Agricultural Education and Research in the Jurisdiction of RVSKVV, Gwalior (M. P.)

(Post - Independence to Establishment of JNKVV)

1947-1964

Volume - II

AGRICULTURE COLLEGES

Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya
Gwalior - 474002 (M.P.)

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Suresh Singh Tomar
G. S. Bhardwaj
A. K. Singh
V. S. Tomar

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Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya
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Compiled and Edited by	:	Dr. Suresh Singh Tomar Dr. G. S. Bhardwaj Prof. A. K. Singh Prof. V. S. Tomar
Technical Assistance	:	Dr. S. S. Bhadauria Dr. Neeraj Hada Dr. S. S. Kushwah Dr. Shobhana Gupta
Consultancy	:	Dr. P. R. Rajput
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CONTENTS

PREFACE

Agriculture is the mainstay of the Indian economy because of the large population which depends upon it for their livelihood and the fact that our agriculture production is providing food to the second largest population in the world. The scenario of agriculture is changing rapidly in the country with need based advancement in the socio-economic status of the peasantry and globalization taking place in agriculture. The nation has achieved self-sufficiency in food grain production with the application of science and technology but the burgeoning population has put considerable pressure on natural resources forcing us to made concerted efforts to augment sustainable food security for future.

Established in year 2008, RVSKVV, Gwalior has been instrumental in educating farmers of the state through various interventions. The University is constantly engaged in generating new technologies for the socio-economic upliftment of the farming community.

This book is in continuation of Volume I, in which history and achievements of agriculture under the area of jurisdiction of RVSKVV during pre-independence period (1916-1947) have been presented. In the Volume II, the work of post-independence to the establishment of JNKVV, Jabalpur period (1947-1964) has been documented. I hope this publication will be of great interest to scientists, teachers, students, farmers etc.

I congratulate Dr. S. S. Tomar, Director Extension Services and his team for the efforts they have made for bringing out this historical publication.

(A.K. Singh)
Vice Chancellor
RVSKVV, Gwalior (M.P.)

FOREWORD

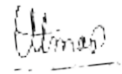
Indian agriculture has come a long way from subsistence farming to commercial agriculture. In the years following Independence, Indian agriculture overcame several challenging situations and achieved phenomenal success to steer the country out of imports based food security to a respectable position of self-reliant food security and food bill. Technologies generated within our National Agriculture Research System (NARS), comprising mainly of research institutions of the Indian Council of Agricultural Research and the State Agriculture Universities, have significantly contributed to the overall transformation of the agriculture that ushered in Green (food grains), White (milk), Golden (horticulture) and Blue (fish) revolutions. Today, Indian agriculture is the single largest private enterprise that sustains livelihood of about two-thirds of the population. Agriculture along with other mainstream sectors, therefore, continues to be the major source of strength for the Indian economy.

Presently, agriculture is on the crossroads due to the challenges posed by the shrinking and degrading natural resource base and the changing climate. But agriculture still is a mine with plenty of hidden jewels of opportunities to overcome these challenges and to provide employment to hundreds of millions of rural poor to move out of hunger and grave poverty. For this, we have to re-orient agriculture to the changes of environment and food basket needs, which are changing at a faster pace. Economic accessibility of food has been linked with better nutrition and health and can be addressed through diversification of agriculture. There is also the need for directing our efforts for global competitiveness of farm commodities. This can be achieved through development of adaptive varieties of crops that can acclimatize to change climate.

The decision of the Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior to bring out this publication is indeed very timely. It will fulfill the long-felt need of all those engaged in agricultural activities. It will provide valuable information about changes in agricultural research & education in the jurisdiction of RVSKVV.

I would like to record my sincere thanks to the RVSKVV in general, and Prof. A. K. Singh, Vice – Chancellor, RVSKVV, Gwalior, in particular, for giving me this opportunity.

I hope this publication will be a useful reference material for all those interested in agricultural research & education.



(V. S. Tomar)
Vice Chancellor
JNKVV, Jabalpur (M.P.)

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We are extremely grateful to Dr. A. S. Tiwari, Ex. Vice Chancellor, JNKVV, Jabalpur, for valuable guidance and suggestions in preparation of this manuscript.

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We are obliged to Dean Faculty Agriculture, Director Extension Services, Director Research Services, Director Instructions, Registrar, Comptroller, Joint Director Extension, Associate Director Research, Programme Coordinators of KVKs and staff members of University, for the valuable information provided by them in their respective fields. We are grateful for their cooperation during the period of preparation of this volume.

We are thankful to all Heads of Departments, I/c Academic Faculty members, Librarian, College of Agriculture, Gwalior, I/c and other staff members of Information and Communication Centre, Directorate of Extension Services, RVSKVV, Gwalior and Officers of Agriculture Department of Madhya Bharat/Madhya Pradesh Government for providing valuable information in preparation of this manuscript.

We thank almighty and all who had directly or indirectly helped in providing information without which this assignment would not be possible.

EDITORS

I. Agricultural Development / Creation of Infrastructure

(1) Establishment of Agriculture School at Gwalior

The school of Agriculture was started in the year 1947 with the primary objective of training the agriculturists in scientific and improved farming on their own estates or lands and also to provide trained men for the Junior Agricultural Service in Madhya Bharat. The School was situated in close vicinity of the Gwalior Central Experimental Farm and the Research Laboratories where facilities of practical training were easily available to students.

The training was imparted in Hindustani and the course of the training extended to two years. For encouraging the cultivating class and to attract sons of cultivators to this training, 30 stipends of Rs. 20 each had been provided by the State Government. In addition to imparting training in theory and practice at the Institute itself, the students were taken for study tours to various farms and Institutions in the State of Madhya Bharat as well as outside the State.

During the year 1949-50, there were altogether 22 students on roll in both the years of the course, 11 each in the first and the second year and all of them were stipend-holders. Out of the 11 students who appeared in the final diploma examination, 10 passed the course. The successful candidates were all absorbed in the Junior Agricultural Service of M.B. Department of Agriculture.

During the year 1949-50, they were taken to the Harsi area, for seeing irrigated farming and intensive cultivation and also to Agra and Muttra (presently Mathura) to see Government farms and the improved practices practised thereon(ARDA, 1949-50).

(2) Cane Development Section

A Sugar Factory of 800 tons capacity was installed in the Harsi area of the Gird District during the year 1936-37. The area of sugarcane crop at that time in the vicinity of this Factory was only about 1,000 acres. With the installation of the Factory, efforts were made by the Department of Agriculture to increase the area under cane and also its per acre yield. The crushing capacity of the mill was about 22,000 maunds* of cane per day and with a working season of say 100 days, about 22 lac maunds* of cane was the minimum requirement of this Factory.

In the 1st year of its working, the Factory got only about 1,02,065 maunds* of cane. Although the cane area did increase from year to year but the production did not come up to the level of feeding the Factory to its full capacity.

In the year 1946-47, the Government of former Gwalior State set up a Board for Cane Development and charged this body with the task of putting the sugar industry on a stable footing by improving the cane area and its per acre yield in the Harsi area.

The Cane Development Board recommended the imposition of a cane cess of Rs. 1/- per maund* on all the cane purchased by the Dabra Sugar Factory and to organise a section for the development of cane in the Harsi area, expenses of which were proposed to be met from the amount of cess so realised from the Factory. Recommendations of the Board were sanctioned by the then Gwalior Government as a result of which the Cane Development Section came into being in the year 1946-47.

This section has subsequentlyincluded on the regular budget of the Agricultural Department since 1st January 1949 and formed a section of this Department.

The strength of the staff in this Section was as shown below –

	1949-50	**1951-52**
(i) Cane Development Officer	1	1
(ii) Cane Supervisor	1	1
(iii) Cane Assistant Demonstrators	10	-
(iv) Cane Demonstrators	-	15
(v) Time-Keepers	-	3

The work of this Section included not only the Sugarcane development work but also the work of development of all the crops grown in the Harsi area. Along with the improvement of crops various other activities responsible for crop improvement, such as preparation of compost, land improvement (putting up small field embankments), distribution of plants, vegetable seed and seedlings, reclamation of virgin lands, etc., are also being advocated and cultivators persuaded to adopt the same. The work done by this Section during the year 1949-50 is summarised below –

*1 Maund = 37.324 kg *1 Seer = 0.9331 kg

(i) Distribution of improved seeds

(a) Paddy	120 maunds*
(b) Wheat	455 maunds*
(c) Gram	17 maunds*
(d) Potato	74 maunds*
(e) Vegetable Seeds & Seedlings	1000 packets of 1 oz. each; 4000 seedlings.
(f) Sugarcane	60000 canes.

(ii) Increasing areas under major crops in acres

	1948-49	**1949-50**
(a) Paddy	14100	16065
(b) Wheat	27000	36000
(c) Sugarcane	4970	7000 (sown during year)

Paddy, wheat and sugarcane were the only major crops that were grown in the Harsi area and during the year under report, the area under each of them increased.The area under sugarcane increased by 2,000 acres in the Harsi area during the year 1951-52 as compared to the preceeding year. The per acre yield of these crops increased due to the practice of the application of fertilisers and manures.

(iii) Distribution and planting of fruit and timber trees

One thousand one hundred and twenty six fruit trees of various kinds were distributed and got planted on cultivators holdings. In addition to these, about 800 timber plants were also distributed and got planted at the time of the celebration of the 'Independence Day'.

(iv) Distribution of Manures and Fertilisers

	1949-50	**1951-52**
(a) Ammonium Sulphate	33 Tons	118 Tons
(b) Groundnut Cake	60 Tons	184 Tons (including Mahua cake also)
(c) Compost	300 Tons	900 Tons

Most of the manure was utilised for the sugarcane crop. The average yield from the manured crop was about 500 maunds* per acre in the case of sugarcane as compared with 254maunds*from the unmanured crop.

A part of the manure was applied to the crop of wheat and paddy. The dose applied was 30 seers* of Ammonium Sulphate per acre. Crop-cutting experiments were conducted in this area and from the results obtained it was clear that the yield from manured plots was 25 per cent to 50 per cent higher than those of the unmanured plots.

(v) Land Development Work

To check the washing away of the surface soil from slopy lands and in order that it may be levelled up in course of time, the cultivators were persuaded to put up small embankments on the sloping sides of their fields. Such embankments were put on an area of about 1,000 acres.

(vi) Opening of virgin lands through the tractor ploughing

There was very heavy demand for tractor ploughing in this area because the area being irrigated was a cash crop growing area. Two government tractors were placed in this tract. These arrived towards the end of February, 1950and about 250 acres of land was ploughed by these tractors.

Subsequently, six tractors were purchased by private parties and these opened up about 250 acres of land. These tractors were also received late - sometime in February and the others towards the close of April and May and hence their output was low.

(vii) Crushing increased by the sugar factories

The factories in the southern division were not able to get the full crush according to their capacities but due to an increase in the area and per acre yield of cane in the Harsi area, the Gwalior Sugar Factory, Dabra got a record crush of about 28,00,000 maunds* during the year 1951-52 as against the highest of about 18,00,000 maunds* ever crushed by it since its installation.

(viii) Construction and repair of temporary culverts and fair weather roads for facilitating the transport of cane

For facilitating the transport of cane from villages to various weighing centres of the sugar factories, the cart tracks have to be repaired every year after the rains. In doing so temporary culverts with wood work,

*1Seer = 0.9331 kg

etc. or pipe crossing have to be put on the small nallas and barhas which happened to cross the tracks. During the year 1951-52, a total length of 180 miles cart track was repaired and crossings over 30 nallas and barhas were made (ARDA, 1949-50 & 1951-52)

(3) Cotton Research Schemes

(i) Nimar Cotton Improvement Scheme: This scheme has been in operation since 1st June 1948, at the Khargone Farm in Nimar tract and was sanctioned for a period of five years at a total estimated cost of Rs. 81,076 out of which the share of Indian Central Cotton Committee was Rs. 67,576 and that of Madhya Bharat Government Rs. 13,500.

The object of the scheme was to evolve a strain of *desi* cotton suitable for the *Nimar* tract of Madhya Bharat which would yield as much as local variety*Nimari* and spin and gin as much as *Jarilla* variety.

As a result of five years breeding work (1948-53), 2 strains, viz. D. 46-5 and D. 48-154 (renamed *Nimar* 1 and 2) were found promising on account of their significant superiority over local *Nimari* and *Jarilla* in yield and ginning out-turn. In fibre properties these were on par with *Jarilla.* These two strains were suitable for the tract of Nimar and their seed were multiplied for release through the department after another years trial.

In view of the encouraging results achieved so far, the Indian Central Cotton Committee at their meeting held in February 1953, sanctioned the extension of the Scheme for a further period of five years from 1st June 1953, under the technical and administrative control of Principal and Joint Director of Research, Gwalior. During this extension period, the scope of work under the scheme was extended to American cottons also, for which an additional post of Botanical Assistant was sanctioned.

(ii) Scheme for breeding long staple cottons for Southern Malwa region of Madhya Bharat : Improved varieties of American cotton evolved at Indore Institute were tested simultaneously at Badnawar as well as Indore from 1946-47 season onwards. It was found that the yield of each strain at Badnawar was three times that at Indore; in addition, the quality of the lint produced at Badnawar was significantly superior in length, fineness and maturity. Climatic and soil conditions prevailing at Badnawar appeared to be more congenial to the growth and development

of the American cotton plant. It was therefore, felt that the breeding work of long staple cottons for Malwa should be located at Badnawar and not at Indore as in the past.

As Director of the Institute of Plant Industry, Indore, Dr. Sankaran submitted a scheme to the Indian Central Cotton Committee, Bombay at an estimated recurring cost of Rs. 46,358 spread over a period of three years to be borne by the Committee. The necessary land and building at Badnawar were to be provided by the Madhya Bharat Government.

The objective of the scheme was to evolve a strain of long staple cotton possessing a staple length up to 1-1/16 inches while retaining the potentialities for yield and ginning out turn of "Dhar Cambodia" so that its cultivation may give high acre-cash-values to the grower and also enable the local mills to spin finer counts ranging between 20's and 30's yarn. The Committee at its meeting held in July 1952, sanctioned the Scheme to come into operation with effect from 1st April 1953.

(iii) Scheme for Cotton Physiological Research : This scheme financed by the Indian Central Cotton Committee was located at the Institute of Plant Industry (IPI), Indore, under the administrative control of the Director, (IPI).

The Indian Central Cotton Committee at its meeting held in July 1952, decided that the technical direction and over all coordination of the Cotton Physiological Research in progress at the three centres, Indore, Dharwar and Mysore under the auspices of the Committee should rest with Dr. R. Sankaran, the Director of the Institute of Plant Industry, Indore. Accordingly after visiting Dharwar and Mysore in September he prepared a critical review of the work done under the scheme since 1947 and a programme of future work which was considered by an Expert Sub-Committee in January 1953. The report of this Sub-Committee as well as the question of technical direction and over all coordination by Dr. Sankaran, consequent on his appointment under the Madhya Bharat Government, were considered by the Indian Central Cotton Committee at its meeting held in February 1953. The Committee decided that the overall coordination of the Scheme at the three stations may be carried out by Dr. Sankaran by an annual visit to each of the stations during the time when the crop was standing, with the concurrence of the Madhya Bharat Government. As the Scheme was due to terminate at the end of February 1954, proposals for its extension for a further period of three years

prepared by Dr. Sankaran were submitted for the consideration of the Committee at its meeting to be held in August 1953 (ARCA, 1952-53).

(4) Vegetable Research Scheme

Vegetable Research Scheme was started in August 1947 at Gwalior and Ujjain, with the objective of improving the vegetable cultivation by –

(i) introduction of better types of vegetables and

(ii) to multiply and distribute the seeds of improved types.

Observations regarding yield, quality of vegetable, resistance to pests & diseases were taken & recorded on rainy, winter &summer vegetables.

Varieties recommended for different regionswere –

(a) Bhindi : (i) Long green Gwalior (for Gwalior tract) - fruit longand high yields.

(ii) Gujarathi long (for Malwa) and high yields.

(b) Gwar : Gwalior local No. 1 - yield 100 maunds* per acre, long podded. The original seed was from Bhavnagar.

(c) Brinjals : Round purple and Nurki. These varieties were resistant to common diseases, very attractive and high yielder.

(d) Beans : Local No. 4 possessing good quality.

(e) Sponge gourd : (i) Local Dulpur (for Gwalior tract).
(ii) Local No. 2 (for Malwa tract).

(f) Tomatoes : (i) Best of all – big size, good quality fruit.
(ii) Prefection – comparatively virus resistant, good yield.

(g) Peas: Laxton's superb – good marketable, compares well with I.P. 29 in yield but sweeter in taste, much better than *Khaper-kheda* (local).

(h) Carrot: Early Nantes – higher yielder than local with attractive orange colour.

(i) Radish : Bombay long (for Malwa), higher yielder than local.

Note : The increased yield of the above varieties ranged from 15 to 50% over local.

Seed Multiplication and Distribution: Seed multiplication of promising varieties was done for distribution given below

Table-1 : Vegetables seeds / seedlings produced and distributed in different years.

		1947-48	1948-49	1949-50
1	Vegetable seeds produced in lbs	162	180	354
2	Vegetable seeds distributed in lbs	10	167	173
3	Vegetable seedlings distributed in numbers	41,425	88,475	3,30,000

Fruit Nursery Work: The Vegetable Research Officer was entrusted with the establishment of nurseries also in connection with Food Production Drive Work. During the year nurseries were established at Gwalior, Ujjain and Biaora Farms and the mango, jack fruit, mosambi, santra, papaya, lime, jambori stock plants were raised. The total numbers of such plants raised were 3,290.

The total income realised by way of sale of vegetables was Rs. 2,108 and aana 10 during the year and the price of vegetable seeds raised and stocked at the farm for free distribution amounted to Rs. 1,047 and aana 1. The sale proceeds were credited to the Treasury. A number of leaflets were issued on vegetable growing in Madhya Bharat and a few of them were published also(ARDA, 1949-50).

(5) Agricultural Farms

There were in all 11 Government Farms in the whole of the Madhya Bharat State. Out of these, 4 were Experimental, one Seed Multiplication and the rest 6, more or less, served the purpose of demonstration farms. Out of these 11 farms, 3 were located in the Northern Division, while 8 in the Southern Division.

The brief description about these farms as per Annual Report of the Department of Agriculture, Gwalior Government for the year 1949-50 is given below :

(i) Central Experimental Farm, Gwalior

The total area of the Farm was 167.85 acres, which was uitilised as given below –

(a) Area under cultivation

i. Kharif crops		
	Dry	52.17 acres
	Irrigated	3.00 acres
ii. Rabi crops		
	Dry	39.61 acres
	Irrigated	13.75 acers
iii. Perennial crops		1.00 acers
iv. Nursery garden		5.58 acres
(b) Area under laboratory experiments		5.00 acres
(c) Area reserved for grazing		14.50 acres
(d) Area under roads and buildings		53.65 acres
	Total area	**167.85 acres**

(ii) Harsi Experimental Farm, Bagwai : This farm was situated in the irrigated tract commanded by the Harsi Dam in the Gird District. The total area of the farm was 45 acres, which was utilized as given below:

(a) Area under cultivation

i.	Kharif	Dry	2.022 acres
		Irrigated	12.388 acres
ii.	Rabi	Dry	6.210 acres
		Irrigated	9.326 acres
iii.	Sugarcane	Dry	5.100 acres
		Total	**35.046 acres**
		Less double cropped area	4.110 acres
		Net cropped area	30.936 acres
(b) Area under roads and building			6.300 acres
(c) Area under canal seepage drain, etc.			2.064 acres
(d) Cultivated fallow			5.700 acres
		Total area	**45.000 acres**

In addition to the above area, an area of about 93 acres was subsequently acquired for purposes of seed multiplication and grazing of farm animals. Out of this area, about 20 acres were sown with gram with the help of hired ploughs and bullocks due to the inadequacy of the equipment at the farm.

(iii) Central Experimental Farm, Bhilsa (presently Vidisha) : The Farm was situated near the town of Bhilsa.The area of the farm was 283.17 acres which was utilised as shown below –

(a) Cultivated area

i.	Under Kharif crops	47.0 acres
ii.	Under Rabi crops	200.17 acres
iii.	Grazing area	39.12 acres
iv.	Under roads and buildings, etc.	11.18 acres
v.	Fruit nursery	0.10 acres
vi.	Fallow	4.00 acres
	Total	**301.57 acres**
	Less double cropped area	18.40 acres
	Net area	283.17 acres

(iv) Agricultural Farm, Biaora : The total area of this farm was about 201 acres out of which about 123 acres was leased to cultivators for farming.The details of the rest of the area were as given below –

i.	Under Kharif crops	22 acres
ii.	Under Rabi crops	21 acres
iii.	Cultivated waste	23 acres
iv.	Uncultivated waste	12 acres

(v) Central Experimental Farm, Indore : The area of the farm was 171 acres out of which the area under cultivation was 151.16 acres. Most of this area was used for multiplication of improved seeds of various crops which were then distributed to the cultivators.

Trial of improved seeds and the various methods of improved agriculture evolved by research were also conducted at the farm with a view to finding out their suitability to the locality.

(vi) Central Experimental Farm, Ujjain : The total area of the farm was 3,00 acres, out of which area under cultivation was 136.00 acres.

(vii) The Mahagarh Agricultural Farm : The total area of the farm was 57.39 acres, out of which 45 acres was under cultivation.

(viii) The Khargone Agricultural Farm : The area of this farm was 50.59 acres, out of which 29.70 acres was under cultivation, while the rest of the area about 20.30 acres was leased to cultivators.

(ix) Agricultural Farm, Dewas : The area of the farm was 35.81 acres, out of which 26.32 acres was under cultivation.

The main objective of the farm was to multiply the improved seeds, which were then distributed to the cultivators. Almost all the area under cultivation on the farm was utilised in the multiplication of improved seeds of Wheat, Gram, Peas, Linseed, Jowar, Tuar, Groundnut and Paddy and all the produce was given out to cultivators for seed purposes after retaining the seed requirements of the farm itself.

Fruit-plant nursery: A nursery for raising the plants of various kinds of fruits suited for the tract was organised on this farm to assist in the Food Production Drive and plants of mango, lemon, guava, papaya, etc., were raised.

(x) Agricultural Farm, Dhar : The area of this farm was only 16.92 acres. A major portion of this area was occupied by fruit garden. The crops raised on the farm during the year under report were –

i.	Paddy	1 acre
ii.	Tuar	5 acres
iii.	Cotton	1 acre
iv.	Maize	5 acres

A nursery of fruit-plants was maintained on this farm where plants of various kinds of fruits were grown and sold out to cultivators, etc.

(xi) Seed Multiplication Farm, Ujjain : The area of the Central Experimental Farm, Ujjain, which was formerly leased out to cultivators was later on taken up for seed multiplication work. This work was carried out on commercial lines. No experiments were conducted under this scheme but only such seeds as have proved successful both in point of yield and quality were multiplied. Thus, there was no risk of failure of crops, etc., under this scheme, except unfavourable weather conditions, etc. The total area of the farm under this scheme was 460 acres which was all under cultivation. Principally, seeds of following crops were multiplied –

i. Jowar
ii. Cotton
iii. Gram
iv. Arhar
v. Wheat

The quantities of seeds supplied to the cultivators, etc., from the seed multiplication farm during the year under report were –

i.	Jowar	235 maunds*
ii.	Cotton	91 maunds*
iii.	Wheat	686 maunds*
iv.	Gram	67 maunds*

In addition to the above farm, the Agricultural Farm at Kharva in the Panth Piploda State was taken over by the Department in the month of February 1950, as the State was merged in the Madhya Bharat Union. The area of this farm was 18.19 acres(ARDA, 1949-50).

(6) Agricultural Engineering and Boring Section

An important addition during the year 1949-50 was the creation of the Agricultural Engineering Section as only the Boring Section existed previously. With the creation of this section the following activities were taken in hand.

(i) Tractor ploughing, discing, harrowing, levelling and bunding.
(ii) Repairs to departmental and cultivators agricultural machinery and implements.
(iii) Manufacture of agricultural implements and tools.

There was a heavy demand from the cultivators for the tractor ploughing work. To meet the demand, two tractors were purchased during 1948-49 and 4 tractors with equipment were purchased by the Department during the year 1949-50. Of these, two were T.D. 14, 60 H.P. and the other two were Farmall and W.D. 6 of 30-35 H.P. each.

The tractors although ordered in the beginning of the season arrived late towards the close of the month of February. It took some time to assemble the parts, etc., but they were put to work immediately without any unnecessary loss of time.

Non availability of the spare parts, etc., some times came in the way of continuous working of these tractors. However, efforts were always made to replace them immediately by getting them manufactured in our own workshop.

*Maunds = 37.324kg

Out of these six tractors, 2 worked in the Bhilsa and 4 in the Gird Districts. The total output of work in the two districts during the year 1949-50 is as shown below –

	Ploughing (acres)	Discing (acres)	Bunding
Gird	92	48	-
Bhilsa	-	-	182654 c. ft.

There was well equipped workshop in the charge of this section. The details of work done in the workshop are as under –

(i) Repair of the old departmental tractors, ploughs, oil and steam engines, pumps, boring machines, bullock power agricultural implements, mower, chaff-cutters and cane crushers, etc.
(ii) Preparation of boring tools, fishing tools, spares of the tractors and other machines and manufacture of agricultural implements and tools on a small scale.

Well boring: From Rs. five lac Scheme sanctioned by the Government for 243 bores, ten bores were taken in hand during the year 1949-50. Out of these, 7 bores were completed successfully during the year 1949-50. The total footage of boring done during the year was 702 feet(ARDA, 1949-50).

(7) College of Agriculture, Gwalior

In order to educate the children of Gwalior State in scientific agriculture, a school was started in the year 1947. Since then the government had been pondering and planning to develop the modern way of cultivation in the rural society also by developing human resourse in the needy areas. This ultimately resulted in the establishment of the College of Agriculture, Gwalior. It was the only college in Madhya Bharat (M.B.) State and therefore, named as M.B. College of Agriculture, Gwalior.

The college was founded by late Shri K.I. Thadani in 1950. As the Director of Agriculture, Madhya Bharat, he drew the plan and got it sanctioned by the government. Later on he was appointed as the first Principal of the college. He did lot of hard and devoted efforts / work for the establishment of the College for which he was remembered all the time. The College was initially affiliated to Agra University and then to Vikram university, Ujjain, till the establishment of JNKVV in 1964.

(8) College of Agriculture, Sehore

The foundation of College of Agriculture, Sehore was laid down by the first Food and Agriculture Minister of India, Late Shri Rafi Ahmad Kidwai on August 01, 1952. At that time, this college was up to intermediate level. On July, 1955, Union Minister for Food and Agriculture, Shri Ajit Prasad Jain laid foundation of Rafi Ahmad Kidwai Undergraduate College and Agriculture Research Institute. Initially, the college was affiliated to Vikram University, Ujjain.

(9) College of Agriculture, Indore

Indore, situated in the heart of Malwa, enjoys the status of an "Educational and Industrial Capital of Madhya Pradesh". To initiate and strengthen agricultural research and development in Malwa and Nimar regions, the Institute of Plant Industry came into existence in the year 1924. Later on, in the year 1959, the Government College of Agriculture was established with the merger of the erstwhile Institute of Plant Industry (IPI). Shri H. P. Dwivedi joined as founder Principal of this College in July 1959 and he continued till June 1963. Dr. R. S. Bhatt worked as Principal from June 1963 to August 1965.

(10) College of Veterinary Science and Animal Husbandry, Mhow

This college was established in the year 1955 to cater the needs of animal care and livestock development of Malwa region. Pt. Jawaharlal Nehru inaugurated its present building in 1959. The impact of College is visible in all spheres of Veterinary Science. The College has strong Under Graduate and Post Graduate programmes. The College makes an impeccable impact on the overall development of livestock production and management through teaching, research and extension activities in basic and applied fields of livestock and poultry.

(11) Grow More Food Scheme

(i) Breaking up of new lands and eradication of weeds by Government tractors : The departmental tractors were mostly used for breaking up of fallow lands of cultivators and eradication of weeds from their lands. 10 per cent of the cost was charged from the cultivators in advance and the remaining charges were recovered in three yearly instalments. The work done during the year 1951-52 was –

(a) Breaking up of new lands 6,601 acres
(b) Harrowing 671 acres
(c) Bunding 3,62,980 c. ft.

5TD-14-A-Tractors were purchased during the year for deep ploughing and 4 Massy Harris 22-K-Tractors were purchased for haul purposes.

(ii) Soil Conservation : In order to check land erosion i.e., the washing away of the rich surface soil by heavy rains, etc. cultivators were advised to put small bunds around their fields across slopes. The width and height and spacings of these bunds was as per the grade of the slope of each individual field. Cultivators were also given *taccavi* loans for this work if the labour and expense required for such a work was beyond their means. The cultivators have now begun to realise the advantages of bunding and a large number of them carry out these operations with their own labour and resources. During the year 1951-52 bunding to the extent of 16,974 acres was done by manual labour and to the extent of 3,62,980 c. ft. was done by means of tractors.

(iii) Control of insect pests and plant diseases : There were four well-equipped Plant Protection Units located in different parts of Madhya Bharat. These were mainly entrusted with the Plant Protection and Anti-locust work.

In times of epidemic and locusts invasions the active help and co-operation of the cultivators was essential. The cultivators were not trained in their work but efforts were being made to educate and train them in this work. They were offered scope to use the equipment and insecticides themselves so that they may learn their use and see their utility. Some progressive cultivators realised their benefits and purchased their own equipments and stocks of insecticides. During the year 1951-52 the following controls and remedial measures were carried out –

(a) Crops of potato and onion were saved from the damage of cut worm by the use of Sodium Fluosilicate in 568 and 17 acres, respectively.
(b) Dusting with Gammexine and Benzoin Hydrochloride was done on crops of cotton and linseed in villages Marol and Sultanpur and the crops were saved in 74 acres.

(c) Jowar smut was checked by mixing the seed with sulphur powder before sowing. For this purpose 1925 sulphur packets were widely distributed at a nominal cost, sufficient for an area of 3,850 acres. In the crop of such treated seed, the ear heads were not affected by smut.

(d) Rice bug was destroyed by dusting Hexamar (B.H.C. dust) in an area of approximately 55 acres.

(e) Geigy 33 and Killoptra were used for protecting 17,143 tons of stored food grain from the attack of insect pests. The stored grain when taken out was found to have remained in very good condition and the seed so treated gave satisfactory germination.

Numerous large swarms of locusts attacked Madhya Bharat during the year 1951-52. The districts where heavy swarms came were Ujjain, Mandsaur, Shajapur and Gird. The swarms were either driven away or wherever they settled were successfully killed by dusting and burning. No appreciable damage was caused to crops.

(iv) Municipal Compost : The Compost Officer was helped in his work by two Assistants comprising of one Senior Assistant and one Assistant Bio-chemist. He was also provided with three assistants from the Grow More Food funds. One Assistant at the Head-quarters analysed samples of urban and rural compost received from the Municipalities and the districts at the Agricultural Research Laboratory, Gwalior.

For convenience, composting work in the State had been divided into 4 divisions, in each of which one Assistant Compost Officer was posted. The Head-quarters of these Assistant Compost Officers were kept at Dhar, Ratlam, Guna and Gwalior and each one of them was placed in charge of 4 to 5 districts. The Assistant at Lashkar carried on the work of analysis of compost in addition to his other duties.

The technical programme was (i) to raise the level of production of municipal compost to 60,000 tons and (ii) to raise the number of compost centres in Municipalities and Cantonment Boards to 60.

The total quantity of compost prepared during the year was 39,46,390 c. ft. (78,928 tons) which increased by 57% over last years production for the same period, which was 25,11,688 c. ft. (50,233 tons). The total quantity of compost sold during the year was 21,87,684 c. ft.

(43,754 tons), which was 55% of the total production and this was 40 per cent. more than the sales over the same period last year, which were 15,71,359 c. ft. (31,427 tons). Out of this 8,21,080 c. ft. (16,422 tons) compost was transported by departmental trucks, as against 14, 592 tons transported during the previous year.

Crop to which manure was applied: Compost was applied to all types of irrigated crops, particularly potatoes, sugarcane, vegetables, melons and to grain crops such as wheat and maize. Results were on the whole encouraging. On the basis that one ton of compost produces on an average one maunds* of extra food grain it may be taken that 43,754 tons of compost sold during the period produced 43,754 maunds* of extra grain and about 87,508 maunds* additional straw (ARDA, 1951-52).

(12) Integration and Re-organisation of Research

(i) Appointment of Principal and Joint Director Research: Integration of teaching with research was effected with the appointment of the Principal as the Joint Director of Research also with effect from 24th October 1952. With a view to place agricultural education under a unitary control, the Agricultural School, Gwalior, was alsotransferred to the over-all direction and control of the Principal, the immediate supervision resting with the Head-master.

Agricultural Regions in Madhya Bharat : There were 5 distinct agricultural regions in Madhya Bharat differing from one another in climatic and soil conditions. They were –

(a) The Northern alluvium (Bhind, Morena, Gird, Shivpuri and upper half of Guna district).
(b) Bhilsa (Vidisha).
(c) Malwa Plateau (Indore, Ujjain, Dewas, Mandsaur, Ratlam, Shajapur, Rajgarh and northern part of Dhar).
(d) Nimar valley (Khargone district and southern part of Dhar).
(e) Western hilly region (Jhabua district and western portions of Dhar and Khargone).

The Institute of Plant Industry at Indore was concerned with the investigation of the problems of the Malwa region, while the Agricultural Research Institute at Gwalior in conjunction with the regional research stations were responsible for the other four regions.

