      d. Bacillus
- Ans. A
19. ha. of nursery needed for transplanting in 10ha. of main field of Rice is .....
- a. 1 ha.                      b. 2 ha.                      c. 5 ha.                      d. 0.5 ha.
- Ans. A
20. The Dwarf variety of rice released in India is .....
- a. IR-8                      b. TN-1                      c. Jaya                      d. APHR-1
- Ans. B
21. Head-quarters of WTO is located at .....
- a. Geneva                      b. Rome                      c. New York                      d. London
- Ans. A
22. Cereals are deficient in the amino acid .....
- a. Lysine                      b. Valine                      c. Tryptophan                      d. Glycine
- Ans. A
23. The law which is most valid in agricultural production is .....
- a. Law of APP                      b. Law of diminishing Returns                      c. Law of MPP                      d. None
- Ans. B
24. Homozygous diploids can be obtained through .....
- a. Anther culture                      b. Ebryo culture                      Ovule culture                      d. Ovary culture
- Ans. A
25. The per cent land resource of India in world is .....
- a. 2.4%                      b. 5.1%                      c. 16%                      d. 4.7%
- Ans. A
26. The authoritative body to approve genetically modified food crops is .....
- a. ICAR                      b. DBT                      c. GEAC                      d. ICGEB
- Ans. C
27. The highest award presented to an Agricultural scientist in the country is .....
- a. Charan Singh award                      b. Rafi Ahmad Kidwai Award                      c. Norman Borlaug prize                      d. J.Nehru Award
- Ans. B
28. Leading phosphatic fertilizer in the country is .....
- a. DAP                      b. SSP                      c. TSP                      d. Rock phosphate.
- Ans. A
29. The growth rate projected in the 12<sup>th</sup> five year plan is .....
- a. 5.6%                      b. 8.0%                      c. 3.5%                      d. 7%
- Ans. B
30. India is the largest producer, consumer as well as exporter of .....
- a. Spices                      b. Fruits                      c. Milk products                      d. Rice
- Ans. A

**General Agriculture – Model Test – 3**

01. The “Arka” series of varieties are released from .....
- a. IIHR – Bangalore      b. CPRI-Shimla      c. CPCRI-Kasargod      d. DOR-Hyderabad
- Ans. A
02. Emmer wheat is .....
- a. T.dicoccum      b. T. aestivum      c. T. durum      d. T. spherococcum
- Ans. A
03. Total assets/Total liabilities is .....
- a. net capital ratio      b. Working ratio      c. Current ratio      d. None
- Ans. A
04. Inflorescence of cauli flower is called .....
- a. Catkin      b. Head      c. Curd      d. None
- Ans. C
05. The first super fine aromatic Basmati hybrid released in India is .....
- a. GEB24      b. PUSA RH-23      c. PUSA RH-10      d. Pusa Basmati-1
- Ans. C
06. Major agricultural import in India is .....
- a. Edible oils      b. Fruits and nuts      c. Pulses      d. Sugar.
- Ans. A
07. Isolation distance in wheat is .....
- a. 3m X 3m      b. 25m X 10m      c. 200m X 100m      d. 1000m X 800m
- Ans. A
08. Date fruit is a .....
- a. Drupe      b. Nut      c. Berry      d. Capsule
- Ans. C
09. Which program also called package programme?
- a. IADP      b. IAAP      c. NATP      d. HYVP
- Ans. A
10. Whip tail of cauliflower is due to the deficiency of .....
- a. Mo      b. Cu      c. Fe      d. Mn
- Ans. A
11. Hatch-Slack cycle is absent in .....
- a. Sorghum      b. Rice      c. Maize      d. Sugarcane
- Ans. B
12. Leading country in sugar cane production is .....
- a. India      b. Cuba      c. Brazil      d. China
- Ans. A
13. Which of the following practice is done in banana?
- a. Wrapping      b. Propping      c. Nipping      d. Curing
- Ans. B
14. What stage of wheat is sensitive to moisture stress .....
- a. CRI      b. Flower      c. Dough      d. Hardening stage.
- Ans. A
15. The gross cropped area in our country is .....
- a. 193 Mha      b. 143 Mha      c. 155 Mha      d. 329 Mha.
- Ans. A
16. India is a net importer in .....

- a. Rice                                      b. Spices                                      c. Oil seeds                                      d. Coconut  
 Ans. C
17. The major soils in India are .....  
 a. Alluvial                                      b. Red soils                                      c. Black cotton soils                                      d. Laterites  
 Ans. A
18. Yellow rust in wheat is caused by .....  
 a. Puccinia graminis                                      b. Puccinia striiformis                                      c. Puccinia recondite                                      d. None tritici  
 Ans. B
19. Dwarf wheat gene is obtained from .....  
 a. Turkey                                      b. Mexico                                      c. USA                                      d. Australia  
 Ans. B
20. Enzyme devoid of protein is .....  
 a. Zymase                                      b. Diastase                                      c. RUBP carboxylase                                      d. Invertase  
 Ans. A
21. The highest ever food grain production achieved is .....  
 a. 212.0 MT                                      b. 183.2 MT                                      c. 195.9 MT                                      d. 219.8 MT  
 Ans. A
22. The largest producer of Tea in the world is .....  
 a. Sri Lanka                                      b. India                                      c. Malaysia                                      d. Brazil  
 Ans. B
23. India's share in the fruit production in the world is .....  
 a. 5%                                      b. 10%                                      c. 15%                                      d. 20%  
 Ans. B
24. The leading country in the productivity of grape?  
 a. India                                      b. France                                      c. Spain                                      d. Portugal  
 Ans. A
25. The leading fruit crop in terms of production is .....  
 a. Banana                                      b. Mango                                      c. Citrus                                      d. Sapota  
 Ans. A
26. The leading vegetable (Fruit) in India is .....  
 a. Brinjal                                      b. Tomato                                      c. Peas                                      d. Okra  
 Ans. A
27. India is the largest producer, consumer, processor and exporter of .....  
 a. Turmeric                                      b. Cashew nut                                      c. Chilli                                      d. Ginger  
 Ans. B
28. NAIS stands for .....  
 a. National Agricultural Information service  
 b. National Agricultural Input Scheme  
 c. National Availability of Indigenous Species  
 d. National Agricultural Insurance Scheme  
 Ans. D
29. Fertilizer consumed in India is .....  
 a. 17.3 MT                                      b. 13.7 MT                                      c. 20.06 MT                                      d. 12.14 MT  
 Ans. A
30. Which of the following fertilizers are completely imported?  
 a. Nitrogenous                                      b. Phosphatic                                      c. Potassic                                      d. Micro nutrient mixtures  
 Ans. C

**General Agriculture – Model Test – 4**

1. The share of agricultural exports in the total exports by India is .....  
 a. 13%                                      b. 21%                                      c. 54%                                      d. 8%
- Ans. A
2. The observation mostly followed in business transactions is .....  
 a. Mode                                      b. Median                                      c. Mean                                      d. B & C
- Ans. A
3. The contribution of agriculture to GDP of India is .....  
 a. 22.2%                                      b. 28.1%                                      c. 33%                                      d. 64%
- Ans. A
4. The state to adopt the panchayat raj system first is .....  
 a. A.P.                                      b. Karnataka                                      c. M.P.                                      d. Rajasthan
- Ans. D
5. Who is the present of Director General of ICAR ?  
 a. Magala Rai                                      b. Ayappah                                      c. R.S. Paroda                                      d. Panjab Singh.
- Ans. A
6. NATP is sponsored by .....  
 a. World Bank                                      b. UNDP                                      c. Govt. of India                                      d. ICAR
- Ans. A
7. The person associated with Etawah project is .....  
 a. Albert Mryer                                      b. Spencer Hatch                                      c. S.K. Dry                                      d. Daniel Hamilton.
- Ans. A
8. The moisture content for safe storage of cereals is .....  
 a. 12-14%                                      b. 14-16%                                      c. 16-18%                                      d. 18-20%
- Ans. A
9. Per cent oil content is highest in .....  
 a. Sesamum                                      b. Ground nut                                      c. Castor                                      d. Soyabean
- Ans. A
10. The worlds first super rice variety for saline and alkali soils is .....  
 a. Jaya                                      b. Lunishree                                      c. Pusa Sugandh – 2                                      d. Phulguna
- Ans. B
11. Centre of origin of rice is .....  
 a. South west Asia                                      b. South east Asia                                      c. South America                                      d. North America
- Ans. B
12. Severe form of water erosion in the following is .....  
 a. Sheet                                      b. Splash                                      c. Gully                                      d. Rill
- Ans. C
13. The formula for Mode is .....  
 a. 3 Median – 2 Mean                                      b. 2 Median – 3 Mean                                      c. (Median+Mean)/2                                      d. Can not be calculated from Mean and Median
- Ans. A
14. State leading in cotton production is .....  
 a. Maharastra                                      b. A.P.                                      c. Karnataka                                      d. Gujarat.
- Ans. A
15. MSP (minimum support price) is formulated by .....

- a. ICAR                                      b. CACP                                      c. FCI                                      d. NABARD  
 Ans. B  
 16. The multi-state Agricultural university in India is .....  
 a. PDKVV-Akola                              b. USA-Dharwad                              c. CAU – Imphal                              d. BCKVV - Kalyani  
 Ans. C  
 17. IGFRI is located at .....  
 a. Nagpur                                      b. Jhansi                                      c. Bhopal                                      d. New Delhi  
 Ans. B  
 18. The neurotoxin present in Lathyrus is .....  
 a. BOAB                                      b. BOAA                                      c. AOBA                                      d. AOAB  
 Ans. B  
 19. “Tundu” disease is due to .....  
 a. Nematode                                      b. Bacteria                                      c. fungi                                      d. A & B  
 Ans. D  
 20. Cashew belongs to the family .....  
 a. Caesalpinaceae                              b. Anacardiaceae                              c. Verbanaceae                              d. Mimosidae  
 Ans. B  
 21. Honey dew and Washington are varieties of.....  
 a. American cotton                              b. Papaya                                      c. Water melon                              d. Sapota  
 Ans. B  
 22. Gauch-1 is a variety of .....  
 a. Castor                                      b. Ground nut                                      c. Sesamum                                      d. Soyabean  
 Ans. A  
 23. Nucleus was discovered by .....  
 a. Robert Hooke                                      b. Robert Brown                                      c. Schleiden                                      d. Fontana  
 Ans. B  
 24. Haploid number of chromosomes in rice is .....  
 a. 8                                      b. 12                                      c. 16                                      d. 20  
 Ans. B  
 25. The constituent of wheat affecting it’s baking quality is .....  
 a. Glutin                                      b. Pectin                                      c. Vitamin B1                                      d. Moisture  
 Ans. A  
 26. Sulphide injury in rice leads to .....  
 a. Khaira                                      b. Akiochi                                      c. Whip tail                                      d. Browning  
 Ans. B  
 27. CRI stage in wheat is achieved at the age of .....  
 a. 21 days                                      b. 15 days                                      c. 53 days                                      d. A day before flowering.  
 Ans. A  
 28. Healthful herb is .....  
 a. Tea                                      b. Menthol                                      c. Eclipta alba                                      d. Rawolfia  
 Ans. A  
 29. Suicidal bags of cell are .....  
 a. Spherosomes                                      b. Lysosomes                                      c. Peroxisomes                                      d. Glyoxisomes  
 Ans. B  
 30. The only Agricultural scientist awarded Nobel prize is .....  
 a. Barbara Mc. Clintock                                      b. Norman E. Borlaug                                      c. H. Khorana                                      d. G.J. Mendal  
 Ans. B

**General Agriculture – Model Test – 5**

1. NABARD was set up on the recommendation of .....  
 a. Siva Raman Committee      b. Narasimhan committee      c. B. Hazare Committee      d. D.R. Gadgil committee  
 Ans. A
2. The estimated cost (Rs.) of river interlinking project is .....  
 a. 1.5 lakh crores      b. 5.6 lakh crores      c. 7.8 lakh crores      d. More than 10 Lakh crores  
 Ans. B
3. Which of the following is not a green house gas .....  
 a. Methane      b. CO<sub>2</sub>      c. Nitrous oxide      d. Chloro - fluoro carbons  
 Ans. D
4. If a pest confined to an area and occurs regularly, It's infestation is .....  
 a. Chronic      b. Epidemic      c. Endemic      d. Sporadic  
 Ans. C
5. White rust of crucifers caused by .....  
 a. Alternaria brassicae      b. Puccinia helianthi      c. Peronospora brassicae      d. Albugo candida  
 Ans. D
6. The discrete distribution whose Mean and variance are equal is .....  
 a. Normal Distribution      b. Binomial Distribution      c. Poisson Distribution      d. X<sup>2</sup>  
 Ans. C
7. Most extensively grown Rabi pulse crop in India is .....  
 a. Lentil      b. Red gram      c. Chick pea      d. Black Gram  
 Ans. C
8. Eight grams of oxygen is equal to .....  
 a. 0.1 mole      b. 0.5 mole      c. 0.25 mole      d. 0.125 mole  
 Ans. C
9. The unit of rural society is .....  
 a. town      b. Village Panchayat      c. Village      d. Co-operative society  
 Ans. B
10. Hard fruits of citrus is due to the deficiency of .....  
 a. N      b. P      c. B      d. Ca  
 Ans. C
11. Particular day which has rainfall more than ..... mm is called a rainy day  
 a. 2.7      b. 2.5      c. 3.0      d. 3.5  
 Ans. B
12. Which property of soil can not be changed?  
 a. Texture      b. Structure      c. Fertility      d. Productivity  
 Ans. A
13. India's rank in milk production is .....  
 a. 1<sup>st</sup>      b. 2<sup>nd</sup>      c. 3<sup>rd</sup>      d. 4<sup>th</sup>  
 Ans. A
14. One Cu Sec equals to .....  
 a. 28.32 liters      b. 30.48 litres      c. 30.12 litres      d. 4.5 litres  
 Ans. A

15. Late sown variety of wheat .....  
 a. Sonalika                      b. Arjun                      c. Heera                      d. Sonara 64  
 Ans. A
16. Tetrasomic is .....  
 a.  $2n-1-1$                       b.  $2n+4$                       c.  $2n+2$                       d.  $2n+1$   
 Ans. C
17. Precursor of IAA is .....  
 a. Tryptophan                      b. IBA                      c. Tyrosine                      d. Thymine  
 Ans. A
18. Central Institute of Post - Harvest Engineering and Technology located at .....  
 a. Ludhiana                      b. Lucknow                      c. New Delhi                      d. Karnal  
 Ans. A
19. Fruit of Okra is .....  
 a. Berry                      b. Capsule                      c. Lomentum                      d. Shizocarp  
 Ans. B
20. Premier oil seed crop of India is .....  
 a. Ground nut                      b. Soybean                      c. Lentil                      d. Mustard  
 Ans. A
21. Macaroni wheat is .....  
 a. *T. aestivum*                      b. *T. durum*                      c. *T. longiceps*                      d. None  
 Ans. B
22. Indian Institute of Tropical Meteorology is located at .....  
 a. Pune                      b. Ghopal                      c. New Delhi                      d. Nagpur  
 Ans. A
23. IADP is started in the year .....  
 a. 1965-66                      b. 1960                      c. 1952                      d. 1974  
 Ans. B
24. Person associated with Gurgoan pilot experiment .....  
 a. P.L. Brayne                      b. Albert Merger                      c. S.K> Dey                      d. A.T. Mosher  
 Ans. A
25. The formula of standard error of Mean is .....  
 a.  $\sigma / \sqrt{n}$                       b.  $\sigma \times 100 / \bar{x}$                       c.  $\sigma / n$                       d.  $\sqrt{n} / \sigma$   
 Ans. A
26. The formula for rate turnover is .....  
 a. Total Assets X 100 Total Liabilities                      b. Differed liabilities / Net worth  
 c. Total expenses /Gross income                      d. Gross income – Cost C  
 Ans. A
27. Which of the following is a virus free culture .....  
 a. Cell culture                      b. Meristem culture                      c. Organ Culture                      d. Anther culture  
 Ans. B
28. Net irrigated area of our country is .....  
 a. 57 Mha                      b. 87 Mha                      c. 67 Mha                      d. 77 Mha  
 Ans. A
29. Multilines are developed through .....  
 a. Back cross                      b. Pedigree Selection                      c. Mass selection                      d. None  
 Ans. A
30. Power house of cell is .....  
 a. Mitochondria                      b. Chloroplast                      c. nucleus                      d. E.R.  
 Ans. A

**General Agriculture – Model Test – 6**

1. “Alphanso” variety of mango is mostly grown in the state of .....  
a. Punjab                      b. Bihar                      c. Maharastra                      d. West Bengal  
Ans. C
2. Vitamin containing cobalt as a constituent is .....  
Ans. a. B<sub>2</sub>                      b. B<sub>6</sub>                      c. B<sub>1</sub>                      d. B<sub>12</sub>  
D
3. Which of the following is a milk protein .....  
a. Lactin                      b. Galactose                      c. Caesin                      d. Collagen  
Ans. C
4. Which of the following antibiotic is produced from bacteria .....  
a. Pencillin                      b. Bacitracin                      c. Tetracycline                      d. Neomycin  
Ans. B
5. Which of the following is a free living nitrogen fixing organism  
a. Rhizobium                      b. Azorhizobium                      c. Azospirillum                      d. Azotobacter  
Ans. D
6. Dark reaction of Calvin cycle takes place in .....  
a. Thylakoids                      b. Stroma                      c. Cristae                      d. Fret work  
Ans. B
7. Exanthema of citrus is due to the deficiency of .....  
a. Zn                      b. Cu                      c. Mn                      d. Fe  
Ans. B
8. Malathion is a .....  
a. Chlorinated hydrocarbon                      b. Organo-phosphate  
c. Carbamate                      d. Pyrethroid  
Ans. B
9. Dwarfing gene in wheat is .....  
a. Norin-10                      b. Dee-gee-woo-gen                      c. GH 23                      d. None  
Ans. A
10. Dead heart in sugarcane is due to .....  
a. Shoot borer                      b. Top borer                      c. Internode borer                      d. None  
Ans. A
11. Wheat gall nematode is .....  
a. Meloidogyne                      b. Anguina                      c. Pratylenchus                      d. Ditylenchus  
Ans. B
12. One Hectare – inch of water is equal to  
a. 10<sup>5</sup> litres                      b. 2.5X10<sup>5</sup> litres                      c. 10<sup>4</sup> litres                      d. 2.5X10<sup>4</sup> litres  
Ans. B
13. Weed that mimics wheat plant is .....  
A. Phalaris                      b. Echinochloa                      c. Cyperus                      d. Chicorium  
Ans. A
14. Centre of origin of Wheat is .....  
a. Turkey                      b. Mexico                      c. Brazil                      d. USA  
Ans. B
15. Debt – equity ratio is .....  
a. Differed liabilities/Net worth                      b. Gross income/Total assets  
c. Current liabilities/Owners equity                      d. Owners equity/Total asset value  
Ans. A

16. Recent WTO ministerial conference is held at .....
- a. Seattle                      b. Geneva                      c. Doha                      d. New Delhi
- Ans. C
17. Total number of deemed universities under ICAR are .....
- a. 4                      b. 3                      c. 2                      d. 10
- Ans. A
18. The Agricultural universities in India were established on the pattern of .....
- a. Land grant universities of USA                      b. Agricultural Universities of Great Britain
- c. Tennessee Valley Authority                      d. Cornell University of USA
- Ans. A
19. LAB to LAND programme started in the year .....
- a. 1979                      b. 1965                      c. 1971                      d. 1986
- Ans. A
20. Kresek symptom is observed when rice is attacked by .....
- a. Blast                      b. Brown Spot                      c. BLB                      Sheath Blight
- Ans. C
21. Loose smut is a .....
- a. Internally seed borne                      b. Externally seed borne                      Air borne                      d. None
- Ans. A
22. Which of the disease caused a set back to Indian wheat exports.....
- a. Stem Rust                      b. Karnal Bunt                      c. Loose Smut                      d. Leaf Rust
- Ans. B
23. Chromosomal theory of inheritance was proposed by .....
- a. Jacob & Monad                      b. Sutton & Boveri                      c. Strasburger                      d. G.J. Mendel
- Ans. B
24. Who is not a recipient of world food prize .....
- a. Swaminathan                      b. Subramanian                      c. V. Kurian                      d. S.K. Wasal
- Ans. B
25. In which distribution Mean, Median and Mode are equal .....
- a. Normal                      b. Binomial                      c. Poisson                      d.  $X^2$
- Ans. A
26. Which of the following SAU's was established first .....
- a. BCKVV                      b. TNAU                      c. GBPUA & T                      d. PAU
- Ans. C
27. The maximum Nitrogen content is found in .....
- a. Urea                      b.  $NH_3$                       c. Urea formaldehyde                      d.  $NH_4NO_3$
- Ans. B
28. The term Genetics was coined by .....
- a. William Gaude                      b. Mendel                      c. Haldane                      d. Bateson
- Ans. D
29. Which of the following is a metamorphic rock .....
- a. Marble                      b. Quartzite                      c. Gneiss                      d. All
- Ans. D
30. State leading the wheat production is .....
- a. UP                      b. Punjab                      c. Haryana                      d. M.P.
- Ans. A











- Ans. b
15. Most of cultivated rice varieties belongs to which group  
 a. Japonica                                      b. Javanica                                      c. Indica                                      d. Jamaica
- Ans. c
16. Cold resistant variety of rice  
 a. Tellahamsa                                      b. Samba                                      c. Ratna                                      d. Nagavali
- Ans. a
17. Which state occupies 1<sup>st</sup> in area and production (in Rice)  
 a. M.P.                                      b. A.P.                                      c. U.P.                                      d. W.B.
- Ans. d
18. Plant types, which are morphologically and physiologically ideal, are  
 a. Old plant types                                      b. Ideotypes                                      c. Both                                      d. None
- Ans. b
19. New plant types first developed in  
 a. Rice                                      b. Wheat                                      c. Maize                                      d. Sorghum
- Ans. B
20. Scented rice hybrid variety is  
 a. Basmati                                      b. Sugandha                                      c. Pusa-10                                      d. Pusa-jaikisan
- Ans. C
21. Bora rice planting is done during  
 a. January – February                                      b. September-October                                      c. Nov – Dec                                      d. March - April
- Ans. C
22. Dapog method was 1<sup>st</sup> adopted in  
 a. China                                      b. India                                      c. Philippines                                      d. Israel
- Ans. C
23. Seed rate generally followed in dapog nursery kg/ha.  
 a. 20                                      b. 30-40                                      c. 100                                      d. 1
- Ans. B
24. Most drought tolerant pulse crop  
 a. Sorghum                                      b. Bajra                                      c. Chickpea                                      d. Cowpea
- Ans. D
25. Most drought tolerant cereal crop  
 a. Maize                                      b. Sorghum                                      c. Rice                                      d. Wheat
- Ans. B
26. High lysine maize variety  
 a. Shakthi                                      b. Protima                                      c. Opaque-2                                      d. all the above
- Ans. A
27. Variety of maize with high starch content  
 a. Shakthi                                      b. Protima                                      c. Opaque-2                                      d. None
- Ans. C
28. Cropping intensity (high poetncincay) is not related to  
 a. Spacing                                      b. Seedrate                                      c. Area                                      d. Intercropping
- Ans. D
29. Phalaris minor mimicas  
 a. Rice                                      b. Wheat                                      c. Maize                                      d. Sorghum













119. Relative proportion of various soil particles is  
 a. Soil structure                      b. Soil color                      c. Soil topography                      d. Soil texture  
 Ans. D
120. pH scale was designed by  
 a. Leibig                      b. Mitscherlich                      c. Sorenson                      d. Samsun  
 Ans. C
121. CEC is highest for  
 a. Kaolinite                      b. illite                      c. Montmorillinite                      d. Vermiculite  
 Ans. D
122. Large soil order in India  
 a. antisoils                      b. Vertisols                      c. inceptisols                      d. ultisols  
 Ans. C
123. Inter dominant soils in India (area wise)  
 a. Red soils                      b. Laterites                      c. Black soils                      d. Alluvial soils  
 Ans. D
124. Reclamation of alkali soils is done by  
 a. Leaching                      b. Gypsum application                      c. Liming                      d. None  
 Ans. B
125. Reclamation of saline soils is done by  
 a. Leaching                      b. Gypsum application                      c. Both                      d. None  
 Ans. A
126. Most Powerful measure of central tendency  
 a. G.M                      b. A.M.                      c. H.M.                      d. Median  
 Ans. B
127. Best and most powerful measure of dispersion is  
 a. range                      b. Mean deviation                      c. S.D.                      d. Coefficient of variation  
 Ans. C
128. Mode is  
 a.  $3 \text{ median} - 2 \text{ mode}$                       b.  $2 \text{ median} - 3 \text{ mode}$                       c.  $2 \text{ mode} / 3 \text{ median}$                       d.  $3 \text{ median} / 2 \text{ mode}$   
 Ans. A
129. Accepting null hypothesis when it is infact false is  
 a. Type 1 error                      b. Type 2 error                      c. error                      d. type 3 error  
 Ans. B
130. To compare two dependent sample we use  
 a. 1 sample t-test                      b. 2 sample t-test                      c. paired t-test                      d. f-test  
 Ans. C
131. Range of correlation coefficient  
 a. -1 to + 1                      b. -  $\alpha$  to +  $\alpha$                       c. 0 to  $\alpha$                       d. o to + 1  
 Ans. A
132. If SEM is 2 then SED is  
 a.  $\sqrt[2]{2}$                       b. 2                      c. 1                      d.  $\sqrt[1]{2}$   
 Ans. A