The farms at Gwalior and Bagwai were to tackle the problems of the *barani* and irrigated tracts respectively of the alluvial region. Bhilsa(Vidisha) farm was the second Regional Research Station while the Khargone farm was the third, for the Nimar tract. A new regional station for the western hilly region was to be established. Under the proposed reorganisation of research in Madhya Bharat, the department farms already existing in each region were converted into Regional Research Stations by the addition of technical staff, equipment and other requisite facilities. At each station the improvement of the principal crops of the region was taken up through breeding. Investigations on agronomic practices such as time and method of sowing, spacing, manuring, irrigation, inter culture, etc., were be undertaken in order to discover the best method to be recommended to the cultivator. A soil survey of different regions was undertaken with a view to determine the physical properties and chemical composition of soils, their fertility status and specific deficiencies, if any (ARCA, 1952-53).

(ii) Establishment of M.P.A.R.I.: The M.P. Agricultural Research Institute, Jabalpur was established by the Government of Madhya Pradesh in May, 1962 in the premises of the Agricultural College, Jabalpur by bringing together various Agricultural Research Sections of the Department of Agriculture located at different Centres in the State. Sections of Agronomist and Second Economic Botanist were already at Jabalpur and Sections of Economic Botanist, Indore, Agricultural Chemist, Gwalior; and Entomologist, Bhopal, were moved to this place during June-July, 1962. Horticulturist, Bhopal, followed in March 1963. Agricultural Economics Section also started in July, 1963 after the joining of Asstt. Agricultural Economist but work could not be continued at that time as he left in October, 1963.

In addition to above, research work on different commodities at different centres and sub-centres viz., Powerkheda for Wheat, Raipur for Rice, Sehore for Sugarcane, Chhindwara for Maize etc. working under different schemes of the Indian Council of Agricultural Research and Commodity Committee were transferred under the control of the Institute. Thus, the organisation of Research came into sound footings under unified control after the establishment of the M.P. Agricultural Research Institute.

The Institute was strengthened by opening separate sections of Agricultural Economics and Statistics in 1963. Millets & Cotton Agronomy schemes were also implemented during the year 1963. Agrostology was separated from Agronomy and established into an independent section during 1964. Agricultural Engineering Research

Section was brought to Jabalpur in 1962 and was considerably expanded after the operation of an Indian Council of Agricultural Research Scheme of establishing R.T.T. Centres for Madhya Pradesh. The research work on Rice and Wheat was considerably expanded under reorganised schemes. Consequently, four new sub centres for Rice viz., Bagwai, Waraseoni, Jabalpur and Rewa and one for wheat at Jabalpur were started. Various sections of the Institute were strengthened during the year 1964 and three Regional Agricultural Research Institutes at Gwalior, Rewa and Indore started functioning with some nucleus staff during the year 1964. The whole organization of Research was transferred under the control of Jawaharlal Nehru Krishi Vishwa Vidyalaya from 1st December, 1964 and then complete integration of research and teaching wings followed.

Besides the regular programme of research, 32 Research Schemes financed by the Indian Council of Agricultural Research, various Commodity Committees and State Government were in operation under the control of the Institute (ASR, 1964-65).

(13) Establishment of Central Mechanized Farm, Bhopal

The Central Mechanized Farm, Bhopal was set up in September 1953 for the reclamation and cultivation by mechanized means of an area of 10,000 acres of jungle land in Sultanpur Tehsil of Bhopal State and the settlement thereon of 1,000 families of landless labourers spread over a period of 10 years. This was the first scheme of its kind undertaken by the Government of India with the object of tackling the problem of settlement of landless workers in the country.

The progress made under the scheme hitherto in relation to the targets set for (i) reclamation (ii) cultivation and (iii) settlement of landless labourers, is briefly indicated in Table 2.

Table 2: Targets and achievements of reclamation and cultivation in different years

(i) Reclamation

Year	Target (acres)	Achievement (acres)
1952-53	1,800	1,800
1953-54	4,200	4,200
1954-55	4,000	2,500 acres reclaimed*

* More area was not available in the locality

(ii) Cultivation

Season	Target (acres)	Achievement (acres)	Yield obtained (maunds*)
1953-54 (Rabi)	1,460	1,284	2,685
1953-55 (Kharif)	3,030	2,650	2,000 (approximately)
1954-55 (Rabi)	4,350	3,205	

The non-fulfilment of targets and the low yield obtained were mainly due to the lack of adequate machinery and acute shortage of manual labour in the locality.

(iii) Settlement of Landless Labourers : The scheme envisaged the recruitment of 600 families of landless labourers by the close of 1954-55 for settlement at the Farm. Half the number was to be taken from the Bhopal State and half from outside. To start with 152 labourers were selected from Bhopal State in April 1954. Of the selected persons very few actually reported at the Farm. In view of this poor response from Bhopal State, it was considered necessary to bring in labourers from other States where the problem of landless labourers was very acute, without prejudice to the quota of 500 families fixed for that State. Accordingly, 200 labourers from Travancore-Cochin State were selected.

II. Salient Achievements

EDUCATION

College of Agriculture, Gwalior

The College of Agriculture, Gwalior was started in the year 1950 to fulfil the long felt need of providing an Institution of high scientific learning and research in Agriculture for the Madhya Bharat Region. The first session of the College started on 31st July, 1950 with 51 students in the 1st year and 9 students in the 2nd year. The College was headed by the Founder Principal Mr. K.I. Thadani, who was retired Director of Agriculture, Sind and Madhya Bharat. It was only in September, 1950 that the regular staff started pouring in and by the end of the session – one Professor, two Assistant Professors, four Lecturers and four Demonstrators were appointed.

In absence of building, the classes were started in 2 halls of the Sports Association and the practicals were held in the hostel building. It was only in July 1951 that the building which was meant for Agriculture School was taken over by the College and permanent planning started.

About 25 acres of land in the vicinity of the College was developed for agriculture work. Within a year with the able guidance of the Founder Principal and the hard working of the staff members the Institution established very well and within a year it was ready to start degree classes. As a result of the inspection of the Vice chancellor and the Registrar of Agra University, the College was allowed to start degree classes from 1st August, 1951 and the Institution was affiliated to Agra University.

With the timely help and provision of sufficient budget, the College developed very well by the year 1957 and was ready to start post-graduate classes and during 1964-65 the College was imparting post-graduate instructions in Agricultural Chemistry, Agronomy, Plant Pathology, Entomology and Zoology, Botany and Extension. With the formation of Vikram University, Ujjain, this College was affiliated to it on July 1, 1957. On 1st July 1964 this College had to be affiliated with JiwajiUniversity, Gwalior which came into existence in May, 1964.

(1) Principals

Till the establishement of JNKVV, Jabalpur, the College of Agriculture, Gwalior was headed by 11 principals for the periods given with their names as below.

S. No.	Principals	Duration		Photograph
		From	To	
1.	Shri Rai Bahadur K. I. Thadani (Founder Principal)	Feb 1950	Jan 1952	
2.	Shri R. K. Mishra	Jan 1952	Oct 1952	
3.	Shri R. Shankaran	Oct 1952	Oct 1954	
4.	Dr. Y. B. Ranganekar	Oct 1954	Feb 1955	
5.	Dr. T. R. Mehta	Feb 1955	Dec 1958	

6.	Dr. P. S. Lamba	Dec 1958	Feb 1961	
7.	Dr. M. L. Purohit	Feb 1961	July 1961	
8.	Dr. R. S. Bhatt	July 1961	June 1963	
9.	Dr. M. P. Singh	June 1963	Dec 1963	
10.	Dr. S. L. Vishnoi	Dec 1963	May 1964	
11.	Prof. S. K. Singh Gaur	May 1964	May 1966	

(2) Staff

During 1964-65, the teaching staff consisted of the 35 capable and highly qualified members. Till 1964-65, 20 members of the staff were sent for higher training abroad. Out of them 6 staff members i.e., Mr. S.K. Singh Gaur, Dr. D.P. Motiramani, Mr. D.K. Sharma, Mr. L.K. Joshi, Dr. G.P. Verma and Mr. H.R. Tyagi have remained in this College.

College of Agriculture – Gwalior 1957-58

Dr. E. Hughes (Trustee). Dean L. B. Howard and other Executive of *Illinois University* with our Staff Members.

(3) Scholarship and Freeship Awards to Students

The following concessions were enjoyed by the students of this College.

(i) Scholarships

(a) Merit-cum-poverty-12 scholarships @ Rs. 75/- p.m. each year up to B. Sc. (Ag.) awarded by State Government.

(b) Merit-cum-poverty-12 scholarships @ Rs. 100/- per year M. Sc. (Ag.) level awarded by State Government.

(c) Post-Matric Scholarships to Scheduled Castes, Scheduled Tribes and Backward Classes up to M. Sc. (Ag.) standard varying from Rs. 50/- to Rs. 75/- p.m. awarded by Government of India.

(d) National Scholarship and National Loan Scholarship-awarded by Government of India.

(e) Merit-cum-Means Scholarship by Indian Council of Agricultural Research to 1st year students @ Rs. 75/- p.m.
(f) Merit stipends up to B. Sc.(Ag.) standard for two students in each class @ Rs. 30/- and Rs. 20/- p.m.-awarded by State Governement.
(g) Vikram University Merit Scholarship to first 5 students @ Rs. 45/- p.m.
(h) Stipend (Deptt.) to final B. Sc. (Ag.) students @ Rs. 50/- p.m.- awarded by the State Government.
(i) Kashmir Government Scholarship to its State nominees @ Rs. 150/- p.m.
(j) Nepal Government Scholarship to its State nominees under Colombo Plan @ Rs. 150/- p.m.

Post Matric Scholarship (UG and PG)

S. No.	Year	SC	ST	OBC
1	1950-51	-	-	-
2	1951-52	-	-	-
3	1952-53	-	-	-
4	1953-54	-	-	-
5	1954-55	-	-	-
6	1955-56	2	2	1
7	1956-57	2	2	1

S. No.	Year	SC	ST	OBC
8	1957-58	6	5	3
9	1958-59	2	2	1
10	1959-60	3	2	2
11	1960-61	2	2	1
12	1961-62	3	3	2
13	1962-63	2	2	3
14	1963-64	2	2	2

(ii) Freeships

(a) All students of Scheduled Castes and Scheduled Tribes.
(b) All sons of Goldsmiths.
(c) Wards of Army personnels.
(d) Wards of Political sufferers.
(e) Deserving wards of poor agriculturists to an extent of 10% of full freeships and 10% half freeships.

Number of students admitted in UG and PG programme and completed their degree

S.No.	Year	UG		PG	
		Enrolled	Passed	Enrolled	Passed
1	1950-51	51	-	-	-
2	1951-52	56	-	-	-
3	1952-53	47	07	-	-
4	1953-54	57	-	-	-
5	1954-55	57	34	-	-

6	1955-56	74	15	-	-
7	1956-57	84	29	-	-
8	1957-58	71	42	10	-
9	1958-59	70	44	14	08
10	1959-60	71	53	32	15
11	1960-61	76	67	33	30
12	1961-62	78	48	35	30
13	1962-63	80	48	38	30
14	1963-64	84	52	34	34

(4) University position / Medal winner

From the very beginning of the College, the Institution was producing excellent results and our students have brought credit by securing positions in the University Examination and winning following prizes.

(a) B. Sc. (Ag.) –

1. Shri D.A. Shinde	1953	Saksaria Gold Medal
2. Shri Laxman Singh	1954	Saksaria Gold Medal
3. Shri Y.L. Nene	1955	Saksaria Gold Medal& Agra Univ. Chancellors Bronze Medel
4. Shri O.P. Makhija	1956	Saksaria Gold Medal & Agra Univ. Chancellors Bronze Medel
5. Shri V.N. Shroff	1957	Saksaria Gold Medal
6. Shri N.S. Sisodia1	958	First Position
7. Shri B.D.S. Bhargava	1959	First Position
8. Shri K.C. Mandloi	1960	First Position
9. Shri B.S. Bhargava	1961	First Position
10. Shri D.D. Dubey	1962	First Position
11. Shri M.L. Bhatt	1963	First Position
12. Shri M.N. Jha	1964	First Position

(b) M. Sc. (Ag.) –

1. Shri N.K. Sood	1960	Vikram University Gold Medal
2. Shri B.D. S. Bhargava	1961	Vikram University Gold Medal
3. Shri U.K. Yadav	1962	Vikram University Gold Medal
4. Shri Arvind Dhabholkar	1963	Vikram University Gold Medal
5. Shri S.S. Yadav	1964	Vikram University Gold Medal

Merit list of M. Sc. (Ag.)

S. No.	Name of student	Year	Medal / Position
Agronomy			
1	B. D. S. Bhargav	1961	Gold Medal
2	U. K. Yadav	1962	Gold Medal
3	K. S. Mandloi	1963	Gold Medal
Botany			
1	A. S. Tiwari	1961	Ist Position
2	K. C. Mandloi	1662	Ist Position
3	Arvind Dhabholkar	1963	Gold Medal
Soil Science			
1	P. G. Deo	1959	Ist Position
2	M. S. Garu	1960	Ist Position
3	G. S. Rathore	1961	Ist Position
4	K. N. Bansal	1962	Ist Position
5	B. S. Bhargav	1963	Ist Position

S. No.	Name of student	Year	Medal / Position
Extension			
1	Sh. A. P. Saxena	1963	Ist Position
Entomology			
1	C. B. Shinde	1959	Ist Position
2	N. K. Sood	1960	Gold Medal
3	S. M. Vaishampayam	1961	Ist Position
4	Y. N. Saxena	1962	Ist Position
5	Suresh Bichoo	1963	Ist Position
Plant Pathology			
1	R. M. Tripathi	1959	Ist Position
2	B. S. Sirdhania	1960	Ist Position
3	S. C. Vyas	1961	Ist Position
4	Anil Indulkar	1962	Ist Position
5	S. C. Agrawal	1963	Ist Position

B. D. S. Bhargava
Topped Vikram University in B. Sc. (Ag.) Part II Exam 1959

N. K. Sood
Topped Vikram University in M. Sc. Ag. (Ent.) Exam 1960.

K. C. Mandloi
1st Position in B. Sc. (Ag.) Exam 1960

(5) Outstanding scholars of College

Year	UG scholar	Position held
1953	D. A. Shinde	Prof. JNKVV, Jabalpur
1954	Laxman Singh	Plant Breeder, ICRISAT
1955	Y. L. Nene	DDG, ICRISAT
1956	O. P. Makhija	DDG, ICAR
1957	V. N. Shroff	Dean, CoA, Indore
1958	N. S. Sisodia	Professor, Plant Breeding
1960	K. C. Mandloi	Dean, CoA, Khandwa
1961	B. S. Bhargava	Head, Division of Soil Sci, Horticulture Institute, Banglore
Year	**PG scholar**	**Position held**
1960	N. K. Sood	Prof. JNKVV, Jabalpur
1961	A. S. Tiwari	Dean Faculty Agriculture &VC, JNKVV, Jabalpur
1961	S. C. Vyas	Prof. JNKVV, Jabalpur
1962	U. K. Yadav	Professor (Agronomy) in U. S. A.
1963	K. S. Mandloi	I/C Cotton Improvement Project, Khandwa
1963	S. C. Agarwal	Dean, CoA, Sehore
1963	A. P. Saxena	ADG (Extension) ICAR
1964	Manohar Haware	Principal Scientist, ICRISAT
1964	S. S. Jakhmola	Dean, CoA, Gwalior

(6) Outstanding personalities who served College of Agriculture, Gwalior

1	Rai Bahadur K.I. Thadani, Founder Principal
2	Shri R. Sankaran Principal & JDR
3	Dr. T. R. Mehta, Dean CoA, Principal & JDR
4	Dr. P. S. Lamba, Principal & JDR

(7) Library

The College library serves the need of students, staff and research workers. During 1964-65, it had 6722 books and 1926 Journals. It contributed to journals in different disciplines. The library was staffed by trained Librarian, who has gone for higher studies in the Library Department of Vikram University.

Thesis records of College of Agriculture

S. No.	Subject	Upto 1964
1	Agronomy	18
2	Botany	29
3	Entomology	34
4	Extension	04

S. No.	Subject	Up to 1964
5	Pathology	13
6	Soil Science	19
	Total	117

(8) Laboratories

During the year 1964-65,all the Laboratories of the College were fairly developed to meet the demand of teaching and research upto postgraduate level.

(9) College Farm

The total area of College Farm during the year 1963-64 was 118.05 acres, which was mainly to meet the need of teaching and research. The newly acquired land was fully reclaimed as a result of levelling, bunding and was used for growing fodder for the College Dairy. About 30 acres of land was irrigated by three wells fitted with electric pumps. It was expected to irrigate the major area of the farm with the help of additional 4 wells. Duringthe year 1963-64, the expenditure of the farm ranged between Rs. 15,000/- to 16,000/- and the income was between Rs. 14,000/- to 15,000/-. The College Farm runs under the able guidance of Professor of Agronomy.

(10) Dairy and Poultry

There were 64 animals in dairy during 1963-64 and 55 birds with the College poultry for imparting teaching in feeding and management. Dairy had Murrah Buffaloes and Haryana and Sahiwal cows and poultry had white leg horn birds. About 108 litres of milk was produced each day during 1963-64.

(11) Horticulture

In addition to teaching, Horticulture upto B. Sc. (Ag.) the College maintained the best lawns, ornamental garden and nursery in whole of Madhya Pradesh, though the area under orchard was very small. Only during the year 1963-64 a few acres of land were provided for olericulture.

(12) Hostel

During the year 1963-64, there were two hostels accommodating about 200 students, the rooms were double seated. An Asstt. Surgeon from the Medical Department looked after the health of the hostellers. The Doctor visited the hostel once a week and on emergencies and was paid @ Rs. 40 per month initially.

(13) Extension Activities

The Extension wing at this College of Agriculture, Gwalior was started on April 01, 1960 with the financial assistance of the Ford Foundation. The wing conducted Teaching, Extension, Research and was well equipped with teaching and demonstrations equipments. Till 1960 Agriculture Extension was taught in B. Sc. (Ag.) Final only. But from 1961-62 post-graduate teaching was also started. The Extension wing had adopted 10 villages of N.E.S. Block, Morar for intensive extension activities.

Agriculture College, Gwalior

Students on Extension work during Vacations 1955-56

Digging the foundation of a School in Bhatpura Village

Students doing extension work in a village

Road Construction

Extension Survey

(14) Students Societies

The Students Societies were started in the College in the year 1953 with the Principal as Patron. There were four Societies.

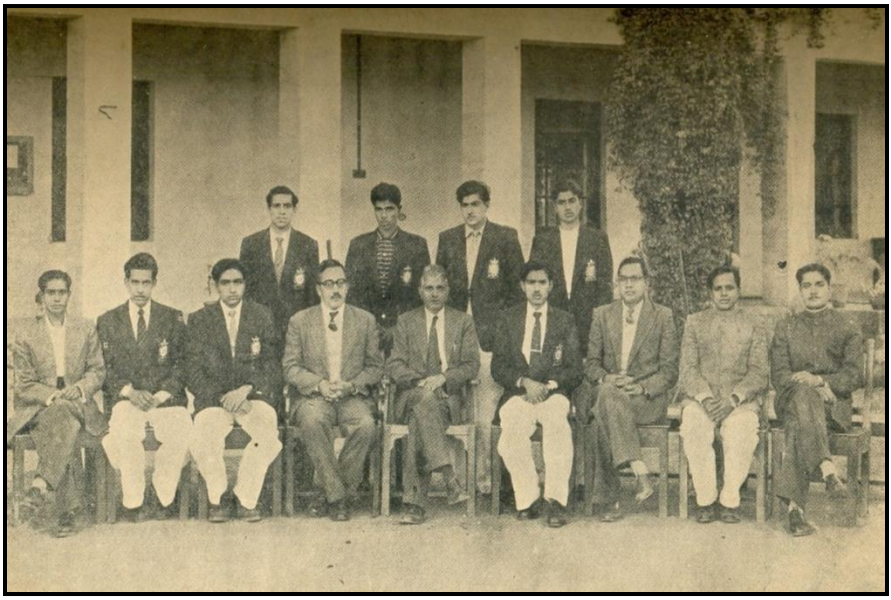
(i) Social & Cultural Society (ii) Literary Society

(iii) V.S. Sabha (iv) Sports Society

There was one staff advisor for each Society and the Society was represented by one student secretary and one representative of each class. There was a President, one Vice President and a General Secretary.

The activities of the various societies were spread over throughout the year. The V.S. Sabha collected about Rs. 1,000/- per year to aid the poor boys. A Poor Boys Fund was also started with the help of the staff, students and outside contributors.

College of Agriculture Gwalior
Students Executive Committee 1959-60

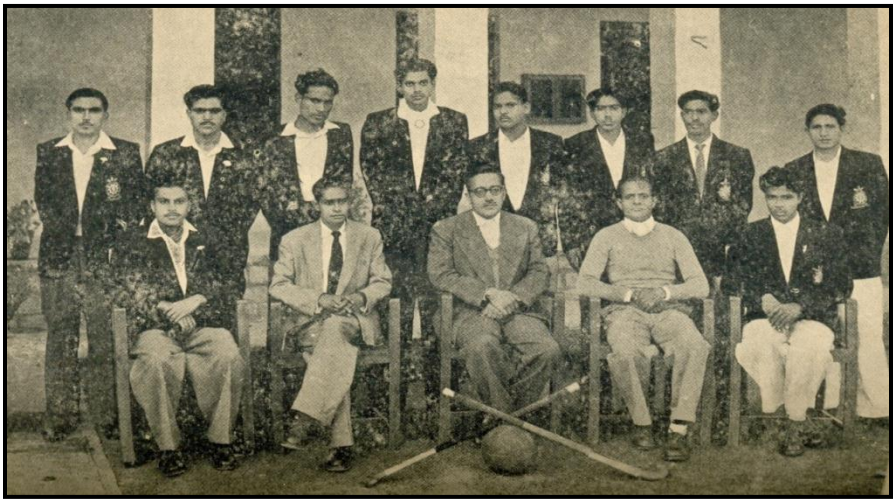


From Left to Right :

Sitting – Dr. R. S. Deshpande (Advisor Sports), Shri A. K. Tiwari (Vice President), Shri B. R. Singh (General Secretary), Dr. P. S. Lamba (Principal), Dr. T. R. Mehta (Ex - Principal), Shri K. N. Sharma (President), Shri V. V. Sharma (Treasurer), Shri M. S. Jadav (Advisor, V. S. Sabha), Shri A. B. Nabar (Advisor Social & Cultural Society).

Standing – Shri R. K. Nagia (Secretary Social & Cultural Society), Shri D. G. Mahadik (Secretary Sports), Shri O. P. Dubey (Secretary Literary Society), Shri V. B. Moghe (Secretary V. S. Sabha)

M. B. College of Agriculture Gwalior
Captains & Sports Committee, Gwalior 1958-59

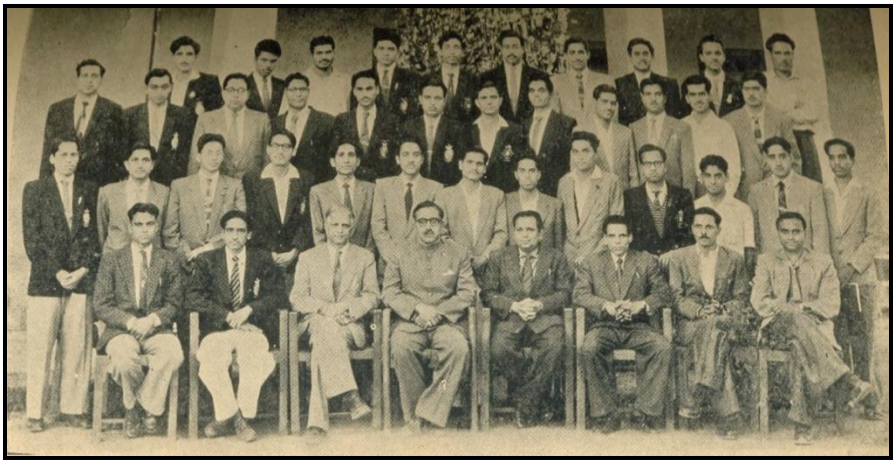


Left to Right :

Sitting – D. S. Ingle (Hockey), Shri R. S. Deshpande (Advisor), Dr. P. S. Lamba, (Principal), Shri P. B. Tembey (Sports Instructor), Shri D. G. Mahadik (Sprorts Secretary)

Standing – Shri K. B. Sharma (Volley-Ball), Shri S. N. Malhotra (Tennis), Shri J. N. Khare (Indoor-games), Shri R. Dravid (Cricket), Saxena (Football), Shri S. S. Tiwari (Athletics), Shri H. S. Thakur (Kabaddi), Shri Y. R. Mehta (Badminton)

Social and Cultural Society, 1959-60 & Participants of the Youth



On Chairs (Left to Right) – Shri Laxman Singh, Shri S. K. Dixit (Secretary), Dr. T. R. Mehta (Ex-Principal), Dr. P. S. Lamba (Patron), Prof. S. K. S. Gaur (Advisor), Shri R. C. Thakur, Shri K. N. Mukerji, Shri M. K. Mishra.

Standing 1st Row (Left to Right) – Shri Gorey, Shri Bhatt, Shri Shahi, Shri Nigam, Shri Tomar, Shri Tiwari, Shri Patidar, Shri Telegaonker, Shri Mahodai, Shri Narsinghpurkar, Shri Kumar, Shri Khazanchi, Shri Mandloi.

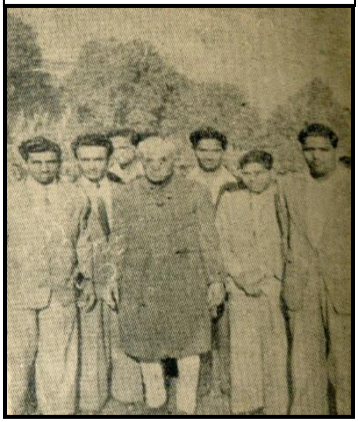
2nd Row – Shri Nagia, Shri Kanungo, Shri Kaul, Shri Mandloi, Shri Jadhav, Shri Sood, Shri Musalgaonker, Shri Sharma, Shri Maheshwari, Shri Khan, Shri Oberoi, Shri Khan.

3rd Row – Shri Ganju, Shri Mahadik, Shri Upadhya, Shri Dhumal, Shri Vyas, Shri Banerji, Shri Mediratta, Shri Julka, Shri Ramanandan, Shri Khare.

V. S. Sabha 1959-60

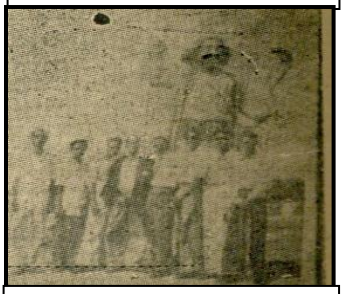
On Chairs (L. to R.) – Shri R. D. S. Bhadoria (Secretary), Shri M. S. Jadhav (Adviser), Shri Dr. P. S. Lamba (Parron), Shri R. A. Gaur (Treasurer), Shri D. M. Chaturvedi.
Standing (L. to R.) – Shri R. K. Saxena, Shri B. L. Sharma, Shri V. K. Saraswat.

Educational Tour



B. Sc. (Ag.) Part II Students with Pt. Nehru in World Agri. Fair, Delhi.

B. Sc. (Ag.) Part II Students in Mysore Garden



B. Sc. (Ag.) Part II Students at Chamundi Hills, Mysore

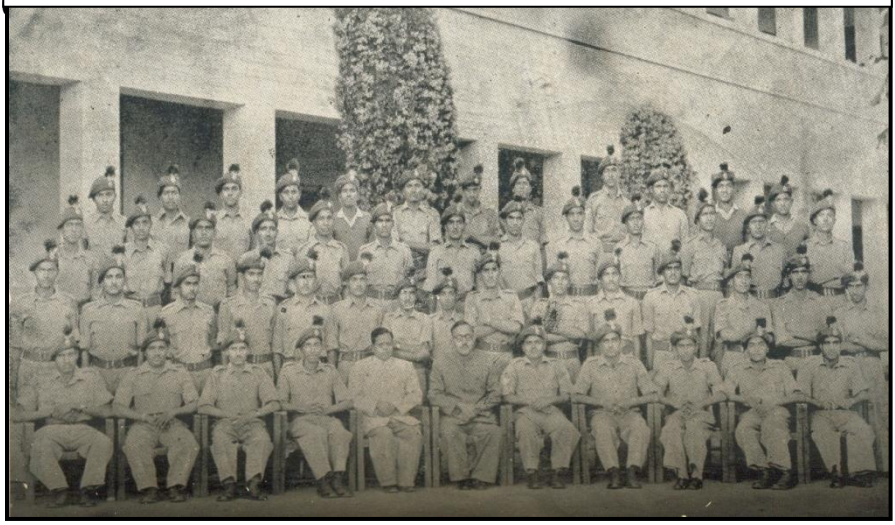
(15) College Magazine

The College has been publishing the College Magazine. The first issue of the College Magazine was published in 1956.The articles;technical in nature, were accepted from students, as well as staff members of College and research sections. The expenditure was met from the Magazine fees and Union funds.

(16) N. C. C.

The College has got an N.C.C. Unit. The cadets received the basic military training with the help of N.C.C. officers and 4 army JCOS. The cultural programme given by the N.C.C. Unit of this College in 1963 Camp was adjudged as the best. One N.C.C. Sergeant has been selected as Air Pilot.

Agriculture College, Gwalior
1st N. C. C. Group (Back from Camp) 1960-61



(17) Co-operative Store

The College has got a Multi-purpose Co-operative Store which provided the day-to-day needs of the staff and students.

(18) The Old Boys Association

The Old Boys Association was started during the year 1963-64.

(19) Office Establishment

Consists of one Head Clerk, one Accountant, one U.D.C. and four L.D.C's.

Staff Position

Year	Prin-cipal	Pro-fessor	Asstt. Pro-fessors	Lectu-rers	Demons-trators	Physical Instruc-tor	Hostal Ward-en	Libra-rian
1950-51	1	1	2	3	4	-	-	-
1951-52	1	1	3	4	6	1	1	1
1952-53	1	2	3	10	4	1	1	1
1953-54	1	3	3	10	4	1	1	1
1954-55	1	4	3	14	4	1	1	1
1955-56	1	4	3	14	4	1	1	1
1956-57	1	4	3	14	4	1	1	1
1957-58	1	4	3	22	5	1	1	1
1958-59	1	4	3	22	5	1	1	1
1959-60	1	4	3	22	5	1	1	1
1960-61	1	5	3	22	6	1	1	1
1961-62	1	5	3	22	4	1	1	1
1962-63	1	6	4	22	2	1	1	1
1963-64	1	6	4	22	2	1	2	1

Starting of Classes/New Classes

S.No.	Year	Classes
1	1950-51	I, II Yr. B. Sc. (Ag)
2	1951-52	III Yr. B. Sc. (Ag)
3	1952-53	IV Yr. B. Sc. (Ag)
4	1957-58	V - Entomology, Agricultural Chemistry and Plant Pathology
5	1958-59	VI - Entomology, Agricultural Chemistry and Plant Pathology
6	1959-60	V - Agricultural Botany and Agronomy
7	1960-61	VI - Agricultural Botany
8	1961-62	V - Extension

Strength of Students

Year	CLASS						Total
	I Year	II Year	III Year	IV Year	V Year	VI Year	
1950-51	51	9	-	-	-	-	60
1951-52	56	46	7	-	-	-	109
1952-53	47	51	27	7	-	-	129
1953-54	57	41	41	19	-	-	158
1954-55	57	58	26	41	-	-	182

1955-56	74	64	43	18	-	-	199
1956-57	84	74	52	34	-	-	244
1957-58	71	77	65	49	10	-	272
1958-59	70	79	78	60	14	8	309
1959-60	71	78	78	55	32	15	329
1960-61	76	69	50	75	33	30	333
1961-62	78	69	59	50	35	31	322
1962-63	80	84	63	51	38	34	358
1963-64	84	64	74	55	34	35	336

Results

Year	CLASS					
	I Year	II Year	III Year	IV Year	V Year	VI Year
1950-51	-	-	-	-	-	-
1951-52	43/47	29/41		-	-	-
1952-53	28/46	35/50	16/26	7/7	-	-
1953-54	46/57	22/41	35/41	18/19		
1954-55	49/57	37/58		34/41	-	-
1955-56	60/74	36/64		15/18	-	-
1956-57	66/84	52/74		29/34	-	-
1957-58	63/71	59/77		42/49	8/10	-
1958-59	43/70	50/79		44/60	13/14	8/8
1959-60	44/71	36/78		53/55	30/32	15/15
1960-61	59/76	46/59	39/50	67/75	31/33	30/30
1961-62	67/78	60/69	55/59	48/50	34/35	30/31
1962-63	71/80	51/84	49/63	48/51	35/38	30/34
1963-64	64/74	64/66		46/55	34/37	34/35

Scholars getting University Positions

S.No.	Name	Year	S.No.	Name	Year
B. Sc. (Ag.)					
1	D.A. Shinde	1953	7	B.D.S. Bhargava	1959
2	Laxman Singh	1954	8	K.C. Mandloi	1960
3	Y.L. Nene	1955	9	B.S. Bhargava	1961
4	O.P. Makhija	1956	10	N.G.G. Nair	1962
5	V.N. Shroff	1957	11	M.L. Bhatt	1963
6	N.S. Sisodia	1958	12	M.N. Jha	1964
M. Sc. (Ag.)					
Agricultural Chemistry			**Plant Pathology**		
1	P.G. Deo	1959	1	R.M. Tripathi	1959

2	S.N. Ganu	1960	2	B.S. Sirdhana	1960
3	G.S. Rathore	1961	3	S.C. Vyas	1961
4	K.N. Bansal	1962	4	Anil Indulkar	1962
5	B.S. Bhargava	1963	5	S.C. Agarwal	1963
6	S.S. Yadav	1964	6	ManoharHaware	1964
Agronomy			**Zoology & Entomology**		
1	B.D.S. Bhargava	1961	1	C.B. Shinde	1959
2	U.K. Yadav	1962	2	N.K. Sood	1960
3	K.S. Mandloi	1963	3	S.M. Vaishampayan	1961
4	S.K. Maheshwari	1964	4	Y.N. Saxena	1962
Botany			5	Suresh Bichoo	1963
1	A.S. Tiwari	1961	6	S.S. Jakhmola	1964
2	K.C. Mandloi	1962	**Extension**		
3	Arvind Dhabolkar	1963	1	A.P. Saxena	1963
4	D.S. Rawat	1964	2	K.P. Govil	1964

Medal Winners

S. No	Name of the Student	Year
Agra University Vice Chancellor Gold Medal		
1	Shri Laxman Singh	1954
2	Shri Y.L. Nene	1955
Vikram University Gold Medal		
B. Sc. (Ag.)		
1	Shri V.N. Shroff	1957
2	Shri N.S. Sisodia	1958
3	Shri B.D.S. Bhargava	1959
4	Shri K.C. Mandloi	1960
5	Shri B.S. Bhargava	1961
M. Sc. (Ag.)		
1	Shri N.K. Sood	1960
2	Shri B.D.S Bhargava	1961
3	Shri U.K. Yadav	1962
4	Shri Arvind Dabholkar	1963
5	Shri S.S. Yadav	1964
Saksaria Medal		
1	Shri D.A. Shinde	1953
2	Shri Laxman Singh	1954
3	Shri Y.L. Nene	1955
4	Shri O.P. Makhija	1956

Foreign Education

S. No.	Name	Year	Under which scheme
Canada			
1	Shri S.P. Pant	1955	
Israel			
2	Shri O.P. Dhama	1955	
United Kingdom			
3	Shri M.L. Purohit	1952	
4	Shri M.P. Singh	1958	
5	Shri O.S. Bindra	1959	
6	Dr. B.P. Singh	1950	Self expenses
United States of America			
7	Shri R.C. Shrivastava	1956	T.C.M.
8	Shri D.P. Motiramani	1958-60	T.C.M.
9	Shri Laxman Singh	1958-59	T.C.M.
10	Shri P.M. Tamboli	1960-62	Rockfeller
11	Shri S.C. Jethmalani	1960-62	Rockfeller
12	Shri V.V. Sharma	1960-62	Rockfeller
13	Shri O.P. Dhama	1959-60	T.C.M.
14	Shri L.K. Joshi	1958	T.C.M.
15	Shri S.K.Singh Gaur	1960-61	T.C.M.
16	Shri H.R. Tyagi	1959-60	T.C.M.
17	Shri G.P. Verma	1960-63	Rockfeller
18	Shri S.S. Solanki	1960-64	Rockfeller
19	Shri D.S. Malik	1960	T.C.M.
20	Shri R. A. Gaur	1961	Rockfeller
21	Shri R.S. Mishra	1962	T.C.M.
22	Shri D.K. Sharma	1956	T.C.M.
		1962-64	Ford Foundation
23	Shri S.P. Dongre	1964	T.C.M.

Dairy & Poultry

Dairy					
Year	**Cows**	**She Buffaloes**	**Calves**	**Bulls**	**Bullocks**
1950-51	-	-	-	-	-
1951-52	2	3	4	-	-
1952-53	24	3	20	1	-

1953-54	15	3	20	1	-
1954-55	15	3	20	1	-
1955-56	11	5	21	1	-
1956-57	13	12	31	2	-
1957-58	11	13	32	2	-
1958-59	11	14	33	2	2
1959-60	12	12	30	2	2
1960-61	13	12	36	2	2
1961-62	11	13	30	2	2
1962-63	13	12	34	2	2
1963-64	12	11	31	2	2
1964-65	14	10	36	2	2

Poultry			
Year	**Cocks**	**Hens**	**Chicks**
1950-51	8	40	-
1951-52	9	50	-
1952-53	9	60	-
1953-54	12	50	-
1954-55	12	50	-
1955-56	12	50	60
1956-57	12	60	-
1957-58	10	44	14
1958-59	16	48	53
1959-60	7	60	19
1960-61	16	66	10
1961-62	-	10	73
1962-63	8	52	-
1963-64	2	17	-
1964-65	-	55	-

Library

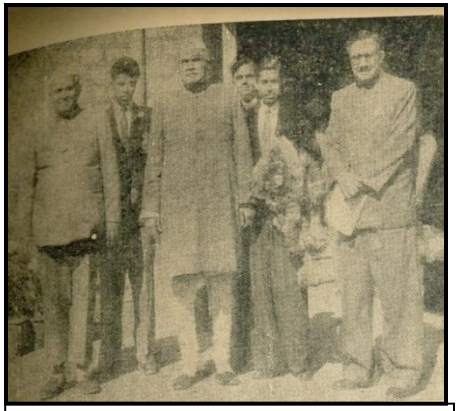
Year	**Books**	**Journals**	**Thesis**
1950-51	-	-	-
1951-52	-	-	-
1952-53	2058	-	-
1953-54	-	-	-
1954-55	1442	30	-
1955-56	951	111	-
1956-57	506	924	-

1957-58	488	212	-
1958-59	565	94	-
1959-60	183	86	-
1960-61	-	-	-
1961-62	481	90	28
1962-63	22	35	28
1963-64	26	44	33

Chief Guests

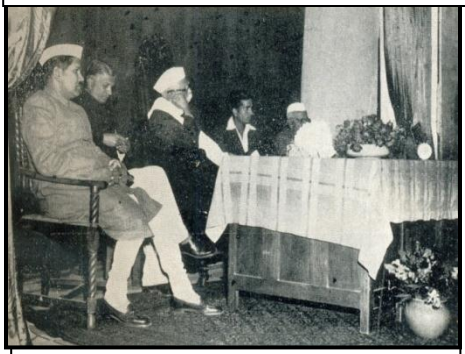
Year	Name
1954-55	Shri M.L. Gangwal, Chief Minister, Madhya Bharat
1955-56	Pandit Ravi Shankar Shukla, Chief Minister, Madhya Pradesh
1956-57	Shri Brijraj Narayan, President, Board of Revenue, Madhya Pradesh
1957-58	Shri L.O. Joshi, Secretary, Agriculture Department, Madhya Pradesh
1958-59	Shri Raghoraj Singh, President, Board of Revenue, Madhya Pradesh
1959-60	Dr. K.N. Katju, Chief Minister, Madhya Pradesh
1960-61	Shri Radhakrishnan, President, Board of Revenue, Madhya Pradesh
1961-62	Dr. K.N. Katju, Chief Minister, Madhya Pradesh
1962-63	Shri V.V. Dravid, Minister for Agriculture, Madhya Pradesh.
1963-64	Shri Arjun Singh, Minister for Agriculture, Madhya Pradesh.

Shri R. A. Kidwai, Food and Agricultural Minister (Central Government), who visited the college in 1954



Hon'ble Dr. Katju, Chief Minister, M. P. and Shri Mandloi, Revenue Minister, M. P. with Principal & Students.

Annual Day Celebration 1955-56



Sitting from Left to Right – Dr. S. D. Sharma, Hon'ble Chief Minister of Bhopal. Dr. T. R. Mehta, Principal & Jt. Director (Research), Pandit Ravi Shankar Shukla, Hon'ble Chief Minister, Madhya Pradesh (Chief Guest), Shri S. N. Parashar, President, Student Union. Shri Takhatmal Jain, Hon'ble Chief Minister, Madhya Bharat

Rai Bahadur K. I. Thadani, The Founder Principal, who came as chief guest on Annual Day celebration of the college in 1956

Student Union

Year	President	Vice-President	General Secretary
1953-54	Principal	-	J.P. Bindal
1954-55	G.N. Chauhan	-	S.N. Parashar
1955-56	S.N. Parashar	K.D. Saxena	S.S. Bhadouria/ J.L. Kaul
1956-57	K.D. Saxena	B.L. Gaur	J.L. Kaul/ K.P. Govil
1957-58	N.S. Sisodia	-	K.P. Govil
1958-59	K.D. Saxena	B.L. Gaur	J.L. Kaul
1959-60	K.N. Sharma	A.K. Tiwari	B.R. Singh
1960-61	S.S. Rathore	R.S. Kushwah	-
1961-62	U.K. Yadav	R.R. Julka	G.P. Singh
1962-63	-	-	-
1963-64	R.D.S. Bhadoria	M.R. Jadhav	T.N. Sharma

1964-65	S.K. Sharma	V.K.S. Kushwah	S.S. Bhadoria

Budget

Year	Budget	Expenditure	Income
1950-51	-	-	-
1951-52	3,57,072	3,34,961	-
1952-53	1,88,845	1,60,810	-
1953-54	2,33,845	2,23,342	-
1954-55	2,30,900	2,28,951	26,611
1955-56	2,42,400	2,15,735	25,295
1956-57	2,96,780	2,45,420	41,925
1957-58	3,92,900	3,77,632	43,923
1958-59	3,76,360	3,66,824	47,937
1959-60	3,01,125	2,91,532	65,871
1960-61	4,82,547	4,83,527	94,702
1961-62	3,61,256	3,51,850	88,664
1962-63	4,83,810	4,69,535	79,952
1963-64	4,03,000	3,97,983	62,630
1964-65	-	-	-

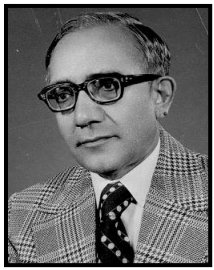
Buildings

S. No.	Year	Name of Building	Amount
1	1956-57	Hostel No. 2	2,06,000
2	1957-58	Class Room & Laboratory	1,35,000
3	1957-58	Logout of Institution and Dairy Farm	30,000
4	1957-58	Dispensary	20,000
5	1958-59	Farm Building	1,00,000
6	1958-59	Library	75,000
7	1961-62	Staff Quarters	1,37,000
8	1962-63	Staff Quarters	39,000

RAK College of Agriculture, Sehore

The foundation of College of Agriculture, Sehore was laid down by the first Food and Agriculture Minister of India, Late Shri Rafi Ahmad Kidwai on August 01, 1952. This college was originally named as Agriculture Institute. At that time, this college was up to intermediate level and was affiliated with Agra University, Agra. OnJuly 17, 1955, Union Minister for Food and Agriculture, Shri Ajit Prasad Jain laid foundation of Rafi Ahmad Kidwai Undergraduate College and Agricultural Research Institute and the college was affiliated with Vikaram University, Ujjain. In the year 1964, after establishment of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, this college became one of the constituent colleges of JNKVV, Jabalpur.

(1) List of Principals of the College with their duration and photograph

S. No.	Principals	Duration		Photograph
		From	To	
1.	Dr. P. S. Lamba	15.07.55	22.12.58	
2.	Dr. R .S. Bhatt	23.12.58	13.07.61	
3.	Dr.M.L.Purohit	14.07.61	30.06.63	
4.	Shri H. P. Dwivedi	01.07.63	06.12.66	

(2) Staff Position

Year	Professor	Associate Professor	Assistant Professor/Lecturer
1955-56	-	-	07
1956-57	-	-	07
1957-58	-	-	07
1958-59	-	-	07
1959-60	03	-	23
1960-61	03	-	23
1961-62	03	-	23
1962-63	03	-	23
1963-64	03	-	23

(3) Number of students admitted in Graduation and Post Graduation programmes and completed their degrees (year wise)

Year	Graduate		Post Graduate	
	Admitted	Completed	Admitted	Completed
1955-56	09(Two Year Course)	-	-	-
1956-57	14	08	08	-
1957-58	22	12	16	08
1958-59	26	19	19	13
1959-60	49(Four Year Course)	22	21	19
1960-61	56	20	26	20
1961-62	45	31	27	26
1962-63	39	51	20	27
1963-64	55	66	16	20

(4) Foreign Education/ Visits of Staff Members

(i) Dr.R.P.Agrawal, Professor Farm Management for higher education at IlliniosUniversity, U.S.A.

(ii) Dr. V.P. Shukla, Professor,Ag.Extension for higher education at Cornell University, U.S.A.

(iii) Dr. U.S. Mishra, Professor, Entomology for higher education at IARI, New Delhi.

(iv) Dr. V.P. Gargav, Lecturer, Entomology for higher education at TashkandUniversity, USSR.

(v) Dr. R.D. Wankhede, Lecturer, for higher education at Illinois University, U.S.A.

(vi) Dr. H.R. Battabar, Lecturer, for higher education at IIT, Kharagpur.

Chief Guests/ Visitors of important programmes in the college

(i) Dr.J.S.Kanwar-Dy. Director General, ICAR.

(ii) Dr.Marshaln, Mc Glammary-Weed specialist.

(iii) Dr. Elwood F. Olber- Chief of party, USAID.

(iv) Dr.Malsura- Agronomy Advisor UPAU.

(v) Dr.Stannard- Entomologist, Illinois.

(vi) Dr. Duane Erickson-Consultant Production Economists.

(vii) Dr.Agr. Theodor Bergmannr- A German Agricultural Economist at the University.

(viii) Mr. O.O.Mowrey- USAID.

(ix) Dr.W.D.Buddeimeir- USAID Advisor.

(x) Dr.Thorne- USAID Advisor.

(5) Outstanding Position/ Assignment of original staff of college

(i) Dr. Sadhuram Sharma, Ex. Sugarcane Agronomist, Sugarcane Commissonar, State of Madhya Pradesh.

(ii) Dr. S.K. Shrivastava, Dean, CoA Sehore- Presently Director of Soybean Research Centre (ICAR) Indore.

(iii) Dr. S.R. Male, M.D. Cynamide India.

(6) Outstanding Scholar of College

Year	B.Sc. (Ag.)	M.Sc. (Ag.)
1957	Mr. Sadhu Ram Sharma	-
1958	Mr. D.N.Vakankar	Mr. D.S.Malik
1959	Mr. S. K. Naidu, Mr. B. S. Ashanani Mr. S. B. Kute	Mr. Sadhu Ram Sharma and Mr. P.C.Netram
1960	Mr. R.N.Saran	-
1961	Mr. S.S.Virmani	Mr. M.M.Husen, Mr. A.K. Bharti and Mr. D.L.Chandrakar
1962	Mr. D.D.Dubey, Mr. A.K.Mishra & Mr. P.K.Agrawal	Mr. O.P.Katiyar and Mr. R.N.Saran

1963	Mr. B.D.Rawat	Mr. S.S.Virmani, Mr. B.K.Jain, Mr. T.B.Singh and Mr. A.B.Abrahim
1964	Mr. A.K.Dhote	Mr. U.K.Koushik, Mr. S.C.Joshi and Mr. M.L.Goyal

(i) Mr. Gajanan Vakankar, Ex. Commerce Advisor.
(ii) Padmashri Dr. Sant Singh Virmani Fellow Scientist of International Institute of Tropical Agriculture.
(iii) Dr.Y.L.Nene, Ex DDG, ICRISAT.
(iv) Shri Mohmad Ajhar Hussain Ex.-Director Agriculture, Govt. of Madhya Pradesh.
(v) Shri G.S.Kaushal, Ex-Director Agriculture, Govt. of Madhya Pradesh.
(vi) Shri Sangram Singh Tomar, Ex-Director Agriculture, Govt. of Madhya Pradesh.
(vii) Dr. Anant Ojha, Ex M.D. Bank of India.
(viii) Shri Dayashankar Gupta, Deputy Commissionar Seeds.

(7) Starting of new courses/ Degree programmes

Year	Starting of new courses/ Degree programmes	
	Graduate	**Post Graduate**
1955-56	Two Year B.Sc. (Ag.) Course	-
1956-57	-	M.Sc. (Ag.) in Botany and Agronomy
1959-60	Four Year B.Sc. (Ag.) Course	-
1960-61	-	M.Sc. (Ag.) in Entomology, Extension Education and Agri. Economics

(8) Library details

Year	Number of Books	Number of Journals	Number of Thesis
1955-56	250	Nil	Nil
1956-57	212	Nil	Nil
1957-58	278	Nil	Nil
1958-59	500	Nil	03
1959-60	354	Nil	10

1960-61	204	Nil	16
1961-62	241	Nil	21
1962-63	299	100	21
1963-64	58	100	18

(9) Student union

Year	Post	Name of student
1955-56	Gen. Secretary	M.C.Bargale
1956-57	Gen. Secretary	Mukut Bihari Khandelwal
1957-58	Gen. Secretary	K.P.Dubey
1958-59	Gen. Secretary	B.B.Gour
1959-60	Gen. Secretary	B.D.Rathi
1960-61	Gen. Secretary	H.G.Kanadey
	Gen. Secretary	K.C.Silakari
1961-62	President	U.K.Uadav
	Vice President	R.Julka
	Gen. Secretary	G.P.Singh
	Social & Cultural secretary	V.S.Raghuwanshi
	Games Secretary	C.L.Ganju
	VSS Secretary	V.S.Kushwaha
	Literary Secretary	G.G.Nair
1962-63	Gen. Secretary	S.K.Sharma
1963-64	Gen. Secretary	N.P.Choudhary

College of Agriculture, Indore

For meeting the needs of Malwa tract with respect to trained agricultural personnel, the College of Agriculture was started in the year 1959 in the Institute of Plant Industry, Indore. The College since then depended; to a large extent, on the buildings, equipments, farm facilities etc. of the Institute.

The College was affiliated to MP Board of Secondary Education for Intermediate Science (in Agriculture) examination. After the completion of two years, the Vikram University granted affiliation for 2 years degree course of B. Sc. (Ag.) in the year 1961.

Four year integrated degree course was introduced by the Vikram University in the year 1962.The College remained affiliated to the Vikram University till September 1964.

A team of teachers drawn from various departments of the college, work in the villages as extension specialists. Each extension specialist adopted at least two cultivators on their fields he laid out demonstration trials based on the modern cultivation practices.

The College farm had an area of 327 acres, out of which 225 acres of land were under cultivation. The farm was partially mechanised and to increase the irrigation facilities six tube-wells weredigged.

The College had a small dairy with 12 buffaloes and 6 cows. Five acres of land were allotted to dairy for producing green fodder.

In the year 1964-65, 71 students were admitted in UG and 12 in PG. Department of Soil Science & Agricultural Chemistry which was established in the year 1963.

(1) List of Principals

S. No.	Principals	Duration		Photograph
		From	To	
1.	Shri H.P. Dwivedi	July 1959	June 1963	
2.	Dr. R.S. Bhatt	June 1963	August 1965	

(2) Staff Positions

Year	Principal/ Assoc. Dean/ Dean	Professors	Associate Professors	Assistant Professors	Demonstrator	Physical Instructor	Hostel Warden	Librarian	Total
1959	1	-	2	31	1	-	-	1	36
1960	1	-	2	31	1	-	-	1	36
1961	1	-	2	31	1	-	-	1	36
1962	1	-	2	31	1	-	-	1	36
1963	1	-	2	31	1	-	-	1	36

(3) Number of students admitted in Graduation and Post Graduation programmes and completed their degrees

Year	B. Sc. (Ag)	
	Admitted	Passed
1959-60	60	-
1960-61	60	-
1961-62	*60*	-

Year	*B. Sc. (Ag)*	
	Admitted	*Passed*
1962-63	*60*	*58*
1963-64	*60*	*57*

(4) Starting of new courses/ degree programmes

Faculty of	Department	Year of starting	Graduate	Post Graduate
Agriculture	-	1959	B. Sc. (Ag)	-
	Soil Science & Ag. Chemistry	1963	-	M. Sc. (Ag) Soil Science

(5) Student Union

Year	Post	Name of student
1962-63	President	B.L. Parikh
1963-64	President	Pratipal Singh

(6) Library Information

Year	Journals	Thesis	SC/ST Books	General books	Book Bank
1959	-	-	-	500	-
1960	-	-	-	200	-
1961	-	-	-	800	-
1962	-	-	-	400	-
1963	-	-	-	425	-

RESEARCH

(1) Agronomical Work (Under Botanical Section)

Bajra

A manurial trial on bajra was conducted at Gwalior during the year 1953-54. The five levels of Nitrogen (0, 10, 20, 30 and 40 lbs N per acre) as main plot treatments and three levels of Phosphorus (0, 20 and 40 lbs P_2O_5 per acre) as sub-plot treatments were tried in split plot design with

4 replications. The S. E. has not been calculated because there were four missing plots. The yield trends however showed that Nitrogen 20 lbs per acre and P_2O_5 at 40 lbs per acre have increased the yield. The combined effect of Nitrogen and Phosphorous (20 lbs N 40 lbs P_2O_5) has also beneficial effect in increasing the yield (ARCA, 1953-54).

Cotton

A varietal-cum-manurial trial was conducted at Jora and Baroda during the year 1960-61. It was observed that 40 lbs N gave an average increase in yield of 26% and 47% at Jora and Baroda, respectively (PMARC, 1961).

A manurial trial on cotton was conducted during the year 1960-61. The following findings were observed:

(i) The application of higher doses i.e. 40 to 60 lbs per acre of Nitrogen proved better than lower doses. The increase in yield being 30% and 40%, respectively over control. Urea proved to be more beneficial as compared to either Amm. Sul./Nitrate.

(ii) The experiment at Khargone revealed that fertilizer when applied at sowing time in full doze (by drilling it behind the seed) was most effective as compared to top dressing at later stages of the crop.

(iii) Cotton did not respond to the application of phosphate fertilizers whether applied alone or in combination with nitrogen. So it shows that Nitrogen alone was effective in increasing cotton yields (PMARC, 1961).

Jowar

A manurial trial on jowar was conducted at Gwalior during the year 1953-54. The five levels of Nitrogen (0, 10, 20, 30 and 40 lbs N per acre) as main plot treatments and three levels of Phosphorus (0, 20 and 40 lbs P_2O_5 per acre) as sub-plot treatments were tried in split plot design with 4 replications. The results are not significant, but the nitrogen @ 20 lbs per acre and P_2O_5 @ 40 lbs per acre has given higher yields.As far as the combined nitrogen phosphate application; nitrogen at 20 and phosphate at 40 per acre, gave the highest yield (ARCA, 1953-54).

Twelve treatments with different doses of Nitrogen and Phosphorous application were tried against no manure as control at

Regional Research Station, Khargone during the year 1953-54. The results indicated that none of the fertiliser treatments was superior to control (No manure). The benefit of fertiliser application can best be seen under irrigated or conditions of good rainfall. It is possible that the full advantages of fertiliser application could not be availed of owing to failure of rain in September when crop was subjected to severe drought (ARCA, 1953-54).

A weed control trial on jowar was conducted at different farms during the year 1959-60. Application of 1 lb. 2, 4-D (Fernoxone) has proved successful in controlling broad leaved and dicot weeds when applied 3 weeks after sowing of crop. The cost of control worked out to be 2.93 N.P. per acre. Cultural method of weeding and post emergence treatment of 2, 4-D was however better than cultural method of weeding alone (PMARC, 1961).

A cultural-cum-manurial trial on jowar was conducted at Gwalior, Khargone and Vidisha during the year 1960-61. The results indicated that 30 lbs N alone gave an average increase in yield of 700 lbs per acre over control at Khargone and Vidisha whereas at Gwalior 30 lbs N and 15 lbs P. gave higher yields i.e. 330 lbs per acre over control. At all places 9 lbs seedrate was found to be the best. Phosphorus did not show any appreciable increase in yield at Gwalior. The response to Potash was also noticed (PMARC, 1961).

A manurial experiment of jowar was conducted at Beora, Khandwa,Khargone and Indore during the year 1960-61. The results indicated that the crop responds to nitrogenous manuring. The application of 22 ½ and 30 lbs N per acre gave abnormally high response (significant) of grain yield at Khandwa and moderate at Beora, whereas at Khargone the manurial treatments were not effective. Application of Phosphate was not responded to by the crop. The residual effect of F.Y.M. applied at the rate of 40 lbs N per acre to previous cotton was visible on grain yield of jowar particularly at Indore. There was no residual effect of N/P and K on jowar applied to previous cotton crop (PMARC, 1961).

A cultural-cum-manurial trial was conducted during the year 1960-61. The results indicated that the treatment of 3′x 1′ spacing and 2 to 3 plant per point with 60 lbs N per acre appeared to be most beneficial (PMARC, 1961).

Gram

A manurial experiment on gram was conducted at Khargone during the year 1960-61. The results indicated that 15 lbs N plus 10 lbs Pgave an increased yield of 157lbs per acre over control. The response due to the application of Phosphorus was also noticed (PMARC, 1961).

Groundnut

Nine varieties of groundnut were experimented at the Regional Research Station, Khargone during the year 1953-54. The yields for different varieties are given below :

Table 3 : Yields of different varieties of Groundnut.

Variety	Yields in maunds* per acre.	Variety	Yields in maunds* per acre.
Spanish pea nut	13.05	Ex. 7	9.00
Spandush-5	8.50	T. M. V. 2	11.35
Ex. 1	11.40	A. H. 218	12.65
Ex. 4	9.52	A. K. 12-24 (control)	6.84
Ex. 5	14.07		

The varieties Ex. 5, Spanish pea nut and A. H. 218 have given yields twice that of control (ARCA, 1953-54).

A cultural-cum-manurial trial on groundnut was conducted at Khargone during the year 1960-61. The results indicated that 80 lbs seedrate was significantly superior to 60 lbs and 100 lbs levels. The increase in yield being 167 lbs and 219 lbs per acre, respectively. The combination of 10 lbs N plus 20 lbs P and 10 lbs N plus 10 lbs P. gave higher yield than control but are at par among themselves. The increase in yield being 224 lbs and 176 lbs per acre, respectively(PMARC, 1961).

A varietal-cum-manurial trial on groundnut was conducted at Bhind and Baroda during the year 1960-61. The combination of N plus P (20 maunds* N plus 10 maunds* P) showed an increase in yield of 19 % and 86 % over control and among variety A.K. 12-24 and Gangapuri gave highest yield at Bhind and Baroda, respectively (PMARC, 1961).

*1 Maund = 37.324 kg

A manurial trial on groundnut was conducted at Khandwa, Khargone, Indore and Jhabua during the year 1960-61. The response to the application of P was noticed at Khandwa whereas no response was found at Khargone, Indore and Jhabua. Similarly this crop also did not respond to the application of N except at Indore and Jhabua (PMARC, 1961).

Maize

A manurial experiment on maize was conducted at Jhabua during the year 1960-61 to find out optimum dose of Nitrogen, Phosphorus and Potash. The results indicated that the best combination for maize was 40 lbs N plus 40 lbs P, which gave an increased yield of 1037 lbs per acre over control. The next in order being 40 lbs N plus 20 lbs P (PMARC, 1961).

An experiment was conducted during the year 1960-61 to find out the effect of Phosphorus on green fodder yield of berseem and its residual effect on maize. On the basis of this experiment, it was concluded that 50 lbs P_2O_5 per acre consistently gave higher yield both in respect of green fodder of berseem and maize than other treatments (PMARC, 1961).

Paddy

An experiment was conducted at the Harsi Experimental Farm, Bagwai during the year 1949-50 to find out the most economic method of sowing of paddy which may give the highest yield. The experiment was tried in 2 series. The variable factors of treatments were :

(i) The distance from point to point of planting.
(ii) The number of seedlings at a point.
(iii) Method of planting (broadcasting and transplanting)

The following treatments were tried:

(i) Distance 6″ seedlings per point 3
(ii) Distance 6″ seedlings per point 4
(iii) Distance 6″ seedlings per point 5
(iv) Distance 6″ seedlings per point 6
(v) Distance 9″ seedlings per point 3
(vi) Distance 9″ seedlings per point 4
(vii) Distance 9″ seedlings per point 5
(viii) Distance 9″ seedlings per point 6
(ix) Distance 12″ seedlings per point 3
(x) Distance 12″ seedlings per point 4
(xi) Distance 12″ seedlings per point 5
(xii) Distance 12″ seedlings per point 6
(xiii) Broadcasting at the rate of 30 seers* seed-rate.
(xiv) Broadcasting at the rate of 40 seers* seed-rate.

*1 Seer = 0.9331 kg

The results obtained show that the distance of 6″ between rows and planting of 4 seedlings per point gave the highest yield. The second best treatment in respect of yield was the method of planting at 9″ distance and 3 to 4 seedlings per point. The planting of paddy at a distance of 6″ to 9″ and putting of 3 to 4 seedlings at a point was recommended for obtaining good yields.

A trial at Regional Research Station, Bhilsa was therefore started during the year 1953-54 with a view to determine the type of fertiliser or combination of fertilisers and the proper dosages best suited for this tract. Nitrogen was given in the form of Ammonium Sulphate and Phosphorous as Super Phosphate. On the basis of results obtained, the following conclusions were drawn –

(i) No fertiliser treatment was significantly inferior to each of the fertiliser treatments.

(ii) N 40 lbs per acre P 30 lbs per acre was significantly superior over N 20 lbs per acre.

(iii) The Economics of fertiliser application reveal that Nitrogen application at 20 lbs per acre and 40 lbs per acre doses yield an additional profit of Rs. 64 and Rs. 73 per acre, respectively as compared to control.

(iv) The Nitrogen plus phosphate application yielded less additional profit than Nitrogen alone (ARCA, 1953-54).

A weed control trial on paddy was conducted at different farms during the year 1959-60. Application of 1 lbs 2, 4-D (Fernoxone) has proved successful in controlling broad leaved and dicot weeds when applied 3 weeks after sowing of crop. Cultural method of weeding and post emergence treatment of 2, 4-D was however better than cultural method of weeding alone (PMARC, 1961).

A varietal-cum-manurial experiment was conducted at Bhind, Baroda and Jora during the year 1960-61. At Jora Farm, 20 lbs N plus 20 lbs P has given more yield i.e. 26% over 40 lbs N and 40 lbs P. While at Bhind the reverse was noticed. The increase in yield being43%. At both places the combination gave increased yield over control. Among varieties, Jhora 349 and N.P. 130 gave the higher yield at Bhind and Baroda, respectively (PMARC, 1961).

Peas

A varietal-cum-manurial experiment was conducted at Baroda and Jora during the year 1960-61. On the basis of results of this experiment, the following conclusions were drawn –

(i) 15 lbs N plus 30 lbs P_2O_5 gave 93% increased yield over no fertilizer, however, with 30 lbs P_2O_5 the increase being 52% only was observed at Baroda.

(ii) No response of Phosphorus or in combination with Nitrogen was observed at Jora (PMARC, 1961)

Sugarcane

Chronology of Sugarcane Research in Madhya Pradesh :

1952 : Establishment of Sugarcane Research Stations at Dabra and Sehore under Indian Central Sugarcane Council.

1959 : Commencement of a scheme on Sugarcane pests at Gwalior.

1961 : Integration and reorientation of all the existing research schemes in Madhya Pradesh and subsequent establishment of Main Sugarcane Research Station (M. S. R. S.) at Sehore and its two substations at Bagwai and Jaora under Directorate of Agriculture, Govt. of M. P.

1964 : With the formation of Jawaharlal Nehru Agricultural University, all the Sugarcane Research Stations were taken over by the University.

Earlier Sugarcane Research Station was situated at RAK College of Agriculture, Sehore. Since its inception (1961) due to the acute shortage of water it has been shifted from Sehore to Zonal Agricultural Research Station Powarkheda w.e.f. 2002.

A manurial trial was conducted on sugarcane at the Harsi Experimental Farm, Bagwai during the year 1949-50 to find out which of the organic and inorganic manures and their mixtures are best suited to the Sugarcane crop under local conditions. The treatments given were :

(i) Farm-yard Manure	@ 120 lbs N. per acre.
(ii) Ammonium Sulphate	@ 120 lbs N. per acre.
(iii) G.N. Cake	@ 120 lbs N. per acre.
(iv) Ammonium Sulphate + F.Y.M.	60 lbs N + 60 lbs N. = 120 lbs N.
(v) F.Y.M. + G.N. Cake.	60 lbs N + 60 lbs N. = 120 lbs N.
(vi) No manure	Control

The experiment was tried in 2 series. The variety of cane was Co 312 in the first, while in the 2nd series the seed was Co 421 in case of Ammonium Sulphate plus F.Y.M.

Application of Ammonium Sulphate alone as top dressing has given the highest yield, next comes the application of Ammonium Sulphate. The variety Co 421 is superior in point of yield as compared with Co 312 (ARDA, 1949-50).

A manurial trial was conducted at Sehore during the year 1959-60. The results indicated that 400 lbs Nwith a basal dressing of 10,000 lbscompost plus 75 lbs P_2O_5 per acre gave better yields over 200 lbs N and control with respective yields of 1,006, 876 and 904 maunds* of cane per acre. The application of P_2O_5 gave very little response whereas K_2O did not give any response.

In an inter-cropping experiment conducted on different farms during 1959-60, sugarcane and onion gave more economic returns than other treatment combinations and alone. The yields being 583 maunds* per acre sugarcane plus 225 maunds* per acre onion against 627 maunds* per acre sugarcane alone treatment (PMARC, 1961).