148. KVK was recommended by  
 a. Ashok Mehta committee    b. Balwant Rai Mehta committee    c. Mohan Singh Mehta committee    d. Shantilal Mehta committee  
 Ans. C
149. The state to adopt panchyat raj system first is  
 a. A.P.    b. M.P.    c. Karnataka    d. Rajasthan  
 Ans. D
150. Father of White revolution, who is world food prize recipient  
 a. M.S.Swaminathan    b. S.K.Wasal    c. Gurudev singh kush    d. Vergheese Kurian  
 Ans. D

**Match with correct answer:**

151. a. t – test    1. Galton  
 b. Anova    2. Gosset  
 c. f - test    3. R.A. Fisher  
 d. N.D    4. Karlapearson  
 e. Regression    5. Demovrie  
 Ans. 1. e 2. a 3. c 4. b 5. d
152. a. Saltation    1. a. weischmier & smith  
 b. Suspension    2. Particle size is 0.1 – 0.5 mm  
 c. Usle    3. Particle size is > 0.5 & < 0.1 mm  
 d. Sedimentary rocks    4. Marble  
 e. Metamorphic rocks    5. Limestone  
 Ans. 1. c 2. a 3. b 4. e 5. d
153. a. Meosis – i    1. Shortest  
 b. Meosis – ii    2. Longest  
 c. Prophse    3. Uniparental inheritance  
 d. anaphase    4. Co-orientation  
 e. Mitosis    5. Auto – orientation  
 Ans. 1. d 2. c 3. e 4. a 5. b
154. a. Promoter    1. Ligase  
 b. C-DNA    2. Topoisomerase  
 c. Gene    3. Cistron  
 d. DNA    4. Reverse transcriptase  
 e. Cloning    5. Cis-acting elements  
 Ans. 1. e 2. d 3. c 4. b 5. a
155. a. Auxins    1. Carotenoids  
 b. GA    2. Adenine  
 c. Cytokinins    3. Mevolenatate  
 d. ABA    4. Methione  
 e. Ethylene    5. Tryptophan  
 Ans. 1. d 2. c 3. b 4. e 5. A

156. a. Niacin  
b. Vitamin – C  
c. Vitamin – B<sub>12</sub>  
d. Folic acid  
e. Vitamin – B<sub>1</sub>
1. Pernicious anemia  
2. Anemea  
3. Scurvvy  
4. Beri-beri  
5. Pellagra

Ans. 1. c 2. d 3. b 4. e 5. a

157. a. Sucrose  
b. White  
c. Golden yellow  
d. Azure blue  
e. Pink
1. Foundation seed  
2. Breeders seed  
3. Non-reducing sugar  
4. Registered seed  
5. Certified seed

Ans. 1. b 2. c 3. a 4. e 5. b

158. a. Anabaena – azolla  
b. Bacillus subtilis  
c. Free living  
d. Autotroph  
e. Frankia
1. Actinomycetes  
2. Azolla  
3. Nitrosomonas  
4. Azospirillum  
5. p-solubiliser

Ans. 1. e 2. a 3. b 4. c 5. d

159. a. White ear  
b. Onion shoot  
c. Rectangular white streaks  
d. Folding of leaves  
e. Alley way
1. Leaf roller  
2. Stemborer  
3. Gallmidge  
4. BPH  
5. Rice hispa

Ans. 1. d 2. a 3. b 4. e 5. c

160. a. IRDP  
b. DPAP  
c. HYVP  
d. CDP  
e. IAAP
1. 1964  
2. 1966  
3. 1952  
4. 1970-71  
5. 1979

Ans. 1. e 2. c 3. d 4. b 5. a

## STATISTICAL DATA ABOUT AGRICULTURE PRODUCTION & AREA

1. Rice production of India in year 2002 – 03  
Ans. 77.7 m.t.
2. Wheat production of India in year 2002 -03  
Ans. 68.9 m.t.
3. Coarse cereals production of India in year 2002-03  
Ans. 25.10 m.t.
4. Pulses production of India in 2002-03  
Ans. 90.30 m.t.
5. Total kharif season production in 2002-03  
Ans. 90.30 m.t.
6. Total rabi season production in 2002-03  
Ans. 92.90 m.t.
7. Total (kharif+rabi) production in 2002-03  
Ans. 183.20 m.t.
8. Groundnut production in 2002-03  
Ans. 4.70 m.t.
9. Rape seed/mustard production in 2002-03  
Ans. 4.5 m.t.
10. Soya bean production in 2002-03  
Ans. 4.3 m.t.
11. Total oil seeds production in 2002-03  
Ans. 15.4 m.t.
12. Cotton (Bales) production in 2002-03  
Ans. 8.9 m.t.
13. Jute & Mesta (Bales) production in 2002-03  
Ans. 11.50 m.t.
14. Sugar Cane production in 2002-03  
Ans. 285.40 m.t.
15. Nitrogenous fertilizer consumption in 2002-03  
Ans. 11.30 m.t.
16. Phosphatic fertilizer consumption in 2002-03  
Ans. 4.38 m.t.
17. Potassic fertilizer consumption in 2002-03  
Ans. 1.67 m.t.
18. Total (N+P+K) fertilizer consumption  
Ans. 17.30 m.t.
19. Ratio of N:P:K in 2002-03  
Ans. 6.0: 2.62: 1.0
20. The state which is first in food grains production  
Ans. Uttar Pradesh
21. The state which is second in food grains production  
Ans. Punjab
22. The state which is 1<sup>st</sup> in rice production  
Ans. West Bengal

23. The state which is 2<sup>nd</sup> in rice production  
Ans. Uttar Pradesh
24. Highest area of the crop  
Ans. Rice
25. The state which is 1<sup>st</sup> in Wheat production  
Ans. Punjab
26. The state which is 2<sup>nd</sup> in Wheat production  
Ans. Uttar Pradesh
27. The state which is 1<sup>st</sup> in per/ha. wheat production  
Ans. Punjab
28. The state which is 1<sup>st</sup> in pulse production  
Ans. Uttar Pradesh
29. The state which is 2<sup>nd</sup> in pulse production  
Ans. Madhya Pradesh
30. The state which is 1<sup>st</sup> in oil seeds production  
Ans. Madhya Pradesh
31. The state which is 2<sup>nd</sup> in oil seeds production  
Ans. Andhra Pradesh
32. The state which is 1<sup>st</sup> in Groundnut production  
Ans. Gujarat
33. The state which is 1<sup>st</sup> in Mustard production  
Ans. Rajasthan
34. The state which is 1<sup>st</sup> in Sugarcane production  
Ans. Uttar Pradesh
35. The state which is 2<sup>nd</sup> in Sugarcane production  
Ans. Maharashtra
36. The State which is 1<sup>st</sup> in cotton production  
Ans. Maharashtra
37. The state which is 1<sup>st</sup> in Jute production  
Ans. West Bengal
38. The state which is 1<sup>st</sup> in Tea production  
Ans. Aassam
39. The state which is 1<sup>st</sup> in Coffee production  
Ans. Karnataka
40. The state which is 1<sup>st</sup> in Rubber production  
Ans. Kerala
41. The state which is 1<sup>st</sup> in Potato production  
Ans. Uttar Pradesh
42. The state which is 1<sup>st</sup> in Onion production  
Ans. Maharashtra
43. The country which is 1<sup>st</sup> in rice production  
Ans. China
44. India's rank in rice production  
Ans. Second
45. Country which is 1<sup>st</sup> in Wheat production  
Ans. China

46. Country which is 2<sup>nd</sup> in Rice production  
Ans. India
47. Country which is 1<sup>st</sup> in Sugarcane production  
Ans. India
48. Country which is 2<sup>nd</sup> in Sugarcane production  
Ans. Brazil
49. Country which is 1<sup>st</sup> in cotton production  
Ans. U.S.A.
50. Country which is 1<sup>st</sup> in Tea production  
Ans. India
51. Country which is 1<sup>st</sup> in tobacco production  
Ans. China
52. India's rank in Tobacco production  
Ans. Third
53. Country first in Coffee production  
Ans. Brazil
54. Country first in Jute production  
Ans. India
55. Country first in Rubber Production  
Ans. Malaysia
56. India's rank in Coconut production  
Ans. Third
57. Largest producer of Tea in world.  
Ans. India
58. Largest consumer of Tea in world  
Ans. India
59. Percentage account of India of world production  
Ans. 20%
60. Percentage account of India of world trade  
Ans. 14%
61. Percentage account of India of world fruit production  
Ans. 10%
62. Fruit production of India in m.t.  
Ans. 46 m.t.
63. The fruit which is 1<sup>st</sup> in area in our country.  
Ans. Mango
64. The fruit which is 2<sup>nd</sup> in area in our country  
Ans. Citrus fruit
65. The fruit which is 3<sup>rd</sup> in area in our country.  
Ans. Banana
66. The fruit which is 1<sup>st</sup> in production in India  
Ans. Banana
67. The fruit which is 2<sup>nd</sup> in production in India  
Ans. Mango
68. The fruit which is 3<sup>rd</sup> in production in India  
Ans. Citrus

69. Rank of India's in cauliflower production  
Ans. First
70. India's rank in onion production  
Ans. Second
71. India's rank in cabbage production  
Ans. Third
72. Country which is first in vegetable production  
Ans. China
73. Country which is 2<sup>nd</sup> in vegetable production  
Ans. India
74. Largest producer and consumer of cashew  
Ans. India
75. Largest Exporter of cashew  
Ans. India
76. Ideal application ratio of fertilizer is  
Ans. 4:2:1
77. Fertilizer which is imported by India  
Ans. Potassic fertilizer
78. Agricultural exports accounts of total export  
Ans. 13%
79. Agricultural imports of total imports  
Ans. 4.3%
80. Imports account of edible oils.  
Ans. 63.50%
81. Imports account of pulses  
Ans. 21.50%
82. Ultimate irrigation potential of India  
Ans. 139.89 M.ha.
83. Gross cropped area of India is  
Ans. 193 M.ha.
84. Gross irrigated area of India is  
Ans. 76 M.ha.
85. Net irrigated area is  
Ans. 57 M.ha.
86. Net cropped area is  
Ans. 143 M.ha.
87. Cropping intensity of India is  
Ans. 135.10 M.ha.
88. Total degraded land of India is  
Ans. 187 M.ha.
89. Geographical area of India is  
Ans. 328 M.ha.
90. Forest area of India is  
Ans. 19.5%
91. Highest forest area in the state  
Ans. Madhya Pradesh

92. Highest geographical area in the state  
Ans. Rajasthan
93. Highest irrigated state  
Ans. Punjab
94. Highest productivity/ha. of the state  
Ans. Punjab
95. Supporting price of Wheat for 2002  
Ans. Rs. 610
96. Highest rainfall occurs in India  
Ans. Mousinram
97. Lowest rainfall in India  
Ans. Jaiselmer
98. Fort of Soyabean known as  
Ans. Madhya Pradesh
99. Garden city known as  
Ans. Bangalore
100. Lowest forest area of India is  
Ans. Western Rajasthan
101. Arable land per head highest of the county  
Ans. Australia (57ha./head)
102. Non reporting area is maximum in  
Ans. Jammu & Kashmir
103. Highest water erosion in the state  
Ans. West Bengal
104. Highest wind erosion in the state  
Ans. Rajasthan
105. The state which is 2<sup>nd</sup> in geographical area.  
Ans. Madhya Pradesh
106. The monsoon which covered highest area in rainfall in India  
Ans. South West Monsoon
107. Highest alluvial soils found in the state  
Ans. Uttar Pradesh
108. First Agricultural University of India  
Ans. G.B. Pant University of Agriculture and Technology, Pant nagar
109. The state which have oldest Agricultural University  
Ans. Uttranchal
110. The Agricultural University which named on India's first President belong to the same state.  
Ans. Rajendra Agricultural University, Bihar.
111. State which have highest area of saline soils.  
Ans. Gujarat
112. Highest area of acidic soils in the state is.  
Ans. West Bengal
113. Highest fertilizer consumption (total) of the state.  
Ans. Uttar Pradesh
114. Highest per/ha. fertilizer consumption of the state  
Ans. Pondichary

115. Highest source of irrigation in India.  
Ans. Wells (52%)
116. Highest open wells are in the state.  
Ans. Gujarat
117. Highest irrigation by canal in the state.  
Ans. Punjab
118. Storage canal found in the state.  
Ans. Madhya Pradesh
119. Total dry land area of India is  
Ans. 34.5 M.ha.
120. Total rainfall area of India is  
Ans. 65.5 M.ha.
121. Percentage arid area of total area of India is  
Ans. 17%
122. Percentage humid area of total area of India is  
Ans. 1.10%
123. Central Agriculture minister is  
Ans.
124. State Agriculture minister is  
Ans.
125. D.G. of I.C.A.R. is  
Ans. Ayappan
126. Contribution of Agriculture in national economy.  
Ans. 26.5%
127. Total state Agricultural Universities are  
Ans. 34

**Basic Principal of crop production:**

128. **Father of Agronomy**  
Ans. Peter Dearesenzi
129. Who wrote the book Horse Hoeing Husbandry is  
Ans. Jethrotull
130. Father of weed Science.  
Ans. Jethrotull
131. Jhum cultivation mostly found in  
Ans. Eastern part of India
132. **Demerit of shifting cultivation is**  
Ans. Soil loss
133. **Object of sustainable Agriculture is.**  
Ans. Ecological balance
134. The pattern of planting has maximum plant population  
Ans. Cubodial pattern

135. Farming which includes crop production and live stock.  
Ans. Mixed farming
136. A system of growing the same crop on the same land year after year is known as.  
Ans. Mono cropping
137. Cultivation of such crops which have different natural habit and zero competition is known as  
Ans. Parallel cropping  
The cropping system in which the yields of both crop are higher than of their pure crops on unit area basis called as
138. area basis called as  
Ans. Synergetic cropping  
Cultivation of two or more than two crops of different heights simultaneously on a certain piece of land in any certain period is called as
139. land in any certain period is called as  
Ans. Multistoried cropping
140. Cropping intensity will be always 100% in  
Ans. Mono cropping
141. Peira cropping is mostly adopted in  
Ans. Bihar & West Bengal
142. Utera cropping is mostly adopted in.  
Ans. Madhya Pradesh
143. The farming system used to develop at the Mars according to the Earth's environment is called  
Ans. Terra farming
144. Formula of Harvest Index is.  
$$\frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$
- Ans.  $\frac{\text{Economic yield}}{\text{Biological yield}} \times 100$
145. Agro climatic Regional planning in India was initiated in which five year plan  
Ans. 7<sup>th</sup> Five year plan (1988).
146. Total agro climatic zones in India are  
Ans. 15 zones
147. Cultivation of crops in areas where annual rainfall is less than 750mm is called as  
Ans. Dry farming  
Cultivation of crops in areas where annual rainfall is more than 750mm. but less than 1150 mm is called as
148. called as  
Ans. Dry land farming
149. Means cultivation of crops in regions where annual rainfall is more than 1150 mm is called as.  
Ans. Rain fed Farming
150. When annual rainfall is less than 75% of normal the situation will be called as  
Ans. Drought
151. If deficiency of rainfall is above 50% of the normal the situation will be called as  
Ans. Severe drought
152. Supplemental irrigation is known as  
Ans. Life saving irrigation
153. P.M.A. is a type of antitranspirants  
Ans. Stomata closing type
154. Kaolin is a type of antitranspirants  
Ans. Reflecting type
155. Cycocel is a  
Ans. Growth retardants



180. Formula of Real value is  
Ans. 
$$RV = \frac{TePurity \% \times Germination \%}{100}$$
181. The seed which is known as mother seed is  
Ans. Breeder seed
182. Cyperus rotandus is a  
Ans. Absolute weed
183. State, where seed law are adopted  
Ans. Karnataka
184. The weed which was first biologically controlled  
Ans. Lantana Camaera
185. Trade name of Alachlor  
Ans. Lasso
186. **Trade name of Butachlor**  
Ans. Machete
187. Trade name of Nitrofen  
Ans. Toke
188. Trade name of Fluchloralin  
Ans. Basalin
189. Trade name of Propanil  
Ans. Stam F-34
190. Trade name of Pendamethalin  
Ans. Stomp
191. Total root parasite  
Ans. Orobanche
192. **Total stem parasite**  
Ans. Cuscuta
193. Semi root parasite  
Ans. Striga
194. Semi stem parasite  
Ans. Loranthus
195. Orobanche is also known as  
Ans. Broom rape
196. Striga is also known as  
Ans. Witch weed
197. Host crops of orobanche  
Ans. Tobacco, Chili, Brinjal & Potato
198. Host plants of striga  
Ans. Sorghum, Maize, Sugarcane & Sunflower
199. Cuscuta is associated with  
Ans. Lucern crop
200. **Horizontal flow of water in channel is called as**  
Ans. Seepage
201. Vertical movement of water in soil is known as  
Ans. Percolation
202. PF value was first time introduced by  
Ans. Schofield

203. Soil moisture tension directly measured by  
Ans. Tensiometer
204. **Lysimeter is used for measurement of**  
Ans. Evapo – transpiration
205. Parshall flume is used for measurement of  
Ans. Water flow
206. Flooding irrigation method commonly used for  
Ans. Rice
207. Fertilizer application through irrigation known as  
Ans. Fertigation
208. Important cultural practice in rice field  
Ans. Puddling
209. Power tiller is most suitable for the cultivation of  
Ans. Paddy
210. **Post harvest losses for cereals accounts for**  
Ans. 10%
211. Salination is a process of  
Ans. Wind erosion
212. Highly salt tolerant cereal crop is  
Ans. Barley
213. Irrigation efficiency of loam soil is  
Ans. 70%
214. **In saline soil the method for irrigation is used**  
Ans. Flood method
215. Crop between the main crop called as  
Ans. Inter crop
216. **Sowing pattern used in dry land**  
Ans. Broadcasting
217. Crop lodging first adopted in which crop  
Ans. Sugarcane
218. Most efficient method of irrigation is  
Ans. Drip irrigation
219. Extensively grown pulse crop in India  
Ans. Chick pea
220. **Relative humidity measured by**  
Ans. Psychrometer
221. **Crop growing for conserve soil moisture known as**  
Ans. Mulch crops
- Cultivation of Some important crops                      1. Rice
222. Scientific name of rice  
Ans. Oryza sativa
223. Family of rice  
Ans. Graminae
224. Origin of rice  
Ans. South East Asia

225. Sowing time of Aus/Autumn rice

Ans. March – April

226. Sowing time of Aman rice

Ans. May - June

227. Sowing time of Boro rice

Ans. December – January

228. Aman rice also known as

Ans. Kharif/winter rice

229. Boro rice also known as

Ans. Summer rice

230. Lodging doesn't occur in

Ans. Japonica rice

231. Rice inflorescence is known as

Ans. Panicle

232. Hull is combination of

Ans. Lemma + Palea together.

233. Test weight of rice grain is

Ans. 25 gm.

234. Rice is a type of plant

Ans. Self pollinated & Short day plant

235. **Cardinal temperature of rice is**

Ans. 30-32<sup>0</sup>C

236. Hulling % of rice is

Ans. 70-75%

237. First developed rice variety

Ans. T.N. – 1

238. **Jagannath is the mutant variety of**

Ans. T.N. – 1

239. **The world's first high yielding variety (dwarf) of rice has been developed by IARI**

Ans. Pusa Basmati – 2

240. Maximum rice Exporter in the world is

Ans. Thailand

241. Highest productivity of rice in the world

Ans. Japan

242. Hybrid rice which is released by private organization

Ans. PHB – 71

243. Most critical stage for water

Ans. Booting stage

244. Seedling ready for transplanting in Depog method

Ans. 12<sup>th</sup> day

245. Best Biofertilizer for rice

Ans. Azolla

246. Area required for rice nursery

- Ans. 700-800 M<sup>2</sup> (.50 ha.)
247. **Fruit of rice is known as**
- Ans. Caryopsis
248. Widely used nitrogenous fertilizer in rice
- Ans. Ammonium Sulphate
249. Most dominant weed sp. In rice
- Ans. Echinochloa sp.
250. White eye of rice is due to
- Ans. Fe deficiency
251. The gas emits from rice field is
- Ans. Methane
252. **Akiochi disease is due to**
- Ans. H<sub>2</sub>S
253. Highest N losses in rice field by
- Ans. Denitrification
254. Paira & utera cropping system is closely related to
- Ans. Rice
255. Puddler & puddling is related to
- Ans. Rice
256. Parboiling of rice conserve the vitamin
- Ans. Vitamin – B<sub>12</sub>
257. Seed rate in depog method for rice
- Ans. 3-4 kg/m<sup>2</sup>
258. Area required for seedling preparation in depog method.
- Ans. 25-30 m<sup>2</sup>
259. **Miracle rice of India as**
- Ans. Jaya
260. **Gene responsible for dwarfness in rice**
- Ans. Dee – Gee – Woo – gene
261. Spacing for sowing of seedlings of rice
- Ans. 20 X 10cm
2. Wheat
262. Botanical name of wheat is
- Ans. Triticum aestivum
263. Origin of wheat
- Ans. South west Asia
264. The state which has highest production
- Ans. Uttar Pradesh
265. The state which has highest productivity
- Ans. Punjab
266. Macaroni Wheat is known as
- Ans. Exported wheat
267. **Emmer wheat is known as**
- Ans. T.dicocum
268. Suitable late sown variety is
- Ans. Sonalika

269. Sowing time of wheat is  
Ans. 15 Nov. – 20 Nov.
270. Spacing of row to row  
Ans. 22.5 cm.
271. Most critical stage for irrigation  
Ans. C.R.I. Stage
272. C.R.I. Stage  
Ans. C.R.I. stage comes after days.
273. Gene responsible for dwarf ness in wheat  
Ans. Norin 10
274. Important mimicry weed of wheat is  
Ans. Phalaris minor
275. Common bread wheat is known as  
Ans. Triticum aestivum
276. Flowering portion of wheat is called  
Ans. Ear/Head/Spike
277. Test weight of wheat is  
Ans. 40 gm
278. Shelling percentage of wheat is  
Ans. 60%
279. Triticum spherococcum also known as  
Ans. Indian dwarf wheat /club wheat
280. Central zig zag axis of theat grain is called  
Ans. Rachis
281. Triple gene dwarf varieties were released in the year  
Ans. 1970
282. If there are only three irrigation it will be applied on  
1. C.R.I stage  
2. Late jointing (hoot) stage  
Ans. 3. Milking stage
283. Seminal roots are  
Ans. Temporary roots
284. Fruit type of wheat is  
Ans. Caryopsis
285. First man made cereal is  
Ans. Triticale
286. **Triticale is a cross of**  
Ans. Wheat X Rye
287. Temperature for germination of wheat seed is  
Ans. 20-25<sup>0</sup>C
288. Protein content in wheat  
Ans. 8-11%
289. Triticum aestivum is a type of wheat  
Ans. Hexaploid