In Madhya Pradesh nitrogenous manuring has been found essential for obtaining good yields of sugarcane. The recommended practice is to apply a basal dressing of 1400 lbs of oil cakes followed by an equivalent amount as top dressing amounting to a total nitrogen dressing of about 150 lbs per acre. Better results have, however, been obtained with a top dressing of ammonium sulphate. In the lighter soils cattle dung or green manure has proved more effective as a basal dressing.

It is customary to apply 40 lbs of P_2O_5 per acre in the form of superphosphate at the time of planting. At Dabra, however, different levels of P_2O_5 applied did not differ in yield significanltly.

At the same station application of more than 120 lbs nitrogen per acre reduced the qulilty of juice while application of 60 lbs P_2O_5 per acre slighltly increased. However no beneficial effect of P_2O_5 was noted when the level of P_2O_5 increased from 60 lbs to 120 lbs per acre. In trials at Sehore, bonemeal and superphosphate did not vary much as carriers of phosphate. Even though doses of P_2O_5 were also insignificantly different higher doses of P_2O_5 gave better yields than control.

At the latter station in an attempt to determine suitable ratio of organic nitrogen from basal compost and inorganic nitrogen from ammonium sulphate the ratio 1:3 recorded significantly higher cane yield over other ratios. Juice quality was also superior as a result of the above ratio.

The following is the fertilizer recommendation in the province (as suggested by Department of Agriculture).

Nitrogen	150 lbs
P_2O_5	100 lbs (Single Super Phosphate 600 lbs)

As regards to the method of fertilizer application apply half the amount of superphosphate before planting cane. The rest of the ammonium sulphate and superphosphate should be applied at the time of earthing in June(Bhargava, 1960-61).

In M. P., use of 12,000 three budded setts per acre planted end to end has been found to give best results. In case of poor germination, a higher seedrate about 1½ times of the normal has been recommended.

In M. P., at Dabra planting during the second fortnight of February gave better results than plantings of March and April. In the crops sown in late April the decrease in yield was found to be more than 50 % in comparison to the February sown crop but there was practically very little difference in sucrose per cent juice and purity coefficient. At Sehore Adsali planted crop in August proved the best in cane yield. This along with planting in November were significantly superior to seasonally planted canes in January. Good quality of juice was obtained early in the season from Adsali crop. However, borer attack was on increased level in the planting done in August and January.

In M. P., at Dabra the results of the spacing experiments with reference to fertility of soil indicated that at no nitrogen level yield decreased with increased spacing (1½′, 2½′ and 3½′) between rows where as with a slightly higher level (60 lbs nitrogen plus 60 lbs P_2O_5) of manuring the yields increased with increased spacing. This gave the highest yield and C. C. S. per acre.

This has led to the recommendation that under the average manuring rate at 60 lbs of nitrogen and 60 lbs of P_2O_5 a spacing of 2½′ is desirable.

At Sehore in an experiment on different row spacings 2′ spacing gave only fractionally better yield than 3′ spacing. Both were significantly superior to 4′ spacing. It was observed that though weight per cane is increased with wider spacing it sufferd from much less number of millable canes at harvest (Bhargava, 1960-61).

Wheat

An experiment on 4 dates of sowing (October 15, October 22, October 29 and November 5, 1948) with 2 varieties Banda Sharbati and G-15 of wheat (dry) was conducted at the Central Experimental Farm, Gwalior during the year 1949-50. The results indicated that both the varieties gave highest yields when sowings done on 5 November 1948. Rust did not appear during 1949-50, therefore, no conclusion can be drawn.

A trial on 4 dates of sowing (October 20, 1948; October 27, 1948; November 3, 1948 and November 7, 1948) with 2 varieties (Pbc-518 and Pipandi White) was conducted on wheat under irrigation to observe the effect of rust. Both the varieties gave slightly higher yield in their sowings on October 27, 1948. Rust did not appear during 1949-50 and hence no conclusion can be drawn regarding the effect of rust (ARDA, 1949-50).

In an experiment conducted at Gwalior during the year 1953-54, different seed rates of sann hemp were compared against no manure. A dressing of 40 lbs P_2O_5 was given in strips and compared against control. The effect of green manuring on wheat was observed. The results show that green manuring with sann hemp gave significantly higher yield over control. There is, however, no significant difference between seed-rates. The effect of P_2O_5 is also not significant (ARCA, 1953-54).

The effect of green manuring of sann hemp, soybean, guar, mung and urid on yield of wheat was compared in a replicated experiment conducted at Gwalior during the year 1953-54. The results did not show any significant difference (ARCA, 1953-54).

Six spacings (3″ x 9″, 6″ x 9″, 9″ x 9″, 3″ x 12″, 6″ x 12″ and 9″ x 12″) were tried in a replicated trial at Gwalior during the year 1953-54. One seed of wheat (Variety N. P. 710) was dibbled at each point. The yield differences between different spacing were not significant, however, 3″ x 9″ spacing gave highest yield (ARCA, 1953-54).

Wheat was sown with the hand dibbler received from the Director of Agriculture, Uttar Pradesh in 3-tenth of an acre plots at Gwalior during the year 1953-54. Spacing between plants and rows was 9″ and one seed was dibbled in each hole. This method was compared with the normal practice of drilling wheat at 1 maunds* per acre on 3-tenth of an acre plots. The results showed that dibbling has given poorer yield than the usual drilling method (ARCA, 1953-54).

Trial with Bone meal : Three doses of Bonemeal 40 lbs, 80 lbs and 120 lbs P_2O_5 along with no bonemeal were tried on irrigated wheat in randomised plot design at Experimental Farm, Gwalior during the year 1953-54. The results were not statistically significant. This fertiliser did not supply readily available phosphorous but its effect was likely to be seen on subsequent crops(ARCA, 1953-54).

Spacing and seed rate trial : This experiment was conducted in "Split plot design" with spacings as main plots and seed rate as sub-plots at Experimental Farm, Gwalior during the year 1953-54. The results for both main plots and sub-plots were statistically not significant(ARCA, Gwalior, 1953-54).

Manurial trial : Different doses of phosphate and Nitrogen were tried in a split plot design with 4 replications at Experimental Farm, Gwalior 1953-54.

Treatments :

Main Plots :(P) Doses of Phosphorous	(A) 0 lbs P_2O_5 per acre. (B) 30 lbs P_2O_5 per acre. (C) 60 lbs P_2O_5 per acre.
Sub-plot I :	
(Aa) Time of application of nitrogen	(M)Ammoniumsulphate applied at time of irrigation.
	(N) Ammonium sulphate half dose at 1st irrigation and remaining at flowering.
Sub-plot II :	
(Ad) Levels of nitrogen	(1) 0 lbs N per acre.

(2) 20 lbs N per acre.
(3) 40 lbs N per acre.
(4) 60 lbs N per acre.
(5) 80 lbs N per acre.

On the basis of results obtained, the following conclusions were drawn –

(i) Main effects viz., doses of Phosphorus and the sub-plot effects viz., time of application of nitrogen, both were not significant.
(ii) Interaction P x Aa i.e., doses of phosphorus x time of application of nitrogen was not significant.
(iii) The sub-plot effect viz., doses of nitrogen was highly significant, the most promising among them were 40 lbs and 60 lbs of nitrogen per acre.
(iv) The interaction Ad x P was highly significant but the results indicated that B and C., were not significant over control in presence of nitrogen.
(v) The interaction Ad x Aa, i.e., level of nitrogen and time of application of nitrogen was highly significant. The results indicated that with 40 lbs and 60 lbs of nitrogen, the effect M, i.e., application of nitrogen at time of irrigation was significant than N i.e., the application of nitrogen in two doses (ARCA, 1953-54).

A munurial-cum-cultural experiment on wheat was conducted under irrigated and unirrigated conditions at Vidisha, Dewas and Ujjain during the year 1959-60. Under irrigated conditions, higher seedrate i.e. 100 lbs per acre has given higher yields at Vidisha and Dewas whereas at Ujjain the differences in yield due to seedrate were not noticed. At all places 40 lbs N and 40 lbs P gave the highest yield. The average increase being 51% over control. Under unirrigated conditions, there was practically no differences in yields due to different seed rates. Lower seed rate i.e. 60 lbs per acre would be adopted for unirrigated lands. The average increase in yield over control obtained by an application of 20 lbs N plus 20 lbs P and 10 lbs N plus 10 lbs P was 229 lbs and 152 lbs per acre, respectively (PMARC, 1961).

A weed control trial on wheat was conducted at different farms during the year 1959-60. The application of Dicotax @ 8 oz. per acre applied after 4 weeks of sowing could effectively control the three weeds

i.e. *Convolvulus arvensis, Launea pinnitifoda* and *Euphorbia sp. Saccharum spontaneum,* however, remained unaffected in all the weedicidal treatments. Cultural method had a temporary effect on the control of weeds (PMARC, 1961).

A manurial experiment on wheat was conducted at Gwalior and Vidisha during the year 1960-61. The results indicated that 40 lbs N plus 40 lbs P gave the highest yield at Vidisha and Gwalior next followed by 40 lbs N plus 20 lbs P. No manure gave the least yield 828 lbs per acre Split dose of N was found superior to single dose (PMARC, 1961).

Atrial on green manuring followed by wheat was conducted at Gwalior during the year 1960-61. All others form of green manure except Dhaincha were found superior to control i.e. fallow. The increase in yield of wheat was 173, 44 and 22 lbs per acre, respectively with Sann, Lobia and Jowar (PMARC, 1961).

A varietal-cum-manurial trial was conducted at Baroda during the year 1960-61. The following conclusions were drawn on the basis of this experiment :

(i) Hy. 65 was found to be highest yielding variety (417 lbs per acre).
(ii) Highest yields were obtained with an application of 20 lbs N/acre; the increase being 26% over control.
(iii) 16 and 27% increase was obtained with an application of 20 and 40 lbs P_2O_5 respectively. Lodging was a problem but C 273 was found to be resistant (PMARC, 1961).

A cultural experiment on Wheat was conducted at Baroda during the year 1960-61. On the basis of this experiment, the following conclusions were drawn :

(i) Optimum date of sowing at Baroda was found to be 8th November followed by 1st November and 25th October.
(ii) Higher seedrate gave better yields i.e. 90 lbs seedrate found to be the best.
(iii) 9″ spacing was better than 12″ spacing (PMARC, 1961).

Fodder Crops / Grasses and Legumes

Five grasses viz. *Sorghum sadanensis, Chloris gayana, Panicum maximum, Tricolena rosea* and*Panicum antidotale* were sown in seed beds on 10-8-53 at Gwalior. They were transplanted giving them 2′ x 1′ spacings in small observation plots 4′ x 30′. The growth of all the five

grasses was satisfactory. The spring growth was also satisfactory.*Panicium antidotale* (Blue Panicum) may proved useful for pasture land.

Trial of grasses and legumes : Twenty two grasses and twenty one legumes received from the Head of the Division of Agronomy, I. A. R. I., New Delhi were grown in Rabi season at Gwalior during the year 1953-54. The preliminary observation indicated that *Phalaris ganariensis, Phalaris minor* and *Secale creal* amongst Grasses and *Melilotus alba, Lathyrus sativus* and *Trigonella foenum* among Legumes gave satisfactory yield.

Trial of *Astragalus sinensis* : Seeds received through I. C. A. R. from Japan and China were sown in November, 1953 at Gwalior. The germination was good. Growth was very poor in spite of giving regular irrigations. The plants also failed to flower.

Glyricidia maculata : The seeds received from the Director of Agriculture Madras State were germinated in pots and were transplanted in the field at Gwalior during the month of August, 1953. The plants made luxuriant vegetative growth and proved very promising for green manuring.

Sesbania speciosa : This was also received from Madras State and were germinated in pots and the plants were transplanted in August, 1953 in the field at Gwalior. The growth of the plants was vigorous with profuse flowering and seed formation (ARCA, 1953-54).

Summary of the experiments conducted during 1959-60 on different farms is as follows :

Varietal : Among the annual grasses B.G. 81 (*Sorgham purpurico cricious*) and N.G. 107 (*Lapogan elegans*) gave the best yields i.e. 31,080 and 8392 lbs per acre on well drained and water logged soils, respectively.

Among perennials *Tricholania rozea* (drought resistant) yield 10,800 lbs per acre and *Dicanthium caricesum* (yield 27,855 lbs per acre) out yielded all other types.

Under limited irrigation facilities available *Melilotaus alba* (yield 15,210 lbs of green fodder per acre) had out yielded all other rabi irrigated leguminous fodders including Berseem and Lucerne.

Manurial : Inorganic forms of Nitrogen showed better response than the organic one for annual and perennial fodders, giving an increase in yield nearly 2 to 2 ½ times, respectively.

As regards different forms of inorganic N fertilizer, urea appeared better than others for annual type, while all other types behavedsimilarly for perennial. There was no response of P alone.

Mixed Cropping: During Kharif and Rabi seasons, mixed cropping of non-leguminous fodder with leguminous fodder gave more yield than single cropping.

Double Cropping (Kharif) : Cowpea with maize gave the best yield of 7,449 lbs per acre of green fodder, also growing cowpea with jowar gave 6,670 lbs of green fodder per acre plus 2,971 lbs of jowar as against 2,878 lbs of jowar alone(PMARC, 1961).

The work done at Bhopal under Fodder Research Scheme during the year 1960-61 consisted of manurial trials, mixed cropping and leguminous and non-leguminous fodders, etc. Among Kharif legumes *Phaseolus calcaralus* No. 3 proved best giving a yield of 15120 per acre. Among Rabi irrigated leguminous fodders, Matri (*Pisum sativum*) was the best. In a manurial trial, inorganic fertilizers and nitrogen gave the best results. It was seen that a combination of G. 73 (*P. pedicellatum*) with *Mueuna chochinchinensis* gave the best yield in mixed cropping of leguminous fodders and non-leguminous fodders(PMARC, 1961).

Mixed Cropping Experiments

Some mixed cropping experiments were conducted both at Gwalior and Ujjain centres during the year 1949-50, to study the economics of mixed cropping practices in vogue in Madhya Bharat.

Mixed cropping experiments were conducted in the Rabi season on wheat plus gram plus rape plus barley. The results were non-significant except in til plus urid at Gwalior in which a mixture of 85% of til plus 15% of urid gave highest monitory return.

In mixed cropping experiment of wheat plus gram plus linseed, a pure crop of linseed gave highest monitory returns. This was due to high market prices of linseed.

An experiment on mixed cropping was conducted at the Central Experimental Farms, Gwalior and Bhilsa during the year 1949-50 to study the effect of randomized sowing of Kharif crops with the main crop of Jowar and also to study the effects of drilling versus broadcasting on the general yield. The following treatments were tried –

(i) Jowar (Drill Sowing) Sown Singly

(ii) Jowar (Broadcast) Sown Singly

(iii) Jowar, Arhar and Mung (Drilled) Mixed together and sown.

(iv) Jowar, Arhar and Mung (Broadcast) Sown mixed

(v) Jowar and Mung mixed together and Arhar sown in separate rows. Three rows of the mixture and three rows of Arhar alone (Drilled).

Jowar, arhar and moong mixed together and drilled gave the highest yield at Gwalior.

Jowar, arhar and moong mixed together and broadcasted gave the highest yield at Bhilsa.

An experiment on cross sowing of wheat and gram in the same field with full seed rate was conducted at the Central Experimental Farm, Gwalior during the year 1949-50 to study the economics of this method of sowing. On the basis of results of this experiment, it was concluded that cross sowing of wheat and gram in same field with full seed rate of both was more profitable than wheat or gram sown singly (ARDA, 1949-50).

Mixed cropping experiment with jowar, arhar and moong was conducted at Gwalior during the year 1951-52. Varying proportions of these three crops in different mixtures were grown in this experiment. Pure jowar was taken as control. In all there were 6 treatments including control. The yields of each plot were converted in money value for the purpose of calculation. The proportion of 96 of jowar, one of arhar and 3 of moong recorded highest monetary return of Rs. 67 per acre. However, the results were not significant. The similar experiment was also conducted at Ujjain. However, the results were not significant. (ARDA, 1951-52)

Mixed cropping experiment with jowar and arhar was conducted at Gwalior during the year 1953-54. Mixtures with different proportions of jowar and arhar were grown and compared against pure crop of jowar & arhar (Table 4).

Table 4: Yields and monetary returns of mixed cropping of jowar and arhar.

Treatments	**Yield in lbs* per acre**		**Monetary returns in Rs. per acre**
	Jowar	**Arhar**	
Jowar sown pure at 6 lbs per acre	403	-	46.6

Arhar sown pure at 16 lbs per acre	-	524	82.9
Jowar-Arhar 80-20	343	91	54.1
Jowar-Arhar 60-40	320	182	65.7
Jowar-Arhar 40-60	219	234	62.5
Jowar-Arhar 20-80	179	297	67.8
S. E.			9.58
C. D.			20.41

*1. Ibs = 459.24 grams

The results show that arhar grown pure gave the highest monetary returns followed by jowar sown mixed with arhar in the proportion of 20 to 80 than a single crop of jowar(ARCA, 1953-54).

Improved Cultural Practices of the Principal Crops of Gwalior Region

Shri S. S. Pathak, Agronomist, Agricultural Research Institute, Gwalior read a detailed paper on "Improved cultural practices of the principal crops of the tract" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from April 03 to 08, 1959. The summary of the paper is given in Appendix – I. He also gave another talk on "The Results achieved in Agronomical Trials on Farms of M. B. Region". The summary of his talk is given in Appendix II. The first presentation includes wheat, cotton, sugarcane, paddy, jowar and groundnut. The second presents the summary of results achieved at Gwalior (wheat and jowar), Indore (cotton, wheat, groundnut, jowar, paddy and sugarcane), Ujjain (jowar, cotton groundnut and wheat), Khargone (jowar, groundnut and cotton), Mahagarh (Jowar, groundnut and cotton) and Jhabua (maize and groundnut).

Response of Crops to Phosphate Fertilizers

It is generally believed that response to phosphate fertilizers is lower than that to nitrogen. This may be true to a certain extent. But the usefulness of phosphate fertilizers should not be evaluated on the basis of one year only since phosphate fertilizers leave a pronounced residual effect while nitrogen fertilizers leave little residual effect. Only a fraction ranging from 10-40 per cent of phosphate applied may be expected to be used in one year.

The continuous use of nitrogen fertilizers have created a greater need for phosphate fertilizers due to increased withdrawal of nutrients

from soil. The actual response in some of experiments conducted in M. P. is given below (Table 5 & 6)

Table 5 : Response of paddy to different levels of phosphate.

(Yields and response expressed in maunds* per acre)

Centre	Region	Year	Yield without phosphate	Response to phosphate ($P_2 0_5$)	
				20 lbs	40 lbs
Bagwai	Gwalior	1954-55	18.19	4.64	6.42
		1955-66	19.17	5.91	8.64

Table 6 : Response of Jowar to different levels of phosphate.

(Yield and response expressed in maunds* per acre)

Centre	Year	Average yield without phosphate	Response to phosphate ($P_2 0_5$)	
			20 lbs	40 lbs
Ujjain	1956-57	16.2	1.1	1.1
	1957-58	10.1	2.1	2.3
	1958-59	5.3	3.1	2.7

Response of paddy and jowar to 20 lbs P_2O_5 (20 lbs superphosphate) is about 20% over no phosphate plots. In all these fertilizer experiments, the average response to phosphate is calculated as an average of all treatments including nitrogen treated plots. If response is calculated over no manure plots, response would be large indeed (Motiramani, 1964-65).

Economics of Fertilizer application

The combined application of nitrogen and phosphate fertilizers has been beneficial in almost all experiments on wheat and paddy conducted at Vidisha, Bagwai, Gwalior, Indore etc. At Bagwai Centre response of paddy to phosphate was greater than to nitrogen. The economics of fertilizer application is shown as below (Table-7).

*1 maund = 37 sear

Table-7: Economics of Fertilizer use at Bagwai.

(Response were average of 4 years 1957-1960, crop-paddy)

S. No.	Treatment	Expenditure cost of Fertilizer	Yield response over no fertilizer *md/acre	Gross from increased yield Rs.	Net profit (Rs.)
1	30 lbs N as ammonium sulphate	25	4.39	52.70	27.7
2	60 lbs N as ammonium sulphate	50	5.19	62.30	12.3
3	30 lbs P_2O_5 as superphosphate	16	5.07	60.8	44.8
4	60 lbs P_2O_5 as superphosphate	32	5.80	61.00	29.0
5	60 lbs N + 30 lbs P_2O_5	66	13.14	157.7	91.7
6	60 lbs N + 60 lbs P_2O_5	82	14.78	177.4	95.4

Price of Paddy Rs. 12 / per md *1 md = 37.32kg

Cost of N Rs. 0.81 / per lb N

Cost of P_2O_5 Rs. 0.54 / per lb P_2O_5

60 lbs nitrogen gave less net profit than 30 lbs nitrogen. Similarly 60 lbs P_2O_5 gave less net profit than 30 lbs P_2O_5, but combined application of nitrogen and phosphate was not only essential for higher yields but gave larger profits. Phosphate response would be larger where only nitrogen fertilizers have been continuously used (Motiramani, 1964-65).

(2) Botanical Section

Crop research work was done at various research centres on major staple crops of the area with a view to evolve suitable high yielding varieties of improved seeds of various staple crops.

Arhar

A number of early and late strains of arhar were tested at Gwalior and Ujjain during the year 1949-50. At Gwalior, early Ambah 3 and late

Bijaipur 7 recorded 14 and 14.2 maunds* per acre, respectively. At Ujjain, early arhar Shivpuri 6 and late arhar Broach 1, recorded 10 and 6.3 maunds* per acre, respectively (ARDA, 1949-50).

During the year 1951-52, at Gwalior, out of the 10 strains of arhar tried along with local as control, Ambah No. 3 has given numerically higher yield of 571 lbs per acre. The yields of arhar were low because of shedding of grains from ripe dry pods due to hail-storm on 1st March. The results were however not significant. At Ujjain, 8 strains with local as control were tried. The differences in yield were significant and the variety C. Farm Ujjain gave the highest outturn of 463 lbs per acre (ARDA, 1951-52).

A varietal trial of 8 new selections and 3 controls, viz. E.B. 38, Ujjain 7 and I.P.I. 5 was conducted at Khargone during the year 1960-61. It was observed that Khargone 2 and other 4 selections were superior to controls in yield and other attributes. In other minor yield trials, a large number of promising selections were good and they would be further tested. A large scale hybridisation work between local strain, Khargone 2 and other type was carried out and hybrid seed obtained.(PMARC, 1961).

Bajra

Out of 5 strains under trial at Gwalior during the year 1949-50, strain Nos. Baroda 5, and 5-6-2 gave the out-turn of 3 maunds* 15 seers* and 3 maunds* 5 seers* per acre, respectively (ARDA, 1949-50).

Baroda-5, a variety evolved earlier, was grown at Gwalior for maintaining seed(PMARC, 1961).

Cotton

A varietal trial on Cotton was conducted at the Mahagarh Agricultural Farm, during the year 1949-50. The results indicated that variety Bhoj gave the highest yield followed by M. 9 and Pratap varieties(ARDA, 1949-50).

During the year 1951-52, selections in Malvi cottons at the Ujjain Farm resulted in the evolution of three promising progenies viz. Nos. 86, 16-5 and 7. As experimental work at Ujjain Farm has been stopped the promising material on hand was transferred to Institute of Plant Industry, Indore for further work (ARDA, 1951-52).

As a result of research work conducted at Indore, Gwalior and Ujjain during the year 1959 , the following improved strains of cotton for different regions have been evolved.

Malwa – *Deshi* – *Malvi* 9 and *Bhoj*.
American – Indore-2.

Nimar East – *Deshi* – H-420.
American – Buri-0394.

Nimar West – *Deshi* – *Maljari.*
American – A-51-9 (PRWC, 1959).

Work on cotton in the State during 1960-61 was carried out under the following schemes of the Indian Central Cotton Committee on the lines of programme approved by them, the details of which are as under –

(i) Scheme for improvement of desi cotton in Malwa :

It aimed to evolve a *desi* cotton strains for Malwa having a yielding capacity of local *Malvi*, ginning percentage of 36 and a spinning of 24^{th}. The scheme was started during the year 1960-61 and the experiments were sown both at Shajapur and Indore. These involved a number of major and minor yield trials of the *desi* cotton material obtained from Khargone and Indore. The results showed that K. 52-519, strain developed from *Jarila* x *Bhoj*, having a spinning of 34's and ginning 36% was promising, both from the point of view of yield and earliness.

(ii) Scheme for the Long Staple American Cotton Breeding at Badnawar :

It aimed to evolve a hirsutum strain suitable for Malwa and which has a staple length of not less than 13/16 and was superior to Indore-2 in ginning percentage, yield of Kapas, quality and resistance to drought and jassid attack.

The work conducted during the year again confirmed the suitability and superiority of Badnawar-1 over Indore-2. During the year under review, the Indian Central Cotton Committee approved a scheme for multiplication and distribution of its seed on 2,00,000 acres. It was noted that *Badnawar*-1 was having ginning 34% and gave an additional income of Rs. 168/- per acre to the grower.

(iii) Nimar Cotton Improvement Scheme, Khargone :

The Scheme aimed to evolve for West Nimar region *desi* and American cottons as would replace *Malwi* and *Narmada*, respectively. The work conducted during the year showed that the *desi* cotton strains, K. 55-

565 and K. 567 were promising inasmuch as they had yielded better than *Maljari* and had a ginning percentage equal to Virnar and spinning superior to *Malwi*.

Amongst American cottons, Narmada (A. 51-9) was the best amongst all the available American cottons for the region. A few more promising selections like A. 56-329 and A.N. 85 were proved better than Narmada in minor yield trials.

A number of hybrid progenies, F.1 to F. 5 and backcrosses of *desi* and American were grown and large number of single plant selections were made therein for further study.

(iv) Scheme for breeding of cotton for the Chambal Project Area, Gwalior –

The scheme aimed to breed out a long staple variety of cotton for Chambal Project Area. The results again confirmed the suitability of C. 58-5 (R-5) for the region (PMARC, 1961).

Gram

Variousearly and late gram strains were tested at Gwalior and Ujjain during the year 1949-50. Early Gwalior 2 and late Bhind 2 gave consistently good yield, i.e., 10.3 maunds* and 12.4 maunds* per acre, respectively at Gwalior. At Ujjain, early Gram Sardarpur 1 and late Bhind 19 recorded 5.6 and 4.3 maunds* per acre, respectively. In another trial at Gwalior, Bhilsa Gulabi 2 and Bhilsa Green 22 gave 3.2 and 3.5 maunds* per acre, respectively (ARDA, 1949-50).

During the year 1951-52, at Gwalior, 10 strains were tried along with local as control. The differences in the yields were significant and showed that local and Morena 6 B have given highest yields of 325 lbs and 310 lbs per acre, respectively. The crop was damaged on 1st March by hail storm and therefore the yields were low. At Ujjain, 9 strains with local as control were tried. The differences in yield were not significant. However, Sardarpur 21 has recorded the highest yield of 408 lbs per acre.

Trials conducted at Gwalior and Bagwai Farms during the year 1951-52, have indicated the superiority of G. 16, G. 37 and G. 75 varieties of gram as compared to all other varieties (ARDA, 1951-52).

Five strains of gram were grown in a replicated trial at Gwalior during the year 1953-54. The results obtained are given below (Table-8).

Table 8 : Grain yield of Gram strains.

Strain	Grain yield (lbs per acre)	Strain	Grain yield (lbs per acre)
G-16	514	G-75	534
Gwalior-2	618	Local	447
Gwalior-3	467	S. E.	39
G-37	541	C. D.	80

The treatment differences were significant and Gwalior-2, G-37 and G-78 have shown statistically superior performance over control. The yields were low due to damage by frost on January 22 and 23, 1954 (ARCA, 1953-54).

In varietal trial conducted at Gwalior during 1960-61, strains 101, 76, 176, Gwalior 2, H. 694 and H. 25-1/2 gave significantly higher grain yields. Eighty-two strains were maintained in culture rows and observation plot. F. 3 bulks of 4445-1/5 x T. 1 and 5401 x 720-8 were grown.

Varietal trial conducted at Khargone during 1960-61 of nine improved varieties including Ujjain 21, Ujjain 24 and Indore 701 showed that Chafa gave highest yield per acre besides being earliest to mature and also with an attractive yellow grain. Trial of eleven selections in other minor yield trials showed the none was better than Chafa both in yield and earliness. It was noted that all the improved strains from other regions of Madhya Pradesh, i.e., Gwalior, Jabalpur etc., were late in maturity than local and did not yield as much as Chafa. Crosses were made during the year between T. 1 and Chafa and local types. The hybrid seed has been collected (PMARC, 1961).

Five strains of gram were compared with the local seed in a replicated varietal trial at Gwalior during the year 1952-53. The material was sown on October 06, 1952. The results are given below (Table 9) –

Table 9 : Grain yield of different strains of Gram.

S. No.	Strain	Grain yield (maunds*per acre)
1	G. 37	14.0
2	G. 16	13.3
3	G. 75	11.5

4	G. 3	11.0
5	Local Control	10.84
6	G 2	10.3
	Critical differences	1.85

While the two strains, G. 37 and G. 16 did not differ among themselves significantly, however, were significantly superior to G. 2, G. 3 and the Local control (ARCA, 1952-53).

A varietal trial on gram was conducted at Regional Research Station, Bhilsa during the year 1952-53. There were 10 Ujjain strains and the Bhilsa Local seed as Control. The yields obtained are tabulated below (Table 10) –

Table 10 : Grain yield of different strains of Gram.

S. No.	Strain	Grain yield (lbs per acre)	S. No.	Strain	Grain yield (lbs per acre)
1	Ujjain 24	540	7	Katila 21	480
2	Yellow 12	540	8	Katila 18	470
3	Yellow 10	533	9	Ujjain 21	460
4	C.F. Yellow	518	10	Ujjain 14	450
5	Local (control)	511	11	Mutant No. 1	297
6	Mutant No. 2	506		Critical differences	51

It was observed that no variety was significantly superior to the Local control. Mutant No. 1 was significantly inferior to all the others.

A trial on commercial varieties of gram was conducted at Regional Research Station, Bhilsa during the year 1952-53. Bhilsa tract is famous for its Gulabi (rose or pink) gram which, though yielding less than the *desi* (local), commands a fancy price and is largely exported to Bombay. This trial was laid out to compare the yield performance of this gram and other commercial varieties from Ujjain as well as local green variety. The plot size was 90′ x 6′ and there were 6 replications. The results obtained are tabulated below (Table 11) –

Table 11 : Grain yield of different strains of Gram.

S. No.	Variety	Grain yield (lbs per acre)
1	Malida-12	563
2	Malida-21	559
3	Green-35	494
4	Malida-10	487
5	Pink-28	472
6	Pink-26	444
7	Green-37	415
8	Local Pink	358
9	Green-36	325
10	Pink-2	318
11	Local Green	249
	Critical differences	58

All the 3 varieties of the Malida type have given significantly higher yields than most other varieties. The local varieties, both pink and green, have fared badly (ARCA, 1952-53).

Groundnut

Avarietal trial on groundnut was conducted at Central Experimental Farm, Gwalior during the year 1949-50 to find out a high yielding variety suited to the locality. The varieties taken for trial were A.H. 334, A.H. 113, B.I., A. 2, D. 3 and C.P., the last variety was put as control. From the results obtained all the varieties have given higher yields than the control. The varieties A.H. 334 and B.I. gave 11 and 10maunds* per acre, respectively as compared with 5.3 maunds*of the C.P. (control) and as such have proved specially promising(ARDA, 1949-50).

As a results of work done on groundnut at Gwalior, varieties R.4, E. C. 1704 and Gangapuri have been developed for Gwalior region (PRWC, 1959).

A trial of 4 varities (viz. N.G. 51, N.G. 53, Exotic 5 and Chandori) against A.K. 12-24 was conducted at Khargone during the year 1960-61 both on heavy and light soils. The results showed that N.G. 51, N.G. 53 and Exotic 5 gave higher yields of pods than A.K. 12-24. Of these N.G. 51 has highest percentage of mature pods and has given consistently good performance (PMARC, 1961).

Jowar

Out of 5 strains under test at Gwalior during the year 1949-50, strain J.B. 12.2 recorded the highest yield of 9 maunds* per acre.

Out of 14 strains under trial at Ujjain during the year 1949-50, strains Nos. 1,3 & 5 recorded 17.5, 17.3 & 16.7 maunds*of yield per acre, respectively.

Six varieties of jowar namely *Pilya Malvi*, *Saoner*, Selection No. 8, Selection No. 6, White badhej and *Mahila* (local) were tried at the Central Experimental Farm, Bhilsa during the year 1949-50 to find out a high yielding variety suited to the locality. The variety *Saoner* stood first in point of yield of grain and *Kadbi* (fodder). Next to Saoner was Selection No. 8 (ARDA, 1949-50).

During the year 1951-52, at Gwalior strain 12-2 and at Ujjain No. 9 proved to be high yielders. These strains gave good yields at Bhilsa Farm also (ARDA, 1951-52).

A replicated varietal trial with 4 jowar varieties (G. 12-2, G. 10-7, Hingona-3 and Mehra Kamlapur) and the local cultivators seed was conducted during the year 1952-53 at Gwalior. It has been observed in the past that Mehra Kamalpur which was selected in Guna district was a very late type and hence not suitable for this region. The other two strain G. 10-7 and Hingona-3 gave significantly higher yields than the local (ARCA, 1952-53).

Fifty four samples of jowar, viz. 28 from Newali, 14 from Rajapur, 7 from Shankerpur, 3 from Bhilsa, and 1 from Sonkatch were sown in single plots for selection of promising lines at Regional Research Station, Bhilsa during the year 1952-53. Five hundred and thirty one plants were examined individually both in the field and in the laboratory. Selections were made in 16 recognised types as well as from crops grown by 15 different cultivators. The period of maturity in different selections varied from 130 to 154 days and the weight of 100 grains from 2.0 to 5.25 grams. The fluctuations in yield of individual plants was very wide, ranging from 6 to 193 grams (ARCA, 1952-53).

Seven varieties of jowar together with local cultivators seed were tried at Gwalior during the year 1953-54. The results obtained are given below (Table 12)

Table 12 : Grain yield of different varieties of Jowar.

Variety	Grain yield in lbs per acre.
Gwalior 12-2	478
Gwalior 10-7	490
Hingona 3	421
Gurumukhi	-
Dadar	-
Double dwarf-yellow saoner	236
Early dwarf Hagari	323
Local (cultivators seed)	380
Standard Error	50
Critical Difference	107

There was no setting of grains in Gurumukhi and Dadar varieties of jowar. The results showed that the variety Gwalior 10-7 only was significantly superior over control (ARCA, 1953-54).

Twelve varieties including control were tested at Regional Research Station, Khargone during the year 1953-54 to find out high yielding variety of jowar for Nimar tract. The results indicated the superiority of Ujjain No.1 and Progeny No. 3. Ujjain No. 8 has been giving higher yields for the past three years (ARCA, 1953-54).

A varietal trial of six varieties conducted at Indore during 1960-61 showed that N.J. 171 was the top yielder of grain. I.P. compact and yellow grained variety yielded more than Ujjain 6, Ujjain 8 or I.P. 3(PMARC, 1961).

Linseed

The work on breeding rust resistant linseed strains was undertaken at Gwalior and as a result of this work three strains viz. H. 603, H. 627 and N. P. R. R. 204 were evolved. At Ujjain, E. B. 3 and C. F. white have given higher yields. For the Malwa region varieties have been evolved at I. P. I. Indore and these were I. P. I. 6, I. P. I. 65 and I. P. I. 11. Among these varieties H. 603, H. 627 and N. P. R. R. 404(from I. A. R. I., New Delhi) have been tested and found to be highly resistant to rust (PRWC, 1959).

A varietal trial of 15 varieties with I.P.I. 6, as control, conducted at Indore during the year 1960-61 showed that six of them out yielded the control; Mahoba and I.P.I. 5 giving the highest yields. Malvi 1, a wilt resistant selection, was at par in matter of yield with control I.P.I. 6.

24 strains of hybrid origin were tested in a varietal trial at Gwalior during 1960-61 of which six including H. 621, H. 603, gave significantly

higher yields. One hundred and sixty cultures and F.4 bulks of crosses of R.R. 9 with E.B. 3 and C.F. yellow were grown (PMARC, 1961).

Maize

The trial of U.S., Australian and Canadian hybrids conducted at Ujjain during the year 1951-52 revealed that the following hybrids gave higher yields than the local –

(i) Visconsin – 641
(ii) Texas – 18
(iii) Texas – 26
(iv) Iowa – 4412
(v) Australia – Q – 104(ARDA, 1951-52).

Five varieties of maize from U. P. viz., T. 19, T. 41, C. 284, T. 4111, T. 4401 and one variety from Bombay i.e., Saneri were grown with local as control at Gwalior during the year 1953-54. The results indicated that the differences in yield were not significant, however, variety T. 4401 was promising as it gave the highest out-turn (ARCA, 1953-54).

Mung

A number of early and late strains evolved were tried in replicated plots at Gwalior and Ujjain in the year 1949-50. At Gwalior, Sardarpur early 4 gave 2.2 maunds* whereas late Bhind 3 gave 2 maunds* of grain per acre. The season and rainfall were most unsuitable for mung crop. At Ujjain, late Jagudan 17 recorded 4.4 maunds* per acre(ARDA, 1949-50).

During the year 1951-52, at Gwalior, out of ten high yielding strains tried with local as control, Krishna 11 has out yielded all the varieties with 437 lbs of yield per acre. At Ujjain, the trial conducted with five strains and local as control proved significant in which Jagoodan 17 gave the highest yield of 327 lbs per acre. (ARDA, 1951-52)

Three varieties of mung from Punjab were grown along with Krishna 11 in small observation plots at Gwalior, during the year 1953-54. The results indicated that variety Krishna 11 gave highest grain yield (345 lbs per acre) followed by U. P. T. 1 (296 lbs per acre) (ARCA, 1953-54).

Varietal trial of 5 improved varieties against local mung conducted at Khargone during 1960-61 established the superiority of Khargone 1 over local in all respects. Trials of other selections in other minor yield trial showed that two selections, M. 59-318 and M. 59-319, which were on par with Khargone 1 in yield and earliness had a bolder grain quality than it (PMARC, 1961).

Mustard

Table 13: Improved strains of Rape & Mustard (Brassica sp.).

Botanical Name	Impro-ved strain	Season		Durat-ion (days)	Seed colour	Avg. yield acre lbs.	Oil %
		Sowing	Harvest-ing				
B. compestris	M3	Oct.	Feb.	106	Brown	820	45
	M18	Nov.	Feb.	104	Brown	820	45.9
	M27	Nov.	Feb.	103	Brown	860	44.6
B. compestris (Var. Brown sarson)	B.R. 23	Oct.	Early Feb.	110	Brown	552	43
	B.R. 29	Oct.	Early Feb.	110	Brown	508	43
	B.R. 32	Oct.	Early Feb.	110	Brown	578	42
	B.R. 36	Oct.	Early Feb.	110	Brown	506	42
	B.R. 13	Oct.	Early March	125	Brown	676	41.3
	B.R. 40	Oct.	Early March	125	Brown	723	41.3
B. compestris (Brown sarson)	B.S.G.	Early Oct.	End Feb.	145	Brown	1000	45
B. compestris (Var. Toria)	Abohar selection	Early Sept.	Early Jan.	115-120	Brown	1000-1200	40-41
B. juncea (Raya)	L. 18	Mid Oct.	End March	160	Black	1400	40
B. compestris (Var. Yellow sarson)	T. 151	Mid Oct.	End March	160	Yellow	800-1000	45
	T. 10	Mid Oct.	End March	155	Yellow	800-1000	45
	T. 1	Mid Oct.	End March	155	Yellow	800-1150	46
B. juncea (Var. Rai or laha)	Rai RT 11	Early Oct.	End Feb.	140	Blackish brown	800-2000	41.5
	Laha 101	Early Oct.	End Feb.	150	Blackish brown	1000-2000	42
B. compestric (Var. Tori)	Tori 7	Oct.	Dec.-Jan.	90	Brown	480	32.8
	Toria No. P. 54	Nov.	Dec.-Jan.	87	Brown	560	42.6
B. juncea (Rai)	Rai 5	Nov.	Jan.-Feb.	110	Dark brown	600	34.7
B. juncea (Rai)	Rai P. 85	Nov.	Jan.-Feb.	110	Dark brown	620	37.1

(Gupta,1959-60)

Paddy

Out of 8 varieties under trial at Ujjain Farm during the year 1949-50, Hari Sutli, Kalinokhi and Sardarpur white recorded 18, 17 and 20 maunds* of yield per acre. These are coarse varieties.

A varietal trial of paddy was conducted at Harsi Experimental Farm, Bagwai during the year 1949-50 to find out high yielding medium quality variety suited to the locality. Six varieties of Paddy namely Lanji, Bankura No. 1, Sutarsal, T. 21, Pusa 18 and Kammod were tried in this experiment. The results obtained showed that the variety Bankura No. 1 gave the highest yield followed by T. 21.

Another trial of similar nature was conducted with 11 coarser varieties (Kabri Mohar, Rajuri, Pusa 246, T. 17, Jhona, Dacca No. 6, C. F. Ujjain, R. 2, J-100, M. T. U. 4 and Suwasra Dangar) of Paddy, each sown in eight rows in duplicate series.The results obtained showed that the variety M. T. U. 4, gave highest yield and next to it was Kabri Mohar.

From a comparison of the record of performance, results of the three years of the various fine varieties of Paddy it was evident that the variety Bankura No. 1 out yielded the varieties Basmati, Banspatri and Kammod which had been established as high yielders for this area, in all the three years.

A varietal trial on paddy was conducted under unirrigated conditions at the Central Experimental Farm, Bhilsa during the year 1949-50. The trial was conducted with 12 varieties (R. 3, Rajuri, Kalinokhi, T. 21, Budgale, Sutarsal, M. T. U. 18, B. A. M. 13, M. T. U. 4, Local Khetu, 61X and Banspatri).From the results of yield it was clear that unirrigated Paddy crop could be successfully grown under the conditions of the annual rainfall of 70″ in Bhilsa area. The varieties Rajuri and M.T.U. 18 have stood first and second in respect of yield. They have given 14 maunds* 24 seers* and 10 maunds* 35 seers*of yield per acre, respectively(ARDA, 1949-50).Varietal testing during the year 1951-52 at Bagwai Farm under irrigated Harsi Canal area indicated that Bankura No. 1 and U.P. T. 21 were the highest in yield.

In similar trials at Bhilsa Farm under rainfed conditions two varieties M.T.U. 18 and Rajuri gave highest yields (ARDA, 1951-52).

A varietal trial on paddy was conducted at Regional Research Staion, Bagwai during the year 1952-53. Twelve varieties from Bihar, eleven from U. P., four from Punjab and three local types (Bankura 1,

Dhubraj and Bhopal-patti) were transplanted on 8th August in duplicate plots measuring 60′ x 60′. The calculated acre yields of paddy are presented below (Table 14).

Table 14 : Grain yield of different varieties of Paddy.

S. No.	Source	Variety	Yield in maunds* per acre
1	Bihar	B. R. 4	11.3
2		Hornomeas	11.1
3		B. R. 7	10.0
4		7/A. 5731	8.0
5		B. R. 3	6.8
6		B. R. 8	5.3
7		B. R. 6	5.1
8		B. R. 5	4.9
9		B. R. 9	4.3
10		B. R. 12	3.6
11		B. R. 11	1.7
12		B. R. 10	0.8
13	U. P.	T. 22/A	12.4
14		T. 17	11.3
15		Ch.4	10.7
16		T. 9	9.8
17		T. 88	7.7
18		T. 138	6.4
19		T. 43	6.4
20		T. 23	5.1
21		T. 1	4.9
22		T. 100	4.1
23		T. 36	3.8
24	Punjab	Jhona S. 20	10.0
25		Jhona 349	7.0
26		Basmati 370	7.0
27		Palman 248	5.7
28		Bankura	15.0
29		Bhopalpatti	3.4
30		Dhubraj	2.4

*1 maund = 37.32 kg

Although the general yield level was low owing to late transplanting of seedlings and lack of manuring, some varieties appeared to be high yielding (ARCA, 1952-53).

Forty nine progeny rows were compared with the local at Regional Research Station, Bhilsa during the year 1953-54. Though some of the progenies gave higher yields than the control variety, the increase ranging from 30 to 40%, the differences were not statistically significant (ARCA, 1953-54).

In the erstwhile of M. B the Institute of Plant Industry carried out the work during 1959 in respect of drilled paddy and found that Barwani-22 selected from Barwani bulk was high yielding, early and coarse and was suitable for Malva and Nimar regions (PRWC, 1959).

In the Gwalior area work was conducted during the year 1959 to find out variety better than Lanji for the Harsi canal area. Trials of extra-provincial strains were conducted, to start with, but none of them was found to be superior. Accordingly, a special scheme of the I. C. A. R. has been launched out a variety for that area. The work is in progress (PRWC, 1959).

As a result of work at Bagwai Farm during the past seven years a fine scented variety *Kalimoonchh* 64 has finally been released during the year 1960-61 (PMARC, 1961).

Peas

Varietal trials conducted at Gwalior or Bagwai Farms during the year 1951-52 indicated that variety I.P. 29 gave highest yield per acre as compared with Khaparkheda& other varieties. 4 maunds seed of improved varieties of peas was distributed to cultivators (ARDA, 1951-52).

A brief description of recommended varieties is given below (Table 15) –

Table 15 : Brief description of recommended varieties of Peas

Early December	(T. 10 + Early badger). Early variety of garden peas. It has sweet green pods ready for picking in 55-60 days. It yields about 3200 kg green pods per acre.
T. 19	A medium maturing variety of garden pea, predered for its sweetness and high out-turn of green pods per unit area.
163	A good variety of field pea with attractive bold round white seeds. It yields on an average 5-6 qu/acre under

	rainfed conditions.
Khaparkheda	A small wrinkled seeded hardy variety which it used both as field and garden pea. Its average yield of dried seeds is 4-5 qu/acre.
G.C. 66	This is a cross between Russian 2 + greater progress. It has medium-early maturity with bushy plant type. It is ready for picking with in 80 days after sowing. Its average yield is 5080 kg/ green pods per acre.
G.C. 141	Its a cross between T. 10 + Greater progress. It is of medium maturity & is ready for picking in 90 days after sowing, it yields about 6460 kg green pods per acre.
G.C. 477	Its a cross between Russion 2 + Greater progress. It is of medium maturity is ready for picking in 95 days after sowing. It yields 6000 kg green pods per acre.
Bonnville	It is like varity T. 19.

Potato

A varietal trial on potato was conducted at Experimental Farm, Gwalior during the year 1953-54. Eight varieties were tried in randomised block design with 6 replications. The yields are given below (Table 16).

Table 16 : Tuber yield of different varieties of Potato.

Variety	Yields in maunds* per acre
Satha Bihar	105.38
Satha Local	97.74
Gola Local	43.38
Gola Dehradun	30.76
Fulwa	96.71
Surkha	80.97
Military special	50.11*
S. E. between treatments except missing	5.21
C. D. between treatments except missing	10.58

* There was one missing plot in Block 1 for this variety.

The results indicated that the best yielderwas Satha Bihar, but it was not significantly superior to Satha local and Fulwa. Satha Bihar, Satha local and Fulwa were superior to Surekha. Satha Bihar, Satha local, Phulwa and Surekha are satistically superior to Military special, Alfa, Gola local and Gola Dehradun (ARCA, 1953-54).

Improved potato varieties for Gwalior Division

(i) Up-to-date:

Special characters

Maturity	:	Early (90 days)
Yield	:	Very heavy both in the hills and plains.
Bulking	:	Early, quick, uniform.
Adaptability	:	(a) Very wide, responds well to both long short day conditions. (b) High commercial acceptability, often securing a good premium for its tuber quality in trade. (c) Suited for U.P., Madhya Pradesh,Bihar, Maharashtra, Himachal Pradesh, Mysore, Haryanaand Punjab.

Fertilizer Response : Very good, particularly to nitrogen and potash.

Tuber characters: Size large, surface smooth, shape oval flattened, dyes flesh white.

Keeping quality: It cannot be successfully stored for long periods in country stores.

Degeneration : Rapidly degenerates, necessitating quick and often annual replacements of seeds.

Late Blight : Susceptible.

Brown Rot, Nematode, Charcoal Rot and Wilts : Susceptible.

(ii) Kufri Kuber

Year of Release : 1958

Special character : Maturity :Early

Yield : Excellent crop in the plains.

Bulking : Early, but somewhat slower than up-to-date.

Adaptability and other merits:

(a) Yields fairly well under long day but tuberisation better under short days.

(b) Highly resistant to mite attack.

(c) Suitable for Maharashtra, Punjab and Bihar. It can also do well in M. P.

Fertilizer Response : Responds very well to liberal doses of fertilizers, particularly nitrogen and potash.

Tuber characters : Size medium, skin white, eyes fleet, flesh white.

Degeneration :

(a) Shows a very slow rate of degeneration in the plain.
(b) Virus Y is very rarely seen on the commercial crops as it is intolerant to this virus.
(c) Leaf-roll effects are not very severe.
(d) Shows mild mosaic symptoms in the field.

Sugarcane

Varietal and manurial trials conducted at the Gwalior and Bagwai farms during the year 1951-52 indicated the superiority of Co 421 and Co 453 over Co 312 (ARDA, 1951-52).

Umat (1958) reported that the main varieties in cultivation in Mahidpur Road, Jaora and Dalauda factories were the old Co canes, Co 213 and Co 210 while Co 419 and Co. 453 were introduced in the areas. In Dabra the main varieties were Co 312 and Co 453, while in Sarangpur it was the Co 419. The following table reveals the approximate acreage and varieties grown in different regions of the State (Table 17).

Table 17 : Sugarcane varieties grown in different regions.

S. No.	Regions	Approxi Acreage	Varieties Grown
1	Gwalior	39,321 acres	Desi, Co 312, Co 453
2	Bhopal	16,527 acres	Desi, Co 419, Co 421, Co 453
3	Indore	27,248 acres	Desi, Co 210, Co 213, Co 419

A varietal experiment on Sugarcane was conducted at Sehore and Dabra during the year 1959-60. The varieties tested, in the final varietal trial, for release, Co 678 and Co 740 proved outstanding against Co 421 the standard variety, with yields of 1001, 870 and 860 maunds* per acre, respectively (PMARC, 1961).

In M. P., Sugarcane varieties received from Coimbatore and other places were tested at Sugarcane Research Station Dabra and Sehore. The following are the recommended varieties during the year 1960-61.

Central Zone Co 410, Co 312

Eastern Zone	Co 419, PoJ 2878, PoJ 2967, Co 453, Co 312 and Co 617
South Western Zone	Co 419, Co 312, Co 453
North Western Zone	Co 321, Co 245, Co 453
Bhopal	Co 419

In the trials conducted at Dabra, Co 453, Co 421 and Co 527 varietieswere found superior to Co 312 in yield and quality of juice while at Sehore, new varieties under trial Co 527, Co 1157 and Co 1169 were compared with Co 421 with regard to sugar quality and behaviour against pests and disease (Bhargava, 1960-61).

Til

In case of Sesamum strains No. 41, No. 128, NP 6 and Gwalior 5 were evolved at Gwalior (PRWC, 1959).

13 strains of til were tested at Gwalior, of which six viz., Nos. 13, 58, 8, 35-A, T-10 & T. 5 gave significantly higher yields (PMARC, 1961).

A replicated varietal trial with ten selections from Indian Agricultural Research Institute, New Delhi, one from Bombay and three from Madhya Bharat was conducted at Gwalior during the year 1952-53. The yield data after statistical analysis are presented below (Table 18).

Table 18 : Yield of different varieties of Til.

S. No.	Strain	Yield in maunds* per acre	S. No.	Strain	Yield in maunds* per acre
1	S	2.58	9	O	1.73
2	NP 6	2.43	10	Chhahfera (M.B.)	1.70
3	NP 7	2.21	11	85 (Bombay)	1.51
4	N	2.21	12	H	1.45
5	P	2.21	13	J	1.13
6	Khetia (M.B.)	2.21	14	Bhabra (M.B)	0.53
7	M	1.89		Critical Difference	1.49
8	K	1.76			

It was observed that the Bombay Strain No. 85 was significantly lower than the first 6 strains from the I.A.R.I., the others did not differ significantly from one another (ARCA, 1952-53).

A varietal trial on sesamun (til) was conducted at Gwalior during the year 1953-54. Ten selections received from I.A.R.I., New Delhi, one from Bombay, three from Madhya Bharat were tried along with Chahfera and local cultivators seed as controls. The results indicated that the differences in yield were not significant. However, variety NP 6 produced highest grain yield (249 lbs per acre) followed by NP 7 (243 lbs per acre), Strain N (215 lbs per acre) and Strain M (208 lbs per acre) (ARCA, 1953-54).

Urid

Variousearly and late urid strains were tested at Gwalior and Ujjain during the year 1949-50. At Gwalior, strains early Khachrod 18, and late Khachrod 25, recorded 8.9 and 9.1 maunds* per acre, respectively. At Ujjain early Jora 4 and Bhilsa Green 15, recorded 5 maunds* and 3.2 maunds* per acre, respectively (ARDA, 1949-50).

During the year 1951-52, at Gwalior, of the 11 strains tried with local as control, Sheopur 17 has given the highest outturn of 316 lbs per acre. At Ujjain, 10 strains with local as control were tried. Out of these, the yield of 1 to 5 strains along with local was satisfactory. Whereas the yield of remaining strains was very low. Therefore the results were split up into two separate analysis of variance. The differences in yield were significant in both the cases. Jora 4 has given the highest yield with 517 lbs per acre (ARDA, 1951-52).

Varietal trial conducted at Gwalior during 1960-61 showed that T.D. 1, Gwalior 2, N.P. 14, Gwalior 18 and strain 121 gave higher yields.

Trial of 5 varieties experimented at Khargone during 1960-61 showed that K.U. 56-53, i.e. Khargone-3 gave highest yield and was suitable from all points of view for Nimar region (PMARC, 1961).

Wheat

Seventeen varieties were tried at Ujjain Farm, during the year 1949-50. Out of these, Howra, Gulab, Niphad, A.O. 13 and A.O. 90 gave good performances. Average yield varied from 9.5 to 12.5 maunds* per acre.

A varietal trial on wheat was conducted at the Central Experimental Farm, Gwalior during the same year to find out a high yielding variety best suited to the locality. Seven varieties namely Panjab 8A, G 5, O 15, C 228, Pbc-591, K. 808 and Pbc-518 (Control) were tried. The results indicated that the varieties Pbc-591 and Pbc-518 have out

yielded other varieties. Of these two varieties, the varieties Pbc-591 stands superior both in point of view yield and quality as compared to variety Pbc-518.

A number of selections from Uttar Pradesh, Punjab and Gwalior were tested at Gwalior during the year 1949-50 for their tillering, height, maturity and yield performances. Some selections appear to be promising.

Six varieties were tried in randomised blocks at Ujjain during the year 1949-50, in which Pbc. 591 recoded highest yield of 20 maunds* per acre(ARDA, 1949-50).

Varietal tests were conducted at Gwalior, Bagwai, Bhilsa and Ujjain farms during the year 1951-52. At Gwalior, NP 710 and 720 gave the highest yield of 16.0 maunds* per acre as against C-591, the variety under general distribution yielding 15.0 maunds* per acre. Among the promising local selections mention may be made of Alapur 3-1. From Primary selections made in Gwalior 249 single plant progenies were examined during the year.

At Bagwai farm among the varieties tested NP 52, C-591 and local Jalalia gave higher yields (ARDA, 1951-52).

A varietal trial with Twelve strains of NP wheats evolved by the I.A.R.I., New Delhi, together with C. 591 and local unselected seed as controls was tested at Gwalior during the year 1952-53. The seeds were sown on November 13, 1952 and the crop matured betweenMarch 09 and 22, 1953. The yields are presented below (Table 19) –

Table 19 : Grain yield of different varieties of wheat.

S. No.	Variety	Yield of grain (maunds* per acre)
1	NP 764	18.8
2	NP 721	18.4
3	C. 591	18.4
4	NP 710	18.3
5	NP 760	18.2
6	NP 720	17.8
7	Local (control)	17.3

S. No.	Variety	Yield of grain (maunds* per acre)
8	NP 781	16.7
9	NP 762	16.4
10	NP 782	15.7
11	NP 775	14.3
12	NP 798	14.2
13	NP 796	14.0
14	NP 797	12.2
	Critical difference	2.7

None of 12 NP strains was significantly superior to either C. 591 or the Local (Control). But 4 NP strains (Nos. 775, 796, 797 and 798) were significantly inferior to either C. 591 or the local (control).

Seven strains from Ujjain, 2 from Gwalior, together with C. 591 and Local (control) were studied at Gwalior during the year 1952-53. The material was sown on 13th November 1952 and the crop attained maturity between March 02 and 15, 1953. The results are given below (Table 20) –

Table 20 : Grain yield of different strains of wheat.

S. No.	Strains	Yield of grain (maunds* per acre)
1	Ujjain 6	26.5
2	Ujjain 1	24.5
3	Ujjain 5	22.1
4	C. 591	20.4
5	Ujjain 4	20.1
6	Ujjain 7	20.1
7	Ujjain 2	19.7
8	Local control	19.1
9	Ujjain 3	18.4
10	Fazilka 3-1	17.0
11	Alapur 9-1	13.1
	Critical difference	3.0

Two Ujjain strains (Nos. 1 and 6) were significantly superior to either C. 591 or local control. C. 591 was significantly superior to Fazilka and Alapur while the Local control was significantly superior to Alapur.

A replicated experiment with C. 591 wheat was conducted at Gwalior during 1952-53 with a view to compare 6 different spacings between rows and between plants within a row. Seeds were dibbled by hand on 11th November 1952. The yield data presented below (Table 21).

Table 21 : Effect of spacing on grain yield of wheat.

Rows	Spacing between Plants	Grain yield (maunds* per acre)
9″	3″	19.3
12″	3″	18.9
9″	6″	18.5
12″	6″	16.0
9″	9″	15.6
12″	9″	13.9
	Critical differences	2.5

Three spacings, viz. 9″ x 3″, 12″ x 3″ and 9″ x 6″gave significantly superior yields to those obtained from the other spacings(ARCA, 1952-53).

A varietal trial of wheat strains was conducted at Regional Research Station, Bhilsa during the year 1952-53. This trial included 13 strains of wheat from Ujjain, 1 from Gwalior, a black-awned *durum* wheat called *Jalalia* and local soft wheat as control. The plot size was 60′ x 12′ and there were 6 replications. The yields are given below (Table 22).

Table 22 : Grain yield of wheat strains.

S. No.	Strain	Yield of grain (lbs per acre)
1	Ujjain 10	695
2	Ujjain 11	684
3	Ujjain 26	672
4	Ujjain 22	659
5	Ujjain 2	648
6	Ujjain 13	645
7	Local (soft)	638
8	Ujjain 6	613
9	Ujjain 17	594
10	Ujjain 20	540
11	Gwalior 15	531
12	Ujjain 9	526
13	Ujjain 1	456
14	Ujjain 3	455
15	Ujjain 2	448
16	Jalalia	382
	Critical differences	118

The results of the trial were significant. There was no significant difference between the Local control and the strains comprising highest group, while *Jalalia* has shown the poorest performance.

A replicated varietal trial of NP varieties was conducted at Regional Research Station, Bhilsa during the year 1952-53. Twelve varieties received from the I.A.R.I., New Delhi were tried along with C. 591 and the local control. The plot size was 60′ x 12′ and there were 6 replications. The results obtained are tabulated below (Table 23).

Table 23 : Grain yield of wheat varieties.

S.No.	Variety	Yield of grain (lbs per acre)
1	NP 781	584
2	NP 760	521
3	C. 591	484
4	NP 720	478
5	NP 782	451
6	NP 721	411
7	NP 710	406

S.No.	Variety	Yield of grain (lbs per acre)
8	NP 775	402
9	Local (control)	387
10	NP 762	370
11	NP 764	355
12	NP 796	328
13	NP 797	244
14	NP 798	234
	Critical differences	102

NP 781 showed no significant difference over C 591, while NP 781 and NP 760 proved significantly superior to Local (ARCA, 1952-53).

A varietal trial on wheat was conducted at Regional Research Station, Bagwai during the year 1952-53. Twelve strains of NP wheat received from the Botany Division of the Indian Agricultural Research Institute, New Delhi were tested against C. 591 and local as controls in a replicated varietal trial. The seeds were sown on November 17and 18, 1952 in plots 38′ x 16′ with 6 replications. The crop attained maturity on March 15,1953. The calculated acre yields are tabulated below (Table 24).

Table 24 : Grain yield of wheat varieties.

S. No.	Strain	Grain yield in (maunds*per acre)
1	NP 781	9.3
2	NP 720	9.2
3	NP 760	9.1
4	NP 710	9.0
5	NP 721	8.7
6	NP 764	8.7
7	C-591	8.7
8	NP 762	8.2
9	NP 797	8.2
10	Local	8.1
11	NP 798	8.0
12	NP 775	7.7
13	NP 782	7.4
14	NP 796	7.3
	Critical difference	1.3

It is observed from the above results that none of the strains differed significantly from either the local or C-591 (ARCA, 1952-53).

Twelve New Pusa wheat varieties (NP 710, NP 718, NP 720, NP 721, NP 758, NP 760, NP764, NP 775, NP 781, NP 797, NP 798 and NP 799) were grown along with C-591 and Local cultivators seed as control at Gwalior during the year 1953-54. The results indicated that NP 721, C. 591, NP 781, NP 760, Local, NP 720, NP 718, NP 758, NP 764 and NP

775 gave higher yield over NP 710 but there differences in yield were not significant besides they were susceptible to rust attack in varying degree. (ARCA, 1953-54).

Seven strains isolated at Ujjain and two strains isolated at Gwalior were tried along with C-591, NP 710 and Local as controls at Gwalior during the year 1953-54. The results indicated that the differences in yield were not significant. However, Ujjain Progeny No. 6 and 7, Alapur 6-1, Ujjain Progeny No. 1, 3 and 4 gave higher yields over C. 591 and NP 710 but NP 710 has shown distinct resistant to rust attack (ARCA, 1953-54).

Twenty two progenies isolated at Gwalior were tested along with NP 710 and Local as Controls at Gwalior during the year 1953-54. The results were significant which indicated that Progenies No. 147, 167, 4, 162 and 68 gave statistically higher yields over NP 710 and Progeny No. 147 and 167 were significantly superior to local control. The Progeny No. 162 and 66 werecomparatively resistant to rust (ARCA, 1953-54).

A trial on strains of Ujjain durum wheat was conducted at Regional Research Station, Bhilsa during the year 1953-54. The trial included 3 strains of Ujjain wheat in addition to G.D. 11 (a departmental recommended variety), *safed jalalia*, a local durum as control and C-591 as a special control. The grain yield data is given below (Table 25).

Table 25 : Grain yield of wheat strains.

Strains	**Yield of grain (lbs per acre)**	**Yield of straw (lbs per acre)**
Ujjain-6	1,085	1,506
C-591 (special control)	993	1,447
Ujjain-2	991	1,384
Ujjain-9	991	1,303
Safed Jalalia (control)	965	1,354
G. D. Jalalia (control)	584	1,424
Critical Difference	93	Not significant

As presented above, Ujjain-6 strain was the best yielder and statistically superior to all other durum varieties, however, at par with C-591. Variety G. D. 11 (*Jalalia*) has given poor performance and was inferior to all other strains(ARCA, 1953-54).

An experiment on wheat was conducted at Regional Research Station, Bhilsa during the year 1953-54 to study the comparative yield potential of local bulk varieties. This trial included 3 easily recognisable local varieties *Safed Jalalia* (white chaff durum), *Lal Kathia* (aprimitive lustre-less red grained durum) *Local Pissi* (Vulgare) and C-591 (control). The results (grain yield) indicated that *Local Pissi* variety was significantly superior to all other varieties including C-591 (ARCA, 1953-54).

Four N. P. varieties (NP 720, NP 781, NP 760 and NP 782) which did well under Bhilsa condition in previous years were tried along with C-591 and *local Pissi* as controls at Regional Research Station, Bhilsa during the year 1953-54. The grain yields alone were statistically significant. None of the NP varieties under trial proved superior to either controls. NP 760 and 782 were even significantly lower in yield than the controls(ARCA, 1953-54).

Five Powarkheda hybrid strains were tested against C-591 and Ujjain-22 as controls at Regional Research Station, Bhilsa during the year 1953-54. The yields are tabulated below (Table 26).

Table 26 : Grain yield of different strains of wheat.

Variety	**Grain yield (lbs per acre)**	**Straw yields (lbs per acre)**
Ujjain-22 (control)	1,023	1,396
Hybrid-11	885	1,212
C-591 (control)	842	1,190
Hybrid 12	822	1,265
Hybrid 38	769	1,026
Hybrid 8	673	1,003
Critical Difference	120	147

On the basis of above data, it is concluded that the control Ujjain-22 was significantly superior to all other varieties in respect of grain yield as well as straw yield (ARCA, 1953-54).

Achievements of Wheat Breeding Sub Station, Indore : The work on incorporation of rust resistance started with the crossing of a *local pissi* strain (N. 24) with E. 145 of Kenya at the Institute of Plant Industry. Early generation material of a number of hybrids from crosses attempted at Delhi in 1951 were also made available. The promising agronomic bases

utilized were NP 125, NP 710, NP 718, NP 758, NP 761, NP 789, NP 790, NP Niphad 4 and Punjab wheats C. 228 and C. 591. The exotic accessions used in crosses were C. 10854 (E. 220). Gabo (E. 569), Ridley (E. 572), Rapier (E. 909), Rio Negro (E. 952) etc.

NP 832 evolved from the cross N. 24 (*pissi* selection) x E. 145 was a very promising *pissi* type with long white plump grains, high yield, smut resistance and resistance to naturally occurring races of black rust in the Malwa tract. It was taken for large scale multiplication then. Of the amber grained aestivums, NP 839, which evolved from a cross between Gabo and Niphad 4, has shown promise in extensive trials during two years. Similarly NP 842 has shown promise under irrigated conditions. NP 842 was obtained from an inter specific cross between Kenphad 25 and Gaza and possesses resistance to large number of races of brown and black rusts. The grain was bold and amber colouredand utilised for improving rust resistance of high yielding varieties.

Work on combining resistance to more rusts than one was also undertaken and some of the early generation strains shown great promise.

Varietal recommendations: The State of Madhya Pradesh could be divided in eight distinct agro climatic zones. The improved varieties of wheat recommended for the various zones during 1964-65 are given below.

(i) Northern Madhya Pradesh

(a) Gird region comprising of Gwalior Division – C. 281, R. S. 31-1, Hy. 65, NP 710, N P 718.

(b) Bundelkhand-Baghelkhand region-comprising north eastern region of Rewa division-C. 591, Hy. 65.