290. When seed is dropped by hand in furrow it's known as  
Ans. Kera method
291. World staple food grain  
Ans. Wheat
292. **Seed rate of wheat is**  
Ans. 100 kg./ha.
293. Most of the present days India's wheat varieties contains the gene  
Ans. Rht<sub>1</sub>, Rht<sub>2</sub>
294. Heera, Moti, Arjun varieties are the type of varieties  
Ans. 3 gene dwarf varieties
295. The protein which is essential for good bread quality is  
Ans. Gluten
296. If the sowing is done by the dibbler the seed rate will be  
Ans. 25-30 kg./ha.
297. Starch in Wheat grain is  
Ans. 60-68%
298. Moisture content at harvesting stage in wheat is  
Ans. 25-30%
299. National average yield of wheat is  
Ans. 22 q/ha.
3. Chick pea (Bengal Gram)
300. Botanical name of Gram (Chick pea)  
Ans. Cicer arietinum
301. Origin of gram was in  
Ans. South West Asia or India
302. Root system of gram is  
Ans. Tap root system
303. Pollination type of gram is  
Ans. Self pollinated
304. **Sour taste of gram leaf is due to**  
Ans. Maleic & Oxalic acid
305. Deep sowing of gram is protection of  
Ans. Wilt disease
306. Best variety for dry land is  
Ans. C-235
307. Early maturing variety is  
Ans. Chaffa
308. Sowing time of gram is  
Ans. 15 oct. – 20 Oct.
309. Seed rate of gram is  
Ans. 80-100 kg/ha.
310. Important operation which is done in gram crop is  
Ans. Nipping
311. Time of nipping operation is  
Ans. 30-40 days after sowing

312. Seed bed for gram should be  
Ans. Rough
313. Gram fruit is known as  
Ans. Pod
314. Spacing for gram is  
Ans. 30 X 10 cm
315. Protein content in gram  
Ans. 21%
316. Gram is a  
Ans. Rabi crop
317. Variety developed IARI  
Ans. Pusa 209, BG 203
318. Critical stage for irrigation  
Ans. Pre flowering, Pod developing stage.
4. Pigeon pea / Red Gram/ Arhar
319. Botanical name of arhar is  
Ans. *Cajanus cajan*
320. Origin of arhar was  
Ans. South Africa
321. Temperature for germination is  
Ans. 30-35<sup>0</sup>C
322. Temperature for growth is  
Ans. 20-25<sup>0</sup>C
323. Sowing time of arhar is  
Ans. 15 June
324. Spacing for arhar is  
Ans. 60 X 15cm
326. Proportion of seeds to pods.  
Ans. 50-60%
327. Highest production in the state  
Ans. Uttar Pradesh
328. Highest productivity in the state of  
Ans. Bihar
329. Early maturing variety  
Ans. Prabhat, UPAS 120
330. Harvest index of arhar is  
Ans. 19% (very low)
331. **Hybrid variety released by ICRISAT**  
Ans. ICPH-8
332. Protein content in arhar is  
Ans. 25%
- Sugarcane (*Sccharum officinarum*)
333. Inflorescence of sugarcane is called as  
Ans. Arrow

334. Arrowing stage arrives on  
Ans. 300-350 days after planting
335. Sugar mills are highest in India  
Ans. Uttar Pradesh (105 mills).
336. In sugarcane upper 1/3 part is used for sowing due to  
Ans. High nitrogenous substance & glucose for better germination
337. Highest producer of sugar from unit area is  
Ans. Maharashtra
338. Higher dose of nitrogen decrease the  
Ans. Sucrose content
339. Most critical stage for irrigation is  
Ans. Formative stage
340. Formative stage comes after  
Ans. 60-130 days after planting
341. Most popular planting method in North India  
Ans. Flat bed planting
342. **Brix reading should be for proper maturity**  
Ans. 16-18%
343. Jaggery extracted from juice is  
Ans. 9-10%
344. Sucrose content in cane is  
Ans. 13-24%
345. Sugar from juice is  
Ans. 6-10%
346. Soils which are unsuitable for sugarcane are  
Ans. Saline soils
347. Noble cane is  
Ans. *S. officinarum*
348. Adsali sugarcane is planted in  
Ans. June – July
349. Duration of adsali sugarcane is  
Ans. 18 months
350. Brix meter is used for  
Ans. Measuring maturity of sugarcane
351. **State which has largest area and production in cane**  
Ans. Uttar Pradesh
352. **State which has highest productivity**  
Ans. Tamilnadu
353. Seed rate for 3 budded sets is  
Ans. 25000 – 30,000 sets
354. **Seed rate for 2 budded sets is**  
Ans. 45,000 – 50,000 sets
355. Seed rate for single budded sets in Sugarcane is  
Ans. 1,25,000 sets

356. Origin of sugarcane is  
Ans. India
357. Set roots are  
Ans. Temporary roots
358. Temperature required for grand phase in sugarcane is  
Ans. 70<sup>0</sup>F
359. Earthing should be done in the month of  
Ans. June – July
360. Tying should be done in the month of  
Ans. August
361. Sowing time of Eksali crop  
Ans. January – February (South India)
362. **Wonder cane is**  
Ans. COC – 671 (High sugar %)
363. Sugarcane ripener chemical is  
Ans. Glyphosate
364. Spacing of row to row  
Ans. 90 cm
365. Name of wild type cane  
Ans. S. spontaneum
366. Family of sugar cane  
Ans. Gramineae
368. Burning of canes is done for  
Ans. Improve sucrose and juice quality
- Ground Nut**
369. Botanical name of Ground nut  
Ans. Arachis hypogea
370. Origin of Ground nut  
Ans. Brazil
371. State which is largest producer  
Ans. Gujarat
372. Shelling percentage  
Ans. 70%
373. Oil percentage in Ground nut  
Ans. 40-45%
374. Nitrogen percentage in Ground nut cake  
Ans. 7 -8 %
375. **Best soil for Ground nut cultivation**  
Ans. Sandy
376. Seed rate of Ground nut  
Ans. 100 -120 kg/ha.
377. Spacing for Ground nut  
Ans. 30 X 10 cm
378. High yielding type of Ground nut  
Ans. Spreading type (Late maturity)

379. Pegging stage in glandut comes after \_\_\_\_\_ days after swoing.

Ans. 55 days

380. Important variety

Ans. Jyoti (Bunch type), Chandra (spreading type)

381. Chemical used for floral initiation

Ans. NAA @40 PPM

382. Fruit of Ground nut known as

Ans. Nut

383. Botanical name of bunchy type Ground nut

Ans. Archis hypogaea sub spp. Fastiglata

384. Botanical name of spreading type Ground nut.

Ans. Archis hypogaea sub spp. Procumbens

385. **Bitterness of kernel is due to**

Ans. Aflatoxin

386. Sowing time in Groundnut

Ans. 20 June to 31 July

387. Protein content in Groundnut

Ans. 26%

388. Protein content in shell

Ans. 7%

389. Gynophore of Ground nut is known as

Ans. Peg

390. Rosette disease is due to

Ans. Virus

391. Vector of virus rosette in groundnut is

Ans. Aphid

392. Major pest of Ground nut

Ans. White grub

393. Tikka disease is due to

Ans. Cercospora personata & C. arachidicola

### **Tomato**

394. Botanical name of Tamato is

Ans. Lycopersicon esculentium

395. Family of tomato is

Ans. Solanaceae

396. Origin of tomato was

Ans. Peru

397. Fruit type of tomato is

Ans. Berry

398. Popular variety of tomato

Ans. Pusa Ruby, Arka vikas, sawrab, Ashish

399. Seed rate of tomato

Ans. 300 – 350 gm/ha.

400. BER disease is due to

Ans. Ca deficiency

401. Major pest of tomato  
Ans. Fruit borer (*Felicoverpo* spp.)
402. Chemical used for tomato sauce preservation is  
Ans. Sodium benzoate
403. Tomato is susceptible for  
Ans. Frost
404. Requirement of per capita vegetables / day.  
Ans. 275 gm/day
405. Availability of per capita vegetables/day  
Ans. 120 gm/day
406. Tomato is also known as  
Ans. Wolf apple
407. Edible part of cauliflower  
Ans. Curd
408. Blanching is a important process in  
Ans. Cauliflower
409. Whiptail in cauliflower is due to  
Ans. Mo deficiency
- Mango and other fruits:
410. Botanical name of mango is  
Ans. *Mangifera indica*
411. Fruit type of Mango is  
Ans. Drupe
412. Origin of mango was  
Ans. Indo-Burma
413. Edible part of mango is known as  
Ans. Mesocarp
414. High content of vitamin found in Mango is  
Ans. Vitamin – A
415. Dwarf variety of mango is  
Ans. Amrapali
416. Seedless variety of mango is  
Ans. Sindhu
417. Sweetest variety of mango is  
Ans. Chausa
418. Suitable variety for processing in mango is  
Ans. Alphanso
419. Propagation of mango is done by the method  
Ans. Veneer grafting
420. Pollination is mediated by  
Ans. House fly
421. Major pest of mango  
Ans. Mango hoppers
422. Major disease of mango  
Ans. Powdery mildew

423. Mango malformation is due to  
Ans. Low temperature
424. In mango black tip disease mostly occurs due to the following  
Ans. SO<sub>2</sub>, CO, C<sub>2</sub>H<sub>2</sub>
425. Control of Black tip is by  
Ans. Borax spray
426. Spongy tissue is due to  
Ans. Convection heats
427. Internal fruit necrosis in Mango is due to  
Ans. Boron deficiency
428. Deblossing is done for  
Ans. Control of malformation
429. Paclobutrazol & Kuttar chemical is used in mango for  
Ans. Avoiding the alternate bearing
430. Fruit type of Grape, Brinjal, Phalsa Chili & Banana  
Ans. Berries type
431. Fruit type of citrus  
Ans. Hesperidum
432. Propagation method for Banana  
Ans. Sword suckers
433. Propagation method for citrus  
Ans. T/shield budding
434. **Propagation method for Grapes.**  
Ans. Hard wood cutting
435. Propagation method for Guava  
Ans. Stooling/mound layering
436. Propagation method for Sapota  
Ans. Inarching
437. Propagation method for Anola  
Ans. Patch budding
438. Propagation method for Datepalm is  
Ans. Offshoot
439. Recommended fruits/day/person  
Ans. 120 gm/day.
440. Availability of fruits /day/person  
Ans. 70-80 gm/day
441. Sindhu variety of Mango is a cross of  
Ans. Ratna X Alphanso
442. Ratna variety is a cross of  
Ans. Neelam X Alphanso
443. Mallika is a cross of  
Ans. Neelam X Dashehari
444. **Amrapali is a cross of**  
Ans. Dashehari X Neelam
445. Rose is propagated by  
Ans. T-budding

Soil Science

446. Granite & Basalt are type of rocks  
Ans. Igneous rocks
447. Lime stone, Dolomite, Sandstone are type of rocks  
Ans. Sedimentary rocks
448. **Gneiss & Marble are type of rocks**  
Ans. Metamorphic rocks
449. Chief constituent of Sandy fraction  
Ans. Quartz
450. Most dominant mineral on Earth crust  
Ans. Feldspar (48%)
451. Major source of rock for Mg is  
Ans. Dolomite
452. Major source of P.  
Ans. Appetite
453. Major source of B.  
Ans. Tourmaline
456. Major source of Mo  
Ans. Olivine
457. **Major source of K**  
Ans. Orthoclase
458. Most resistant rock to weathering is  
Ans. Quartz
459. Least resistant to weathering  
Ans. Calcite
460. Kankar nodules are found mostly in  
Ans. Red soils
461. Process of moving out of sesquioxide is known as  
Ans. Podzolization
462. Process of mixing of soils is known as  
Ans. Pedoturbation
463. Each Soils having at least 20% organic matter are known as  
Ans. Organic soils
464. **Law of minimum was proposed by**  
Ans. Von Liebig (1840)
465. 'O' horizon is absent in  
Ans. Arable soils
466. Top most mineral horizon is  
Ans. 'A' horizon
467. Maximum Eluviation horizon is seen in horizon  
Ans. E horizon
468. Alluvial horizon is  
Ans. B horizon
469. Physical property which can't be changed is  
Ans. Soil texture

470. Mechanical analysis of soils separation is done by  
Ans. Hydrometric method
471. Particle more than 250mm in diameter is known as  
Ans. Stone
472. Diameter of coarse sand particle is  
Ans. 0.2 – 2mm
473. **Diameter of fine sand particle is**  
Ans. 0.02- 0.2 mm
474. Diameter of silt particle is  
Ans. 0.02 – 0.002 mm
475. Diameter of clay particle is  
Ans. Less than 0.002 mm
476. The soils which are most suitable for most of the crops are  
Ans. Sandy loams
477. Soil structure which is best for cultivation is  
Ans. Crumbly structure
478. Particle Density of general soil is  
Ans. 2.65 g/cm<sup>3</sup>
479. Bulk Density of general soils is  
Ans. 1.33 mg/cm<sup>3</sup>
480. **Total pore space is highest in**  
Ans. Clay soils  
Portion of capillary water lying between field capacity (1/3 atm) and wilting coefficient (15 atm)
481. is known as  
Ans. Available water
482. The water held up to the tension about 31 atm is known as  
Ans. Hygroscopic coefficient
483. **Kaolinite is a type of mineral**  
Ans. 1 : 1 type
485. Montmorillonite is a type of mineral  
Ans. 2 : 1 type expanding type mineral
486. Vermiculate is \_\_\_\_\_ a type of mineral  
Ans. Limited expanding 2:1 type mineral
487. Micas are type of mineral  
Ans. Non Expanding type mineral
488. Chlorites are type of mineral  
Ans. 2:1:1 type mineral
489. Recently formed soil order is  
Ans. Entisols
490. Black soils found in  
Ans. Maharashtra
491. **Red soils are dominant in**  
Ans. Tamil Nadu

492. Laterite soils are dominant in  
Ans. Karnataka & Kerala
493. Weight of soil furrow slice  
Ans.  $2 \times 10^6$  kg/ha
494. Humic acid is soluble in  
Ans. Alkali solution
495. C: N ratio of humus is  
Ans. 10 : 1
496. CEC of humus  
Ans. 150-300 C mol ( $p^+$ )/kg soil
497. C: N ratio of Legumes is  
Ans. 20:1 to 30:1
498. C:N ratio of FYM is  
Ans. 100:1
499. C:N ratio of micro organism is  
Ans. 4:1 to 9:1
500. Wood is mainly decomposed by  
Ans. Actinomycetes
501. Organic matter content in Indian soils is generally  
Ans. < 0.5%
502. Optimum temperature & pH for Nitrifying bacteria is  
Ans. Temp. 30-35<sup>0</sup>C, pH 6.5 – 7.5
503. Loss of N<sub>2</sub> in the form of NH<sub>3</sub> in alkaline medium is known as  
Ans. Volatilization
504. ECE of vermiculate  
Ans. 80 -150 C mol( $P^+$ )/kg soil
505. CEC of monthmorillonite  
Ans. 80 – 100 C mol( $P^+$ )/kg soil
506. N,P,K % in FYM  
Ans. 0.5%N, 0.2%P<sub>2</sub>O<sub>5</sub>, 0.5% N<sub>2</sub>O
507. Most out standing green manure crop is  
Ans. Sun hemp
508. Fastest N fixing plant  
Ans. Sesbania rostrata
509. N% in cotton cake  
Ans. 6.5% N
510. N% in safflower cake  
Ans. 7.8% N
511. Substances added to soils for the improvement of their condition are known as  
Ans. Amendments
512. The fertilizer having less than 25% of the primary nutrients known as  
Ans. Low analysis fertilizers
513. Equivalent acidity of NH<sub>4</sub>Cl  
Ans. 128
514. Equivalent acidity of (NH<sub>2</sub>)<sub>2</sub> SO<sub>4</sub>  
Ans. 110

515. Equivalent acidity of urea  
Ans. 80 – 85
516. Equivalent acidity of DAP  
Ans. 77
517. Equivalent acidity of Ammonium Nitrate  
Ans. 60
518. Equivalent basicity of  $\text{NaNO}_3$   
Ans. 29
519. Equivalent basicity of  $\text{Ca}(\text{NO}_3)_2$   
Ans. 21
520. The crops which absorb the ammonical form directly  
Ans. Paddy & Potato
521. N% in sodium nitrate  
Ans. 16% N
522. N% in ammonium sulphate  
Ans. 20.6% N
523. Sulphur percentage in Ammonium sulphate  
Ans. 24% S
524. N % in Ammonium Nitrate  
Ans. 33-35% N
525. N% in Ammonium Sulphate Nitrate  
Ans. 26% N
526. Sulphur percentage in Ammonium sulphate Nitrate  
Ans. 15% S
527. N% in kisan khad (CAN)  
Ans. 25-28% N
528. N% in Ammonium Chloride  
Ans. 26% N
529. N% in urea  
Ans. 46% N
530. Biuret should be according to fertilizer control order  
Ans. < 1.5%
531. N% in calcium cyanamide  
Ans. 20.6%
532. Highest N% in fertilizers is seen in  
Ans. Aqueous Ammonia (80% N)
533. Water soluble phosphatic fertilizer  
Ans. 1. S.S.P., D.S.P., T.S.P., D.A.P.
534. Citrate soluble P fertilizer  
1. Di calcium phosphate
2. Basic slag
- Ans. 3. Rhemania Phosphate
535. Citrate & Water insoluble P fertilizer  
Ans. Rock phosphate, Raw bone meal, steamed bone meal

536.  $P_2O_5$ % in single super phosphate  
Ans. 16-20%  $P_2O_5$
537.  $P_2O_5$ % in Double super phosphate (D.S.P)  
Ans. 32%  $P_2O_5$
538. N &  $P_2O_5$  percent in DAP  
Ans. 16% N, 48%  $P_2O_5$
539.  $P_2O_5$ % in Di calcium phosphate (D.C.P.)  
Ans. 33-40%  $P_2O_5$
540.  $P_2O_5$ % in Basic slag  
Ans. 14-18%  $P_2O_5$
541.  $P_2O_5$ % in Rock phosphate  
Ans. 20-30%  $P_2O_5$
542.  $P_2O_5$ % in Raw bone meal  
Ans. 20-25%  $P_2O_5$
543.  $P_2O_5$ % in steamed bone meal  
Ans. 20-30%  $P_2O_5$
544. Sulphur % in S.S.P  
Ans. 12% S
545. Ca% in S.S.P  
Ans. 18-21% Ca
546. Ca percent in Gypsum ( $CaSO_4 \cdot 2H_2O$ ) is  
Ans. 29.2% Ca
547. S% in Gypsum  
Ans. 18.6% S
548. S% in potassium sulphate  
Ans. 17.5% S
549.  $K_2O$ % in Murate of potash (KCl)  
Ans. 60%/20
550.  $K_2O$ % in potassium sulphate  
Ans. 48-52% (20)
551. Indian soils are deficient in  
Ans. Zinc
552. N% in Thio urea  
Ans. 36.8%
553. AM & N serve are  
Ans. Nitrification inhibitors
554. Rhizobium melilots is used for the crops  
Ans. Medicago (Alfalfa), Trigonella (Fenugreek)
555. R. trifoli is used for  
Ans. Trifolium (Clover)
556. R. leguminosarum is used for  
Ans. Pisum (Pea), Lens (Lentil)
557. R. Phaseoli is used for  
Ans. Phaseolus (beans)
558. R. Japonicum is used for  
Ans. Glycine (Soyabean), Vigna (Cow pea), Arachis (Ground nut), Crotonaria

559. Azotobacter and Beijerinckia are  
Ans. Aerobic bacteria
560. Anaerobic bacteria  
Ans. Clostridium
561. Azotobacter is used for the crops like  
Ans. Rice, Cotton and Sugarcane
562. Azospirillum is used for  
Ans. Sorghum
563. Low status of N in soil when it is less than  
Ans. 250 kg/ha.
564. Analyzing process for determination of available N  
Ans. Alkaline permanganate method
565. Phosphorus is extracted by the musheed  
Ans. Olsen's method & Bray No. 1 method
566.  $K^+$  &  $Na^+$  is determined by  
Ans. Flame photometer
567. Organic carbon is determined by  
Ans. 1. Walkley & Black method 2. Morgan's method
568. Application of clay to sandy soils is known as  
Ans. Marling
569. The form of N is preferable for saline soils  
Ans. Nitrate form
570. Amomical fertilizers should be applied in  
Ans. Reduced zone
571. Nitrate fertilizers should be applied in  
Ans. Oxidized zone
572. Criteria of essentiality was given by  
Ans. Arnon & stout (1939)
573. Functional nutrients are in number  
Ans. 20
574. Source of N for plants for absorption  
Ans.  $NO_3$  (Mostly)
575. Source of P for plants for absorption  
Ans.  $H_2PO_4^-$ ,  $HPO_4^{2-}$
576. Source of B for plants for absorption  
Ans.  $B_4O_7^{2-}$ ,  $H_2BO_3^-$
577. Source of Mo for plants for absorption is  
Ans.  $MoO_4^{2-}$
578. Elements provide basic structure  
Ans. C,H,O
579. Energy Exchange elements  
Ans. H, O
580. Highly mobile nutrients in plants  
Ans. N, P & K
582. Immobile nutrients in plant  
Ans. Ca & B

583. Secondary nutrients are  
Ans. Ca, Mg, S
584. Zn, Fe are  
Ans. Micro nutrients
585. Co is the structural component of  
Ans. Vitamin B<sub>12</sub>
586. S is essential for  
Ans. Oil seed crops
587. Na is essential for  
Ans. Sugarbeets
588. 'V' shaped yellowing at the tip of the lower leaves shows  
Ans. N deficiency
589. Chlorosis in between the veins and veins remain green shows  
Ans. N deficiency
590. Tip burn, margin scorching shows the deficiency of  
Ans. K<sup>+</sup>
591. Interveinal chlorosis is occurs due to the deficiency of  
Ans. Fe deficiency
592. Complete interveinal chlorosis occurs due to  
Ans. Mn deficiency
593. Grey speck of oat, Phala blight of sugarcane caused by  
Ans. Mn deficiency
594. Rosetting and excess gumming occurs due to  
Ans. Cu deficiency
595. Top sickness of tobacco occurs due to  
Ans. B deficiency
596. Beneficial elements are  
Ans. Co, Si, Na, Ni, Va
597. Ni & Co is most useful for the crops  
Ans. Legumes
598. Silicon is essential for  
Ans. Rice, Maize
599. Excess vegetative growth is due to the supply of  
Ans. High supply of N
600. Major constituent of chlorophyll is  
Ans. Mg
601. White tip and white bud of maize occurs due to  
Ans. Zn deficiency
602. Sickle leaf disease occurs due to  
Ans. P deficiency
603. Whiptail of cauliflower occurs due to the deficiency of  
Ans. Mo deficiency
604. Tea yellow disease occurs due to  
Ans. S deficiency
605. Failure of terminal bud and root tip due to  
Ans. Ca deficiency

606. Osmotic regulation is maintained by the element  
Ans.  $K^+$
607. Die back of citrus occurs due to  
Ans. Cu deficiency
608. Brittle leaf occurs due to  
Ans. Ca deficiency
609. Little leaf of cotton occurs due to the deficiency of  
Ans. Zn deficiency
610. High lime requirement crops are  
Ans. Soybean & Sugarbeet
611. Problems of soils are highest in  
Ans. Uttar Pradesh
612. Alluvial soils are dominant in  
Ans. Uttar Pradesh
613. If  $pH < 8.5$ ,  $EC > 4$ (dS/m),  $ESP < 15\%$  the soil be  
Ans. Saline
614. If  $pH > 8.5$ ,  $EC < 4$ (dS/m),  $ESP > 15\%$  the soil will be  
Ans. Alkali
615. If  $pH < 8.5$ ,  $EC > 4$ (dS/m),  $ESP > 15\%$  the soil be  
Ans. Saline Alkali
616. Leaching is used for the treatment of  
Ans. Saline soils
617. Gypsum is used for the reclamation of  
Ans. Alkali soils
618. Lime stone is used for the reclamation of \_\_\_\_\_ soils.  
Ans. Acidic soils
619. Urea is type of fertilizer  
Ans. Organic fertilizer
620. Highly salt tolerant crops are  
Ans. Barley, Sugarbeet
621. Acid tolerant crop is  
Ans. Rice
622. The soils which have  $pH < 4.0$  are known as  
Ans. Cat soils
623. The soils which have organic matter +Na are known as \_\_\_\_\_ soils.  
Ans. Black alkali soils
624. Potato scab disease is favoured by \_\_\_\_\_ soils.  
Ans. Alkaline soils

### **Structure & Function of cell organelles cells mitosis & Meiosis & Mendelian Genetics**

625. Power house of cell  
Ans. Mitochondria
627. Ploidy level in endosperm is  
Ans. Embryo –  $2n$ , Endosperm –  $3n$ , Testa –  $2n$ , Aleuren –  $2n$
628. Rediscovery of Mendelian principles in the year  
Ans. 1900

629. Chromosomal theory of inheritance (1903) by  
Ans. Sutton & Boveri
630. Term genetics given by  
Ans. Bateson (1905)
631. Chromosome named by  
Ans. Waldayer
632. First used X-rays as mutation  
Ans. Muller
633. The lines are homozygous and homogenous in nature called as  
Ans. Pure line
634. Allo Hexaploidy found in  
Ans. Wheat
635. Autopolyploidy found in  
Ans. Sugarcane, Cotton, Brassica
636. Autotetraploidy found in  
Ans. Potato, Coffee
637. Autotriploidy found in  
Ans. Banana
638. Two lines different for a single locus called  
Ans. Iso genic line
639. If Embryo originates from unfertilized egg process called  
Ans. Parthenogenesis
640. If the development of fruit without fertilization the process called  
Ans. Parthenocarpy
641. Change in the genome with reference to individual chromosomes called as  
Ans. Aneuploidy
642. Repeated crossing of hybrid progeny back to one of its parents called as  
Ans. Back cross
643. If a single gene governing multiple traits, it is called as  
Ans. Pleiotropy
644. Embryo development without fertilization is called  
Ans. Apomixis
645. First inter specific cross was made by  
Ans. Thomas Fairchild
646. N.E. Borlaug was awarded for Noble Prize in  
Ans. 1970
647. Father of Hybrid cotton  
Ans. C.T. Patel
648. First hybrid of rice was developed by  
Ans. Y.L. Ping (China)
649. First transgenic plant was developed by  
Ans. Fraley (1983) Tobacco
650. Laws of heredity were first discovered by  
Ans. Mendel
651. Tift 60 is an important source of male sterility in  
Ans. Sorghum

652. The term Germplasm was first used by  
Ans. Weismann
653. Centers of origin was first given by  
Ans. Vavilov
654. NBPGR established in  
Ans. 1976
655. The term genetic resources was coined by  
Ans. Frankel
656. The term parthogenesis was coined by  
Ans. Owen
657. Cevelopmentof seed by self pollination refers to  
Ans. Autogamy
658. Often cross pollinated crops are  
Ans. Cotton, Sorghum P.Pea
659. Concept of pure line theory was developed by  
Ans. Johansen
660. Term heterosis was coined by  
Ans. Shull
661. Jagannath is a mutant variety of  
Ans. Rice
662. A nullisomic individual is represented by  
Ans.  $2n - 2$
663. Chromosome discovered by  
Ans. Strasburger

**Elementary Knowledge of Photosynthesis; Respiration and Transpiration**

664. Glycolysis occurs in the part of cell  
Ans. Cytoplasm
665. Krebs cycle & ETC occurs in  
Ans. Mitochondria
666. Glycolysis is a type of reaction  
Ans. Anaerobic
667. Total ATP synthesis from one 2 X 2 molecule of glucose in respiration  
Ans. 36 ATP (Net gain), Gross – 38 ATP
668. Total ATP synthesis in glycolysis is  
Ans. 8 ATP (Net gain – 2ATP)
669. Krebs cycle is also called  
Ans. Citric acid or T.C.A. cycle
670. Final product of glycolysis is  
Ans. Pyruvate
671. Kerbs cycle starts with  
Ans. Acetyl COA & Oxaloacetate
672. Energy content of molecule of glucose is  
Ans. 684 K.Cal.