(ii) Central Madhya Pradesh

(a) Eastern region comprising mainly of paddy growing tract of Bilashpur and Chattisgarh, No specific recommendation. Hy. 65, however, did well.

(b) Central Vindhya Plateau, comprising Sagar, Damoh, Vidisha, Bhopal etc – C. 591, Hy. 38, Hy. 65, Hy. 11.

(c) Malwa Plateau-Soft aestivums: Hy. 11, NP 832, hard aestivums: Hy. 65, NP 710, NP 718 and C. 281 and durums N. 111, NP 404 and NP 412.

(iii) Southern Madhya Pradesh

(a) Narbada Valley – Hoshangabad & Nimar Hy. 38, Hy. 65, among aestivums, Hy. 34 and Jaya among durums.

(b) Haveli tract– Jabalpur, Hoshangabad, Narshingpur etc. Hy. 11, Hy. 19, Hy. 65, Hy. 277, C. 591, NP 710.

(c) Satpura Plateau – Betul, Chindwara etc., Hy. 11, Hy. 65, Hy. 227, NP 710. Bansi as durum(Upadyaya& Singh, 1964-65).

Fodder Crops

The work done at Bhopal under the Fodder Research Scheme during the year 1960-61 consisted of yield trials of promising strains. In varietal yield trials, annual grasses B.G. 81, and N.G. 107 gave the best results. Among rainfed perennial grasses, *Tricholeana roses* was the best yielder whereas on heavy soils *Dicanthian caricesum* out yielded other crops (PMARC, 1961).

Introduction of new varieties

Wheat : NP 710 from I. A. R. I., New Delhi was found suitable and has been released for general distribution.

Peas : Variety Early Badgar and Delwich commands

Cowpea: variety Phillipine early from I. A. R. I. was found suitable and was released (ARCA, 1953-54).

Varieties recommended for different regions

Shri S. M. Wakankar, Assistant Economic Botanist, Gwalior read a paper on "Recent Advances in the Improvement of Crops of the Gwalior-Indore Tract" during First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. He also presented a list of varieties of crops recommended for Gwalior and Indore divisions. The list is given in AppendixIII.

Fundamental Research in Botany

The work carried out at the Department of Botany, College ofAgriculture, Gwalior and at the Department of Botany, R.A.K. Agricultural Research Institute, Sehore during the year 1959-60 consisted mainly on the study of effect of colchicines and growth promoting hormones on different horticultural and agricultural crops. The former were expected to produce chromosome mutations while the latter, some economic results in the matter of growth. Besides these, studies were made on hybrid vigour in tomatoes and on the hybrid population of *vulgare*. These results have been incorporated by the University students in their thesis (PMARC, 1961).

(3) Chemical Section / Soil Science Section

The following analytical work was done during the year 1949-50.

Total number of samples received for analysis was328 distributed as under:

(i)	Agricultural samples	136
(ii)	Medico legal samples	186
(iii)	Miscellaneous samples	6
	Total	**328**

129 samples carried over from the last year made the total to 457. Out of these 457 samples, 266 were analysed and reported upon during the year leaving a balance of 191 samples pending at the close of the year on 31st March, 1950.

266 samples which were analysed during the year comprised of the following categories :

(i)	Agricultural	127
(ii)	Medico legal	136
(iii)	Miscellaneous	3
	Total	**266**

Soil and crop survey work :Sampling of fine earth and separation of coarser particles of about 120 samples were completed.

Samples received from I.C.A.R.'s pulse scheme were analysed for their protein contents(ARDA, 1949-50).

The following analytical work was done during the year 1951-52 :

Five year programme of soil survey : This represents work on Gwalior soils initiated with the object of studying how far the revenue classifications of soils fits in with the classification known to science.

In this connection 180 samples of soil of the four principal revenue classification prevalent in the Northern as well as in the Southern Division of Gwalior State were collected from all the districts (except Guna and Sardarpur) and analysed for mechanical analysis.

During the course of this investigation, samples of soils from the districts of Shajapur, Bhilsa, Mandsaur, Ujjain and Shivpuri were analysed. During the year 1951-52, 13 samples from Sheopur district, 4 from Ugar (District Bhilsa) and 5 from Kanad (District Shajapur) were analysed. The analytical data of the samples done in 1951-52 are given in Appendix – IV.

Out of 180 samples collected, mechanical analysis of 103 samples was completed. Since the samples so far analysed fairly include all the different soil groups and the work done so far was considered sufficient enough to draw out conclusion, it was proposed to discontinue this work and to draw out a report on the basis of work done so far.

Work connected with Chambal Vally Development Scheme : The Chemical Section was asked in October 1951, to complete the Soil Survey of the Chambal command area in Madhya Bharat within a period of four months. Accordingly a scheme for Soil Survey of the commandarea was drafted costing about Rs. 1 ½ lakhs. The scheme was discussed in a meeting held on 19th October 1951, attended by the Chief Engineer of Chambal Project, the Director of Agriculture and the Chief Chemist. The scheme was approved and the Chief Chemist was asked to proceed immediately to Delhi for consultation with I.A.R.I. and to see also if a trained personnel for the scheme could be secured.

After visiting I.A.R.I., New Delhi, the Chief Chemist submitted his report and the same was discussed in the meeting held on 27th October 1951.

Then after the interstate meeting held at Gwalior in the last week of January 1952 and as per decision arrived jointly by both the Directors of Agriculture,Rajasthan and Madhya Bharat, a meeting of the Agricultural Chemists of both the States was held at Gwalior on the February 9 and 10, 1952, with a view to decide jointly the form and the proper heads and other relevant matter in connection with the writing of reports on the following 8 points of agricultural aspects to be incorporated in the report of the Chambal Hydel Project Scheme-

(i) Soil survey
(ii) Principal crops grown
(iii) Crop seasons
(iv) Garden crop
(v) Pasture
(vi) Crop pattern
(vii) Depth of sub-soil water & quality
(viii) Manure problem

Reports on the above had to be submitted finally on the March 15, 1952 after the collection of the necessary data. The soil survey report in this connection was to be submitted on the basis of the examination of soil profile of 30 representative pits in the entire commanded area. For this

purpose, the Chemist undertook a rapid tour of the Bhind-Lahar area. During this tour, samples of underground water were collected for analysis with a view to report on the quality of water. The actual soil survey as mentioned above was to have been done by the Chemical Section but with the arrival of Punjab Irrigation Soil Survey Party towards the end of 3rd week of February 1952, the Chemical Section was relieved of this item, viz. Soil Survey.

The analysis showed that the quantity of total solids present except in a few cases was normal. The soils in the commanded area being well-drained, the sodium salts though present being extremely soluble were all drained out under irrigation and there appeared to be no possibility of any rise in the alkali content of the soils. This problem was, however, likely to arise only in soils which were ill-drained. But the proportion of such soil in the commanded area was small.

Study into the available plant nutrients contained in compost prepared at the various Government Farms in Madhya Bharat : This work was undertaken as per recommendations of the Scientific Committee of the I.C.A.R. for work to be taken up in States.

During the year 1951-52, 5 samples of compost, one from Central Experimental Farm, Gwalior, 2 from Plant Institute, Indore and 2 from the Economic Botanist (one of Adhashishi compost and one of 'k' manure) were examined with the following results (Table 27) -

Table 27: Contents of different type of compost

S. No.	Samples	Percentage of			
		Moisture	Organic Matter	Nitrogen	Phosphate
1	Compost Central Experimental Farm, Gwalior	1.5	20.40	0.88	0.99
2	F.Y.M. Plant Institute, Indore	11.91	20.01	0.81	0.22
3	Farm Compost Plant Institute, Indore	8.33	19.14	0.68	0.20
4	Adhashishi compost	2.07	8.28	0.30	0.22
5	'K' Manure	7.72	48.83	2.01	1.10

Potash in the above samples could not be estimated during the year under report. The samples of Adhashishi compost appeared to be deficient in nitrogen content as compared to FYM/compost.

Investigation into the manurial value of tank silt : This work was undertaken as per recommendations of the Scientific Committee of the I.C.A.R. for work to be taken up by the States, with a view to see if silts that are deposited in old silted up tanks could be used as a potential source of manure.

During the year 1951-52, four samples only were collected. The nitrogen in the samples was estimated.The percentage of nitrogen contained in the samples examined, worked on an average to about 0.05% which is extremely small.

Evaluation of pulse varieties on the basis of their protein content : The Botany Section has under operation an I.C.A.R. Pulse scheme since last 6 years. About 150 samples of various pulse varieties have on an average been analysed every year in this connection. During the year 1951-52 some 140 samples of plants grown in 1951 were analysed for their protein contents. The results of the samples analysed are given in Appendix – V and VI.

Chemical composition of a few varieties of sweet potatoes grown by the vegetable research section : Seven varieties of sweet potatoes were grown at the farm in 1951, one of the varieties being local. The object of the investigation was to study how far the local variety differed from the other foreign varieties(ARDA, 1951-52).

The following analytical work was done during the year 1952-53 :

The total number of samples analysed during the year was 206, out of which 153 were soils, 20 pulses, 12 water, 6 compost and 5 oil-seeds.

"Kharcha" lands of Badnawar and "Khar" lands of Barnagar in Malwa : Owing to lack of drainage, the consequent water logging and both surface and underground in the soils of these areas, accumulation of salts took placein. Earlier work on this problem done by the Institute of Plant Industry, Indore, revealed that the construction of (a) open drains, (b) Sub surface tile drains, (c) use of manures with fertilisers could improve such soils.

As this problem was referred to the Chemical Section, the Chemist visited the areas in June 1952 and collected samples which were analysed.

The results of the analysis are presented below (Table 28):

Table 28 :Chemical composition of soil samples collected from Badnawar (KhedaVillage) and Barnagar.

S. No.	Description of samples	Moisture %	Parts in 1,00,000 parts					pH value
			Total soluble salts	Sodium carbonate	Sodium bicarbonate	Chlorides	Sulphate	
Badnawar (Kheda Village)								
1	Plot No Drains	5.96	590	Nil	34	390	122	Above 9
2	Plot Tile under drains.	6.04	600	Nil	130	270	135	Above 9
3	Plot open drains	6.39	460	Nil	75	230	159	Above 9
4	Plot No drains 0″-6″	6.08	203	Nil	113	29	13	Above 9
5	Plot 6″-20″	6.37	204	Traces	134	29	Traces	Above 9
6	Plot 20″-32″	6.58	234	5	168	46	Traces	Above 9
7	Scraping from badly affected plot	4.50	520	Traces	63	385	66	Above 9
Barnagar								
1	Baloda-Lekha 0″-6″	8.39	154	Nil	117	14	8	9
2	6″-18″	8.20	241	Traces	168	41		Above 9
3	Nakuch-Khedi 0″-18″	7.10	360	5	170	110	67	
4	Jhalaria 0″-6″	6.81	253	Traces	168	17		9
5	Kajlana 0″-3″	5.12	994	Traces	71	555	240	9
6	3″-6″	5.20	806	5.30	126	432	380	9
7	6″-18″	5.27	572	10	150	300	92	9

It was observed that the soils were highly alkaline, the pH value was above 9. Sodium Carbonate was absent while sodium bi-carbonate was present in quantities ranging between 30 and 168 parts per 1,00,000.

Studies on the soils of the regional farms : A study on a profile basis of the physical texture and chemical composition of the soils from the department farms located in the different regions of Madhya Bharat was begun during the year 1952-53. The results of the mechanical analysis, pH value and total soluble salts content of a few samples are presented below (Table 29) –

Table 29 : Physical texture and chemical composition of the soil samples collected from different regions of Madhya Bharat.

Tract	Farm	Depth in inches	Percentage of					pH	Total soluble salts per 1,00,000
			Gravel	Coarse sand	Fine sand	Silt	Clay		
Nimar	Khargone	0″-6″	12.0	10.7	31.2	31.9	19.7	7.7	71
		6″-10½″	7.5	11.7	30.4	30.0	21.6	7.7	50
		10½″-20″	9.3	14.6	28.4	31.2	21.1	7.7	61
		20″-32″	16.8	16.7	30.0	34.9	16.0	7.8	48
		32″-44″	20.5	21.2	27.5	38.2	14.3	7.8	96
Malwa	Dhar	0″-7″	0.0	3.9	21.4	23.1	51.5	-	-
	Biora	0″-9″	5.3	0.6	20.7	27.1	52.1	7.9	52
		9″-18″	7.3	1.0	20.4	27.6	52.3	7.9	61
		18″-27″	5.7	1.1	19.2	23.7	52.8	7.9	52
		27″-36″	5.1	0.7	19.2	25.4	54.8	7.9	42
		36″-45″	5.5	0.9	18.1	26.5	53.8	8.0	65
		45″-54″	6.2	0.6	18.8	26.8	53.8	8.0	51
	Bhilsa	0″-7″	0.0	1.8	19.8	25.3	54.2	7.8	-
		7″-19″	0.0	1.4	19.5	24.0	55.4	-	-
Northern Alluvium	Gwalior	0″-6″	0.2	3.4	70.6	14.1	10.6	8.0	96
		6″-18″	0.3	3.0	64.0	12.7	20.4	8.0	83
		18″-30″	0.0	1.7	53.2	16.2	18.8	8.2	57
		30″-42″	0.0	1.5	50.7	16.9	31.3	8.2	53

In Nimar, soilat various depths of the profile examined did not vary appreciably from one another as regards their texture. The clay content varied from 14 to 22%, the sand from 42 to 49% and gravel from 8 to 21%. The pH value was 7.7 at all the depths while the total soluble salt content was low, varying from 50 to 96 parts per 1,00,000.

In Malwa, soils represented by the farms at Dhar, Biora and Bhilsa, the clay content was uniformly high ranging between 52 and 55%. The sand varied from 19-25%. Gravel was absent in Dhar and Bhilsa but present at Biora farm from 5-7%. The Malwa soils thus present a marked contrast to Nimar soils in having higher clay and lower sand contents. The pH value was 7.7-8.0. The total soluble salts in Biora soils ranged from 50-65 parts per 1,00,000, which was low.

In the soils of the northern alluvium represented by Gwalior farm, the surface contained more fine sand (71%) which decreased with depth.

The clay content was on the contrary, low at the surface (11%) but increased with depth. The pH range was 8.0-8.2 while the total soluble salts were low, varying from 53-96 parts per 1,00,000 (ARCA, 1952-53).

The following analytical work was done in Chemistry Section during the year 1953-54 –

Studies of Madhya Bharat Soils : The study of Madhya Bharat Soils started in 1952-53 was continued. Soil profile samples were taken from different farms. The results of the Mechanical analysis are given below (Table 30 and 31) –

Table 30 : Mechanical analysis of soils of Bhilsa farm profile.

S. No.	Area	Depth	Sand%	Silt%	Clay%
1	Upland area	0″-9″	21.2	26.9	47.0
		9″-18″	19.2	27.9	47.8
		18″-27″	19.6	26.2	48.7
		27″-36″	20.0	28.0	49.2
		36″-45″	19.2	25.6	49.8
		45″-54″	18.6	25.6	48.5
2	Middle Portion	0″-9″	16.1	22.2	54.0
		9″-18″	15.2	22.5	53.7
		18″-27″	15.2	20.5	55.5
		27″-36″	15.5	20.5	55.9
		36″-45″	16.2	20.9	53.5
		45″-54″	18.3	20.3	52.5
3	Low land Area	0″-9″	3.3	24.2	63.9
		9″-18″	3.8	23.9	63.4
		18″-27″	3.7	23.7	62.7
		27″-36″	3.9	22.5	63.3
		36″-45″	4.0	24.8	60.9

Table 31 : Mechanical analysis and chemical composition of soils of Bagwai farm.

Area	**Depth**	**Sand %**	**Silt %**	**Clay %**	**pH**	**N%**	**Soluble salts parts per 1,00,000**		
							Na_2CO_3	**$NaHCO_3$**	**NaCl**
TCM plot	0″-9″	29.8	29.0	31.0	7.9	0.05	Nil	16.8	330
	9″-18″	30.3	24.0	36.0	7.9	0.03	Nil	33.6	390

	18″-27″	31.6	23.3	33.5	7.9	0.02	Nil	16.8	390
	27″-36″	39.0	20.0	40.0	8.1	0.03	Nil	16.8	390
	36″-45″	37.0	17.0	42.0	8.4	0.03	Nil	16.8	390
	45″-54″	38.2	25.0	35.4	8.4	0.04	Nil	16.8	390
									T.S.S.
Old Farm area	0″-9″	44.8	21.3	31.9	7.7	0.05	-	-	94
	9″-18″	44.7	20.4	31.2	7.8	0.03	-	-	118
	18″-27″	45.8	20.6	32.0	8.3	0.03	-	-	334
	27″-36″	43.6	20.0	34.5	8.3	0.02	-	-	N. D.
	36″-45″	44.6	20.1	32.0	8.3	0.02	-	-	N. D.
	45″-54″	46.9	21.5	31.7	8.3	0.01	-	-	N. D.

N. D. – Not Determined

The above results of mechanical & chemical analysis showed that

Bhilsa soils were heavy in texture and uniform throughout the depth. The clay ranged from 47 to 64%. The low land area had very little of sand and high amounts of clay as compared to the middle or upland area. The clay percentage decreased with the slope of the farm.

In the Bagwai farm, the clay percentage varied from 31 to 42% and the texture was fairly uniform throughout the depth. The soluble salt content was fairly high.

The chemical analysis of Khargone soil profile revealed high percentage of calcium which increased with depth and deficient in Nitrogen and P_2O_5content.

The chemical analysis of Biora Rajgarh Experimental Farm soils revealed that Hydrochloric acid soluble phosphate was fairly high. Calcium and nitrogen content was only 1.2% and 0.04% in the surface layer (0-9″) (ARCA, 1953-54).

Motiramani and Verma (1957) conducted an experiment at Gwalior to study the magnitude of nitrogen loss by volatilization with the aid of a more accurate quantitive method viz, Olson'a method. The results obtained are summeried as under –

(i) Both the applied and soil nitrogen were lost from the soil by volatilization.

(ii) About 60% of the applied Nitrogen was lost from Gwalior soil under the conditions of the experiment.

(iii) The loss further increased with the $CaCO_3$ content.

(iv) The maximum loss with 10% $CaCO_3$ addition was 80.86%(Motiramani& Verma, 1957).

Tamboli and Bali (1957) conducted reconnaissance soil survey of Guna district (M.P.). The analytical data revealed that the surface soils were clay loam to clay in texture having sand 20-40 %, silt 16-27 % and clay 32-50 %. This medium heavy to heavy texture of the soils was also indicated by high oven dry moisture content (4-8 %) and moisture equivalent figures ranged from 25-35 %. These characteristics suggested that the soils had good moisture retention capacity.

The soil reaction was within the range of 6.5 to 8.0 showing that the soils were normal i.e. in the zone of very slight acidity and slight alkalinity. Most of the soils had pH near about neutral, a favourable condition for the plant growth. The conductivity (as mmhos cm at 25^oC) was between 0.2 to 1.5 indicating that the concentration of the soluble salts was much below the harmful limits. It was also pointed out that saline and alkaline areas did not come across during the reconnaissance soil survey. The lime content was generally below 3 %, hence the surface layers were not much calcareous.

The study of the contents of total nitrogen, organic carbon and available phosphorus lead to the conclusion that the soils were at a somewhat lower level of fertility. The total nitrogen content ranged between 0.03 to 0.09 %, organic carbon between 0.2 to 1.2 % and the available P_2O_5 being 5 to 30 pounds per acre. The soils with available P_2O_5 above 50 pounds per acre were considered to be well supplied with phosphorus(Tamboli and Bali, 1957).

The following work was done in Soil Science Section during the year 1960-61 –

At Gwalior, 1335 soil samples of Government Farms were registered and analysed during the year 1960-61. Some pot culture and field experiment work was also taken up and the results are indicated below –

In a pot culture experiment no response to molybdenum was found on Mung crop. In an experiment three types of phosphatic fertilizers viz. superphosphate, dicalcium phosphate and bonemeal, with 100 and 200 lbs each were studied and the result indicated that heavy doses of dicalcium phosphate were equal in response to similar doses of superphosphate.

Basic slag which was a by-product of steel factories was also analysed for phosphate content, which was of the order of 1% only(PMARC, 1961).

Motiramani (1961-62) conducted an experiment to study phosphate fixation in Gwalior and Ujjain soils. On the basis of results obtained, the following conclusions were drawn.

(i) The amount of PO_4 fixation increased with the concentration of added P_2O_5 but not proportionately.

(ii) The per cent fixation of the added phosphate decreased with the increase in concentration.

(iii) The phosphate fixation of the added phosphate was favoured by 1 : 4 soil solution ratio as compared to 1 : 10 soil solution ratio.

(iv) The speed of phosphate fixation declined after an intial rapid rate. It is suggested that there is a rapid reaction and a slow one which may or may not be complete depending upon the concentration used.

(v) The lower doses of phosphate additions to the soil are likely to be almost completely fixed. In view of this field experiments with larger doses of phosphate are suggested.

(vi) The above coclusions are true for both Gwalior and Ujjain soils. However these two soils differ in one respect namely that Black cotton soil of Ujjain possesses higher phosphate fixing capacity due presumable of high clay per cent and presence of $CaCO_3$(Motiramani, 1961-62).

A preliminary study on the soils of Khandwa (Nimar) district (M. P.) was conducted by Shastry and his associates (1961-62). 164 soils samples from Punasa area, 146 from Khandwa area and 30 each from Burhanpur, Khakner and Harsud areas were analysed for pH, conductivity, organic carbon, available phosphorus, available potash and carbonates.

A study of the results shows that the soil reaction in the district is mostly near neutral varying from 6.0 to 8.0 except Punasa and Khandwa areas where some of the soils show alkaline tendencies. The soluble salts are normal for the growth of the most of the crops and again in Punasa and Khandwa some patches with high salt content are met with.

The organic carbon content is low in about half of the soils of the district being below 0.5 %, medium in another two third cases and high in the remaining. Towards Burhanpur and Khakner, in more than half of the

cases the organic carbon content is low. The available nitrogen is primarily low and varies from 100 to 200 lbs per acre. In the areas of Burhanpur and Khakner, even lower values are recorded.

The available phosphorus in the district is low in about 40 % soils, medium in 33 % and high in the remaining soils. In Burhanpur and Khakner tracts phosphorus content is low in more than 60 % soils. The potash is mostly high in about 95 % of the soils, whereas in the remaining ones it is medium. The soils of Burhanpur, Khakner and Harsud are comparatively high in potash content.

The carbonates are universally present in almost all the soil samples analysed and vary between 1 -10 %. In many cases, especially in Khandwa area, carbonates above 10 % also come across.

The soils of the district have colours of grey and brown admixtures primarily being grey brown to dark grey brown with a few yellowish patches. The texture is mostly medium to heavy ranging from loam to clay having 20-45 % clay content. A few of the soils are sandy loam with clay less than 20 %.

From the stand point of fertility status of the soils of Khandwa district, it could be summarized that the soils are fairly poor in nitrogen and organic matter contents, low to medium in phosphorus and well supplied with potash. The soil reaction and soluble salts are favourable for the growth of the most of the crops. The texture of the soil being mostly heavy presents certain difficulties in cultivation practices, but helps the soils to retain good amount of moisture(Shastry, 1961-62).

Expanded Soil Testing Service in the Madhya Bharat State

This Scheme was started during 1955-56 under the control of Indian Agricultural Research Institiute(I. A. R. I.). A Soil Testing Laboratory with sufficient staff and equipment has been established at the Chemistry Section of the Agricultural Research Institute, Gwalior. This is an all India scheme and the Laboratory at Gwalior aims at providing free soil testing service to the cultivators of Madhya Bharat for recommending proper manurial and fertilizer doses. This service will also analyse the soil samples for fertilizer experiments so as to prepare correlations between yield response and the soil tests. These will later on, be very useful for chalking out suitable manurial schedules in the State.

A statement showing the number of samples dealt with during these years in the Chemistry Section of Agricultural Research Institute, Gwalior is given below (Table 32) –

Table 32: Samples analysed / studied by Chemistry Section during different years.

Year	Seeds, Fertilizers etc	Soil	Total
1952	52	118	170
1953	106	60	166
1954	54	34	88
1955	81	83	164
1956	26	147	173
Total	**319**	**442**	**761**

(ARI, 1952-56).

Shri Y. P. Bali, Soil Chemist, Soil Testing Service, Gwalior, gave a talk on the working, organization and importance of 'Soil Testing Service' in M. P. during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. The summary of his talk in the form of "A note on Progress and Programme in Gwalior and Indore Divisions" is given in Appendix VII.

Preliminary studies of the soils of Alirajpur (District Jhabua), M. B.

With a view to start a regional experimental station in the South Western of Madhya Bharat, about 50 Soil Samples were collected from villages, Godat, Kathiwada, Jobat and Koocia of Alirajpur Tehsil of Jhabua District. The analytical results of some of the samples are presented in Appendix VIII.

These soils are to some extent representative of the sandy soils of hilly tract of Jhabua District. The soils are normal to slightly alkaline in reaction, the calcium carbonate is usually low, though at certain places it is very high exceeding 10% . The percentage of clay in some of the pits is below 10 only while in others it is about 20. It is also clear from the data that the pH value, calcium carbonate content and the clay percentage are irregularly distributed in different layers up to 36″(ARI, 1952-56).

Report on soil samples from Lahar Pargana (District Bhind), Madhya Bharat

The soil samples were collected from different villages in the Lahar Development Block with a view to find out the cause of lowering yields of cotton in that area. Seven soil samples were analysed and results are given in Appendix IX.

These soils are alluvial, sandy loam in texture, light brown in colour and friable and fine grained. The analytical results show that the pH and total soluble salts are fairly normal and there is no indication towards salinity and alkalinity. The moisture percentage is low (1.11 to 2.24%) and indicates low retentivity of moisture in the soils. Hence, it was reported that the low yields may be due to poor physical conditions of the soils and low nutrient status (ARI, 1952-56).

Studies of surface soils of some villages in Guna District (Madhya Bharat)

This work was under taken to judge the suitability of the soils of either of the Guna or Raghogarh Tehsil for starting a mechanised cultivation farm under the Central Government. The area covered was nearly 300 sq. miles and 26 surface samples of 0-9″ depth were collected. The results indicate that the soils are clayey and have a range of 35-50% clay which may also favour high adsorption and good base exchange capacity. The moisture percentage is fairly high indicating good moisture retention capacity. The pH is slightly acidic to slightly alkaline and the total soluble salts are low indicating that the soils are normal with respect to salinity. The surface soils are not much calcareous as the calcium carbonate percentage varies between 0-3.7% only. The organic matter content, the total nitrogen the available phosphorus content etc. show that the soils are rather poor in their nutrient status.

The soils of both the Tehsil are suitable for mechanized cultivation. The site at Guna Tehsil is more suitable due to a smooth topography and vast stretches of waste lands available (ARI, 1952-56).

Investigations of the soils of Dabra Sugarcane Farm

Surface samples from some experimental plots at Dabra were sent for analysis by the Cane Development Officer. Later on, some more soil samples were collected for investigation into the cause of some diseases in the Sugar cane crop. The problem was referred to this section by the

Manager, Gwalior Sugar Co., Dabra. The results of analytical work(Appendix - X)show that, the soils are some what alkaline as the pH value in most of the cases is above 7.5 and are medium heavy in texture, their clay percentage being 30-40. The soils are poor in nitrogen and phosphorus supply. It shows that the soils require balanced manurial doses in respect of nitrogen and phosphorus (ARI, 1952-56).

Soil Profile studies of some proposed experiment farms in the Chambal Commanded area

Profile samples from Bhind, Jora and Baroda were collected with a view to study their characteristics and suitability for establishing the experimental farms in the Commanded area under Chambal Irrigation Project. The farms are proposed to serve as pilot Experimental Stations for studying the frequency and intensity of irrigation and other allied problems. The results are presented in Appendix XI.

The soils of Bhind and Jora are medium heavy in texture with a clay percentage of 20-32, while those of Baroda are quite heavy having a clay percentage of over 40. The soils of Bhind and Jora are neutral to slightly alkaline, respectively while those of Baroda are alkaline having a pH value over 8.2. All the profiles show an increase in pH values and clay content with the depth. The figures for total nitrogen in Jora profile are extremely high owing to this being heavily manured and being under vegetable culture (ARI, 1952-56).

Pre-Irrigation Soil Survey of Chambal Commanded Area

Under this scheme 1959 soil samples from 166 profiles have been analysed from Gohad, Sabalgarh, Sheopur, Morena, Ambah, Bhind and Mehgoan Tehsil. All the samples have been analysed for clay content, pH, Total soluble salts and calcium carbonate. The work of classification of these soils with regard to their suitability under irrigation is in progress (ARI, 1952-56).

Scheme for the study of the physical properties of certain Chemical Fertilizers under storage conditions

Under the I. C. A. R. control, six different fertilizers, namely, Ammonium Sulphate, Ammonium Nitrate,Ammonium Phosphate, Urea, Nitro phosphate and Triple Super Phosphate (imported under T. C. M.) were studied at 20 different places in India with a view to find out their storage qualities with respect to –

(i) Their physical properties like moisture absorption, lump formation, deliquescency etc. under pacca and kacha godowns.
(ii) Changes into the chemical composition.
(iii) Finding suitable packing material.

The centre in Madhya Bharat was situated at Indore. The work was conducted during 1952-53 and 1953-54.

The results from all the centres were complied at I. A. R. I. In general, it has been observed that the Nitro phosphate absorbs moisture to become deliquescent. The tendency to form lumps is related with the granular nature of the fertilizers and fine crystalline fertilizers like Ammonium Sulphate and Urea form hard lumps. Packing of fertilizers in "Alkathine liners", multiwall 50 ply kraft paper bags with two ply asphalt laminated etc. store the fertilizers in an appreciably good condition. It is also recommended to have bags of 1 cwt. Capacity for easy handling and transport (ARI, 1952-56).

Scheme on Agronomic Trials under T. C. M.

This scheme in the State of Madhya Bharat was run by I. A. R. I. in complete co-operation with the Chemistry Section of the Agricultural Research Institute, Gwalior. The TCM scheme had 2 parts: (a) Simple fertilizer trials on cultivators fields and (b) Complex Agronomic Trials on Experimental farm. Under(a) of this scheme simple agronomic trials with different fertilizers were conducted on cultivators field in Mhow Development Block on wheat crop. The trials consisted in different levels and types of nitrogen alone and in combination with phosphorus. These experiments were spread over 40 villages, during the year 1954-55 to 1955-56. The results have been passed on to the I. A. R. I., for the compilation and the general report. Some of the conclusions are.

(i) Response to Nitrogen was observed in all the experiments.
(ii) Urea seemed to be a better source of Nitrogen.
(iii) A general response to phosphatic fertilization alone and in combination with nitrogen was observed.
(iv) Maximum yield was obtained by applying 40 lbs Nitrogen in the form of Urea with 20 lbs P_2O_5 in the form of Triple super phosphate.
(v) The optimum dose was considered to be 20 lbs Nitrogen as Urea.

The second part of the TCM scheme consisted in laying out complex agronomic trials on a 15 acre block. These trials were conducted at Experimental Farm Bagwai on paddy and wheat from 1954-55 to 1955-56. These experiments dealt with –

(i) Levels and kinds of nitrogen and phosphorus.
(ii) Time of application of nitrogenous fertilizers.
(iii) Placement of phosphatic fertilizers.
(iv) Residual and cumulative effect of phosphates.
(v) Irrigation cum manurial trials.
(vi) Manurial cum varietal trials.

The results of these experiments have been passed on to I. A. R. I. for compilation and preparing the general report. In general these experiments showed that the Bagwai soils responded well to the phosphatic fertilizers. Triple Super Phosphate placed 2-1/2″ below the seed gave better results. Although there was a response to nitrogen and phosphorus fertilizers individually, the maximum yield of paddy was obtained with 40 lbs phosphorus along with 40 lbs nitrogen (ARI, 1952-56).

Shri G.P. Verma who was appointed as the first Research Assistant, T.C.M. Scheme, Bagwai, in 1954, published two research papers based on the work of the scheme.

(i) Phosphatic manuring of paddy and its economics (Verma, 1961a).
(ii) Interaction of paddy varieties with fertilizers (Verma, 1961b).

I.C.A.R. Scheme on Model Agronomic Experiments and Co-ordinated Scheme on Simple Fertilizers trial in Cultivators field

After the termination on the TCM Agronomic trials scheme on 29-2-56, the I. C. A. R. took up the work of continuation of the studies on responses of different fertilizers on different crops under various climate and soil conditions. Under these schemes the work was in progress at Ujjain and Bagwai in respect of Model Agronomic Experiments and at Mhow with regard to the Co-ordinated Scheme on Simple Fertilizers in Cultivators field.

At Ujjain, three experiments were laid out on Cotton and Jowar inkharif andfour experiments on wheat have been laid out during the Rabi of 1956-57.

At Bagwai, five experiments were completed on paddy during the Kharif, 1956 and during Rabi 1956-57 five experiments laid out on wheat.

At Mhow, seventeen experiments were conducted during Kharif 1956 on cotton and jowar and twenty experiments were laid out during Rabi 1956-57 on wheat.

Soil Conservation Programme and Increased Production

Shri Khanwilkar, Assistant Soil Conservation Officer, Gwalior, presented a talk on "Soil Conservation Programme and Increased Production" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. He emphasized on contour bunding and adoption of dry farming measures. He disclosed that the cost of contour bunding averaged about Rs. 50 per acre, in the region. He emphasised on planting of grasses on bunds and grading of fields. The summary of his talk is given in Appendix XII.