673. CO<sub>2</sub> concentration in the atmosphere is  
Ans. 0.03%
674. Light or Hill reaction takes place in  
Ans. Grana of chloroplast
675. Dark reaction or Calvin cycle takes place in  
Ans. Stroma of chloroplast
676. C<sub>3</sub> pathway found in  
Ans. Rice, Wheat, Pea, Soybean
678. C<sub>4</sub> (Hatch Black pathway) found in \_\_\_\_\_ plants  
Ans. Sorghum, Maize, Sugarcane
679. CAM pathway found in  
Ans. Pineapple, Opuntia, Agave, Cactus, Shishal
680. Most abundant protein in the world  
Ans. Rubisco
681. First enzyme in CO<sub>2</sub> fixation in C<sub>3</sub> plants  
Ans. Rubisco
682. First enzyme in CO<sub>2</sub> fixation in C<sub>4</sub> plants is  
Ans. PEP Carboxylase
683. Highest water use efficiency is seen \_\_\_\_\_ plants.  
Ans. CAM > C<sub>4</sub> > C<sub>3</sub>
684. Kranz type leaf anatomy found in  
Ans. C<sub>4</sub> plants
685. Calvin cycle & Hatch – Slack pathway occurs in \_\_\_\_\_ cell organelle.  
Ans. Chloroplast
686. Photosynthetic rate is highest in  
Ans. C<sub>4</sub> plants
687. Harvest Index in cereals is  
Ans. 0.4 – 0.5
688. Harvest Index in pulses  
Ans. 0.2 – 0.3
689. First product of photosynthesis in C<sub>3</sub> plants is  
Ans. 3 PGA

### **Structure and functions of Carbohydrates, Proteins, Nucleic acids, Enzymes and Vitamins**

690. Glucose is a type of sugar  
Ans. Monosaccharide
691. Sugar which is sweetest among all sugars is  
Ans. Fructose
692. Disaccharides are  
Ans. Maltose, Lactose, Sucrose, Cellobiose
693. Non-reducing sugar is  
Ans. Sucrose
694. Sugar found in germination seeds largely  
Ans. Maltose

695. Lactose is a combination of  
Ans. Glucose + Galactose
696. Glycogen present only in  
Ans. Animal cells
697. Pectin normally present in  
Ans. Cell wall
698. Protein name was suggested by  
Ans. Berzelius
699. Proteins are the polymer of  
Ans. Amino acid
700. Collagen found in  
Ans. Muscle protein
701. Keratin found in  
Ans. Hair & wool & nail
702. Fibroin found in  
Ans. In silk
703. Elastin found in  
Ans. Insect wings
704. Regulatory proteins  
Ans. Enzymes
705. Transport protein  
Ans. Myoglobin, Hemoglobin's
706. First enzyme found initially from  
Ans. Yeast
707. Enzymatic activity was first discovered by  
Ans. Buchner
708. The term Enzyme was coined by  
Ans. W. Kutins
709. Lock & Key model was proposed by  
Ans. Fisher
710. Term vitamin was introduced by  
Ans. Funk
711. Water soluble vitamins  
Ans. Vitamin B complex & vitamin C, & B<sub>6</sub>
712. Fat soluble vitamins  
Ans. Vitamin A, D, E, K
713. Xerophthalmia and night blindness is due to  
Ans. Vitamin A (retinal)
714. Arbtflovinosis (cracks on skin) is due to  
Ans. B<sub>2</sub> (riboflavin) deficiency
715. Anemia is due to the deficiency of  
Ans. Vitamin B<sub>12</sub> (cyanocobalomin)
716. Pellagra (Black tongue) is due to the deficiency of  
Ans. B<sub>6</sub> (Niacin)
717. Scurvy is due to the deficiency of  
Ans. Vitamin C (Ascorbic acid)

718. Rickets is due to  
Ans. Vitamin D (Calciferol)
719. Sterility is due to  
Ans. Vitamin E (  $\alpha$  Tocopherol)
720. Beri Beri is due to  
Ans. Thiamine (Vitamin B<sub>1</sub>)
721. Nucleoside + Phosphate group called as  
Ans. Nucleotide
722. Bacteriophages are  
Ans. Single strain DNA
723. The most abundant form of RNA is  
Ans. r-RNA (80%)
724. The scientist used the word cell  
Ans. Robert hook
725. The scientist used the word nucleus  
Ans. Robert brown
726. Cell theory was given by  
Ans. M. Schleiden & Schwann
727. Free living N fixing bacteria is  
Ans. Azotobacter
728. Stem and root nodules found in  
Ans. Sesbania rostrata
729. Crossing over can be seen in the stage  
Ans. Pachytene

**Major pest & Disease of Rice, Wheat, Cotton, Chickpea, Sugarcane & their management**

730. Rice stem borer (*scirpophaga incertutas*) is a  
Ans. Monophagous
731. Trichogramma is a  
Ans. Egg parasitoid
732. Silver shoot or onion leaf is caused by  
Ans. Gall midge
733. Vector of Rice tungro is  
Ans. Green leaf hopper (*Nephotettise* spp.)
734. Vector of Grassy stunt disease  
Ans. Brown plant hopper (*Nilaparvata* spp.)
735. Chaffy grains with black spot is due to  
Ans. Gundhi bug (*leptocoris* spp.)
736. Family of Gundhi bug is  
Ans. Alydidae
737. Gundhi bug caused on the stage  
Ans. Milking stage
738. Ufra disease of rice is due to  
Ans. *Ditylenehus angustus*

739. White grub is a  
Ans. Beetle, Polyphages
740. Serious pest of wheat  
Ans. White grub & termite
741. Ear cockle nematode is  
Ans. *Anguina tritici*
742. Tundu/yellow ear rot disease is due to  
Ans. *Anguina tritici* + *Carynebacterium tritici*
743. Control of tundu disease is done by hot water treatment at \_\_\_\_\_ °C for \_\_\_\_\_ hours.  
Ans. Hot water treatment 50°C for 2 hours
744. Wheat stem borer *Sesamia inferens* attack in  
Ans. Night
745. Name of rice yellow stem borer  
Ans. *Scirpophaga incertula*
746. Highest consumption of pesticide in crop  
Ans. Cotton (54%)
747. Hooper burn in cotton is due to  
Ans. *Amrasca biguttula*
748. Family of cotton white fly  
Ans. Aleyrodidae
749. Vector for cotton leaf curl virus is  
Ans. *Bemisia tabaci*
750. Glaring of squares in cotton is due to  
Ans. Spotted bollworm (*Earias vitella*)
751. Rosetting of flowers due to  
Ans. Pink bollworm (*Pectinophora gossypiella*)
752. Double seed formation is due to  
Ans. Pink bollworm
753. Large circular bore holes with faecal pellets is the symptoms of  
Ans. American bollworm (*Helicoverpa armigera*)
754. *Dysdercus cingulatus* is known as  
Ans. Red cotton bug
755. Bt formulation is used for  
Ans. Early instars of bollworms
756. *Helicoverpa* and *Agrotis ypsilon* is the serious pest of  
Ans. Chickpea
757. Greasy cut worm attack in  
Ans. Night
758. Scientific name of Sugarcane shoot borer is  
Ans. *Chilo infuscatellus*
759. Bunchy top appearance in sugarcane is due to  
Ans. Top borer (*Scirpophaga excerpta*)
760. Family of Top borer  
Ans. Pryalidae

761. Family of shoot borer  
Ans. Crambidae
762. *Pyrrilla perpusilla* (Fam. Lophopidae) is a  
Ans. Leaf hopper
763. Biological control of borers  
Ans. *Trichogramma Japonicum*
764. Destructive insect pest (DIP) Act was passed in the year  
Ans. 1914
765. Insecticide act passed  
Ans. 1968
766. Pest occurs most frequently on cultivated crops  
Ans. Regular pest
768. Pest occurs in a few isolated localities is known as  
Ans. Sporadic pest
769. Pest occurs in same area of year after year  
Ans. Endemic pest
770. Pest occurs in area in severe form  
Ans. Epidemic pest
771. Central plant protection training institute  
Ans. Hyderabad
772. Safest insecticide for honeybee  
Ans. Endosulphohn
773. Pest population should be kept below  
Ans. Economic threshold level
774. Serious pest of Rice is  
Ans. Yellow stem borer
775. What is the sequence of coating of seed by insect fungicide & Rhizobium  
Ans. Fungicide + Insecticide + Rhizobium

### **Diseases of important Crops**

#### **1. Rice:**

776. Blast disease is due to  
Ans. *Pyricularia Oryzae* (airborne)
777. Brown spot disease due to  
Ans. *Helminthosporium Oryzae* (seed borne)
778. Bacterial blight disease due to  
Ans. *Xanthomonas Campestris* pv. *Oryzae*
779. Kresek symptom found in  
Ans. Bacterial blight
780. Foot rot disease due to  
Ans. *Gibberella fujikorai*
781. Sheath blight disease due to  
Ans. *Rhizoctonia solani*

782. Udabatta disease in rice is due to  
Ans. *Ephelis oryzae*  
783. Vector of rice tungro virus  
Ans. Green leaf hopper (*Nephotettix virescens*)

## II. Wheat

784. Black stem rust disease is due to  
Ans. *Puccinia graminis tritici*  
785. Brown rust is due to  
Ans. *Puccinia graminis rocondita*  
786. Yellow rust in Wheat is due to  
Ans. *P. graminis striiformis*  
787. Loose smut is due to  
Ans. *Ustilago tritici*, (Internally seed borne)  
788. Hill bunt is due to  
Ans. *Tilletia foetida*  
789. Karnal bunt is due to  
Ans. *Neovossia indica*  
790. Flag smut is due to  
Ans. *Uroustis gamines*  
791. Molya disease is due to  
Ans. *Heterodera avcnae*  
792. Vitavax & hot treatment is used for  
Ans. Loose smut  
793. Wilt disease is due to  
Ans. *Fusarium oxysporum*  
795. Black arm is due to  
Ans. *Xanthomonas compestris*  
796. Red top is due to  
Ans. *Colletotrichum falcatum*  
797. Smut is due to  
Ans. *Ustilago scitaminea*  
798. Gumming disease is due to  
Ans. *Xanthomonas campestris*, Pv. *Vascularum*  
799. Red stripe disease is due to  
Ans. *Pseudomonas rubrilineans*  
800. Grassy shoot is due to the pathogen  
Ans. MLO  
801. Wilt disease is due to  
Ans. *Fusarium oxysporum* sp. *Ciceri*  
802. Blight is due to  
Ans. *Asechochyta rabei*  
803. Mancozeb, Zenab, Thiram are  
Ans. Dithio carbamates  
804. PMA (Agrosan G N) is a  
Ans. Organomercurials

805. Endosulfan is a \_\_\_\_\_ grape pesticide.  
Ans. Chlorinated hydrocarbons
806. Aldicarb (Temik), Carbaryl is  
Ans. Carbamates & their thio salts
807. Ceresan & Aretan are  
Ans. Organomercurials fungicide
808. Father of Extension is  
Ans. Leagues
809. Model villages given by  
Ans. Daniel Hamilton (1903)
810. Rural reconstruction institute started  
Ans. Shanti niketan – 1921
811. Marathandan project by  
Ans. Spencer Hatch – 1921
812. Gurgaon experiment by  
Ans. F.L. Brayne – 1921
813. Sevagram project who started by  
Ans. Mahatma Gandhi (1929)
814. Indian village service by  
Ans. A.T. Moscher & B.N. Gupta
815. Firka development scheme by  
Ans. T. prakashan (1946)
816. Mazdoor Manzil by  
Ans. S.K. Dey (1947)
817. Grow more food campaign  
Ans. 1948
818. Etawah pilot project  
Ans. Albert mayer (1948)
819. Grow more food campaign enquiry committee  
Ans. 1952
820. (C.D.P.) community development project started  
Ans. 1952
821. (NES) National Extension Service  
Ans. 1953
822. Panchayati Raj started  
Ans. 1957-58
823. First state to adopt Panchayati Raj system is  
Ans. Rajasthan
824. (IADP) Intensive Ag. District programme started  
Ans. 1960
825. (IAAP) Intensive Ag. Area programme started  
Ans. 1964
826. (ICDP) Intensive Cattle Development project  
Ans. 1964
827. High yielding varieties programme  
Ans. 1966

828. (MCP) Multiple Cropping Programme  
Ans. 1966
829. (MKP) Minikit Programme for Rice  
Ans. 1971
830. (SFDA) Small Farmer's Development Agency  
Ans. 1970
831. (MFAL) Marginal Farmers and Agricultural labors Programme  
Ans. 1970
832. (DPAP) Drought Prone Area Programme was started in the year  
Ans. 1970
833. (MNP) Minimum Needs Programme  
Ans. 1972
834. (T & V) Training & Visit Programme Stated by  
Ans. Daniel Borner (1974)
835. In India, the first state to adopt (T & V) is  
Ans. Rajasthan
836. K.V.K. was recommended by  
Ans. Mohan Singh Mehta Committee (1974)
837. First K.V.K. was established by  
Ans. TNAU at Pondichery (1974)
838. (CAD) Command Area Development Programme was initiated in the year  
Ans. 1974
839. (IRDP) Integrated Rural Development Programme was started in the year  
Ans. 1979
- (TRYSEM) Training Rural Youth for self Employment was implemented in the  
840. year  
Ans. 1976
841. (NREP) National Rural Employment Programme  
Ans. 1980
842. (NARP) National Agricultural Research Project  
Ans. 1980
843. (NAEP) National Agricultural Extension Project  
Ans. 1983
844. (RLEP) Rural Landless Employment Gurantee Programme  
Ans. 1983
845. (JRY) Jawahar Rozgar Yojna  
Ans. 28<sup>th</sup> April, 1989
846. (IVLP) Institute Village Linkage Programme  
Ans. 1994
847. (MSY) Mahila Samrudhi yozna  
Ans. 1993
848. (PMRY) Prime Minister Rozgar Yozana  
Ans. 1994
849. (NATP) National Agricultural Technology Project  
Ans. 1999

850. (JGSY) Jawahar Gram Samuridhi Yozana  
Ans. 1999
851. (SGSY) Swaran Jayanti Gram Swarajgar Yozana  
Ans. 1999
852. IRDP, TRYSEM, DWCRA, SITRA merged into \_\_\_\_\_  
Programme.  
Ans. SGSY
853. Lab to land programme started in the year  
Ans. 1<sup>st</sup> June, 1979
854. Integration of all programmes in K.V.K. was planned from the year  
Ans. 1<sup>st</sup> April, 1992
855. First Agriculture University established in the year  
Ans. 1960, Utranchal, GB. Pant
856. Establishment of MANAGE  
Ans. 1986, Hyderabad
857. Royal commission on Agriculture  
Ans. 1928
858. FISCAL commission  
Ans. 1949
859. Land Care programme  
Ans. 1990, Australia
860. N.S.S.  
Ans. 1969
861. First rural youth programme of India is  
Ans. 1920 (Sri Niketen)
862. Indira Mahila Yozana started in the year  
Ans. 1995
863. (NES) National Extension Service  
Ans. 1953
864. (PPTD) Pilot Project for Tribal Development  
Ans. 1972-73
865. Auntuoyadya uojana started in the year  
Ans. 2<sup>nd</sup> Oct, 1977
866. (NSC) National Seed Corporation founded in the year  
Ans. 1963 (Delhi)
867. (DPAP) Drought Prone Area Programme  
Ans. 1970-71 (Pant Nagar)
868. Indian Society of Agronomy  
Ans. 1955
869. Indian Society of Soil Science  
Ans. 1934
870. First Department of Agriculture established  
Ans. 1881
871. First Irrigation commission appointed  
Ans. 1901

872. Indian Central Sugarcane Committee  
Ans. 1944
873. Indian Central Cotton Committee was constituted in the year  
Ans. 1921
874. National commission of Agriculture was set up by Government of India in the year  
Ans. 1970
875. Imperial Lac Research Institute (Ranchi)  
Ans. 1925
876. 1<sup>st</sup> five year plan was started in the year  
Ans. 1951 – 1956
877. Food corporation of India (F.C.I) was established in the year  
Ans. 1970
878. Nationalization of Banks was done in the year  
Ans. 1969
879. NABARD came in to existence in the year  
Ans. 1980
880. IARI was established in Bihar in the year  
Ans. 1905
881. IARI was established under the Vice Royalty of  
Ans. Lord Curzon
882. Building of IARI was damaged due to earthquake in the year  
Ans. 1934
883. Transfer of IARI from Pusa to New Delhi was done in the year  
Ans. 1936
884. IARI was given the status of deemed university in the year  
Ans. 1958
885. ICAR was established by the recommendation of  
Ans. Lord Linlithgo
886. Imperial council of Agricultural Research was established in  
Ans. 23<sup>rd</sup> May, 1929
887. First President of ICAR was  
Ans. Mohammad Habibullah
888. First secretary of ICAR  
Ans. S.A. Hydari
889. Renaming of ICAR was done in the year  
Ans. March, 1946
890. Renaming of ICAR under the president ship of  
Ans. Jogendra Singh
891. ICAR was reconstituted into full autonomous body in the year  
Ans. 1966
892. First D.G. of ICAR was  
Ans. Dr. B.P. Pal
893. First Indian Director of IARI was  
Ans. Dr. B. Vishwanath
894. First vice chairman of ICAR was  
Ans. Diwan Bhadur Vijayaraj Acharya

895. Establishment of IRRI in the year  
Ans. 1960 (Philippines)
896. Green revolution occurred in the year  
Ans. 1965-66
897. White revolution is related to  
Ans. Milk production
898. Blue revolution is related to  
Ans. Fisheries
899. Round revolution is related to  
Ans. Potato
900. Silver revolution is related to  
Ans. Eggs and Poultry
901. Brown revolution is related to  
Ans. Fertilizer production
902. NBAIM (National Bureau on Agriculturally Importance Micro Organism) located at  
Ans. New Delhi
904. The first step of summarizing the data is  
Ans. Classification
905. The measure of central tendency to be used to study average rate of change in population is  
Ans. Geometric Mean
906. To find the average size of shoes sold in the market should use  
Ans. Mode
907. To find the average speed of vehicle when distance is covered with different speeds, the suitable measure is  
Ans. Harmonic mean
908. To find the average of quantity prices, the measure of central tendency to be used is  
Ans. Harmonic mean
909. To find the average height of plants we should use  
Ans. Arithmetic mean
910. We study measure of central tendency to represent  
Ans. To represent the whole data by only single value
911. The suitable measure to find average speed when time for each speed is fixed would be  
Ans. Arithmetic mean
912. In industries for quality control, the most important measure of dispersion used is  
Ans. Range
913. The relation between Arithmetic Mean, Geometric Mean and Harmonic mean is  
Ans.  $AM \geq GM \geq HM$
914. The formula for Geometric mean on n values  $X^1, X^2, \dots, X^n$  is  
Ans.  $(X_1, X_2, \dots, X_n)^{1/n}$
915. If all the viriate values are negative the standard deviation will be  
Ans. Positive
916. The student 't' test was discovered by  
Ans. W.S. Gosset

917. The standard deviation for the values 4,5,6,7,8 will be  
Ans.  $(2)^{1/2}$
918. Coefficient of variation is calculated by the formula  
Ans. Standard deviation / mean X 100
- The degrees of freedom for error in R.B. design with 10 treatments and 4  
919. replication will be  
Ans. 27
920. Under the assumption for analysis of variance, the parent population should be  
Ans. Normal
- For any two values a & b the following relationship among Arithmetic mean (A)  
921. Geometric mean (G) and Harmonic mean (H) exists  
Ans.  $G^2 = A.H.$
922. For testing the hypothesis about mean of one population we use 't' test when  
Ans. Sample size is small and S.D. is unknown
923. For testing the significance of correlation coefficient, \_\_\_\_\_ test is used.  
Ans. 'T' test
924. To test the agreement between observed frequencies and expected frequencies would be  
Ans. Chi Square test
925. The minimum sample size for using chi square test should be  
Ans. 50
926. The analysis of variance techniques used for comparing  
Ans. Comparing the means of more than two population
927. Latin square design is suitable for comparing  
Ans. 5 to 12 treatments
928. Infield experiments the commonly used design is  
Ans. Random Block Design (RBD)
- The following relationship among the correlation coefficient (r) and the two  
929. regression coefficient byx & byz exists  
Ans.  $r^2 = b_{yx} \cdot b_{yz}$
930. The regression coefficient lies between  
Ans. - 0 to  $\alpha$
931. The correlation coefficient lies between  
Ans. - 1 to + 1
932. For testing the independence of two attributes, the test used is  
Ans.  $X^2$  test
- Correlation of continuity in 2 X 2 contingency table should be used when expected  
933. frequency of cell is  
Ans. Less than 5
934. The value of ( $x^2$ ) chi square always lies between  
Ans. 0 to  $\alpha$
- The degrees of freedom to test the significance of different between two means  
935. based on  $n_1$  &  $n_2$  observation is  
Ans.  $n_1 + n_2 - 2$
- For comparing 4 treatments with R.B. design, the 15 different frequencies can be  
936. obtained when the number of replication are  
Ans. 6

937. The most commonly used measure of central tendency is  
 Ans. Arithmetic Mean
938. Which of the following is considered as best measure of dispersion  
 Ans. Standard deviation
939. The value of standard deviation may vary between  
 Ans. 0 to  $\infty$
940. Average rate of depreciation would be obtained by  
 Ans. Geometric Mean
- If  $r$  is the observed correlation coefficient in a sample of  $n$  pairs of observation then
941. its standard error is denoted by  
 Ans. Standard error  $(r) = \frac{1-r^2}{\sqrt{n}}$
942. Probable error of the correlation coefficient given by  
 Ans. S.E.  $(r) = \frac{1-r^2}{\sqrt{n}}$
943. When two variables move in the same direction, correlation is said to be  
 Ans. Positive
944. When two variables move in the opposite direction correlation is said to be  
 Ans. Negative
945. Correlation is used for analysis of the behavior of  
 Ans. 2 or  $>2$  variables
946. In the case of perfect negative correlation the degree of correlation will be  
 Ans. - 1
947. There is no skewness when the values of mean, median & mode are  
 Ans. Equal
948. When Mean  $>$  Median  $>$  Mode, skewness will be  
 Ans. Positive
949. Probability of any event is a number lying between  
 Ans. 0 to 1
950. Probability is the science of  
 Ans. Decision
951. Mode of given set of observation is that value which occurs with the  
 Ans. Maximum frequency
952.  $\chi^2$  can be obtained by  
 Ans.  $\sum \left( \frac{O_i - E_i}{E_i} \right)^2$
953. Median is better suited for  
 Ans. Positional interval series
954. Harmonic mean is the reciprocal of the  
 Ans. Arithmetic mean
955. If a card is drawn from a pack of cards the probability of getting either a king or a queen is  
 Ans.  $\frac{2}{13}$
956. If A & B are mutually exclusive events  $P(A \cap B)$   
 Ans. 0
957. The normal distribution with  $\mu = 0$ , and  $\sigma = 1$  is known as  
 Ans. Standard normal distribution
958. The distribution of  $\chi^2$  depends on the  
 Ans. Degree of freedom

959. The  $X^2$  test should not be applied if N is less than  
Ans. 50
960. ANOVA table stands for analysis of  
Ans. Variance
961. The randomized block design is available for a wide range of treatments  
Ans. 2 to 24 (RBD)
962. In a double sampling plan the decision to accept or reject a lot is made on the basis of  
Ans. Two samples
963. Given Mean 25, Mode 25, the Median would be  
Ans. 24
964. When data are observed over a period of time the type of classification is known as  
Ans. Chronological classification
965. Neutral scale indicates  
Ans. Absolute changes
966. Ratio scale indicates  
Ans. Relative changes
967. Quartile deviation is  
Ans. 0.6745 of S.D.
968. When mean is 79, variance is 64 then CV is  
Ans. 10.126
969.  $B_2$  is a measure of  
Ans. Kurtosis
970. Chi square is a index of  
Ans. Dispersion
971. The S.D. of X-S is often called alternatively  
Ans. Standard error of X-
972. The student 't' distribution test discovered by  
Ans. W.S. Gosset (1908)
973. The student 't' test was perfected by  
Ans. R.A. Fisher (1926)
974. In describing the amount of variation in population and measure often used  
Ans. Coefficient of variation (C.V.)
975. In an investigation when two groups or two procedures are compared, these procedures are called  
Ans. Treatments
976. 't' test some times called  
Ans. Parametric test
977. Sign test some times called  
Ans. Non parametric test
978. Who developed the idea of regression  
Ans. Galton
979. The analysis of Co-Variance is a technique that combines the features of analysis of variance and  
Ans. Regression
980. In normal distribution  
Ans. Mean, Mode, Median are equal

- If fertility variation in the field is in two direction at right angles, which of the
981. experimental design is suit.  
Ans. Latin Square Design (LSD)  
As a general rule, the number of classes in the frequency distribution should be
982. about  
Ans. 30
983. Range of distribution is  
Ans. The difference between largest & smallest observation
984. Biometry deals with  
Ans. Observation with living things
985. Arithmetic mean is most commonly used because  
Ans. Based on all observation
986. 'F' test can be used for testing the significance of  
Ans. Several difference
987.  $X^2$  test is applied to  
Ans. Qualitive observation
988. Local control helps in  
Ans. Reducing Experimental error & homogeneity of experimental units
989. When sample size is small and population S.D. is known the test to be used is  
Ans. 't' test
990. To reduce the experimental error with heterogeneous material we need  
Ans. More replication & use of local control technique
1. First Indian Director of IARI was  
Ans. Dr. B. Vishvanath
  2. Father of Modern plant pathology  
Ans. Anton de Bary
  3. Bordeaux mixture was developed by  
Ans. PMA. Millardet
  4. Wart disease of potato is caused by  
Ans. *Synchytrium endobioticum*
  5. Nitrogen fixation in rice field is carried out by which blue green algae  
Ans. Azolla
  6. Total area of India is  
Ans. 32,87,263 sq. km.
  7. Forest area in India  
Ans. 19.39%
  8. Which country tops in the sugar producer of Rice  
Ans. India
  9. Which state is highest producer of Rice  
Ans. West Bengal
  10. In India which state is leading sugar producer  
Ans. Uttar Pradesh
  11. The most critical stage during the growth of wheat is  
Ans. CRI stage
  12. Urea contains \_\_\_\_\_ % of Nitrogen.  
Ans. 46%

13. Pusa ruby is a variety of \_\_\_\_\_ crop.  
Ans. Tomato
14. Net sown area of India is  
Ans. 143 million hectare
15. Gross cropped area of India is  
Ans. 193, million hectare
16. KVK was recommended by which committee  
Ans. Mohan Singh Mehta Committee
17. Inflorescence of sugarcane is known as  
Ans. Arrow
18. Red colour of tomato is due to  
Ans. Lycopen
19. Richest source of Vitamin C is  
Ans. Barbados cherry
20. Which Indian scientist shared world food prize for miracle maize  
Ans. Dr. Surinder K. Vasal
21. Power tiller is most suitable for the cultivation of  
Ans. Paddy
22. Harvesting of Paddy is done at moisture content  
Ans. 21-23%
23. National seed corporation was established in the year  
Ans. 1963
24. Seed act was passed in  
Ans. 1966
25. Loose smut of wheat is  
Ans. Internally seed borne
26. TZ test is done for  
Ans. Viability & Vigour
27. Establishment of NABARD  
Ans. 12<sup>th</sup> July, 1982
28. Cereals are deficient in which amino acid  
Ans. Lysine
29. Harvest index is  
Ans.  $\frac{\text{Economic yield}}{\text{Biological yield}} \times 100$
30. Kresek in rice is caused by  
Ans. *Xanthomonas oryzae*
31. Grassy shoot disease of sugarcane is caused by  
Ans. *Mycoplasma*
32. Bunchy top of Banana is caused by  
Ans. Virus
33. Which oil seed crop leads in the production  
Ans. Ground nut (33%)
34. Which state has highest production of soyabean in India  
Ans. Madhya Pradesh
35. Which state in India is the leading producer of coffee  
Ans. Karnataka

36. The name of the macaroni wheat is  
Ans. Triticum durum
37. Hand refractometer reading for sugarcane maturity is  
Ans. 20
38. Which portion of cane is the best suited to be used as seed / set.  
Ans. Top 1/3<sup>rd</sup> to 1/2
39. In Mango edible part is  
Ans. Mesocarp
40. Amino acid which is deficient in legumes  
Ans. Methionine
41. The plants growing in salt water are known as  
Ans. Halophytes
42. Granite is \_\_\_\_\_ rock.  
Ans. Igneite
43. Sugarcane is \_\_\_\_\_ plant.  
Ans. C<sub>4</sub>
44. Kresek symptom is present in  
Ans. Bacterial Leaf Blight
45. Pahala blight of sugarcane is caused due to deficiency of  
Ans. Mn
46. Reclamation disease due to deficiency of  
Ans. Cu
47. Contribution of live stock to agriculture GDP  
Ans. 25%
48. What is the amount of fertilizers consumed in India annually  
Ans. 19 million tones
49. The term Green Revolution was coined by  
Ans. William Gudd
50. RBI was established in which year  
Ans. 1935
51. Central Soil Salinity Research Institute is situated in  
Ans. Karnal
52. Late blight of potato is caused by  
Ans. Phytophthora infestans
53. Hormone related to drought tolerance is  
Ans. Absicis acid
54. Apical bud dominance is caused by which hormone  
Ans. Auxin
55. A hormone used as a herbicide is  
Ans. 2,4 – D
56. Proteins are made up of  
Ans. Amino acids
57. How many nutrients are termed as essential elements for plants  
Ans. 17
58. Translocation of water and nutrients from roots to above ground parts of plants takes place through  
Ans. Xylem

59. Causal agent of Mad Cow Disease is  
Ans. Prions
60. Dormancy breaking hormone is  
Ans. Cytokinin
61. Total registered pesticides in India are  
Ans. 164
62. ICAR day is celebrated on  
Ans. 16<sup>th</sup> July
63. ICRISAT is situated at  
Ans. Hyderabad
64. Double helical structure of DNA was given by  
Ans. Watson & Crick
65. Which wind cause rainfall in Tamilnadu  
Ans. North East Monsoon
66. Ring worm disease is caused by  
Ans. Fungus
67. Total number of KVK in India  
Ans. 288
68. National Agriculture Insurance Scheme was introduced in the year  
Ans. 1999 – 2000 (Rabi)
69. Who discovered Vitamin  
Ans. Funk
70. Theory of evolution was given by  
Ans. Charles Darwin
71. Law of Heredity was given by  
Ans. Gregor Mendal
72. Instrument used to measure atmospheric pressure is  
Ans. Barometer
73. Mycorrhiza is a symbiotic association between  
Ans. Fungi & roots of higher plants
74. Growing of plants under soil less condition is called  
Ans. Hydroponics
75. Stress hardening in plants can be activated by  
Ans. ABA
76. Flowering hormone used in pineapple is  
Ans.  $H_2C = CH_2$  (Ethylene)
77. Photo respiration is \_\_\_\_\_ process  
Ans. Energy Spending
78. The major form of transport carbohydrate in higher plant is  
Ans. Sucrose
79. Element contributing to the disease & drought resistance  
Ans. Potassium
80. Khaira disease is caused by the deficiency of  
Ans. Zn
81. Little leaf of citrus is caused by  
Ans. Zn deficiency

82. Complex disease in association with nematode  
Ans. Yellow ear rot
83. Solar heat treatment is recommended against  
Ans. *Ustilago segetum tritici*
84. The element involved in energy transfer and storage in plants is  
Ans. Phosphorus
85. Muriate of Potash (MOP) is chemically  
Ans. KCl
86. Maximum allowable Biurate content of urea is  
Ans. 1.5%
87. For the maximization of net revenue the condition is  
Ans.  $\frac{\Delta YI}{\Delta XI} = \frac{PXI}{PYI}$
88. Over the years the contribution of Agriculture to GDP of Indian economy has been  
Ans. Decreasing
89. On the indifference curve, the utility is  
Ans. Constant
90. The 'U' shape of cost curves could be best explained by the law of  
Ans. Variable properties
91. For the consumer to be in equilibrium the necessary condition is that the ratio of  
Ans. Marginal utilities is equal to price ratio
92. In difference curve approach could be attributed to  
Ans. Hicks
93. Pineapple is a \_\_\_\_\_ plant  
Ans. CAM
94. In the tropical climate \_\_\_\_\_ plants are more productive.  
Ans. C<sub>4</sub> plants
95. Mg<sup>+2</sup> is a component of \_\_\_\_\_ part of plant  
Ans. Chlorophyll
96. Heart rot of sugarbeet is caused by  
Ans. Boron deficiency
97. 2,4 – D is used for \_\_\_\_\_ - type weeds control.  
Ans. Broad leaf
98. The berry size of Thomson Seedless grapes increased by the hormone.  
Ans. GA<sub>3</sub>
99. The optimum spacing for wheat is (line to line)  
Ans. 22.5 cm
100. The non traditional area for cultivating wheat is  
Ans. Eastern India
101. The all India average for wheat yield is  
Ans. 12-14 qt/ha.
102. The haploid number of chromosome in rice is  
Ans. 12
103. Rice is considered as a \_\_\_\_\_ plant  
Ans. Short day plant
104. The optimum depth of puddling in rice is  
Ans. 5 cm

105. In wet nursery for rice, the level of water is maintained at  
Ans. 5 cm
106. In field paddy grains are harvested when per cent moisture is  
Ans. 20 – 25%
107. Total water requirement of the sugarcane crop is  
Ans. 200 -300 cm
108. Sugarcane is irrigated every \_\_\_\_\_ days during its growing period.  
Ans. 8 – 12 days
109. In India, the predominant species of cultivated cotton is  
Ans. *G. hirsutum*
110. Regur refers to  
Ans. Black soil
112. N content of FYM and Urban compost respectively is  
Ans. 0.5 and 1.4%
113. Major P fertilizer in India is  
Ans. DAP
114. Salination is a type of  
Ans. Wind erosion
115. Very few poor (below poverty line) people are in  
Ans. Punjab
116. Biologically active form of glucose is  
Ans. D - form
117. The bond present in sugars is  
Ans. Phosphodiester bond
118. The most abundant protein present in the world is  
Ans. Rubisco
119. The form of amino acids present in living organisms is  
Ans. L – form
120. The pairs are strongly bound with each other  
Ans. A +T, G+C, A+C
121. Bio fertilizer more suited for sugarcane is  
Ans. Azotobacter
122. Lines joining equal rainfall are called  
Ans. Isohyet
123. Origin of maize center is \_\_\_\_\_  
Ans. South America
124. Depth of sowing of soyabean seed is  
Ans. 3 cm
125. Cropping intensity of India is  
Ans. 140%
126. First rice variety introduced in India  
Ans. IR – 8 (1966)
127. Nicotine content in tobacco is related with  
Ans. Nitrogen
128. Boro rice is transplanted in  
Ans. Nov., to Dec.,

129. Glyphosate is a \_\_\_\_\_ - herbicide  
Ans. Non selective
130. Indian mustard is  
Ans. Brassica juncea
131. Mass flow is affected by  
Ans. Transpiration
132. Carbon content in organic matter is  
Ans. 58%
133. Desi cotton is known as  
Ans. Gossypium arboretum
134. Metric suction is measured by  
Ans. Tensiometer
135. Nitrogen bio- fertilizer for wheat is  
Ans. Azotobacter
136. Brix measures in terms of \_\_\_\_\_  
Ans. TSS
137. Verticillium mulch is used in soils  
Ans. Black cotton soils
138. Design used when fertility gradient is in two directions  
Ans. LSD
139. Criteria of essentiality was given by  
Ans. Arnon & Stout
140. Nucleus was discovered by  
Ans. Robert Brown
141. Segregation occurs during  
Ans. Meiosis only
142. The longest mitotic phase is  
Ans. Prophase
143. Tetrad is seen in  
Ans. Pachytene
144. Chiasma is seen during  
Ans. Diplotene
145. Multi lines in wheat are produced by  
Ans. Back cross breeding  
The selection procedure which provides the maximum improvement ever in the base population is
146. population is  
Ans. Pure line selection
147. Most dangerous disease of Potato  
Ans. Late blight of Potato
148. Phyllody disease in plants is caused by  
Ans. Mycoplasma
149. Father of Plant Nematology  
Ans. Bastian
150. Rice production is highest in the world  
Ans. China
151. Single super phosphate contains sulphur  
Ans. 12%

152. Most prominent soil group of India  
Ans. Alluvial soil
153. Murate of potash is chemically known as  
Ans. KCl
154. Highest contribution to vegetable oil is  
Ans. Groundnut
155. Explosive fertilizer is  
Ans. Ammonium nitrate
156. Most mutation tolerant are  
Ans. Polyploids
- The person acting as a connecting link between higher department official and farming community in T & V system, known as
157. Village Extension Worker
158. The pest which attacks all the parts of the plant is  
Ans. Termite
159. White grubs prefer to lay eggs on  
Ans. Sandy soil
160. Pesticide consumption in India is  
Ans. 450 g/ha.
161. Micro nutrient deficient in India  
Ans. Zn
162. Mantek disease of rice is caused by  
Ans. Rice root nematode
163. International pest is  
Ans. Schistocerca gregaria
164. The first Fisheries University was  
Ans. CIFE, Mumbai
165. Indian Institute of tropical meteorology is  
Ans. Pune
166. The second Indian recipients of world food prize was  
Ans. Dr. Varghese Kurien
167. Spike tooth harrow is a  
Ans. Secondary tillage implement
168. India ranks \_\_\_\_\_ - rank in fruit production  
Ans. First
169. Club root of cauliflower is caused by  
Ans. Plasmodiophara brassicae
170. Sheath blight of rice is caused by  
Ans. Rhizoctonia solani
171. Father of microbiology  
Ans. Louis Pasteur
172. Bacterium was discovered by  
Ans. Anton Leewenhock
173. The variety of wheat which is resistant to all the three rusts is  
Ans. Chotilerma

174. In sugarcane, taking of ratoon crop is advisable only for  
Ans. One time
175. Wilt disease is \_\_\_\_\_ disease  
Ans. Soil borne
176. Vector of leaf curl disease in Cotton  
Ans. White flies
177. 'Flared square' symptoms seen in cotton due to the  
Ans. Spotted boll worm
178. The number of electrons required for conversion of  $\text{NO}_3^-$  to  $\text{NH}_4^+$   
Ans. 8
179. Conversion of fat to sugar occurs in  
Ans. Glyoxysomes
180. The net requirement for assimilation of  $\text{CO}_2$  in  $\text{C}_4$  plants is  
Ans. 5
181. The primary acceptor of electron in PS II is  
Ans. Pheophytin
182. Gneiss is a \_\_\_\_\_ rock  
Ans. Metamorphic
183. Under the USDA system, silt is classified as having a particle size of  
Ans. 0.02 to 0.002 mm
184. Hygroscopic water is held at a tension of \_\_\_\_\_ atmosphere  
Ans. 31 or more
185. Kaolinite is a layer silicate type  
Ans. 1 : 1 type
186. Clays are \_\_\_\_\_ - minerals  
Ans. Secondary
187. C : N ratio of organic matter is  
Ans. 10:1
188. CAN is \_\_\_\_\_ fertilizer.  
Ans. Neutral
189. Most widely used additive for correcting soil acidity is  
Ans. Lime
190. Largest importer of cut flowers in the world is  
Ans. Germany
191. Density of water is maximum at \_\_\_\_\_  $^{\circ}\text{C}$ .  
Ans.  $4^{\circ}\text{C}$
192. Diara cultivation method is followed in  
Ans. Cucurbits
193. The irrigation method which is suitable for saline soils is  
Ans. Flood method
194. The role of extension education in India is performed by  
Ans. State Agricultural Universities (SAUs)
195. Extension is a  
Ans. Two way flow of message
196. Oldest method of selection is  
Ans. Mass selection

197. The limit of the regression coefficient is  
Ans. 0 to 1
198. Highly salt tolerant crop is  
Ans. Barley
199. Formation of male flowers is induced by  
Ans. GA<sub>3</sub>
200. Cytokinin is mostly synthesized in  
Ans. Root tips.
201. Recent method of control of bollworms is  
Ans. Bt. transgenic plants
202. Orabanche is a parasite associated with  
Ans. Tobacco
203. Dr. B.P. Pal is associated with  
Ans. Breeding
204. Art of giving shape to shrubs resembling to figure is called as  
Ans. Topiary
205. The dwarf variety of mango is  
Ans. Amrapali
206. Mango malformation can be checked by  
Ans. NAA Spray
207. Photo – respiration occurs in  
Ans. Chloroplast
208. Photosynthesis is an  
Ans. Oxidation – reduction process
209. Root promoting hormone is  
Ans. IBA
210. Fruit of rose is known as  
Ans. Hips
211. What concentration of sugar is used for preservation  
Ans. 60 – 70%
212. Fruit crop which requires the highest number of irrigations  
Ans. Banana
213. Photo system II is absent in  
Ans. C<sub>4</sub> plants
214. Conversion of fat into carbohydrate is seen in  
Ans. Glyoxylate cycle
215. Peroxisome is a \_\_\_\_\_ membrane organelle.  
Ans. Single membrane organelle
216. The main site for the dark reaction of photosynthesis is  
Ans. Stroma
217. The F<sub>2</sub> ratio for complementary interaction is  
Ans. 9 : 7
218. The shortest phase of all the Mitosis phases is  
Ans. Anaphase
219. Longest phase of all the mitosis phases is  
Ans. Prophase

220. The site of protein synthesis is  
Ans. Ribosomes
221. Operation flood is related to  
Ans. Dairy development
222. Bunch terracing is done when the slope is more than  
Ans. 15%
223. Mass per unit volume is called as  
Ans. Bulk density
224. Disk plough is used when the soil is  
Ans. Tough
225. Post harvest losses for cereals account for \_\_\_\_\_ of total production  
Ans. 10%
226. National seed was act passed in the year  
Ans. 1966
227. ICAR was initiated as per recommendation of  
Ans. Royal commission on Agriculture 1925
228. Mango variety which is suitable for high density planting is  
Ans. Amrapali
229. Mango, Malika is a cross between  
Ans. Nellam X Dashari
230. T & V was first started in  
Ans. Rajasthan
231. Indian Journal of Agriculture Sciences is published by  
Ans. ICAR
232. The design to be followed for one directional fertility gradient is  
Ans. RBD
233. The distribution where the sp. is equal to the root of means is  
Ans. Poisson
234. Maximum contribution of the crop to the production of cereals in the country is  
Ans. Rice
235. Highest sugarcane yield per hectare is in the state  
Ans. Tamilnadu
236. Distribution of Mean, Median, Mode is a  
Ans. Normal distribution
237. Nursery area required for seedling of rice for one hectare field is  
Ans. 0.10 ha.
238. Marble is a  
Ans. Metamorphic rock
239. Time duration for adsali crop of sugarcane is  
Ans. 18 months
240. Crossing over occurs in \_\_\_\_\_ stage.  
Ans. Pachytene
241. First man made cereal is  
Ans. Triticale
242. Triticale is a crossing of  
Ans. Wheat X Rye

243. Interveinial chlorosis occurs due to  
Ans. Fe deficiency
244. Saline tolerant fruit crop is  
Ans. Date palm
245. Optimum pH for rice is  
Ans. 4 – 6 pH
246. Dead heart & white ear are associated with the crop  
Ans. Rice
247. Formula of urea  
Ans.  $\text{CO}(\text{NH}_2)_2$
248. MOP contains  $\text{K}_2\text{O}$   
Ans. 58-60%
249. Fruit ripening hormone is  
Ans. Ethylene
250. Water use efficiency is highest in plants is  
Ans. CAM plants
251. Ooze test is done for detecting  
Ans. Bacteria
252. Maximum arable land in country is  
Ans. Australia
253. Malathion is a \_\_\_\_\_ insecticide.  
Ans. Systemic organo phosphate
254. Family of sugarcane is  
Ans. Graminae
255. Most widely grown rabi pulse crop is  
Ans. Bengal gram
256. Unit of rural society is  
Ans. Village
257. Fruit type of guava is  
Ans. Berry
258. The term genetics was coined by  
Ans. Bateson
259. Sodic soils are reclaimed by  
Ans. Gypsum
260. I.I.S.R. is situated at  
Ans. Lucknow
261. IPGRI is situated at  
Ans. Italy, Rome
262. Proportion of sand, silt and clay is known as  
Ans. Soil texture
263. Cheapest N containing fertilizer is  
Ans. Urea
264. Total Land capability classes are  
Ans. 8
265. Bacteria change nitrite to nitrate is  
Ans. Nitro bacter

266. Akiochi disease is due to the toxicity of  
Ans. Sulphur toxicity
267. First product of urea hydrolysis is  
Ans. Ammonium carbamate
268. Azolla is a \_\_\_\_\_ Algae.  
Ans. Blue green algae
269. Functional nutrients concept was given by  
Ans. Nicholas
270. State leading in wheat production in India is  
Ans. Uttar Pradesh
271. NABARD was set up on the recommendation of  
Ans. Siva Raman committee, Narasimhan Committee
272. White rust of crucifers is caused by  
Ans. Albugo candida
273. The hard fruits of citrus is due to the deficiency of  
Ans. B deficiency
274. Which is the antidote of insect poisoning is  
Ans. Atropin
275. Tetrasomic is  
Ans.  $2n + 2$
276. Precursor of IAA is  
Ans. Tryptophan
277. Fruit of okra is  
Ans. Capsule
278. Vitamin containing cobalt as a constituent is  
Ans. Vit. B<sub>12</sub>
279. Free living nitrogen fixing organism is  
Ans. Azotobacter
280. Dwarfing gene in rice is  
Ans. Dee gee woo gen
281. Centre of origin of wheat is  
Ans. Mexico
282. Total deemed universities under ICAR  
Ans. 4
283. Total National Bureaus under ICAR are  
Ans. 5
284. Lab to land programme started in the year  
Ans. 1979
285. Disease which was discovered in Haryana  
Ans. Karnal bunt
286. Chromosomal theory of inheritance was proposed by  
Ans. Sutton & Boveri
287. Ufra disease in Rice is caused by  
Ans. (Nematode) Ditylenchus sp.
288. The fruit of mustard is known as  
Ans. Siliqua