Role of Micro-organisms in Building up of Soil Fertility

Shri G. P. Verma, Lecturer in Agricultural Chemistry, College of Agriculture, and I/c Chief Chemist, Gwalior, talking on "Role of Micro-organisms in Building up of Soil Fertility" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959, concluded that micro-organisms are highly indispensable for our existence. His talk has been summarised in Appendix XIII.

(4) Mycological / Plant Pathology Section

The following diseases were dealt with during the year 1949-50 –

Jowar Smut : Rupees five thousand were sanctioned by the F.P. Commissioner to purchase sulphur for preparing sulphur packets for distribution to cultivators.

Wheat Smut : Solar energy treatment against wheat smut was advocated to Inspectorial staff and also to the Farm Superintendent i.e. to expose wheat seed on a day when the temperature is 110^{o} F and above.

Wheat Rust : These experiments were conducted at Gwalior, Bagwai, Bhilsa, Ujjain, Indore, Dewas, Dhar and Biaora Farms with varieties recommended for wheat rust trial by various Provincial Governments. No rust attack was reported from farms except at Gwalior.

Eighty-two varieties from I.A.R.I., Indore Plant Institute, Bombay, Punjab, C.P. and some local selections were grown on Gwalior Farm to observe their comparative performance and incidence of rust thereon. Observations were recorded on 22nd and 28th of March, 1950 and it was found out that not a single variety escaped the attack of rust (either black, brown and yellow). No damage was seen on the crop as it appeared after the crop had ripened. The prevalence of rust was hardly about 10% on Niphad 4, I.P. 165, N.P. 52, I.P. 111 and I.P. 80/5 and severity was in traces. Rest of the varieties has an attack varying in intensity escaped brown and yellow rust, but it was found susceptible to black rust which was the worst of the three. Yellow rust was the first to appear and was noted on 30th January, 1950. Brown rust was seen on 13th March, 1950 and black rust on 18th March, 1950 at Gwalior Farm. The Varieties Niphad and I.P. being early in maturity by 3 to 4 weeks showed indications of resistance.

Linseed Rust: Thirty six rust resistant varieties of linseed were brought from I.A.R.I. and were tried at Bhilsa and Gwalior Farms to observe their comparative performance. Out of these Nos. 5, 9, 10, 122 and 187 had shown hopeful indication.

Rust on millets (Jowar and Bajra) : The survey work for rust on millets was done during the year, with a view to find out the incidence of rust on these crops and to investigate control methods as per instructions from I.C.A.R. During the course of survey, it was observed that the incidence was very insignificant.

Dieback of Chillies: Dieback disease on Chillies at Sundersi villages in Shajapur Districts was reported. It was treated with lime Sulphur wash and the damage was thus reduced to 50%.

Powdery mildews on mango: Twenty mango plants at J.C. Mills, Gwalior were affected by powdery mildews. Sulphur dusting was done which controlled the disease completely.

Pan Wilt disease: A scheme (costing Rs. 12,000 for 3 years) on control of Pan wilt disease by spraying with Boredeux mixture has been prepared and submitted for sanction.

Coriander wilt research scheme: This was the 5th year of the scheme. The work was carried out as per programme laid down. Five varieties, viz. local, Coimbatore, Dharwar, Seoni and Raichur were under

trial. The crop was reported to have been damaged by cold wave in February 1950.

Apart from the above work done by the section, 50 specimen of diseases from various parts of Madhya Bharat were dealt with and control measures were taken.

Leaflet on Jowar Smut, Wheat Smut Powdery Mildew, etc. were prepared in Hindi and submitted for approval and get them printed for free distribution.

Spraying of fernoxone against *Adhashishi* weed was done at villages of Kuleth, Mehgoan, Gohad & Purani Chhaoni(ARDA, 1949-50).

The following research and experimental work in Plant Pathology section was done during the year 1951-52 :

Wheat Rust : This year 9 races of black rust were procured from Rust Research Sub-station, Simla to test resistance of strains grown in this locality along with 6 new strains obtained from Delhi (2) and Bombay (4). In all 13 strains, viz., G.D. 11 (control), E. 144, 220, (Kenya); Atarra 1-1, Allapur, Fazilca G. 5 and G. 15 (Gwalior local); Niphad 4, Kenphad 21, 28 and 34 (obtained from Bombay) and Pbc. 591 (Punjab) were inoculated with mass culture in their seedling and adult stages. E. 144, E. 220, Kenphad 21, 28 and 34 did not show incidence of rust in both the stages in pots as well as in the fields.

Coriander Wilt: The results of the experiments in constant temperature tanks at I.P.I. Indore indicated that the wilt reaches its maximum development in soil temperature between 20^{o} - 27^{o} C and in 50% moisture holding capacity of the soil.

The application of organic and inorganic manures did not induce the resistance to the wilt to any extent.

Morphological and physiological study of the fungus revealed that the organism resembles *Fusarium oxysporium.*

Betal Vine Wilt : A survey of Betel Vine gardens revealed losses ranging from 25 to 40% due to the wilt disease. In isolation *Sclerotium spp., Fusarium spp.* and *Verticillium spp.* were obtained.

Identification of the diseased specimens: This year 103 specimens of diseased plants were identified and remedial measures thereof were suggested.

Record of new diseases: The following diseases which appeared to be new ones were isolated and identified –

(i) Wilt in Brinjal. (ii) Wilt in Chillies.
(iii) Wilt in Wheat Seedlings. (iv) Wilt in Ginger.
(v) Leaf-spot of Sweet Potato. (vi) Leaf-spot of peas.
(vii) Leaf-spot of Jack fruit.

Smut of Jowar : During the year 1951-52 about 240 of powdered sulphur made into 1 oz. packets sufficient for treating 8 lbs of Jowar seed each were sold to cultivators at the rate of half anna per packet through the District Inspectors of Agriculture.

Smut of Wheat : At Ujjain Farm about 100 maunds* of wheat seed were subjected to solar energy treatment with a view to prevent the incidence of smut in the resulting crop.

Powdery Mildew of Mango : Two hundred and twenty-four lbs of sulphur were used for dusting mango trees (about 500) at the blossom time against mildew and mango hoppers in orchards round about Gwalior (ARDA, 1951-52).

The following diseases were dealt with during the year 1952-53 –

Wheat Rust : The 3 Kenphad strains of wheat (21, 28 and 34) were sown along with local wheat and C-591 on Gwalior and Bagwai Farms, with a view to study their comparative performance under local conditions. While the percentage of infection of rust was 40 in the Agra local and 25 in the Gwalior local varieties, there was absolutely no incidence of any of the 3 rusts (Yellow, Brown, Black) whatsoever in the Kenphad strains.

Coriander Wilt : Study of the temperature and moisture relations of the fungus-growth was made at the Plant Institute, Indore, where constant temperature tanks were available. It was found that wilt fungus attained maximum development at soil temperature ranging between 24^{o} and 27^{o} C and 50% moisture holding capacity of the soil.

Application of organic and inorganic manures to coriander did not induce resistance to wilt, but on the contrary, increasing doses of nitrogen, phosphate and potash increased the severity of the disease.

Betel Vine Wilt : The 3 wilt fungi (*Sclerotium, Fusarium* and *Verticillium*) were isolated from diseased material and pure cultures developed. In a heavily infested patch in a betel-garden, the soil was

loosened and applied with varying concentrations of formalin in water at the rate of 5 per sq. ft. The application of 1:50 dilution proved effective.

Wheat seedling Wilt : Observation at Bhilsa and Gwalior farms revealed that seedlings were destroyed by the maggots of a fly (*Atheriogona-sp*) which bored into the stem and killed the plant, the damage in some fields being as high as 90%. '*Fusarium*' was secondary infection, and as the death of the wheat seedlings was not caused by the fungus, the study was given up.

Identification : Fifty specimens of diseased plants received from cultivators, Inspectors of Agriculture and Plant Protection staff identified and remedial measures suggested for each.

The following new diseases were recorded, the causal organisms identified, isolated and their life-history studied.

i. Gingere wilt (*Fusarium*).
ii. Chillies wilt (*Fusarium*).
iii. Sweet Potato Leaf Spot (*Alternaria*).
iv. Peas Leaf Spot (*Alternaria*)(ARCA,1952-53).

The following research work was done in Plant Pathology Section during the year 1953-54 –

Wheat Rust : Kenphad No. 21 and 28 which had proved resistant to Black rust in both seedling and adult stages under Gwalior conditions in 1951-52 and 1952-53 were sown in a replicated trial with five wheat hybrids received from Wheat Specialist, Madhya Bharat and N.P. 710 and Local as control. This experiment was conducted in collaboration with Economic Botanist. The results are given below (Table 33) –

Table 33 : Grain yield and date of maturity of different varieties of Wheat.

Variety	**Yields of grain in lbs per acre**	**Date of maturity**
Hybrid 8	1,083	31-3-54
Hybrid 11	1,220	31-3-54
Hybrid 12	1,134	30-3-54
Hybrid 38	908	28-3-54
Hybrid 278	1,034	3-4-54
Kenphad 21	1,145	3-4-54
Kenphad 28	1,215	2-4-54
N. P. 710 Control 1	1,215	31-3-54
Local Control 2	968	3-4-54
S. E.	66.50	
C.D.	136.99	

The results are significant and indicate that Hybrid No. 11, Kenphad 28, N.P. 710, Kenphad 21 and Hybrid No. 12 are significantly superior over local control but there is no significant difference among these five varieties.

Kenphad 21 and 28 were free from Black rust. Where as it was present in varying degrees in rest of the varieties.

Agra local, I.P. 4 and local (Madhya Bharat) wheats were sown at Gwalior and Bhilsa farms to study the incidence of rust. Slides exposed in Aeroscopes fixed in these varieties were examined and sent to the Head of the Division of Plant Pathology, Indian Agricultural Research Institute, New Delhi for the study of the incidence of wheat rust in India.

In the southern portions of Madhya Bharat, wheat rust was totally absent whereas in northern regions, the rust in all the three forms, appeared particularly in the districts of Bhilsa, Gird and Bhind.

Linseed Rust and Wilt : The linseed crop grown in the State was, in general, free from rust, but wilting due to the fungus (*Fusarium lini*) was observed all over, the damage being estimated to vary from 10 to 20%.

Gram Wilt : The disease did considerable damage ranging from 25 to 50% in the districts of Guna, Bhilsa and Mandsaur. *Verticillium Rhizoctonia* and *Fusarium* species were found in most of the isolations.

Potato Disease : The mycologist of the Directorate of Plant Protection and Quarantine Ministry of Food and Agriculture, New Delhi inspected the varieties of potatoes in the cold storage at Gwalior. "Wart"disease (due to *synchytrian*) was not observed in any of the varieties including the material imported from Holland. *Sclerotia, Fusarium* and Bacterial rots were observed to the extent of 30%.

Field observation on the above varieties grown in Gwalior Dairy Farm, cold storage and Dabra Sugar Factory Farm revealed the occurrence of *Alternaria* virus, *sclerotia*, *Rhizoctonia* and Bacteria to the extent of 10 to 20%.

Rice Diseases: *Sclerotia, Helminthosporium, Entyloma* and *Phyllosticta* species were observed on the rice crop grown in Gohad, Harsi and Purani Chhawani area of Gird and Bhind districts. In general the extent of damage varied from 10 to 25% while in some field it was as high as 50-75%.

Survey and Study of Life-History of New Diseases : The following diseases were recorded in Madhya Bharat for the first time in the State. Most of these fungi were isolated and study of their life-history was in progress –

(i) Gummosis of Mosambi due to *Diplodia indica*.
(ii) Leaf spots on cucumber and bettle-gourd due to Bacterium.
(iii) Powdery mildew on sounf due to *Erysiphe*.
(iv) Spots on stem of sounf (*Foeniculum vulgare*) due to *Cerospora sp*.
(v) Spots on leaf, stem and fruit of Til due to *Alternaria*.

'Smuts' on number of grasses were collected from different parts of the State and their identification study was in progress.

Advisory and Disease Control Work :Seventy five disease specimens of crop plants received from the cultivators, plant protection and district Agricultural staff were examined, the causal organism identified and remedial measures suggested.

Treatment of Jowar seed with sulphur dust and wheat seed with solar energy were done.

Control of Jowar and wheat smut. 1,515 maunds* of Jowar seed and 73 maunds* of wheat seed were treated.

Forty maunds* of wheat seed were treated with Agrosan G.N. against foot rot of wheat and treated seed gave good & disease free crop.

Spraying with Peronox on Lowki (*Lagneria leaucantha*) against Peronoxposa and dusting with sulphur on wheat and *Cucurbita maxima* (kaddu) against rust and powdery mildew were done and diseases were brought under control.

Pan garden of Bhilsa villages was treated with Formalin to control wilt disease but with no success(ARCA, 1953-54).

Dr. A.C. Jain, Plant Pathologist, Gwalior giving a talk on "Important plant diseases and their practical control measure" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions held at College of Agriculture, Gwalior from 3rd to 8th April, 1959, pointed out that there was a loss of 10 to 20% in our agricultural produce due to various diseases and there was a great necessity of protecting the crops from diseases. He also submitted a list of important diseases of important

crops of the region, with main symptoms and control measures for them. The summary of his talk is given in Appendix XIV.

Common pests and diseases observed in Gwalior and Indore Divisions

Name of the crop	Disease	Inspects pests.
I. Foodgrain crops and pulse-		
(a) Jowar and Maize	Red rot, smut	1. Root borer.
	collar rot, rust and	2. Jowar & maize stem
(c) Wheat and barley	smut wilt.	borer, grass hopper, hairy
(d) Gram and Arhar		caterpillar, Rice bug, grass-hopper, white grub, termites, beetle, gram caterpillar and pod borer, hairy caterpillar.
II. Cash crops-		
(a) Sugarcane	Red rot	All the three borers, pyrilla, white fly and termite.
(b) Fibre crop cotton.	Black arm,	aphids, jassids, red spider mite, leaf roller, pink and spotted bolloworms.
(c) Oilseeds, Groundnut		Tikka, collar rot Aphids,
	jassids, Grasshopper	
and Til		til pod borer.
(d) Tobacco	Damping of	Aphids, grasshopper, caterpillar.
(e) Singhara		Singhara beetles.
(f) Beetlevine	Virus, pan wilt	Pan beetle, aphids.
III. Vegetables-		
(a) Potato	Late and early blights,	Leaf eating caterpillar, cut
	bacterial blight, leaf	worm, aphid. curl.
(b) Tomato	Virus.	Aphids, leaf eating caterpillars thrips.
(c) Chillies	Virus, leaf, curl, Die back	Thrips, aphids & jassids.
(d) Onion	Mildew	Thrips and aphid.
(e) Cauliflower		Leaf eating caterpillar, aphids grasshopper, Beetle.
(f) Cucurbits	Mildew	Aphids, jassids, thrips, red pumpkin beetle, leaf eating caterpillar and flee beetle.

IV. Stored grain pests		Khapara, ghun, weevil.
V. Fruit plants-		
(a) Citrus Lemon	Citrus canker cymosis	Borer, fruitfly, whitefly, butterfly, aphids bug.
(b) Mango	Mildew	Borers, hopper, bug.
(c) Papaya	Virus	Aphids, thrips.
(d) Grape	Mildew	Aphids.

(PFSCRC, 1959).

A varietal trial for resistance against the Early Blight of Potato was conducted at Gwalior during the year 1959. Varieties Satha, Type 194 and Hybrid 22 seemed to be resistant and Gola and Military Special highly susceptible. Spraying of foliage with copper fungicide and zinc carbonate (Dithane) checks the disease (PRWC, 1959).

At Indore, about 350 cotton selections have been tested for the wilt resistance. A variety 'Bhoj' which has also desirable economic qualities has been found to be highly wilt resistant (PRWC, 1959).

The results achieved during the year 1960-61 at Gwalior Centre are briefly described below –

Pan Wilt :

(a) Pathogenocity of *Scalorotium rolfsii* was established.

(b) The fungus growth was much better at 29^{o} than at 14^{o}C.

Survey of Diseases and Pests of Pan : This scheme was started from August, 1960. Gwalior, Shivpuri, Chhatarpur, Mandsaur and Ratlam Districts were surveyed.

Wilt Disease of Coriander : Wilt resistant strain 5365 gave nearly 10% higher yield than the local variety. The yield was higher in case of Ceresan dry seed treatment than in control.

Root Rot of Til : *Macrophomina phasooli* was shown to be the causal agent of this disease.

Soft Rot of Ginger : (a) Pathogenocity of *Pythium sp.* isolated from diseased tubers was established. (b) Ceresan wet, Dithane Z-78 and Copposan were tried as soil treatment, seed treatment and seed plus soil-treatment. The results showed that Dithane Z-78 gave the best results especially when used as seed treatment.

Potato early blight : (a) Of the two fungicides tried i.e., Dithane Z-78 and Fytolan, the former proved better. (b) An experiment on the effect of treatment of potato cut seed with Cupravit, Ziram, thiram, Dithane Z-78, Ferbam and Agallol showed that treatment improved germination. The highest germination was found in case of Agallol.

Root Rot of Gram : (a) *Operculleia padwickii* was found pathogenic and was reisolated from the inoculated plants. (b) Studies indicated that fertilizing the soil @ 0.2% predisposed the plants to root rot infection. (c) Laboratory studies showed that growth of *Operculleta padiwickii* is directly correlated with concentration of KH_2PO_4. (d) Field tests on the effect of super-phosphate manuring on the incidence of root rot were inconclusive due to uneven incidence of disease.

Fungicidal treatment of Pea Seed : Seed treatment with Agrosan GN improved the germination considerably. Field studies suggest that microbial activity decreased as the temperature went down with advance in winter season (PMARC, 1961).

The results achieved during the year 1960-61 at Plant Pathology Section, Institute of Plant Industry, Indore are briefly described below –

Study of Wilt resistance in *desi* cotton strains : Resistant selection of 7 cotton strains from the Economic Botanist, Madhya Pradesh State, obtained from the test conducted in the wilt plot in 1959-60 were tested in the wilt sick plot during 1960-61. Highly resistant material has been obtained from this test.

Fifteen resistant selections obtained from the wilt plot and the glass house during 1959-60 were tested in the glass house during 1960-61 under optimum conditions of infection. Highly resistant strains of *desi* cotton have been obtained from this test. Resistant material passed on to the Economic Botanist for breeding work or multiplication.

Study of black arm (Angular leaf spot) resistant in American cotton varieties : During 1960-61 incidence of black arm on 9 resistant selections of 1959-60 was studied in the field. This test yielded highly black arm resistant strains under field conditions. High incidence of black arm was recorded in the cotton crop of the Insititute.

Preliminary Studies on the Grey mildew of cotton : Observations were taken on the incidence of Grey mildew on 8 promising strains of desi cotton. None of the strains were found to be resistant.

Inoculation experiments with the inoculum collected from the infected leaves from the field crop gave negative results. Attempts to culture the fungus on artificial medium were unsuccessful.

Programme of the oil seeds Scheme (I.C.O.C.) :

Linseed Wilt – Seventy seven linseed strains and varieties from I.A.R.I. New Delhi, I.P.I. Indore, Gwalior (Madhya Pradesh), Kanpur (Uttar Pradesh) and Nagpur (Bombay) were tested for wilt resistance in the 'wilt sick' nursery during 1960-61. Out of these nine varieties were found to be resistant, 14 were intermediate and 54 were found to be susceptible.

Linseed Rust – Out of the 49 Linseed strains and varieties from I.P.I. Indore and U.P. (Kanpur) tested for rust resistance with the mixture of five physiologic races of the linseed rust by creating artificial epidemic, 8 were found to be resistant and the rest were susceptible.

A wilt resistant linseed strain : Indore 1 with good yielding ability, developed by the Plant Pathology Section was multiplied for distribution in the Malwa region of the Madhya Pradesh State(PMARC, 1961).

(5) Entomological Section

Plant Protection work

Control of Field Insects Pests : Usually the damage done to the field crops by insect pests comes to about 15%. This can be checked by taking timely control measures.

Pests controlled and remedial measures taken and suggested : An area of six bighas of vegetable crops infected by Red Pumpkin beetle and painted bugs was controlled, in the suburban gardens of Gwalior in July, 1949.

A crop of rice was affected by rice bug in Harsi area. This had spread over an area of 580 bighas. This was controlled by insecticidal drugs and crop worth Rs. 90,000 was thus saved.

Vegetable crops like Brinjal, Cauliflower, Knol-Khol, Radish, etc. were destroyed by Aphids and Saw fly grubs in Girwahi Naka and Lohagarh. Prompt control measures checked the pest.

Field Rats damaging wheat crop in Sehrai and Sugarcane crop in Bagwai were effectively killed by Cynogas fumigation and poison baits.

Stored Grain Disinfection : A tremendous quantity of grains is lost in store due to unscientific method of storing or due to damage by

insect pests in stores. Weather conditions are also responsible to some extent when the storage godowns are not constructed scientifically. Rats and Rodents take a heavy toll of stored grains. With the knowledge of modern efficient control methods of stored grains pests, the total quantity of 1,35,044 maunds* of grains stocked at various government godowns in Madhya Bharat Union was saved from being lost during the year 1949-50.

Anti-locust work

As per warning issued from time to time by Government of India Locust Swarms have begun to threaten the territory of Madhya Bharat Union from June onwards and consequently control measures have been taken in this respect from April onwards as per instructions of Government of India. The Government of India had started training classes in April at Jodhpur. The Entomologist and Agricultural Inspector, District Morena were sent to attend the training for about a week. Again the Entomologist along with the Development Secretary went to Jodhpur to attend the Administrator's Conference to finalize the plans for Anti-locust measures to be adopted in Madhya Bharat Union. There upon an Anti-locust scheme

*1 Bigha = 2000 sq. m.

costing Rs. 53,000 was prepared and submitted. The Government have accorded sanction for Rs. 45,000 for the same.

After taking training at Jodhpur, the Entomologist imparted training to all Agricultural Inspectors who were called here for conference during the month of April. These Inspectors after reaching their destination will disseminate this knowledge in their respective districts. In view of the impending danger from locust invasion all districts were provided with insecticides and dusting machines.

Publicity : To apprise the villagers of Madhya Bharat Union of Anti-locust measures, folders were issued from the Plant Protection Directorate, Government of India and illustrative posters prepared in the Section are being widely distributed throughout the Union. The locust charts prepared here have been appreciated by eminent Entomologist of India. Circulatory letters describing in details the various steps to be taken at the time of locust invasion have been issued to the district officers of Revenue and Agriculture Department. Locust information cards were sent to all Patwaris. Thus an efficient locust intelligence services were set up

throughout the State and thus the whole work was well organised. A fortnightly bulletin on locust movement was also issued.

Training : The Entomologist gave training to 150 candidates in grain storage, weed eradication and plant protection measures. All Inspectors were given training in anti-locust work, *Adhashishi* eradication work and also in grain storage work (ARDA, 1949-50).

Research/ Experimental work

The following research and experimental work in entomological section was done during the year 1951-52 :

Rearing of different immature stages : Mass rearing of *Poecilocerus pictus* was carried out. It was observed that the insect becomes quiescent one hour before and after each moult. It is polyphagous and herbivorous eater. The mating lasts for about 14 hours.

Rearing of *Dysdercus cingulatus* was carried out. In the month of June very high mortality was observed in all the stages when humidity was below 25%.

During the second rearing a pair of *Dysdercus cingulatus* was raised for breeding. The rearing was successful up to egg stage, 117 eggs were laid by the female. The eggs were yellowish-white in colour.

Some living locusts were collected and reared for observation of colour variation and breeding.

Affected lady's finger (Bhindi) were collected. The attack of *Earias fabia*was observed. Rearing was carried out. Sixty-one moths emerged out successfully. These have been preserved.

The apex part of the Brinjal branches were collected. Rearing of Brinjal stem borer was carried out. Twenty moths could successfully be preserved.

Seventeen pupae of *Anti-gastra sp.* were collected on Til crop at Central Farm. Rearing was carried out. Ten moths emerged and have been preserved.

On similar lines mass rearing of *Laphygam sp.* was carried out and 130 moths have been preserved.

Semi-loopers of *Plusia sp.* were collected on pea plants. Rearing was carried out. One moth successfully stretched and has been preserved.

Exelactus sp. pupae were reared. Four moths emerged out successfully out of these one pair was released for breeding. Mating period

was for more than 56 hours. The female died after laying 60 eggs. The rearing was continued only up to egg stage.

Thirteen grubs of Arhar root borer (*Sphenoptera sp.*) were collected. The rearing continued up to 60 days. The grubs tunnel the root rendering it to the form of saw dust. During the period under rearing ten grubs died. The rest were preserved.

Chemical Hormone Weed-killer of DCPA group gave very satisfactory results when tried against *Chenopodiumalbum* growing profusely in the wheat plots of Economic Botanist, Central Farm, Gwalior. One and a half lb. of chemical Hormone Weed-killer was diluted in 100 gallons of water which was sufficient for one acre field. The third day after spraying the weed was found turned pale yellow in colour and after six days of spraying the weed was found dead.

During the year 1951-52, the Entomology Section published a Booklet "DECADE IN ENTOMOLOGY" (ARDA, 1951-52).

The following work was done in Entomological Section during the year 1952-53 –

Survey of Prevalent Pests in Madhya Bharat : Crop wise collection of insect pests from various parts of the State was made and the collected pests were preserved for future reference. The Incidence of the various pests during the different parts of the year was recorded.

Laboratory Work : The important pests of Experimental Farm, Gwalior were reared in the insectary and their seasonal life history was studied.

Anti-locust and Plant Protection Work : The section was mostly busy throughout the period for organising anti-locust work in the State and had been constantly imparting technical advice to different Plant Protection Inspectors.

Miscellaneous : The construction of entomological museum, parasitological laboratory, taxonomical laboratory, insectary and toxicological laboratory was completed during the period under report.

Training and Education : Due to paucity of equipment and lack of teaching staff in Department of Agricultural Zoology and Entomology in Madhya Bharat College of Agriculture, the Entomologist was ordered to teach final year B. Sc. (Ag.) class of the college in Entomology practical and theory from January end and he completed the course accordingly.

Eight Officers were sent to Jodhpur for Anti-locust training(ARCA, 1952-53).

The following research work in Entomology Section was done during the year 1953-54 –

A study of the efficiency of different Rhodenticides : Observations on zinc phosphide, barium carbonate and tomarin revealed that zinc phosphide gave immediate effect and barium carbonate next.

Insect Pest Collection Work : The major insect pests of the following crops have been collected –

Sugarcane	Root borers (*Emmalocera deprisella*)
Cotton	Larvae of leaf roller (*Sylepta deregata*)
	Larvae semilooper (*cosmophitaerosa*)
Jowar and Maize	Larvae of stem borers (*chilesp*) and *Sesamia sp*.
Paddy	*Leptecorisa varicorius.*
Wheat	Stem borers *Atherigona sp*.
Peas	Leaf rollers
Cabbage	Eggs and adults of *Bagroda picta*.
Bhindi	Larvae of *Earias sp.*
Brinjal	Hairy caterpillars.
Karela	Maggots of *Dacus sp.*
Phalsa	Beetles
Tobacco	Larvae and pupae of *lensonode sp.*
Lemon	Eggs and Larvae of *papitio demotens*.
Akaua	Adults of *Poecilocerus pictus*.
Ber Plant	Larvae of Tussock moth, *Hemirocampa lancestigma*.
Grasses and Weeds	Eggs of coried bug Larvae of semilooper.
	Larvae of leaf roller (*sylepta deorgata*)

Incidence of Insect epidemics in the State : The under mentioned insect epidemics were recorded during the year 1953-54 –

(i) Cricket in the sannehemp fields where the Crop was sown for green manuring for paddy.
(ii) Rice Gandhi Bug (*Leptocorise sp.*) in the paddy area.
(iii) Field rat epidemic in all the cultivated area.

Rearing of insect pests : Major insect pests collected on the crops were reared in the insectory to study their life-history. In addition to this silk moths were reared. A study on a predator of cotton leaf roller has been taken up.

Two hundred samples of cotton seed of the Economic Botanist, Central Farm, Gwalior were treated with Killoptera as well as solar-heat treatment against different insect pests of cotton particularly pink boll worm (ARCA, 1953-54).

The results achieved during the year 1959 at Gwalior are briefly mentioned below –

Biology of mustard aphis has been worked out. Metasystox and Folidol E. 605 at 0.01% and 0.05% respectively,were found effective.

Study on Sugarcane borers showed that February-planted canes were less susceptible to damage. *Iceryapilosa*, a coccid on sugarcane was controlled by Basudin & Folidol E. 605 at 0.069% & 0.092%, respectively.

Against termites in unirrigated wheat fields, Aldrin 5% dust at the rate of 20 to 40 lbs sown with the seed gave promising results.

D. D. T. 3% dust or Endrin 0.1% were found to control the cotton Bollworms (PRWC, 1959).

The results achieved during the year 1960-61 at Gwalior Centre are briefly described below –

Chemical Control of Wheat Termites : Dusts of Aldrin, B.H.C., Chlordan, Toxaphene, Basudin and Folidol were tried as (i) Seed-treatment and (ii) Soil-treatment under both (a) dry and (b) irrigated conditions. In all 15 experiments were conducted at Gwalior, Bhind, Jora and Ujjain.

On the basis of low termite incidence, good germination, tillering and yield, aldrin 5% dust @ 20 lbs per acre proved to be the best under both dry and irrigated conditions when tested as a seed-treatment as well as soil treatment. No adverse effect was observed in the case of this insecticide. Toxaphene, B.H.C. and Chlordane deserve further trials as soil treatment. D.D.T., Basudin and Folidol do not need any further trial for control of wheat termites.

Studies on Sugarcane Pests : In an experiment on chemical control of termites carried out at Gwalior highest germination was found in aldrin and highest tillering in sp. treated plots. Texaphene affected both germination and tillering. Due to large scale pilferage the yield data could not be assessed and the results of the experiment were inconclusive.

Survey and Studies on Insect Pests of Pan : Studies on the biology of the white mealy-bug, *Ferrisiane virigata* and unidentifiedscale insect were started during March, 1961. The life cycles of mealy-bugs and scales

(males of both) were successfully completed in 19-23 and 24-26 days, respectively. Unidentified Hymenopterous parasites attack both insects.

Survey Biology and Chemical Control of Cruciferous Pests : *Memestrae brassicae* and *Breyicoryne pseudobrassicae*occurred as serious pests and *Athalia proxima, Bargada cruciferarum, Plusia orichalcoa,* a semilooper, a hairy caterpillar and a Memracid were found as minor pests on cauliflower.

The results of three experiments carried out on chemical control of *Memestrae brassicae* indicate that Folidol spray at a strength of 0.325% @ 100 gallons per acre or over effectively control larvae of this pest of cauliflower.

Studies on Phytotoxicity of Insecticides to Cucurbits : Aldrin, B.H.C., Chlordan, D.D.T. (5% dusts), Folidol, E-605, Parathion and Basudin (1.5% dusts), 3% Lindano dust and 1% Aldrin dust were tried as seed dressing @ 1 teaspoonful to each pit. In all the treatment except D.D.T. and Aldrin germination was poorer than in control. D.D.T. was safest, but B.H.C. Linpane, Chlordan and parathion affected germination adversely.

Studies on the Phytotoxicity of Insecticides applied to wheat seed before sowing: B.H.C. dusts @ 10 and 20 lbs per acre, Chlordan 5% dust @ 15-30 lbs per acre, and 1.5% Folidol dust @ 15-30 lbs per acre when used to treat wheat seed just before sowing, germination and yield were affected adversely. On the other hand, 5% aldrin dust @ 10 lbs per acre was the best for seed treatment. Considering germination, tillering, height and yield together D.D.T., Texaphene and Basudin did not show any adverse or beneficial effect.

Research work on the following aspects was carried out with the assistance of M.Sc. (Ag.) students of Entomology Department, College of Agriculture, Gwalior –

(i) *Earias sp*. as a pest of Bhindi and its control.
(ii) Control of *Carpomyiavosuviana* Costa at Gwalior.
(iii) Incidence and control of Brinjal fruit and shoot borer at Gwalior.
(iv) Effect of application of some systematic insecticide on aphid and its predator, *Coccicell tumpunctata*(PMARC, 1961).

The dust at 2.00% and 3.00% concentration and emulsifiable concentrate at 0.02%, 0.08%, 0.1%, 0.2% and 0.3% concentration of each of the four insecticides namely D. D. T., Dieldrin, Toxaphene and

Malathion were tested at Gwalior on potted plants of three species of cucurbits namely Loki (*Lagenaria vulgaris*), Tinda (*Citrullus vulgaris*) and Torai (*Luffa eagyptica*) replicated three times. The plants were treated at four leaf stage.

D. D. T. and Toxaphene did not show any adverse effect on Tinda and Torai at any concentration of both the formulations namely, dust and emulsifiable concentrate, but these insecticides were phytotoxic to Loki. As emulsifiable concentrate their phytocidal effect was visible at 0.1% concentration. Phytocidal action increased with rise in concentration, so much. so that at 0.3% concentration they were highly phytotoxic. As dust D. D. T. was mildly phytotoxic at 2.0% concentration and highly phytotoxic at 3.0% concentration whereas Toxaphene was nonphytocidal at 2.0% and mildly phytocidal at 3.0%.

Dieldrin and Malathion did not show any phytocidal action on any of the three varieties of cucurbits at any concentration of both the formulations namely dust and emulsifiable concentrate.

The phytocidal action of D. D. T. dust was more rapid than that of spray for the ill effects of the former were visible after 24 hours whereas that of the latter after about 72 hours, speed of phytocidal action of both spray and dust of D. D. T. was directly proportionate to concentration within phytocidal limits.