289. N content in ammonium sulphate is  
Ans. 21%
290. Herbicides are not used in the dust formulation because of  
Ans. Drift hazard
291. The fungicide which is used for smut control is \_\_\_\_\_  
Ans. Vitavax
292. First stable product formed in C<sub>3</sub> plants is  
Ans. PGA
293. The green house gas that is released from paddy field is  
Ans. CH<sub>4</sub>
294. B.P.Pal is a variety of  
Ans. Rose
295. Over the years the per cent contribution of agriculture to GDP is  
Ans. Decreasing
296. IADP programme started in the year  
Ans. 1960
297. Person associated with Gurgoan pilot project is  
Ans. P.L. Brayne
298. Net irrigated area of India  
Ans. 57 m.ha.
299. What is the price called which is fixed by government  
Ans. Minimum Support price
300. Power house of cell is  
Ans. Mitochondria
301. The per cent land resource of India in the world is  
Ans. 2.4%
302. Head quarters of W.T.O. is located at  
Ans. Geneva
303. The highest award presented to an agricultural scientist in the country is  
Ans. Rafi Ahmad Kidwai Award
304. The growth rate projected in the 10<sup>th</sup> five year plan is  
Ans. 8.0%
305. IARI is a  
Ans. Deemed University
306. Highest CEC found in  
Ans. Vermiculate
307. ESP of normal soil is  
Ans. Less than 15%
308. Sugar trun out from Sugarcane in India is  
Ans. 8-10%
309. Permanent wilting point is observed at  
Ans. - 15 bar
310. Mango is mostly propagated through  
Ans. Veneer grafting
311. Micro organism associated with the symbiotic N<sub>2</sub> fixation in non legumes is  
Ans. Azolla

312. Emmer wheat is  
Ans. Triticum dicoccum
313. Net capital ratio is  
Ans. Total assets / Total liabilities
314. Catkin is a inflorescence of  
Ans. Cauliflower
315. Black heart of potato is due to  
Ans. Poorly drained soil
316. The Arka series of varieties are released from  
Ans. IHR, Bangalore
317. Major agricultural import in India is  
Ans. Edible oils
318. Which programme also known as package programme  
Ans. IADP
319. Whip tail of cauliflower is due to the deficiency of  
Ans. Mo
320. Gross cropped area in India is  
Ans. 193 M.ha.
321. Yellow rust in wheat is caused by  
Ans. Puccinia striiformis
322. Seedless mango variety is  
Ans. Sindhu
323. Pink revolution refers to  
Ans. Onion
324. Correlation coefficient ranges between  
Ans. - 1 to + 1
325. Pusa snow ball is a variety of  
Ans. Cauliflower
326. CRIDA is located at  
Ans. Hyderabad
327. India's share in the fruit production in the world is  
Ans. 10%
328. Fertilizer's which are completely imported  
Ans. Potassic
329. The contribution of Agriculture to GDP of India is  
Ans. 22.2%
330. Present D.G. of ICAR  
Ans. Mangala Rai
331. Moisture content for safe storage of cereals is  
Ans. 12-14%
332. Lunishree is a variety of  
Ans. Super Rice
333. Highest cotton production in India  
Ans. Maharastra
334. Supporting price of wheat in 2002  
Ans. 610

335. Minimum support price is formulated by  
Ans. CACP
336. Central Agricultural University is located at  
Ans. Imphal
337. Constituent of wheat affecting its backing quality is  
Ans. Glutin
338. IGFRI is situated at  
Ans. Jhansi
339. CRI stage occurs in wheat in  
Ans. 21 days
340. Bulk density is high in  
Ans. Sandy soil
341. Suicidal bags of cell are  
Ans. Lysosomes
342. The fertilizer also called Nitro chalk  
Ans. CAN
343. Regression coefficient varies between  
Ans.  $-\alpha$  to  $+\alpha$
344. Soil transported through wind is  
Ans. Aeolian soil
345. Formation of mRNA from DNA is called  
Ans. Transcription
346. The ion generally dominant in soil solution is  
Ans.  $\text{Ca}^{2+}$
347. Fixation in soil is a problem in case of  
Ans. Phosphatic fertilizers
348. Luxury consumption is generally associated with  
Ans. Potassium
349. The journal Indian farming published by  
Ans. ICAR
350. Pride fruit of India is  
Ans. Mango
351. Solar constant is  
Ans.  $1.94 \text{ cal/cm}^2/\text{sec}$
352. C.V. of rainfall is more in  
Ans. Thar desert
353. Striga is \_\_\_\_\_ type parasite.  
Ans. Semi root
354. Lady bird beetle is a  
Ans. Predator
355. Monophagus pest is  
Ans. Yellow stem borer
356. Maximum production of potato in  
Ans. Uttar Pradesh
357. CIPHET is situated at  
Ans. Ludhiyana

358. First project launched in India  
Ans. Etawah
359. Maximum oil seed producer crop in India  
Ans. Ground nut
360. Maximum nutrient uptake by plants  
Ans.  $K^+$
361. Nutrient available in combined form  
Ans. Nitrogen
362. Sulphur is available in which form  
Ans.  $SO_4^{-2}$
363. Sugarcane sets required per ha.  
Ans. 35,000 – 40,000
364. Most efficient irrigation system  
Ans. Drip irrigation
365. How many deemed universities under ICAR  
Ans. 4
366. Insects which attacks rice at night  
Ans. Army worm
367. Formula of gypsum  
Ans.  $CaSO_4 \cdot 2H_2O$
368. Maximum productivity among cereals in world  
Ans. Maize
369. Queen of cereals known as  
Ans. Maize
370. Gold of America known as  
Ans. Soyabean
371. Back bone of America is the crop  
Ans. Maize
372. Hulling percent in rice is  
Ans. 65%
373. Weight of cotton bale is  
Ans. 170 kg
374. Which is not a measure of central tendency  
Ans. Range
375. Pungency in onion is due to presence of  
Ans. Sulphur compound
376. CEC of humus is  
Ans. 200 – 300
377. Movement from higher concentration to lower concentration known as  
Ans. Diffusion
378. 'V' shape pattern of yellowing shows  
Ans. N deficiency
379. Fiber of cotton contains  
Ans. Cellulose
380. Available water lies between  
Ans. 33 to 15 bar

381. Growing subsidiary crop between widely rowed space of main crop is called  
Ans. Intercropping
382. Least degree of freedom in ANOVA is  
Ans. 12
383. Sugar cane is  
Ans. Quantative short day plant
384. Isotopes have some number of  
Ans. Proton
385. N<sub>2</sub> deficiency occurs in plants on  
Ans. Lower leaves
386. Highest K<sub>2</sub>O containing fertilizer  
Ans. KCI (60%)
387. Boron is harmful for plants when more than  
Ans. 3 PPM concentration
388. Which is not a measure of dispersion  
Ans. Coefficient of variation
389. Irish famine (1845) was caused by  
Ans. Phytophthora infestans
390. Production of ATP in the presence of light is known as  
Ans. Photo-Phosphorylation
391. For seed purpose carrot is grown as  
Ans. Binneal
392. Soil moisture is measured by  
Ans. Tensiometer
393. Bacteria which convert NH<sub>4</sub><sup>+</sup> to NO<sub>2</sub><sup>-</sup>  
Ans. Nitrosomonas
394. Physical condition of soil known as  
Ans. Soil tilth
395. Infra red thermometer used for  
Ans. Crop canopy temperature
396. Most serious disease in sugarcane  
Ans. Red rot
397. Ribosome found in mitochondria  
Ans. 70s type
398. Black soils found in  
Ans. Maharastra
399. World staple food is  
Ans. Wheat
400. 3M deep, more than 18M. wide gully known as  
Ans. Small gully
401. In which fertilizer N and P present in highest amount  
Ans. DAP (18%, 46%)
402. Leading state in acreage of rice  
Ans. West Bengal
403. Which crop having highest percentage of irrigation  
Ans. Wheat

404. Sugarcane sowing in trench method to  
Ans. Prevent lodging
405. Dough stage means  
Ans. Milking to just maturing
406. C:N ratio of most arable soils  
Ans. 10:1
407. Noble cane is  
Ans. *Saccharum officinerum*
408. Re discovery of Mendel laws by  
Ans. Devries, Correns, Trashe mark
409. Pattern used in dry land  
Ans. Broadcasting
410. Parboiling in rice conserves  
Ans. Vitamin B
411. Maize is a  
Ans. C<sub>4</sub> plants
412. In 1943 Bengal famine was due to  
Ans. Blast of rice (*Pyricularia oryzae*)
413. Maximum total porosity found in  
Ans. Clay soils
414. Most frost effected crop  
Ans. Gram
415. H.D. -2329 is a variety of  
Ans. Wheat
416. Drip irrigation introduced in India from  
Ans. Israel
417. N percent in CAN is  
Ans. 25%
418. Highest amount of rainfall received in India by  
Ans. South West Monsoon
419. The river basins have more utilizable flow is  
Ans. Ganga
420. First Agricultural chemist of imperial Agricultural Research station was  
Ans. J.W. Leather
421. Pseudo cereal is  
Ans. Buck Wheat
422. King of Fruits  
Ans. Mango
423. Queen of spices  
Ans. Cardamom
424. How water rises in plant  
Ans. By transpiration pull
425. The first fertilizer produced in India was  
Ans. SSP
426. Oil content in soyabean  
Ans. 20%

427. Hand book of Agriculture published by  
Ans. ICAR
428. Growth of plants towards light known as  
Ans. Photoperiodism
429. Agmark is  
Ans. Quality of food product
430. Diameter of clay particles  
Ans.  $<0.002$
431. Available form of N in soil  
Ans.  $\text{NH}_4^+$  &  $\text{NO}_3^-$
432. ESP of alkali soils  
Ans.  $> 15\%$
433. The normal ratio of rice/paddy is  
Ans.  $2/3$
434. Crop for attracting insects  
Ans. Trap crop
435. Wind velocity can be measured by  
Ans. Anemometer
436. Deflocculation of soil particles occurs by  
Ans. Na
437. Planting before harvest of main crop known as  
Ans. Relay cropping
438. Which is not a green house gas  
Ans.  $\text{O}_2$
439. Urea is maximum marketed as  
Ans. Prills
440. Maximum metabolic activity of plant is at  
Ans.  $22 - 30^\circ\text{C}$
441. ICMR recommendation for pulse consumption /day/capita.  
Ans. 85 gram/day
442. 1 gm. Glucose has  
Ans. 0.45 gm fat
443. Harvest Index in wheat is  
Ans.  $0.35 - 0.45$
444. Leaf curl of tomato due to  
Ans. Virus
445. The crop which prefer ammonical form of N  
Ans. Rice
446. PUFA content is highest in  
Ans. Sunflower
447. Intero specific hybrid are more common in  
Ans. Cotton
448. Shedding of plant parts is due to  
Ans. ABA
449. Soil is clay when clay separates are minimum of  
Ans.  $30\%$

450. Maximum N loss in rice in form of  
Ans. Denitrification
451. Head of planning commission is  
Ans. Prime Minister
452. Climate for arhar is  
Ans. Warm tropical
454. High yielding variety of wheat produced by in world  
Ans. Borlog
455. Maximum P available at pH  
Ans. 6.5 – 7.0 pH
456. Chemical used for delinting of cotton  
Ans. H<sub>2</sub>SO<sub>4</sub>
457. Highest nutrient content in which fertilizer  
Ans. SSP
458. Sowing time of cotton in north India  
Ans. 15 May
459. Soil erosion in India is  
Ans. 16 tun/ha./year
460. Number of eggs/sec. laid by termite  
Ans. 60
461. Which is a stable element  
Ans. Zr
462. Nature and properties of soil is written by  
Ans. N.C. Brady
463. Which gas is dominant in water logged soils  
Ans. CO<sub>2</sub>
464. Rothemsted Agricultural Research station was founded by  
Ans. Larves & Gilbert
465. Protein content in wheat  
Ans. 12 – 14%
466. Curing is related to the crop  
Ans. Tobacco
467. Which micro organism is responsible for maximum nutrient cycling in the soil  
Ans. Bacteria
468. The extension programme linked form planed with credit for farmers  
Ans. IRDP
469. Ratooning is practiced in crop  
Ans. Sugarcane
470. Molybdenum is required by plants because it is a cofactor for  
Ans. Nitrate reductase
- The basic unit of development under the Integrated Rural Development
471. Programme is a  
Ans. Family
472. Botanical name of green gram is  
Ans. Vigna radiate

473. Irrigation method best for undulation topography  
Ans. Sprinkler irrigation
474. Present farming system of India has become  
Ans. Market Oriented
475. The chemical widely used to treat seed of potato to break its dormancy  
Ans. Thio urea
476. Wheat is a origin of  
Ans. Mediterranean
477. Azotobacter fixes atmospheric nitrogen  
Ans. Non symbiotically
478. Rock phosphate use in  
Ans. Acidic soil
479. Cycocel is a  
Ans. Growth retardant
480. Wheat is a  
Ans. C<sub>3</sub> plant
481. SAR of alkali soils is  
Ans. > 13
482. Most of the plant obtain nitrogen from the soil in the form of  
Ans. Nitrate
483. Total agro climatic zones are in India  
Ans. 15
484. Foundation seed is produced by  
Ans. Breeder seed
485. Pulse crop doesn't fix N from atmosphere  
Ans. Rajma
486. If only three irrigations are available indicate critical stages of wheat when there will be applied  
Ans. CRI, tillering, doughing stage
487. Potao tuber is a modified form of  
Ans. Stem
488. The most efficient use of phosphorus is achieve by  
Ans. Basal placement at the time of sowing
489. Goodness of fit is used for distribution of  
Ans. Chi-square test
490. Growing plants of different heights in the same field at the same time is known as  
Ans. Multi storied cropping
491. Water sue efficiency is the highest in case of  
Ans. Drip irrigation
492. Type of soil water which is most useful for plants  
Ans. Capillary water
493. Scorching of burning on margins of bottom leaves manifests the deficiency of  
Ans. Potassium
494. Plants takes carbon from  
Ans. Air

495. Concept of plant ideotype was first propounded by  
Ans. C.M. Donald
496. The nutrient plays important role in controlling the rate of transpiration  
Ans. Potassium
497. Highest contribution in GDP  
Ans. Milk
498. IVLP is  
Ans. Institution Village Linkage Programme
499. Very few poor (below poverty line) people is in  
Ans. Punjab
500. Micro nutrient deficient in Indian soils  
Ans. Zn
501. In waterlogged area which gas is found abundantly  
Ans. CH<sub>4</sub>
502. What means photo-respiration  
Ans. Production of ATP
503. Scientific name of berseem is  
Ans. *Trifolium alexandrium*
504. The insect "Boll Worm" commonly found on  
Ans. Cotton
505. Most destructive disease of sugarcane is  
Ans. Red rot of sugarcane

**Grand Test – 3**

**Date: January, 2013**

1. Highest forest area in the state \_\_\_\_\_
2. Highest wind erosion in the state \_\_\_\_\_
3. The monsoon which covered highest area in rainfall in India \_\_\_\_\_
4. Highest alluvial soils found in the state \_\_\_\_\_
5. State which have highest area of saline soils \_\_\_\_\_
6. Highest source of irrigation in India \_\_\_\_\_
7. Percentage arid area of total area of India is \_\_\_\_\_
8. D.G. of I.C.A.R. is \_\_\_\_\_
9. Who wrote the book Horse Hoeing Husbandry is \_\_\_\_\_
10. Farming which includes crop production and live stock \_\_\_\_\_
11. The farming system used to develop at the Mars according to the Earth's environment is called \_\_\_\_\_
12. If deficiency of rainfall is above 50% of the normal the situation will be called as \_\_\_\_\_
13. Tobacco is a Kharif / Rabi crops (Strike the wrong) \_\_\_\_\_
14. Highest consumption of K fertilizer in \_\_\_\_\_
15. De suckering is a process of a crop \_\_\_\_\_
16. Formula of Real value is \_\_\_\_\_
17. The weed which was first biologically controlled \_\_\_\_\_
18. Trade name of Alachlor \_\_\_\_\_
19. Total root parasite \_\_\_\_\_
20. Vertical movement of water in soil is known as \_\_\_\_\_
21. Fertilizer application through irrigation known as \_\_\_\_\_
22. Highly salt tolerant cereal crop is \_\_\_\_\_
23. Extensively grown pulse crop in India \_\_\_\_\_
24. Most critical stage for water \_\_\_\_\_
25. Widely used nitrogenous fertilizer in rice \_\_\_\_\_
26. Seed rate in depog method for rice \_\_\_\_\_

27. Most critical stage for irrigation \_\_\_\_\_
28. Important mimicry weed of wheat is \_\_\_\_\_
29. The protein which is essential for good bread quality is \_\_\_\_\_
30. Moisture content at harvesting stage in wheat is \_\_\_\_\_
31. Pollination type of gram is \_\_\_\_\_
32. Seed rate of gram is \_\_\_\_\_
33. Spacing for arhar is \_\_\_\_\_
34. Protein content in arhar is \_\_\_\_\_
35. Inflorescence of sugarcane is called as \_\_\_\_\_
36. Most critical stage for irrigation is \_\_\_\_\_
37. Noble cane is \_\_\_\_\_
38. Seed rate for single budded sets in sugarcane is \_\_\_\_\_
39. Name of wild type cane \_\_\_\_\_
40. Origin of Ground nut \_\_\_\_\_
41. Pegging stage is glandut comes after \_\_\_\_\_ drop often sowing
42. Vector of virus rositte in groundnut is \_\_\_\_\_
43. Tikka disease is due to \_\_\_\_\_
44. Fruit type of tomato is \_\_\_\_\_
45. Chemical used for tomato sauce preservation is \_\_\_\_\_
46. Edible part of mango is known as \_\_\_\_\_
47. Internal fruit necrosis in Mango is due to \_\_\_\_\_
48. Fruit type of citrus \_\_\_\_\_
49. Propagation method for palm Date is \_\_\_\_\_
50. Sindhu variety of Mango is a cross of \_\_\_\_\_
51. Major source of rock for Mg is \_\_\_\_\_
52. 'O' horizon is absent in \_\_\_\_\_
53. Physical property which can't be changed is \_\_\_\_\_
54. Diameter of silt particle is \_\_\_\_\_
55. Soil structure which is best for cultivation is \_\_\_\_\_
56. Bulk Density of general soils is \_\_\_\_\_

57. Portion of capillary water lying between field capacity (1/3 atm) and wilting coefficient (15 atm) is known as \_\_\_\_\_
58. Vermiculate is \_\_\_\_\_ type of mineral
59. C:N ratio of FYM \_\_\_\_\_
60. Loss of N<sub>2</sub> in the form of NH<sub>3</sub> in alkaline medium is known as \_\_\_\_\_
61. Most outstanding green manure crop is \_\_\_\_\_
62. Substances added to soils for the improvement of their condition are known as \_\_\_\_\_
63. Highest N% in fertilizers is seen in \_\_\_\_\_
64. N & P<sub>2</sub>O<sub>5</sub> percent in DAP \_\_\_\_\_
65. Ca per cent in Gypsum (CaSO<sub>4</sub>.2H<sub>2</sub>O) is \_\_\_\_\_
66. Rhizobium melilotis is used for the crops \_\_\_\_\_
67. Phosphorus is extracted by the method \_\_\_\_\_
68. Criteria of essentiality was given by \_\_\_\_\_
69. Source of Mo for plants for absorption is \_\_\_\_\_
70. Interveinal chlorosis is occurs due to the deficiency of \_\_\_\_\_
71. Excess vegetative growth is due to the supply of \_\_\_\_\_
72. Whiptail of cauliflower occurs due to the deficiency of \_\_\_\_\_
73. Osmotic regulation is maintained by the element \_\_\_\_\_
74. Little leaf of cotton occurs due to the deficiency of \_\_\_\_\_
75. If pH>8.5, EC<4(dS/m), ESP >15% the soil will be \_\_\_\_\_
76. Lime stone is used for the reclamation of \_\_\_\_\_ soils.
77. Acid tolerant crop is \_\_\_\_\_
78. The soils which have organic matter +Na are known as \_\_\_\_\_ soils.
79. Chromosomal theory of inheritance (1903) by \_\_\_\_\_
80. The lines are homozygous and homogenous in nature called as \_\_\_\_\_
81. If a single gene governing multiple traits, it is called as \_\_\_\_\_
82. Embryo development without fertilization is called \_\_\_\_\_
83. Centers of origin was first given by \_\_\_\_\_
84. Jagannath is a mutant variety of \_\_\_\_\_
85. A nullisomic individual is represented by \_\_\_\_\_
86. Glycolysis occurs in the part of cell \_\_\_\_\_

87. Total ATP synthesis from one 2 X 2 molecule of glucose in respiration \_\_\_\_\_
88. Kerbs cycle starts with \_\_\_\_\_
89. CO<sub>2</sub> concentration in the atmosphere is \_\_\_\_\_
90. C<sub>4</sub> (hatch Black pathway) found in \_\_\_\_\_ plants.
91. First enzyme in CO<sub>2</sub> fixation in C<sub>4</sub> plants is \_\_\_\_\_
92. Highest water use efficiency is seen \_\_\_\_\_ plants.
93. Calvin cycle & Hatch – slack pathway occurs in \_\_\_\_\_ cell organelle.
94. Harvest Index in cereals is \_\_\_\_\_
95. Sugar which is sweetest among all sugars is \_\_\_\_\_
96. Proteins are the polymer of \_\_\_\_\_
97. Enzymatic activity was first discovered by \_\_\_\_\_
98. Scurvy is due to the deficiency of \_\_\_\_\_
99. The most abundant form of RNA is \_\_\_\_\_
100. Free living N fixing bacteria is \_\_\_\_\_

**Grand Test – 3 Answer Key:**

1. Madhya Pradesh
2. Rajasthan
3. South West Monsoon
4. Uttar Pradesh
5. Gujarat
6. Wells (52%)
7. 17%
8. Ayappan
9. Jethrotull
10. Mixed farming
11. Terra farming
12. Severe drought
13. Rabi crop
14. Maharashtra
15. Tobacco
16. 
$$RV = \frac{TePurity \% \times Germination \%}{100}$$
17. Lantana Camaera
18. Lasso
19. Orobanche
20. Percolation
21. Fertigation
22. Barley
23. Chick pea
24. Booting stage
25. Ammonium Sulphate
26. 3-4 kg/m<sup>2</sup>
27. C.R.I. Stage
28. Phalaris minor
29. Gluten
30. 25-30%
31. Self pollinated
32. 80-100 kg/ha.
33. 60 X 15cm
34. 25%
35. Arrow
36. Formative stage
37. *S. officinarium*
38. 1,25,000 sets
39. *S. spontaneum*
40. Brazil
41. 55
42. Aphid
43. *Cercospora personata* & *C. arachidicola*
44. Berry
45. Sodium benzoate
46. Mesocarp
47. Boron deficiency
48. *Hesperidum*
49. Offshoot
50. Ratna X Alphanso
51. Dolomite
52. Arable soils
53. Soil texture
54. 0.02 – 0.002 mm
55. Crumby structure
56. 1.33 mg/cm<sup>3</sup>
57. Available water
58. Limited expending 2:1 type mineral
59. 100:1
60. Volatilization
61. Sun hemp
62. Amendments
63. Aquous Amonia (80% N)
64. 16% N, 48% P<sub>2</sub>O<sub>5</sub>
65. 29.2% Ca
66. Medicago (Alfalfa), Trigonella (Fenugreek)
67. Olsen's method & Bray No. 1 method
68. Arnon & stout (1939)
69. MoO<sub>4</sub><sup>2-</sup>
70. Fe deficiency
71. High supply of N
72. Mo deficiency
73. K<sup>+</sup>
74. Zn deficiency
75. Alkali
76. Acidic soils
77. Rice
78. Black alkali soils
79. Suttan & Boverly
80. Pure line
81. Pleiotrophy
82. Apomixis
83. Vavilov
84. Rice
85. 2n – 2
86. Cytoplasm
87. 36 ATP (Net gain), Gross – 38 ATP
88. Acetyl COA & Oxaloacetate
89. 0.03%
90. Sorghum, Maize, Sugarcane
91. PEP Carboxylase
92. CAM > C<sub>4</sub> > C<sub>3</sub>
93. Chloroplast
94. 0.4 – 0.5
95. Fructose
96. Amino acid
97. Buchner
98. Vitamin C (Ascorbic acid)
99. r-RNA (80%)
100. Azotobacter

**Grand Test – 4**

1. A – value is proposed by\_\_\_\_\_.
2. A – value is used for the assessment of available \_\_\_\_\_
3. Usually Acid rain has a pH of \_\_\_\_\_
4. Typical nutrient content of Activated sludge is \_\_\_\_\_
5. Clods and crumbs formed by binding together of sand, silt and clay particles is called \_\_\_\_
6. Soil order representing soils having moderately high base saturation and accumulation \_\_\_\_
7. Acidic igneous rocks contain \_\_\_\_\_ % quartz.
8. Metamorphic rocks are formed from \_\_\_\_\_ rocks.
9. Slate is formed from \_\_\_\_\_
10. The most important chemical weathering process is \_\_\_\_\_
11. Name of the soil formed by transport of the wind is \_\_\_\_\_
12. The study of soil in relation to crop growth is \_\_\_\_\_
13. The smallest volume that can be recognized as a soil and is 3 – dimensional \_\_\_\_\_
14. A+B+C horizons are called \_\_\_\_\_
15. Who gave the active and passive factor concept \_\_\_\_\_
16. Red colour in red soils is due to the presence of \_\_\_\_\_
17. The parent material for red soils is \_\_\_\_\_
18. \_\_\_\_\_Covers an area of about 74 m ha accounting for 24% of the total geographical area.
19. The clay content ranges from \_\_\_\_\_ in Black soils.
20. Soils of recent origin \_\_\_\_\_
21. Alluvial soils deficient in \_\_\_\_\_ and \_\_\_\_\_
22. Alluvial soils contain \_\_\_\_\_ type of clay minerals.
23. Shifting cultivation is mainly practiced in \_\_\_\_\_ soils.
24. \_\_\_\_\_ developed in the arid and semi arid regions.
25. Alkali soils are reclaimed by applying \_\_\_\_\_
26. \_\_\_\_\_ are very sensitive to saline Alkali soils.
27. The loss in soil productivity due to physical, chemical and biological deterioration is called \_\_\_\_\_

28. Area affected by soil degradation is \_\_\_\_\_ of the total geographical area.
29. The severe form of rill erosion where in grooves form deep channels called gullies are formed \_\_\_\_\_
30. \_\_\_\_\_ is the most important process in wind erosion.
31. \_\_\_\_\_ are less erodible than black soils.
32. Loss of plant nutrients increases with increase in \_\_\_\_\_
33. \_\_\_\_\_ are stronger in preventing soil loss.
34. Whip tail in cauliflower is caused by deficiency of \_\_\_\_\_
35. 'Speckled yellow' of sugar beet is caused by deficiency of \_\_\_\_\_
36. Little leaf in citrus is caused by deficiency of Cu.
37. Internal necrosis in Mango is caused by deficiency of \_\_\_\_\_
38. Khaira disease of rice is caused by deficiency of \_\_\_\_\_
39. Interveinal chlorosis in apple and citrus is caused by deficiency of \_\_\_\_\_
40. Tip burn of rice \_\_\_\_\_
41. Ballast elements are \_\_\_\_\_ and \_\_\_\_\_
42. \_\_\_\_\_ gave the term functional or metabolic nutrients.
43. \_\_\_\_\_ mechanism enables nutrient movement without the movement of water.
44. \_\_\_\_\_ is available both in anionic and cationic form.
45. Luxury consumption is noticed with \_\_\_\_\_ element.
46. Anhydrous Ammonia contains N content \_\_\_\_\_
47. India imports K fertilizers mainly from \_\_\_\_\_
48. The relative proportion of sand, silt and clay is known as \_\_\_\_\_
49. The most abundant soil found in India is \_\_\_\_\_
50. Maximum population of microorganisms found in soils is \_\_\_\_\_
51. Most resistant mineral present in soils is \_\_\_\_\_
52. The most abundant mineral present on the earth is \_\_\_\_\_
53. Degree of soil salinity is indicated by its \_\_\_\_\_
54. Dark colour of soils is due to presence of \_\_\_\_\_
55. Stoke's law is applied in the determination of \_\_\_\_\_
56. Silt has intermediate characteristics between \_\_\_\_\_ and \_\_\_\_\_.

57. Value of Bulk Density is \_\_\_\_\_
58. Porosity % in Sandy soil is \_\_\_\_\_
59. Colloidal property increases with decrease in \_\_\_\_\_
60. Water held between  $1/3^{\text{rd}}$  and 15 atm is called \_\_\_\_\_
61. Darcy's law in soils deals \_\_\_\_\_
62. Soil contain \_\_\_\_\_ times more carbon dioxide as that of air.
63. Fick's law deals about the \_\_\_\_\_ in soils.
64. Soil air is characterized by \_\_\_\_\_ Rate.
65. In soils, heat is mainly transferred through \_\_\_\_\_
66. Fourier's law deals with \_\_\_\_\_ in soils.
67. \_\_\_\_\_ gave pH scale.
68. One unit change in pH changes H ion concentration by \_\_\_\_\_ while 2 units by \_\_\_\_\_ times.
69. Fertile soils are saturated with \_\_\_\_\_ ions.
70. CN ratio of Organic matter m is \_\_\_\_\_ whereas that of Indian soils is \_\_\_\_\_ to \_\_\_\_\_
71. Histosols are called \_\_\_\_\_ soils.
72. The smell of soils after fresh showers is due to \_\_\_\_\_
73. Non-symbiotic or Free living bacteria is \_\_\_\_\_
74. In paddy \_\_\_\_\_ fixes N.
75. Nitrification Inhibitors are \_\_\_\_\_
76. Serpentine is hydrated silicate of \_\_\_\_\_
77. Amorphous clay mineral is \_\_\_\_\_ (Found in Soil order Andosols).
78. Forest area is surveyed by \_\_\_\_\_ method.
79. The two largest soil orders in India are \_\_\_\_\_ followed by \_\_\_\_\_
80. Problem soils are highest in \_\_\_\_\_ State.

**Grand Test – 4 Answer Key:**

- |  |  |   |
|--|--|---|
| 1. Fried and Dean (1952)   | 25. Gypsum                                       | 55. Soil texture                                |
| 2. P and S in soils.   | 26. Pulses and Oilseeds                          | 56. Sand and Clay                               |
| 3. 5 – 7   | 27. Soil degradation                             | 57. 1.4 to 1.8 Mg/m <sup>3</sup>                |
| 4. 5.8% N, 3.2% P <sub>2</sub> O <sub>5</sub> and 0.6% K <sub>2</sub> O. | 28. 187.9 Mha.                                   | 58. 30%   |
| 5. Aggregate   | 29. Gully erosion                                | 59. Diameter                                    |
| 6. Alfisols  | 30. Saltation                                    | 60. Available water                             |
| 7. 60 – 75%  | 31. Lateritic soils                              | 61. Hydraulic gradient                          |
| 8. Igneous and sedimentary rocks.  | 32. Degree of slope                              | 62. 10 times                                    |
| 9. Shale.  | 33. Legumes and grasses                          | 63. Diffusion of Gases                          |
| 10. Hydrolysis   | 34. Mo   | 64. ODR-Oxygen Diffusion                        |
| 11. Loess  | 35. Mn   | 65. Conduction                                  |
| 12. Edaphology   | 36. Cu   | 66. Heat Conduction                             |
| 13. Pedon  | 37. B  | 67. Sorenson                                    |
| 14. Regolith   | 38. Zn   | 68. 10 times and 100 times                      |
| 15. Jenny  | 39. Mg   | 69. Ca <sup>++</sup> and Mg <sup>++</sup> ions. |
| 16. Oxides of Iron.  | 40. O <sub>2</sub> deficiency and excess of Zinc | 70. 10:1; 5:1 to 25:1                           |
| 17. Granite.   | 41. Al and Si                                    | 71. Organic soils                               |
| 18. Black soils (Vertisols)  | 42. Nicholas                                     | 72. Actinomycetes                               |
| 19. 40-69%   | 43. Diffusion                                    | 73. Azotobacter                                 |
| 20. Alluvial soils (Entisols)  | 44. Nitrogen                                     | 74. Alage or Azolla                             |
| 21. Nitrogen and Organic matter.   | 45. K  | 75. N – Serve and AM                            |
| 22. Kaolinite  | 46. 32%  | 76. Mg  |
| 23. Laterite and lateritic soils (Ultisols)                              | 47. Germany and France                           | 77. Allphane                                    |
| 24. Saline & Alkaline soils.   | 48. Soil texture                                 | 78. RSS   |
|  | 49. Alluvial soil                                | 79. Inceptisols ; Entisols                      |
|  | 50. Bacteria                                     | 80. Uttar Pradesh                               |
|  | 51. Quartz                                       |   |
|  | 52. Feldspar                                     |   |
|  | 53. Total soluble salt content                   |   |
|  | 54. Titanium and Mn                              |   |

**ICAR MODEL – GENERAL AGRICULTURE PAPER**

1. What is total food grain production in 2011 – 12.  
a. 212 m.t                                      b. 220 m.t                                      c. 196.7 m.t                                      d. 208.8 mt.
2. TMO was launched in the year  
a. 2001                                      b. 1991                                      c. 1986                                      d. 1971
3. Amrapali is a cross between  
a. Neelum X dashehari                      b. Baneshan X neelum                      c. Dashehari X Neelum                      d. Mallika X ratnam
4. Mallika is a cross between neelum and  
a. Ratna                                      b. Amrapali                                      c. Dashehari                                      d. Baneshan
5. Major operation in rice cultivation  
a. puddling                                      b. ploughing                                      c. furrowing                                      d. puddling
6. Major source of N in rice is by  
a. Nitrate                                      b. Ammonia                                      c. Both                                      d. None
7. The gas that is evolved from submerged rice field  
a. CH<sub>4</sub>                                      b. H<sub>2</sub>S<sub>2</sub>                                      c. H<sub>2</sub>SO<sub>4</sub>                                      d. SO<sub>2</sub>
8. The gene that is responsible for dwarfness in rice  
a. Norin-10                                      b. dee-geo woogen                      c. Nerica                                      d. D5
9. Most of cultivated rice varieties belongs to which group  
a. Japonica                                      b. Javanica                                      c. Indica                                      d. Jamaica
10. Cold resistant variety of rice  
a. Tellahamsa                                      b. Samba                                      c. Ratna                                      d. Nagavali
11. Plant types, which are morphologically and physiologically ideal, are  
a. Old plant types                      b. Ideotypes                                      c. Both                                      d. None
12. New plant types first developed in  
a. Rice                                      b. Wheat                                      c. Maize                                      d. Sorghum
13. Scented rice hybrid variety is  
a. Basmati                                      b. Sugandha                                      c. Pusa-10                                      d. Pusa-jaikisan
14. Bora rice planting is done during  
a. January – February                      b. September- October                      c. Nov – Dec                                      d. March - April
15. Dapog method was 1<sup>st</sup> adopted in  
a. China                                      b. India                                      c. Philippines                                      d. Israel
16. Seed rate generally followed in dapog nursery kg/ha.  
a. 20                                      b. 30-40                                      c. 100                                      d. 1
17. Most drought tolerant pulse crop  
a. Sorghum                                      b. Bajra                                      c. Chickpea                                      d. Cowpea
18. Most drought tolerant cereal crop  
a. Maize                                      b. Sorghum                                      c. Rice                                      d. Wheat
19. High lysine maize variety  
a. Shakthi                                      b. Protima                                      c. Opaque-2                                      d. all the above
20. Variety of maize with high starch content  
a. Shakthi                                      b. Protima                                      c. Opaque-2                                      d. None
21. Cropping intensity (high potential) is not related to  
a. Spacing                                      b. Seedrate                                      c. Area                                      d. Intercropping
22. Phalaris minor mimicas  
a. Rice                                      b. Wheat                                      c. Maize                                      d. Sorghum

23. Single dwarf gene variety is  
a. Sonalika                      b. Kalyan sona                      c. Sonara – 64                      d. All
24. Dominant group in the world is  
a. Aquatic algae                      b. Green plants                      c. Phytophagous insects                      d. Invertebrates & vertebrates
25. Predominant cotton cultivar is  
a. Gossypium hirsutum                      b. G.arboreum                      c. G.Herbaceum                      d. G.barbadense
26. Indian cotton is  
a. G.hirsutum                      b. G.arboreum                      c. G. herbaceum                      d. G.barbadense
27. Cotton bale weight is around  
a. 100 kg                      b. 170 kg                      c. 210 kg                      d. 900 kg
28. Among oil seeds which crop occupies maximum area  
a. Soyabean                      b. Groundnut                      c. Rapeseed & mustard                      d. Castor
29. Brown revolution relates to  
a. Oil seeds                      b. Cereals                      c. Pulses                      d. Warfare
30. Least water requirement is for  
a. Rice                      b. Bajra                      c. Ragi                      d. Wheat
31. Low water use efficiency is for  
a. Rice                      b. Bajra                      c. Ragi                      d. Wheat
32. Crop that is transformed with bt genes is  
a. Cotton                      b. Mustard                      c. Both                      d. None
33. Niacin in rice in  
a. Red gram                      b. Groundnut                      c. Wheat                      d. chickpea
34. Vitamin that is susceptible while cooking is  
a. Vitamin C                      b. Vitamin B<sub>2</sub>                      c. Vitamin B<sub>6</sub>                      d. Vitamin B<sub>12</sub>
35. Which of the following is correct  
a. Pleiotropism can be broken but linkage cannot be broken  
b. Pleiotropism cannot be broken but linkage can be broken  
c. Both can be broken  
d. both cannot be broken
36. Optimum size of soil aggregate is (dia)  
a. 1 to 5 mm                      b. 5 to 10 mm                      c. < 1 mm                      d. > 10 mm
37. Crop with minimum seed size is  
a. Cucurbits                      b. Tomato                      c. Tobacco                      d. Kodo millet
38. Crop with maximum seed size is  
a. Cucurbits                      b. Tomato                      c. Tobacco                      d. Kodo millet
39. Both fodder and pulse crop is  
a. Chick pea                      b. Cow pea                      c. Red gram                      d. Mung
40. Nutrient mostly deficient in acid and alkali soils is  
a. S                      b. N                      c. P                      d. K
41. Drip or trickle method of irrigation was first adopted by  
a. China                      b. India                      c. Israel                      d. Japan
42. Which of the following do not have ss DNA  
a.  $\phi$  X 174                      b. Gemini virus                      c. S 13                      d. None
43. Ds RNA is present in  
a. Polyoma virus                      b. Vaccinia                      c. Wound tumour virus                      d. All



66. Diara cultivation is followed in  
 a. Potato cultivation                      b. Tobacco cultivation    c. Cucumber cultivation                      d. All
67. Most common green manure crop is  
 a. Cow pea                                      b. Diancha                      c. Sun hemp                                      d. Sunflower
68. ICGEB is located at  
 a. New Delhi                                      b. Kolkota                      c. Triesty, Italy                                      d. A & C
69. Walamtari is located at  
 a. New Delhi                                      b. Mumbai                      c. Hyderabad                                      d. Pune
70. NBPGR located at  
 a. Mumbai                                      b. New Delhi                      c. Kolkotta                                      d. Pune
71. CIMMYT is located at  
 a. Nigeria                                      b. Mexico                      c. Philippines                                      d. Columbia
72. Fungi responsible for loose smut  
 a. ustilage garmini                      b. U. Scitaminae                      c. U.nuda tritt                                      d. U.cephala
73. Double seed formation is associated with the pest  
 a. Spotted bollworm                      b. American bollworm    c. Pink bollworm                                      d. Tobacco C.P.
74. Control of bollworm is done by  
 a. Bacillus thurengensis                      b. Thermus homiphilus                      c. b.Cryogensis                                      d. B. Subtilis
75. Taq DNA polymerase used in PCR studies is obtained from  
 a. thremophilus auillarius                      b. Thermus homophillus                      c. Thermus thermos                                      d. Thermus aquaticus
76. Which of the following is not an acid tolerant crop  
 a. Barley                                      b. tomato                      c. Tobacco                                      d. None
77. Cereals are deficient in the amino acid  
 a. Valine                                      b. Glycine                      c. Tryptophan                                      d. Lysise
78. Pulse state is  
 a. West Bengal                                      b. Uttar Pradesh                      c. Bihar                                      d. Madhya Pradesh
79. Unpredictable legume is  
 a. Cowpea                                      b. Chickpea                      c. Redgram                                      d. Groundnut
80. Non protein amino acid is  
 a. Citrulline                                      b. Mimosine                      c. Ornithine                                      d. All the above
81. Early stem borer is controlled by  
 a. Wrapping                                      b. Thrash mulching                      c. Bund formation                                      d. Burning
82. Wrapping in sugarcane is to control  
 a. Leaf hoppers                                      b. Scales                      c. Termites                                      d. Mealybugs
83. Which of the following variety of Tomato is resistant to cracking  
 a. Pusa ruby                                      b. Pusa early dwarf                      c. redeloud                                      d. Sioux
84. Among cereals, maximum protein content is present in  
 a. Rice                                      b. Wheat                      c. Maize                                      d. Sorghum
85. King of cereals is  
 a. Rice                                      b. Wheat                      c. Maize                                      d. Sorghum
86. Queen of cereals is  
 a. Rice                                      b. Wheat                      c. Maize                                      d. Sorghum
87. Red color of Tomato is due to  
 a. Lycopene                                      b. Carotent                      c. Lycopersicine                                      d. Carotent



110. Mode is  
a. 3 median – 2 mode                      b. 2 median – 3 mode                      c. 2 mode /3 median                      d. 3 median/2 mode
111. Accepting null hypothesis when it is infact false is  
a. Type 1 error                                      b. Type 2 error                                      c. error                                      d. type 3 error
112. To compare two dependent sample we use  
a. 1 sample t-test                                      b. 2 sample t-test                                      c. paired t-test                                      d. f-test
113. Range of correlation coefficient  
a. -1 to + 1                                      b. -  $\alpha$  to +  $\alpha$                                       c. 0 to  $\alpha$                                       d. o to + 1
114. If SEM is 2 then SED is  
a.  $\sqrt[2]{2}$                                       b. 2                                      c. 1                                      d.  $\sqrt[1]{2}$
115. For sugarcane at maturity brix reading is  
a. 8%                                      b. 14%                                      c. 18-20%                                      d. 25%
116. If disease is occurring in a localized area is  
a. Endemic                                      b. Epidemic                                      c. Pandemic                                      d. Spordic
117. Loose smut of wheat is  
a. Internally seed borne                      b. Externally seed borne                      c. Both                                      d. None
118. Vector for leaf curl disease of cotton  
a. White flies                                      b. Aphids                                      c. Jassids                                      d. Leaf roller
119. Kresek in rice is caused by  
a. helminthosporium oryzae                      b. Pyricularia oryzae                      c. Xanthomonas oryzae                      d. Selerotium oryzae
120. Vector for grassy shoot of sugarcane  
a. Nilaparvata lagens                      b. hemicia tabaci                      c. Myzus percicae                      d. Assamia moesta
121. Little leaf of citrus is due to deficiency of  
a. Zn                                      b. N                                      c. K                                      d. Mo
122. Khaira disease of rice is due to deficiency of  
a. Zn                                      b. Mn                                      c. Mg                                      d. Mo
123. First director general of reconstitute ICAR is  
a. N.S. Randhwa                      b. R.S. Paroda                      c. M.S. Swaminathan                      d. B.P. Pal
124. First Indian director of IARI  
a. Dr.A.B. Joshi                      b. Dr. B.P. Pal                      c. Dr. Viswanath                      d. M.S.Swaminathan
125. First agricultural university is  
a. BCKVV                                      b. TNAU                                      c. GBPAU & T                                      d. PAU
126. IADP was started in the year  
a. 1965-66                                      b. 1960                                      c. 1929                                      d. 1974
127. ICAR was established in the year  
a. 1927                                      b. 1905                                      c. 1929                                      d. 1935
128. Lab to land programme was started in the year  
a. 1979                                      b. 1965                                      c. 1971                                      d. 1986
129. KVK was recommended by  
a. Ashok Mehta committee                      b. Balwant Rai Mehta committee                      c. Mohan Singh Mehta committee                      d. Shantilal Mehta committee
130. The state to adopt panchyat raj system first is  
a. A.P.                                      b. M.P.                                      c. Karnataka                                      d. Rajasthan
131. Father of White revolution, who is world food prize recipient  
a. M.S.Swaminathan                      b. S.K.Wasal                      c. Gurudev singh kush                      d. Vergheese Kurian

**ICAR MODEL – GENERAL AGRICULTURE PAPER ANSWERS KEY:**

1.	B	45	C	89	D
2.	C	46	B	90	D
3.	C	47	D	91	B
4.	C	48	A	92	C
5.	D	49	B	93	B
6.	B	50	B	94	D
7.	A	51	D	95	B
8.	B	52	B	96	C
9.	C	53	C	97	C
10.	A	54	D	98	D
11.	B	55	D	99	A
12.	B	56	B	100	B
13.	C	57	D	101	D
14.	C	58	A	102	C
15.	C	59	A	103	D
16.	B	60	B	104	C
17.	D	61	C	105	D
18.	B	62	B	106	B
19.	A	63	B	107	A
20.	C	64	B	108	B
21.	D	65	C	109	C
22.	B	66	C	110	A
23.	A	67	C	111	B
24.	A	68	D	112	C
25.	A	69	C	113	A
26.	B	70	B	114	A
27.	B	71	B	115	C
28.	B	72	C	116	D
29.	C	73	C	117	A
30.	C	74	A	118	A
31.	A	75	D	119	C
32.	C	76	B	120	D
33.	B	77	B	121	A
34.	A	78	D	122	A
35.	B	79	D	123	D
36.	A	80	D	124	C
37.	C	81	B	125	C
38.	A	82	B	126	B
39.	B	83	D	127	C
40.	A	84	B	128	A
41.	C	85	A	129	C
42.	D	86	C	130	D
43.	D	87	A	131	D
44.	B	88	B		

## History of Microbiology

### Answer the following question

- Q. 1. One who studies the frequency and distribution of diseases is called  
a. Microbiologist                      b. Ecologist                      C. Epidemiologist  
d. Mycologist                      e. Immunologist
- Ans. c.
- Q. 2. Who discovered high quality magnifying lenses (early microscope)  
a. Koch                      b. Leeuwenhock                      C. Pasteur  
d. Fleming                      e. Loeffler
- Ans. b.
- Q. 3. Who Disproved the spontaneous generation of maggot on decaying meats.  
a. Lister                      b. Pasteur                      c. Hooke  
d. Redi                      e. Koch
- Ans. d.
- Q. 4. The average wavelength of light visible to our eyes is  
a. 800 nm                      b. 100 nm                      c. 200nm  
d. 420 nm                      e. 550nm
- Ans. e.
- Q. 5. \_\_\_\_\_ discovered the T.B. bacillus and cholera vibrio.
- Ans. Robert Koch.
- Q. 6. In 1900, the ABO blood grouping was discovered by \_\_\_\_\_
- Ans. Landsteiner.
- Q. 7. \_\_\_\_\_ in 1929, discovered Penicillin.
- Ans. Fleming.
- Q. 8. The limit of resolution with unaided human eye is \_\_\_\_\_
- Ans. 200  $\mu$ M.
- Q. 9. \_\_\_\_\_ and \_\_\_\_\_ are examples of simple stains.
- Ans. Methylene blue or basic fuchsin
- Q. 10. In negative staining \_\_\_\_\_ stain used.
- Ans. India ink or nigrosin.
- Q. 11. Gram positive bacteria do not possess pili expect \_\_\_\_\_ (bacteria).
- Ans. Corynebacterium renale.
- Q. 12. The bacteria which derive their energy form sunlight are called \_\_\_\_\_
- Ans. Phototrophs.
- Q. 13. The bacteria which derived their energy form chemical reactions are called \_\_\_\_\_
- Ans. Chemotrophs
- Q. 14. The bacteria which synthesize all the organic compounds are called \_\_\_\_\_
- Ans. Autotrophs.
- Q. 15. The bacteria that are unable to synthesize their own metabolite and depends on preformed organic compound are called \_\_\_\_\_.
- Ans. Heterotrophs
- Q. 16. Acidophilic bacteria such as \_\_\_\_\_ grow under acidic condition.
- Ans. Lactobacillus sp.







- Q. 66.  $\gamma$  ray and X rays are effective in killing microorganism because they  
 a. Dislodge electrons from atoms, creating ions  
 b. Damage DNA  
 c. Produce powerful oxidizing agents  
 d. All of the above  
 e. None of the these
- Ans. d.
- Q. 67. Quarternary ammonium compounds are a type of  
 a. Soap  
 b. Alkylating agent  
 c. Phenolic substances  
 d. Basic solution  
 e. Detergent
- Ans. e.
- Q. 68. The active antimicrobial ingredient in bleach is  
 a. Phenol  
 b. Hydrochloride  
 c. Hypochloride  
 d. Iodine  
 e. Bromide
- Ans. c.
- Q. 69. The minimum time used for sterilization by autoclaving  
 a. 5 min  
 b. 15 min  
 c. 45 min  
 d. 1 hour  
 e. 2 hour
- Ans. b.
- Q. 70. Which of the following is a limitation of the autoclave?  
 a. Length of time  
 b. Ability to inactivate virus  
 c. ability to kill endospores  
 d. Use with heat sensitive materials
- Ans. d.
- Q. 71. Endotoxin is associated with \_\_\_\_\_ bacteria while exotoxins can be made by \_\_\_\_\_ bacteria.  
 a. Gm+, Gm -  
 b. Gm -, Gm+  
 c. Gm -; Gm+ & Gm-  
 d. Gm+; Gm+ & Gm -;  
 d. Gm+& Gm -; Gm-
- Ans. c.
- Q. 72. If a bacterium cell having generation time of 30 minutes, is placed in a suitable broth at time 0, what will be the cell numbers after 4 hours of incubation.  
 a. 256  
 b. 128  
 c. 64  
 d. 96  
 e. 32
- Ans. a.
- Q. 73. The collapse of a cell due to water loss is called  
 a. Hydrolysis  
 b. Halophile  
 c. Osmoregulation  
 d. Plasmolysis
- Ans. d.
- Q. 74. Bacteria that live in high salt concentration are called  
 a. halophiles  
 b. Acidophiles  
 c. Mesophiles  
 d. Alkaliphiles  
 e. Meningophiles
- Ans. a.
- Q. 75. Extreme halophiles grow in condition containing high amount of  
 a. N<sub>2</sub>  
 b. O<sub>2</sub>  
 c. Temperature  
 d. Salt  
 e. Methane
- Ans. d.



- Q. 92. In agglutination reactions the antigen is a \_\_\_\_\_ and in precipitation reactions the antigen is a \_\_\_\_\_  
 a. Whole cell/soluble molecule  
 b. Soluble molecule/whole cell  
 c. Bacterium/Virus  
 d. Protein/carbohydrate  
 e. Protein/antibody  
 Ans. a.
- Q. 93. Fusion between a plasma cell and a tumour cell creates a  
 a. Myeloma  
 b. NK cells  
 c. Lymphoblast  
 d. Lymphoma  
 e. Hybridoma  
 Ans. e.
- Q. 94. Monoclonal antibodies recognize a single  
 a. Antigen  
 b. Epitope  
 c. B cell  
 d. Bacterium  
 e. Virus  
 Ans. b.
- Q. 95. Which antibody is the first to be released into the blood following an infection?  
 a. IgD  
 b. IgG  
 c. IgA  
 d. IgE  
 e. IgM  
 Ans. e.
- Q. 96. Theoretically type \_\_\_\_\_ blood can be donated to all persons because it lacks  
 a. O / antigen  
 b. Ab / antibodies  
 c. A/antibodies  
 d. O/antibodies  
 e. a/IgE  
 Ans. a.
- Q. 97. Human immunodeficiency virus (HIV) binds specifically to which immune cell marker  
 a. CD8  
 b. CD4  
 c. MHC  
 d. gp 120  
 e. CDC  
 Ans. b.
- Q. 98. HIV has a high mutation rate due to the imprecise operation of its  
 a. Viral membrane  
 b. CD4 receptor  
 c. Reverse transcriptase  
 d. Protease  
 e. Dismutase  
 Ans. c.
- Q. 99. A transplant between individuals of different animal species is termed a (n)  
 a. Allograft  
 b. Isograft  
 c. Enterograft  
 d. Endograft  
 e. Xenograft  
 Ans. e.
- Q. 100. Two tests that are used to detect the presence of HIV infection are  
 a. Agglutination and neutralization reactions  
 b. CFT and IFT  
 c. RIA and IFT  
 d. ELISA and WB  
 e. HA and Coomb's antiglobulin test  
 Ans. d.
- Q. 101. One of the common defense mechanisms of pathogenic bacteria to avoid phagocytosis is the presence of  
 a. Pili  
 b. Cell membrane  
 c. Peptidoglycan  
 d. Capsule  
 e. Endospore  
 Ans. d.

- Q. 102. Gram positive bacteria are particularly susceptible to killing by Lysozyme.  
Ans. True.
- Q. 103. AB blood group persons are called universal donor.  
Ans. False.
- Q. 104. The toxin produced by *V. Cholerae* is called \_\_\_\_\_  
Ans. Cholera toxin.
- Q. 105. \_\_\_\_\_ (medicine) is used for treatment of Asiatic cholera.  
Ans. Asiatic cholera.
- Q. 106. Traveller's diarrhea is caused by \_\_\_\_\_  
Ans. E. Coli.
- Q. 107. The drug of choice for Campylobacteriosis is \_\_\_\_\_  
Ans. Terramycin / Erythromycin.
- Q. 108. Streptomycin was discovered by \_\_\_\_\_  
Ans. Waksman and others.
- Q. 109. Widal test is used for diagnosis of \_\_\_\_\_  
Ans. Typhoid.
- Q. 110. Which of the following cannot be treated with anti-microbial drugs?  
a. Atypical pneumonia                      b. Q fever                      c. common cold  
d. T.B.    e. Otitis media
- Ans. c.
- Q. 111. The DPT immunization is for  
a. Diphtheria, Parainfluenza, tetanus  
b. Dermatomycoses, Pontiac fever, TB  
c. Diphtheria, Pertussis, Tetanus  
d. Diphtheria, pneumonia, tetanus
- Ans. c.
- Q. 112. Which microorganisms are called primary symbiotic nitrogen fixers  
a. Klebsiella                                      b. Azotobacter                      c. Clostridium  
d. Rhizobium                                      e. None of the above
- Ans. d.
- Q. 113. The form of nitrogen that is most usable in plant is  
a. Nitrate    b. Nitrite                                      c. Ammonia  
d. Ammonium ions                                      e. Molecular nitrogen
- Ans. a.
- Q. 114. Which form of sulfur is most usable by both microorganisms and plants  
a. Sulfite    b. Hydrogen sulfide  
c. Sulfate    d. None of the above
- Ans. c.
- Q. 115. All sulfate reducing bacteria are classified as  
a. Anaerobes    b. Psychrophilic                      c. Thermophilic  
d. halophilic    e. Mesophilic
- Ans. a.
- Q. 116. The most numerous groups of microorganism found in soil are  
a. Fungi    b. Algae                                      c. Protists  
d. Bacteria    e. Viruses
- Ans. d.















- Q. 200. The non – viable mutations are called  
 a. Non-sense mutation                      b. Missense mutation  
 c. Frameshift mutation                      d. All of the above  
 Ans. d.
- Q. 201. In bacteria, the sex factor is determined by  
 a. R factor                                      b. F factor  
 c. Bacteriocin                                d. Lysogeny  
 Ans. b.
- Q. 202. Ribosomal RNA constitutes about  
 a. 50% of the total cellular RNA  
 b. 70% of the total cellular RNA  
 c. 90% of the total cellular RNA  
 d. None of the above  
 Ans. c.
- Q. 203. For synthesis of DNA, enzyme required is  
 a. RNA polymerase                      b. DNA polymerase  
 c. Proteinase                                d. Ligase  
 Ans. b.
- Q. 204. A gene with 1800 bp can code \_\_\_\_\_ amino acids in a polypeptide.  
 Ans. 600
- Q. 205. Transfer of gene from one bacterium to another with the help of a phage is called \_\_\_\_  
 Ans. Transduction.
- Q. 206. Bacterial conjugation was first observed in \_\_\_\_\_  
 Ans. E.Coli.
- Q. 207. In E. Coli different mating types are known as \_\_\_\_\_  
 Ans. F+, F- and high frequency recombinants (Hfr).
- Q. 208. When F factor of F+ cells becomes integrated into bacterial chromosome, the F+ cells become  
 \_\_\_\_\_
- Q. 209. The bacteriocins of E. coli are called \_\_\_\_\_  
 Ans. Colicins.
- Q. 210. UV rays are primarily absorbed by \_\_\_\_\_ and result in the formation of \_\_\_\_  
 Ans. Pyrimidine: pyrimidine  
 dimer.
- Q. 211. Pyrimidine dimer can be removed by \_\_\_\_\_ and repaired by \_\_\_\_\_  
 Ans. Exonuclease/endonuclease; Ligase/polymerase.
- Q. 212. The rate of spontaneous mutation in bacteria varies from 1 in \_\_\_\_\_ to \_\_\_\_\_  
 cells.  
 Ans. 1 million; 1 billion.
- Q. 213. One amino acid coded by 3 nucleotides is called \_\_\_\_\_  
 Ans. Codon.
- Q. 214. \_\_\_\_\_ amino acids are coded by 6 different codons.  
 Ans. Leucine, Arginine, Serine.
- Q. 215. \_\_\_\_\_ amino acids are coded by 4 different codons.  
 Ans. Valine, Proline, Threonine, Alanine, Glycine.
- Q. 216. \_\_\_\_\_ amino acids are coded by 1 codon.  
 Ans. Methionine, Tryptophan.

- Q. 217. \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ are called termination docon.  
Ans. UAA, UAG, UGA.
- Q. 218. UAA, UAG and UGA are called \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ respectively.  
Ans. Ochre; Amber; Umber or Opal.
- Q. 219. \_\_\_\_\_ and \_\_\_\_\_ (codons) are chain initiating codons  
Ans. AUG and GUG.
- Q. 220. The termination codons are also called \_\_\_\_\_  
Ans. Nonsense codons.
- Q. 221. Match the following:  
1. Giffith (1928) a. Conjugation  
2. Zinder and Lederberg (1946) b. Transformation  
3. Lederberg and Tatum c. Transduction  
Ans. 1 b, 2 c, 3 a.
- Q. 222. Bacteriocins are protein in nature  
Ans. True
- Q. 223. Bacteriocins can kill only the same or related bacteria.  
Ans. True
- Q. 224. Bacteriocins are useful in distinguishing certain strains of the same species.  
Ans. True
- Q. 225. The base sequence of mRNA is complementary to DNA template.  
Ans. True
- Q. 226. \_\_\_\_\_ showed that genetic information is stored in DNA.  
Ans. Avery et al. (1944).
- Q. 227. \_\_\_\_\_ proposed the double helical structure of DNA.  
Ans. Watson and Crick (1953).
- Q. 228. \_\_\_\_\_ first made attempt to break the genetic code.  
Ans. Nirenberg and Matthaei (1961).
- Q. 229. \_\_\_\_\_ synthesized a complete gene in vitro.  
Ans. Khorana et al. (1970).
- Q. 230. \_\_\_\_\_ discovered first restriction endonuclease.  
Ans. Hamilton Smith et al. (1970).
- Q. 231. \_\_\_\_\_ discovered reverse transcriptate.  
Ans. Temin and Baltimore (1970).
- Q. 232. \_\_\_\_\_ used plasmid vectors for gene cloning.  
Ans. Boliver et al. (1973).
- Q. 233. \_\_\_\_\_ discovered southern blot.  
Ans. Southern (1975).
- Q. 234. \_\_\_\_\_ and \_\_\_\_\_ separately first developed the methods for sequencing D.N.A.  
Ans. Sanger et al. (1977) ; Maxam and Gilbert (1977).
- Q. 235. \_\_\_\_\_ discovered introns.  
Ans. Jeffrey and Flavell (1977).





- Q. 272. Corynebacteria are non-motile, non-capsulated and non-sporing?  
 Ans. True.
- Q. 273. Actinomyces contain two medically important species \_\_\_\_\_ and \_\_\_\_\_.  
 Ans. Actinomyces; Nocardia.
- Q. 274. Actinomyces affects bones and teeth and causes \_\_\_\_\_ in cattle.  
 Ans. Lumpy jaw.
- Q. 275. Fungi have cell walls composed primarily of \_\_\_\_\_ -  
 Ans. Chitin.
- Q. 276. Organisms such as slime molds have characteristics of both fungi and \_\_\_\_\_.  
 Ans. Amoebas.
- Q. 277. Actinomyces are non-motile, nonsporeforming and non-capsulated organism.  
 Ans. True
- Q. 278. Match the following:
- |             |   |
|-------------|---|
| 1. Archaea  | a. Not composed of cells                                  |
| 2. Algae    | b. Prokaryote without peptidoglycan cell wall             |
| 3. Bacteria | c. Cell wall made of cellulose                            |
| 4. Fungi    | d. Cell wall made of peptidoglycan                        |
| 5. Helminth | e. Cell wall made of chitin                               |
| 6. Protozoa | f. Multicellular organisms                                |
| 7. Viruses  | g. Unicellular complex cell structure lacking a cell wall |
- Ans. 1 b, 2 c 3 d, 4 e, 5 f, 6 g, 7 a.
- Q. 279. Cell wall of Mycobacteria contains mycolic acid.  
 Ans. True
- Q. 280. BCG vaccination interferes with tuberculin testing.  
 Ans. True
- Q. 281. Enhancement of growth of mycobacteria by addition of glycerine is called \_\_\_\_\_.  
 Ans. Eugonic.
- Q. 282. Mycolic acid is present in the cell wall of all except
- |                    |                   |
|--------------------|-------------------|
| a. Nocardia        | b. Mycobacteria   |
| c. Corynebacterium | d. Erysipelothrix |
- Ans. d.
- Q. 283. Shiga toxin is produced by \_\_\_\_\_.  
 Ans. Shigella dysenteriae.
- Q. 284. E. coli can produce both exotoxin and endotoxin/  
 Ans. True
- Q. 285. Fluorescein is a greenish yellow pigment soluble in water but not in chloroform.  
 Ans. True
- Q. 286. Pyocyanin is a bluish green pigment soluble in water and chloroform.  
 Ans. True
- Q. 287. They are Gm-, short rod, motile by sheathed polar flagella.  
 Ans. True
- Q. 288. Vibrios are facultative anaerobes.  
 Ans. True
- Q. 289. Most of the species of Campylobacter will not tolerant NaCl > 1.5%.  
 Ans. True
- Q. 290. On solid media mycoplasmas produce colonies of \_\_\_\_\_ shaped.  
 Ans. Fried egg.

- Q. 291. Mycoplasmas are susceptible to \_\_\_\_\_ (antibiotics) but not to \_\_\_\_\_ (antibiotic).  
Ans. Tetracycline and Erythromycin; Penicillin.
- Q. 292. The organisms under the genus Mycoplasma were earlier known as \_\_\_\_\_.  
Ans. PPLLO.
- Q. 293. Smallest free living organism that grow on artificial media are \_\_\_\_\_.  
Ans. Mycoplasma.
- Q. 294. The optimum temperature for growth of Mycoplasmas and Ureaplasmas is \_\_\_\_\_ whereas in case of Spiroplasmas and Acholeplasmas is \_\_\_\_\_.  
Ans. 37<sup>0</sup>C; 22 to 37<sup>0</sup>C.
- Q. 295. The size of mycoplasmas is about \_\_\_\_\_.  
Ans. 0.3 μm.
- Q. 296. Mycoplasma are Gm-, no flagella, no pili and stained well with Giemsa.  
Ans. True.
- Q. 297. VDRL test is  
a. Microscopic slide flocculation test  
b. Tube flocculation test  
c. CFT  
d. Precipitation test  
Ans. a.
- Q. 298. They are Gm- except \_\_\_\_\_ which is Gm+.  
Ans. C. burnetii.
- Q. 299. The chemical composition of cell wall is similar to Gm- bacteria except \_\_\_\_\_ which is like Gm+.  
Ans. C. burnetii.
- Q. 300. Rickettsia do not grow in artificial media except genus \_\_\_\_\_.  
Ans. Rochalimaea.
- Q. 301. Rickettsia are sensitive to \_\_\_\_\_ (antibiotics).  
Ans. Tetracyclines, Erythromycin, Sulphonamides.
- Q. 302. Write down the source following cell lines.  
HeLa, HEP – 2, Kb, McCoy  
Ans. HeLa: Human carcinoma of cervix cell line.  
HEP-2: Human epithelioma of larynx cell line.  
Kb: Human carcinoma of nasopharynx cell line.  
McCoy: Human synovial carcinoma cell line.
- Q. 303. Name the basic dyes.  
Ans. Methylene blue, carbol fuchsin, crystal violet, gentian violet, methyl violet. Charges carried are +.
- Q. 304. Name the acidic dyes.  
Ans. Eosin, safranin. Charges carried are -.
- Q. 305. What is the difference between protoplasts and spheroplasts?  
Ans. When the cell wall of Gm+ bacteria is completely removed it is called protoplasts whereas in spheroplasts the cell wall of Gm- bacteria is partially removed.
- Q. 306. Name the smallest microorganism capable of growing on artificial media.  
Ans. Mycoplasma.

Q. 307. Name the different kinds of mosquito transmitted human diseases.

Ans. Aedes: Dengue, yellow fever.

Anopheles: Malaria

Culex: arboviral encephalitis.

Q. 308. What are the different enzymes produced by different bacteria and their function?

Ans.

<b>Enzymes</b>	<b>Source</b>	<b>function</b>
Coagulase	Staphylococcus sp.	Forms a fibrin clot.
Streptokinase	Streptococcus sp.	Dissolves a fibrin clot
Hyaluronidase	Pneumococcus sp., Streptococcus sp., Staphylococcus sp.	Digests hyaluronic acid.
Leukocidin	Streptococcus, Staphylococcus, Certain rods	Disintegrates phagocytes
Haemolysins	Clostridium sp., Staphylococcus sp.	Dissolves RBC

Q. 309. Name the prokaryotic microorganism that have no cell wall

Ans. Mycoplasma.

Q. 310. Bacteria which are capable of photosynthesis.

Ans. Cyanobacteria.

Q. 311. Compare the cell walls of Gm<sup>+</sup> and Gm<sup>-</sup> bacteria.

Characteristics	Gm <sup>+</sup>	Gm <sup>-</sup>
1. Peptidoglycan	Yes, thick layer	Yes, thin layer
2. Teichoic acids	Yes	No
3. Outer membrane	No	Yes
4. Lipopolysaccharide	No	Yes
5. Porin proteins	No	Yes
6. Periplasmic region	No	Yes

Q. 312. Two diseases for which synthetic vaccines are available or being developed.

Ans. FMD and HBV

Q. 313. Two bacterial diseases for which toxoids are used.

Ans. Tetanus and Diphtheria.

Q. 314. Two viral diseases where passive immunity is used.

Ans. Hepatitis A and Chicken pox.

Q. 315. Two bacterial diseases where passive immunity is used

Ans. Diphtheria and Tetanus.

Q. 316. Retrovirus contains reverse transcriptase and DNA dependent DNA polymerase.

Ans. True.

Q. 317. Gram's iodine acts as a mordant to fix violet dye in Gram's staining.

Ans. True.

Q. 318. Gm<sup>+</sup> bacteria have greater amount of peptidoglycan in their cell wall than Gm<sup>-</sup> bacteria.

Ans. True





- Q. 343. The name Actinomyces was coined by \_\_\_\_\_  
Ans. Harz.
- Q. 344. Rickettsiae do not have capsule except \_\_\_\_\_  
Ans. R. prowazekii.
- Q. 345. Viruses were first crystallized by \_\_\_\_\_ in 1935.  
Ans. Stanley
- Q. 346. Monkeys were used for the isolation of poliovirus by \_\_\_\_\_ in 1909.  
Ans. Landsteiner and Popper.
- Q. 347. Plaque assay was introduced in animal virology by \_\_\_\_\_ in 1931.  
Ans. Dulbecco
- Q. 348. The term viroid was introduced by \_\_\_\_\_ in 1971.  
Ans. Diener.
- Q. 349. Bacteriophage was first seen by \_\_\_\_\_ in 1915 and name was given by \_\_\_\_\_ in 1917.  
Ans. Twort; D'Herelle.
- Q. 350. Variola virus was first demonstrated microscopically by \_\_\_\_\_ in 1887.  
Ans. Buist.
- Q. 351. \_\_\_\_\_ used agar as solidifying agent for bacteriological media.  
Ans. F. Hesse.
- Q. 352. The magnification of microscope developed by A.V. Leeuwenhock was \_\_\_\_\_ times.  
Ans. 300
- Q. 353. \_\_\_\_\_ in 1892 first showed that tobacco mosaic disease is caused by a filterable agent.  
Ans. D. Iwanowski.
- Q. 354. \_\_\_\_\_ in 1930 discovered the ABO blood groups of humans.  
Ans. Karl Landsteiner.
- Q. 355. \_\_\_\_\_ is known as father of bacteriology.  
Ans. Robert Koch.
- Q. 356. \_\_\_\_\_ is known a father of antiseptic surgery.  
Ans. Lister.
- Q. 357. Electron microscope was invented by \_\_\_\_\_ in 1937.  
Ans. Ruska and Mortom.
- Q. 358. \_\_\_\_\_ classified all unicellular organism as protists.  
Ans. Haeckel.
- Q. 359. The limit of resolution of unaided eye is \_\_\_\_\_  
Ans. 250  $\mu$ m.
- Q. 360. The limit of resolution of ordinary light microscope is \_\_\_\_\_  
Ans. 200 nm
- Q. 361. The limit of resolution of electron microscope is \_\_\_\_\_  
Ans. 0.1 nm.
- Q. 362. The wavelength of visible light is \_\_\_\_\_ nm.  
Ans. 365-450 nm.
- Q. 363. The wavelength of light used in light microscope is \_\_\_\_\_ nm.  
Ans. 546 nm.
- Q. 364. The wave length of electrons used in electron microscope is \_\_\_\_\_ nm.  
Ans. 0.005.

- Q. 365. The wavelength of UV light used in UV microscope is \_\_\_\_\_ nm.  
 Ans. 200-300 nm.
- Q. 366. The wavelength of light used in bright field compound microscope is \_\_\_\_\_ nm.  
 Ans. 560.
- Q. 367. Sterilization by moist heat is done at \_\_\_\_\_<sup>0</sup>C for \_\_\_\_\_ min.  
 Ans. 121; 15
- Q. 368. Sterilization by dry heat is done at \_\_\_\_\_<sup>0</sup>C for \_\_\_\_\_ min.  
 Ans. 160; 60.
- Q. 369. Pasteurization of milk is done at \_\_\_\_\_<sup>0</sup>C for \_\_\_\_\_ min.  
 Ans. 63; 30.
- Q. 370. Pasteurization of milk is done at \_\_\_\_\_<sup>0</sup>F for \_\_\_\_\_ (duration).  
 Ans. 145 °F for 30 min or 161°F for 15 sec
- Q. 371. After Gram staining Gm+ bacteria appear as \_\_\_\_\_ in colour and Gm- bacteria appear as \_\_\_\_\_  
 Ans. Violet; Pink
- Q. 372. The isoelectric point of Gm+ bacteria is at pH \_\_\_\_\_ and Gm- bacteria is at pH.  
 Ans. 2-3; 4-5.
- Q. 373. The charge of acid dye (anionic) is \_\_\_\_\_  
 Ans. Negative
- Q. 374. The charge of acid dye (cationic) is \_\_\_\_\_  
 Ans. Positive
- Q. 375. Giemsa stain is used to stain \_\_\_\_\_  
 Ans. Rickettsia.
- Q. 376. Fontana stain is used to stain \_\_\_\_\_  
 Ans. Spirochaetes.
- Q. 377. Hiss method of staining is used to stain \_\_\_\_\_  
 Ans. Capsule of bacteria
- Q. 378. In 1857 \_\_\_\_\_ proposed that plant and fungi to be placed in plant kingdom.  
 Ans. Carl von Nageli.
- Q. 379. Selective medium for isolation fo Streptococci is \_\_\_\_\_  
 Ans. Edward's medium
- Q. 380. \_\_\_\_\_ is neither prokaryotic nor eukaryotic.  
 Ans. Virus
- Q. 381. \_\_\_\_\_ coined the name protista for microorganisms.  
 Ans. Haecke.
- Q. 382. Pink eye is caused \_\_\_\_\_  
 Ans. Haemophilus aegypticus
- Q. 383. Diseases covered in MMR are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_  
 Ans. Diphtheria, Whooping cough and Tetanus.
- Q. 384. \_\_\_\_\_ (organ) possibly damaged by excessive use of antibiotic.  
 Ans. Liver
- Q. 385. Riboflavin is a product of \_\_\_\_\_ ( a mold).  
 Ans. Aspergillus oryzae.
- Q. 386. Amylase is produced by \_\_\_\_\_ - (mild).  
 Ans. Aspergillus oryzae.
- Q. 387. Pectinase is produced by \_\_\_\_\_ (bacteria).  
 Ans. Clostridium sp.
- Q. 388. Invertase is produced by \_\_\_\_\_  
 Ans. Yeast.