In case of Toxaphene, emulsifiable concentrate showed phytocidal action more rapidly than dust and the speed was proportional to concentration. All the same D. D. T. dust at 3.0% concentration showed its phytocidal action more rapidly than Toxaphene both as dustand emulsifiable concentrate. Formulation for the ill effects of D. D. T. and Toxaphene emulsifiable concentrate appeared simultaneously and nearly at the same speed (Sood& Mishra, 1964-65).

(6) Horticultural Section

(i) Rejuvenation of old orchards

Dr. P. S. Parsai gave a talk on "Rejuvenation of old orchards" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. He emphasized that the target of rejuvenation of old orchards in M. P. during the II Five year Plan was 42,000 acres and also described the

methods to be adopted for rejuvenation. The summary of the talk is given in Appendix XV.

(ii) Problems of fruit and vegetable growing

(a) Shri G. S. Yadav, Horticulture Development Officer, Indore read a paper on "Problems of Fruit and Vegetable Cultivation" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. He classified the problems into 3 major heads – i. Problems relating to the technical aspect of the subject. ii. Problems connected with supply of fruit plants and vegetable seeds and iii. Marketing problems and also suggested the ways of tackling these problems. The summary of talk is given in Appendix XVI.

(b) Shri R. C. Shrivastava, Horticulturist, Research Institute, Gwalior presented a paper on "Problems of Fruit Growing in the Region" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. He pointed out that the region could be divided into five distinct zones according to the climate and soil types, namely –

i. The Northern semi-arid, very hot and cold region.
ii. The Central hot and cool region.
iii. The Southern part of Shivpuri district
iv. The very hot and Nimar region and
v. Exceptional situations.

He gave two charts showing workable solutions for general guidance. The paper has been summarized in Appendix XVII.

The results achieved during the year 1960-61 at Gwalior Centre are briefly described below –

Medium dose of nitrogen i.e., 1 lb. N as ammonia sulphate per plant has given significant results at 5% level inspite of non-calibrated plant material. Chemical analysis of the leaves and the soil has shown that uniformly high yields can be obtained without the application of potassium and phosphorous for some time to come.

The percentage success in rooting guava layers has increased from 13% (last year) to 40% this year to improving upon the technique of layering with the help of the 1% Indole acetic acid powder.

Late September and early October transplanting of papaya has been confirmed to be the most suitable period for the northern M.P. districts. The crop is harvested after 17 months of transplanting. The average fruiting height is 3 feet and two economic crops can be taken with one intercrop of vegetable in the first year for giving a uniform income in all the three years.

Killikrankie and Sharbati varieties of peach gave a few fruits in June, 1960 but were not up to the standard at Gwalior and at Shivpuri.

Parletta, Beauty, seedless and Bangalore purple are promising varieties of grapes as observed in 1960-61. Early Muscat needs training on bower for full evaluation. Berletts and Beauty seedless are early maturing varieties. Berry thinning is essential for these varieties except Early Muscat.

Cleopatra mandarin showed better growth than Troyer. Kahatta and Jambhiri are also growing vigorously. These citrus rootstock trees will serve as mother plants for future rootstock trials.

Solo, Coorg Honey Dew Ranchi and Perideniyan varieties of papaya have been found to be unsuitable for the tract. Co. 1, Barwani Red, Honey Dew, Giant Phillipines and Saharanpur varieties have been control bred. Selections have been made from Barwani Red for getting superior strains for this region 50:50 male and female ratio has been obtained in F-1 papaya lines and reciprocal crosses have been made for having F-2 lines.

Observations on the varieties of hybrid oranges are being continued. Kinnow is more vigorous than Srinagar oranges. Hybrid Sunshine, Yalaha and Orlando are more susceptible to leaf miner than the Valencia and other oranges.

Layered guava trees have grown more vigorously in 1960-61 than the inarched ones from the same tree in the field(PMARC, 1961).

(7) Agricultural Engineering Section

Improvement in Indigenous Implements

Shri V. G. Deshmukh, Assistant Agriculture Engineer I/c Implements, Gwalior in his talk on "Improvement in Indigenous implements for increasing their efficiency" during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April. 1959, pointed out that improved implements of imported design were not suited to Indian conditions and

the Indian implements, though inefficient, were very useful, as they fit in our village conditions. The summery of this talk is given in Appendix XVIII.

The newly designed agricultural implements which had given successful results during 1960-61 are being described below –

Bharat Plough

The previous design of the Bharat Plough was not scouring well in the black soils and hence was not working satisfactorily. As such the design of its Ankri or chen was modified by giving a ridge in the centre of the top. This modified design of the plough was tried this year. It was seen in the trials that the previous defect of non-scouring was removed and the plough was working much better than before, but it was giving more draft of about 300 to 350 lbs which was rather heavy. So the design of the chars was still further modified this year. The modified design is found giving draft of about 200 to 250 lbs. This design of the plough appears to be quite perfect and ready to be recommended for use by the farmers for seedbed preparation during monsoon in various soil condition.

Summer Plough

The summer plough designed by this section to open the hard and dry fields after harvest during summer with one bullock pair was doing quite satisfactory the job for which it was designed, but the draft was reported to be little heavy for one pair ranging from 300 to 350 lbs as such the plough and also its Ankri or chene was modified this year to reduce the draft after careful study and experimentation. Now the net share has now reduced the draft of the plough upto 200 to 250 lbs in hard and dry soils during summer. The modified designed was tried on the central farm Gwalior and also in Morar Block area near Gwalior and has been found giving very satisfactory results. The farmers have also liked it.

Improved Bakhar

One of the common defect in the Desi Bakhar is that soil heaps in front of the long horizontal lead due to the short clearance between the blade and the double beams, consequent to which the draft is increased. In order to remove this defect an improvement in the Bakhar was designed by taking a vertical load with one beam only. This design was also thought useful for hoeing in cotton sown quite wide apart. But this design when tried last year was not found to work satisfactorily. Moreover the method

of working with thisnew model was quite different from the usual local one, which would have prevented its easy popularisation. Hence this design of Bakhar with vertical load has been changed again to the horizontal load but with one beam only instead of two in the indigenous Bakhar. The load has been provided some curvature in the bottom of the load to allow the soil pass behind and thus to avoid heaping or clogging of soil in front of the load. This design has given quite good results in the trials taken so far.

Modified Chinese Reaper

The Chinese reaper exhibited in the World Agriculture Fair, 1960 was thought suitable in our conditions for harvesting wheat due to its simple construction and absence of any such device in our country for harvesting. The original design when tried could not work properly and hence it was modified by providing wheels. This modified design had given some encouraging results in wheat harvest. This was further tried in paddy but did not work satisfactorily. In wheat also it was found to be lacking in some essential features required for harvesting and hence it did not attain the required efficiency. Hence, instead of modifying this Chinese design some new design containing the essential features for harvesting such as moving blades, were being deviced. The working model of one design with two serrated circulating discs was fabricatedand tried this year while fabrication of the working models of the other two designs was under progress. One of the designs is similar to bullock drawn mower and hence it is hoped to be successful.

Designing of Seed Drill

(i) Simple Seed Drill

A simple two-rows seed drill with all the necessary controls,mechanisms and adjustment for sowing the general crops was designed by this section. It was tried last year, had given very encouraging results but some minor defects in the furrow openers and seed rate control were left. Similarly the furrow openers lifting device also remained to be completed. These defects have been removed. The seed rate control mechanism now evolved is very simple, efficient and has speciality of its own. The modified design of the drill was tried in wheat sowing at Agriculture College Farm, Gwalior and the germination result was found

to be very good. The furrow opener lifting device is also reading and the work on this seed drill will be quite ready for release after its final trial in the ensuing Kharif and Rabi seasons. The present model of the drill is made completely of iron with all the mechanisms also reading.

(ii) Fertilizer Placement Drill

A model similar to theDeshi seed drill was designed to sow the seed and the fertilizer in one row 2'' below one another and tried this year. It had given quite encouraging results, but still has some minor defects such as clogging in rough and cloddy seed bed. As such it requires further modifications(PMARC, 1961).

(8) Statistics Section

The following work was done by the Statistics Section during the year 1952-53 –

The Assistant Statistician analysed the data from 43 experiments conducted in 1951-52 and 4 experiments in 1952-53 by the Botany section. Experimental designs for various sections were also prepared.

The study of rainfall data at Indore, Gwalior and Bhilsa was taken up by the method adopted by Dr. R.A. Fisher. The daily rainfall figures from 1st January to 31st December for each year from 1925 to 1952 were grouped into 52 weekly totals. Polynomial curves of the fifth degree were fitted to the weekly totals of rainfall values (ARCA, 1952-53).

The following work was done by the Statistics Section during the year 1953-54 –

Design of Experiments : Thirty seven designs were prepared for various sections of the Research Institute and the College of Agriculture –

Agricultural Chemistry	1
Entomology	2
Botany and Experimental Farms	28
Professor of Agriculture	6
Total	37

Statistical Analysis of Experimental data : Statistical analysis of the statistical data of 25 experiments received from various units was completed –

Botany Section, Gwalior	8
Central Experimental Farm, Gwalior	9
Botany Section, Bagwai	3
Experimental Farm, Bagwai	2
Botany Section, Bhilsa	3
Total	25

Research : The section investigated the statistical distribution of weekly rainfall for Gwalior, Bhilsa, Basoda, Kurwai and Indore with the help of Orthogonal Polynomial equation. The expected values of the weekly rainfall were investigated.

The average weekly temperatures and relative humidity (average 1938-52) were computed for Gwalior and Indore.

The following investigations are in progress and would be continued in the year 1954-55 -

(i) Frequency of occurrence of weekly rainfall.

(ii) Comparison of average annual rainfall during the different 7 year periods.

(iii) Comparison of average weekly rainfall during the two halves (i.e., 1925-38 and 1939-52).

(iv) Analysis of variance of the six rainfall constants.

Shri R. K. Saxena, Statistician gave lectures on Agricultural Statistics and field plot technique to the Third Year Class of the College during the year (ARCA, 1953-54).

(9) Agricultural Extension Section

Shri O. P. Dahama, Lecturer and Head of the Department of Agricultural Economics and Extension, College of Agriculture, Gwalior, gave a talk on "Extension Methods for Disseminating Knowledge to Farmers", during the First Seminar-cum-refresher Course, Gwalior and Indore Divisions, held at College of Agriculture, Gwalior from 3rd to 8th April, 1959. He emphasized that it was not enough to know some technique but the more important for an extension worker was to know the method of dissemination of knowledge to those for whom it was meant. He gave the methods under three main heads –(a) Methods of approach, (b) Extension techniques and (c) Methods of enlisting farmer's co-operation. The summary of the paper is given in Appendix XIX.

(10) Institute of Plant Industry, Indore

Cotton Breeding and Genetics

(i) Inter Specific Hybridisation

Ganesan (1952a) reported that all the material selected from (1) (*G. thurberi* X *G. arboreum* Doubled X *G. barbadense*) and further back-crosses to barbadense (2) (*G. thurberi* X *G. arboreum*) Doubled X *G. barbadense*) X *G. hirsutum* (3) *G. hirsutum* X *G. raimondri* Doubled X *G. hirsutum* together with further back-crosses to *hirsutum,* proved disappointing. However, other progenies developed from the cross *G. thurberi* X *G. arboretum* Doubled X *G. hirsutum,* wherein enormous amount of variability was found in matter of morphological, physiological and economic characters, showed that some of them had a very high survival value as compared to others and were also promising from economic point of view.

Ganesan (1952b) further suggested a new line of work for breeding long staple cottons by crossing *G. hirsutum* X *G. barbadense*. He advocated that the hybrid be first back-crossed to the *G. hirsutum* parent and then the stock be subjected to natural selection, so as to evolve fittest types before human selection for economic characters is exercised. Accordingly Sakel, Early Pima and Sea Island (*G. barbadense*) were crossed to Indore 2. (*G. hirsutum)* and the hybrid back-crossed to Indore 2 in 1951-52. By continued selection eleven progenies good in staple, 0.89-0.96 ″, have been obtained.

(ii) General Botany

Plant Characters in Response to Environment Artificially Created in the Laboratory or Field –

(a) *Effect of agronomic treatments on cotton seeds*-Arising out of results that heavier seeds, (whether occurring in general crop produce or produced by hybrid vigour) produced a better and higher yielding crop, Ganesan (1949) studied the effect of the agronomic treatments on the quality of the cotton seed produced under them. It was found that the seeds obtained from widely spaced and unmanured crop had a higher yielding potential. A closely spaced and manured (with ammonium sulphate) crop, on the other hand is found to have a deleterious effect on the quality of the seed, due partly to the lowering of seed weight in the case of closer spacing. These results were however not corroborated on field scale trials.

(b) Jaloor and Sahasrabudhe (1953) developed a technique for facilitating seedling grafts in cotton and were able to show that under normal cropping season of cotton Karnak could produce the Egyptian quality of lint if grafted on *Malvi* 9 or *Jarila* stock.

Improvement in other Crops

Jowar (Sorghum)

Single plant selections were made in cultivated fields in 1953. A large number of bulk samples were also obtained from different localities in Malva and grown. Fifty samples were tested against I. P. 3 and I.P. 9. Subsequently, by mass selection 12 types were developed, which proved superior to control in grain yield in 1955-56.

Agronomical investigation on different Crops

(i) Cotton

(a) Effect of graded doses in the form of Ammonium sulphate and groundnut cake on the yield of cotton, its maturity and loss of Ammonia –

The experiment was further repeated in two fields rich and poor from 1948-49 to 1951-52 with same two manures applied in graded doses of 20 to 80 lbs N per acre with and without superphosphate at 30 or 40 lbs P_2O_5. Chilean nitrate was also included in the experiment in 1951. It was found that the application of phosphate increased the yield significantly in two seasons. Two nitrogenous manures gave response of similar magnitude while Chilean nitrate proved inferior to Ammonium sulphate. With regard to the economics 40 lbs N per acre as Ammonium sulphate was found to be optimum for cotton.

(b) Effect of soaking cotton seeds in nutrients solutions:

Cotton seeds were soaked in different chemical nutrients like Cerasan, Nomerson and Levulenic acid with one and five per cent solution. None of the treatments was found effective to accelerate germination.

In other series of experiment cotton seeds were soaked for different duration (4 to 8 hours) in molar solution of Ammonium sulphate, Ammonium phosphate and mono potassium phosphate and 1 and 5% solution of calcium nitrate. These were compared with seeds soaked in water and dry seed as control. In 1949-50 the effect of soaking was observed to be significant for treatment with Ammonium sulphate and Ammonium phosphate as against mono-potassium phosphate and water.

Seeds without any soaking treatment gave significantly lower yield of seed cotton than other. In other seasons none of the treatments was found beneficial.

(c) Trials on phosphate manuring of various crops and its residual effect on cotton –

The experimental was conducted for six seasons (1947-48 to 1952-53) with the object to study the effect of application of superphosphate at 30 lbs P_2O_5 to various crops, viz., Jowar, Tuar, groundnut, soybean, sann hemp, cowpea and gram and their residual effect has been studied on the yield of succeeding cotton-Bhoj, which was manured with groundnut cake at 30 lbs N per acre.

Out of six seasons the difference in Kapas yield due to preceding crops were significant in five seasons and for direct application of nitrogen to cotton in 4 seasons while the residual effect of phosphate was significantly only in two seasons for the yields of cottons. Generally soybean, groundnut and gram proved better than others as rotational crops for cotton.

(d) Effect of organic and inorganic manures applied singly and in combination on the yield of Jowar, Tuar and groundnut and their residual effect on cotton:

The trial was started in 1951-52 with two objectives:-

i. To study the response in Jowar, Tuar and groundnut of the inorganic N and P applied singly and in combination and with and without a basal dressing of farm compost, and

ii. Their after effects as reflected in the yields of succeeding cotton. Ammonium sulphate at 20 lbs N, superphosphate at 20 lbs P_2O_5 and farm compost at 40 lbs N per acre singly and in combination were applied to the three preceding crops. The results are summarised as follows:-

The application of nitrogen in the form of Ammonium sulphate or farm compost proved beneficial for increasing the yields of Jowar grain and *Karbi.* Tuar did not respond to the application of Ammonium sulphate which appreciably increased the yield of groundnut pods. The application of organic manure did not show significant effect on the yield of Tuar or

groundnut while the application of phosphate proved beneficial for increasing *Karbi* outturn of Jowar and dry pod yield of groundnut.

It is concluded from the results achieved on cotton during four seasons that the residual effect of manures applied to preceding crops were generally observed for phosphatic fertiliser and compost. Cotton grown after groundnut gave significantly higher yields than those obtained matured earlier than after other two crops.

(e) Effect of organic manures and superphosphate singly and in combination on the yield of cotton and their residual effect on Jowar:

The experiment was started in 1952-53 to study the effect of compost, F.Y.M. groundnut cake and 'k' manure (textile waste from local mill containing 2.5% N) applied on equal nitrogen basis at 20 and 40 lbs N per acre with and without superphosphate at 30 lbs P_2O_5 per acre on the yield, ginning percentage and weight of 100 seeds of cotton –Bhoj and their residual effect was studied on the yield of Jowar. The results of four seasons (1952-53 to 1955-56) are summarised below.

The application of organic nitrogen not only increased the yield of cotton but also left enough residues to be utilised by the following crop of Jowar and in this respect the dose of 40 lbs N showed the maximum direct as well as residual effect. Amongst manures, groundnut cake and farm compost were found superior to F.Y.M. and 'k' manure.

The yields of cotton and Jowar were also increased significantly with the application of 30 lbs P_2O_5.

The different sources of nitrogen and its levels had no marked effect on the ginning value of cotton while the application of superphosphate gave significantly higher ginning value than control. It has also been ascertained that ginning values of cotton is not so much influenced by seasonal variations with the application of F.Y.M. as with other organic manures rather it may give higher ginning in seasons of heavy rainfall.

The application of superphosphate or different organic manures and their dose has no bearing on the weight of cotton seeds. However, it has been found that during the seasons of heavy rainfall the ginning

percentage is significantly the lowest and the weight of cotton seed is significantly the highest and *vice versa.*

(f) Residual effect on the yield of cotton of farm compost and superphosphate applied singly and in combination to preceding wheat and grown sole crop on single and mixed.

This experiment has been in progress since 1954-55 where in preceding crops of wheat and gram grown alone and mixed in different proportions were manured with compost at 40 lbs N and superphosphate at 40 lbs P_2O_5 per acre. The results obtained in 1954-55 did not show any residual effect on the yield of cotton due to manures or crops while in the second year (1955-56) the yield of cotton was significantly higher under the residual effect of N and P in combination. The yield of Kapas obtained with the application of superphosphate did not show significant difference either from that of control or farm compost which gave significantly higher yield than control. There was no significantly difference in the yields obtained after wheat or gram or their mixtures.

(g) Two years rotational trial:

The trial has been in progress for two years (1954-55 and 1955-56) where the important Kharif and Rabi crops were grown in rotation with cotton so as to find out the most remunerative sequence of crops in rotation with cotton.

First Year

Kharif: Groundnut, Mung, Mung, Mung, Jowar, Tuar, Fallow, Fallow.

Rabi: Fallow, Fallow, Gram, Linseed, Fallow, Fallow, Gram, Linseed.

Second Year : All followed by cotton

Groundnut-Cotton or Mung-Linseed-Cotton was found to be most remunerative sequence.

(h) Effect of sowing time on the yield of Cotton:

During 1950-51 to 1953-54 *Desi* and American cottons were sown in dry soil before the advent of rains and at the normal time with the onset of rains. In *desi* Cotton premonsoon sowing did not increase the yield significantly over the rain-sown crop while American type showed a

tendency to give higher yield with premonsoon sowing. Premonsoon sowing gives an additional advantage to spare more time to the cultivator to attend to other important operations during the short period.

(i) Effect of spacing on the yield of Cotton:

From the results obtained in 1953-54 to 1955-56 a spacing of 14″ between rows of *desi* cotton was found to give higher yield than 7″, 21″ and 29″ spacing.

(j) Effect of cultivation on the yield of cotton:

The experiments on cultivation were carried out in 1953-54 when shallow and deep cultivation with different implements was compared. The results have shown that there is no advantage due to deep cultivation for Cotton crop and winter cultivation also has no bearing on the yield of cotton.

(k) Effect of interculture on the yield of Cotton:

Experiments were carried out in 1953-54 to study the efficacy of different implements for weeding and hoeing in cotton and it was found that hand weeding is the best method of removing weeds to get higher production.

(l) Effect of seed size on the yield of Cotton:

The results of the trial conducted during1947-48 gave the indication that the yield of cotton can, to a certain extent, be increased by using heavy and large-sized seeds.

(m) Associated growth of cotton with Legumes:

The experiments on the associated growth of cotton and groundnut were carried out in 1952-53 to 1955-56. In these trials a few rows of Cotton were grown alternating with few rows of groundnut. The results have shown that in such mixtures the yield of cotton was much lower as compared to cotton alone while the yields of groundnut were not substantially affected as compared to groundnut alone. The intercropping of these crops fetches higher money returns than groundnut alone when 2 rows of cotton were grown alternating with10 rows of groundnut.

(ii) Other Crops

(a) Jowar (Sorghum)

i. Manuring:

In an experiment carried out for four seasons (1947-48 to 1950-51) nitrogen and phosphate were applied each at 20 and 40 lbs per acre in the form of groundnut cake and superphosphate both singly and in combination.

The yields of both grain and *Karbi* were significantly higher with the application of 20 and 40 lbs N per acre than control and there was no significant difference in the yield obtained from 20 and 40 lbs N except in one season. In other words, the rate of response wasof higher magnitude with 20 lbs N than 40 lbs N and hence the dose of 20 lbs N per acre seems to be better than 40 lbs N. The application of phosphate did not have significant effect on the yields of Jowar.

The same experiment was modified in the year 1952-53 and was continued up to 1955-56. The details of the trial and results are mentioned under cotton (Effect of organic and inorganic manures on the yield of Jowar, Tuar and Groundnut and their residual effect on cotton).

ii. Seed rate cum manuring:

Studies on the effect of seed rates and manuring were carried out for four consecutive seasons (1947-48 to 1950-51) to find out the optimum seed rate of Jowar from 5, 10, 15, 20 and 25 lbs per acre with and without the application of 20 lbs N per acre in the form of Ammonium Sulphate or groundnut cake. It has been concluded from the results that a seed rate of 10 lbs per acre was the optimum from the point of view of both grain and Karbi yield and where thinning operation too, need not be done except removing the plants at crowded spot and 20 lbs N per acre may also be applied to get higher yields.

iii. Sowing date cum manuring:

The experiment was conducted for four seasons (1952-53 to 1955-56) to find out the difference in the yield of Jowar by drilling the seeds in dry soil before the advent of rains and at the normal time after the onset of rains and whether manuring with Ammonium Sulphate or mixture of Ammonium Sulphate and groundnut cake applied in graded doses or different spacings between the plants in the same row have any effect on the yield.

By considering the results of all the four seasons it was concluded that the application of Ammonium Sulphate gave higher yields of both grain and *Karbi* than no manure. The dose may, however, vary from 10 to 20 lbs N per acre. The spacing of 9″ or 18″ between plants did not affect the yields. Pre-monsoon sowing was advantageous as the yields obtained there were higher compared with that of normal sown crop. The precaution to be taken in pre-monsoon sowing is that the seeds should be thoroughly covered and sowing should not be done earlier than second week of June.

iv. Rotation:

In Malwa, Jowar is generally grown in rotation with Rabi crops particularly wheat preceded either by cotton or some leguminous crops grown for green manuring or as catch crops. The results for two seasons 1953-54 and 1954-55 have shown that green-manuring in situ does not seem to be a sound practice under rainfed conditions and there is likelihood that short duration legumes like Mung, Urid, Cowpea, etc., may be helpful when grown as catch crops.

(b) Tuar (Pigeon Pea) andGroundnut

i. Replicated trials were conducted for four seasons (1947-48 to 1950-51) to study the effect of application of graded doses of nitrogen and phosphate both singly and in combination on the yield of Tuar and groundnut. Nitrogen in the form of groundnut cake, phosphate as superphosphate were applied at 20 and 40 lbs per acre singly and in combination. The yield of both the crops were appreciably increased with the application of nitrogen but in general the higher dose did not prove so effective as the lower dose.

Similarly the application of lower dose of phosphate increased the yields significantly over control in groundnut as well as in Tuar. Here it is important to mention that both the crops gave higher yields when manured with N and P in combination than with N or P.

ii. *Seed rate trial on Groundnut:*

To fix up the optimum seed rate of groundnut, replicated trials were carried out for two seasons (1950-51 and 1951-52) with seed rates of 40, 60, 80 and 100 lbs per acre. The yield of groundnut obtained from different seed rates did not differ significantly in both the seasons.

However, 40 lbs per acre seemed to be the optimum seed rate for groundnut.

(c) Maize

Experiments on varietal trials including hybrid maize were started in 1953-54. The varieties tested were U.S. 13, Dixie 18, Dixie 22, Dixie 33, Texas 26, Wisconsin 416 and local Sathi yellow and white. The first three hybrids, namely, U.S. 13, Dixie 18 and Dixie 22 proved significantly superior to other varieties, the increase in the grain yield was 169%, 92% and 53%, respectively over local yellow Sathi (369 lbs) and 124%, 61% and 28%, respectively over local white (441 lbs)

In 1954-55, the experiment was conducted with 14 varieties, viz., yellow sathi, white sathi, Texas 26, U.S. 13, Dixie 18, Dixie 22, Dixie 33, Wisconsin 416, Ohio C 92, Iowa 4417, Iowa 4412, Indiana C 620, K.T. 4111 and K.T. 41. The yield difference were not significant, however, K.T. 41 was found to be the highest yielder.

In 1955-56, pure inbred seed was obtained from I.A.R.I. of eight varieties, namely, Pusa yellow 2, Dixie 18, N.C. 37, Wisconsin 641AA, Dixie 11, U.S. 13, U.S. 523 W and K.T. 41 and these were compared with local yellow Sathi. It was noted from the results that Pusa yellow 2 which lodged at silking stage gave significantly lowest yield. K.T. 41 (1773 lbs) and U.S. 523 W (1553 lbs) which were early maturing gave significantly higher yield than the local Sathi (1242 lbs per acre).

(d) Potato

Manurial cum sowing date trial:

The experiment was carried out for four seasons (1947-48 to 1950-51) to know the manurial requirements of potato crop as well as to determine the optimum date of its planting. The potato crop was applied manure at the rate of 40 lbs N, 40 lbs P_2O_5 and 80 lbs K_2O per acre singly and in combination and a basal dressing of either F.Y.M. or municipal compost was also given. The crop was planted in early December and late December. The yield of potato tuber was higher for the application of nitrogen alone or in combination with P_2O_5 or P_2O_5 and K_2O than other treatments. The two manures used as basal dressing did not show any significant difference in the yield. The crop planted in the early part of December gave higher yield than late planted crop.

(e) Sugarcane

i. Effect of early and late planting on the yield of sugarcane:

In the year 1947-48 the two varieties of sugarcane, Co. 419 and Co. 421, were planted in October as well as at normal time in February. Co. 419 gave significantly higher yield of cane with February planting than that of October planting while Co. 421 showed the opposite effect.

ii. Varietal trial:

In this trial eight Coimbatore varieties of Sugarcane were compared for four seasons (1948-49 to 1951-52) for their tonnage and *Gur* production. The average yields for four seasons were as follows (Table 34)

Table 34 : Yield of Cane and *Gur* of different varieties of Sugarcane.

Variety	**Yield of Cane in tons per acre**	**Yield of *Gur* in maunds* per acre**
Co. 213	36.2	118.0
Co. 312	35.7	118.5
Co. 412	32.0	97.0
Co. 527	33.3	103.0
Co. 419	28.8	97.5
Co. 428	33.5	92.5
Co. 413	24.6	75.5
Co. 443	25.0	87.5

The two varieties Co. 213 and Co. 312 were found to be the highest yielders, while Co. 413 and Co. 433 gave the lowest yield both of cane as well as *Gur*. The remaining four varieties, however, were intermediate in yield.

(f) Rice

A series of experiments on drilled rice were started in 1952-53 and continued up to 1954-55 where Ammonium sulphate and groundnut cake were applied in graded doses of 20, 40 and 60 lbs N per acre with and without 15 and 30 lbs P_2O_5 per acre in the form of single superphosphate. The experiment was to be carried out under rainfed condition but irrigations had to be resorted to avoid complete failure whenever such as emergency arose during the crop season. An analysis of data obtained during the three consecutive seasons revealed that the yields of rice

increased corresponding with an increase in the dosage of nitrogen but the differences were significant for 40 and 60 lbs N as compared with 20 lbs N and control. The application of superphosphate on the other hand, depressed the yield though not significantly. Amongst manures, Ammonium sulphate proved significantly superior to groundnut cake.

(g) Wheat

i. Effect of sowing dates on the yield of wheat under rainfed conditions:

In order to find out the optimum period for sowing, wheat experiments on different sowing dates were started in 1947 and were continued till 1952-53. The sowing dates included in the experiment varied from 1st October to 15th November. It has been concluded from the results that sowing of wheat should be completed between 15th to 30th October. Later sowing gave low yield of grain on account of lack of moisture in the soil and also due to too low soil temperature for effective germination.

ii. Effect of seed rates on the yield of wheat under rainfed and irrigated condition:

The experiment was started in 1947 with five seed rates viz., 40, 60, 80, 100 and 120 lbs per acre and two spacings 6″ and 12″ in 1947 and 9″, 14″ in 1948, 1949 and 1950 seasons. In some seasons, some block were manured with 20 to 25 lbs N per acre and 40 lbs N and 40 lbs P_2O_5 per acre under rainfed and irrigated condition respectively. The experiment was repeated for four consecutive seasons under rainfed as well as under irrigated conditions.

The result under rainfed conditions have shown that manuring or spacing have no significant effect on the yield of wheat. Amongst seed rates 40 lbs per acre seemed to be advantageous under local conditions.

Under irrigated conditions the yield of wheat obtained from different seed rates did not differ significantly except in 1947 when a seed rate of 40 lbs per acre gave significantly lower yield than 80, 100 and 120 lbs per acre. The differences in yield due to spacing were not significant in any season. Application of N and P singly and in combination increased the yield of wheat significantly over control.

iii. Effect of compost and fertilizers on the yield of wheat:

Experiments on wheat EK 69 or C 591 grown under *barani* condition were conducted from 1947 to 1949 to study the response to the

application of Ammonium sulphate and groundnut cake each applied at 20, 40 and 60 lbs N per acre with and without superphosphate at 20, 40 and 60 lbs P_2O_5 per acre. The results have shown that wheat responds to fertilizer application under *barani* conditions provided the rainfall is favourable and the combination of N and P gives better response than either of them applied alone.

These experiments were again repeated for 3 seasons (1951-52 to 1953-54) to study the effect of N and P applied singly in combination of the yield of wheat grown under rainfed and irrigated conditions. The treatments consisted of 3 levels of nitrogen as Ammonium Sulphate and five levels of phosphate as superphosphate. For irrigated wheat C 591 the doses were O, 15 and 30 lbs N per acre and O, 15, 30, 45 and 60 lbs P_2O_5 per acre while for *Barani* wheat EK 69 the doses were O, 10 and 20 lbs N per acre and O, 10, 20, 30 and 40 lbs P_2O_5 per acre. In all the three seasons there was no response to N or P in *Barani* wheat due to early cessation of rains. While under irrigation, wheat responded to the application of nitrogen only.

iv. Effect of green manuring on the wheat under rainfed conditions:

The experiments were laid out to find out (a) the best leguminous crops to be used for green manuring (b) the stage at which the crop should be buried in the soil and (c) the method of manuring the field.

Best leguminous crop as green manure:

In 1951 Mung and Urid were introduced in the trial along with Sann and were also taken as catch crops. They were manured with 40 lbs P_2O_5 per acre. The yield of wheat from plots green manured with Sann was significantly lower than that from fallow or Mung plots and almost equal to that of Urid plot. The result further indicated that more cash returns per acre could be obtained by growing legumes like Mung and Urid in Kharif and Wheat after them in Rabi, than that by growing Sann for green manuring.

In 1953 Sann hemp, Dhaincha, Mung type I, Mung Sindhkhera Urid, Cowpea, Guara Mung local, Soyabean black and *Sesbania speciosa* were grown, with and without 30 lbs P_2O_5, for green manuring wheat. It was found that almost all the green manuring legumes and the application of superphosphate increased the yield of wheat but it was not statistically significant. In the year 1954 in addition to the green manuring legumes

and their manuring with phosphate, two burying dates 5 and 7 weeks after sowing were also included. The highest green matter was produced by Sann followed by Dhaincha, Mung Sindkhera and Mung type 1 but it did not increase the yield of wheat significantly over control. The early or late burying of the green matter or the application of phosphate did not show any marked effect on the yield of wheat. Green manuring of wheat had no significant effect on the yield of succeeding Jowar as well.

Since under rainfed condition green manuring with Sann generally does not give any appreciable increase in the yield, the experiment was modified in 1955 to compare yield of wheat obtained from fallow and early Mung grown for green manuring and as catch crop with and without the application of 30 lbs P_2O_5. The yield of wheat was significantly highest with green manuring and lowest after catch crop of Mung. In 1956 the experiment was repeated to compare the yields of wheat obtained after green manuring and catch cropping of Mung, Urid and Cowpea vs. green manuring with Sann Vs. fallow. Superphosphate at 40 lbs P_2O_5 was also applied to these legumes. Green manuring with Sann gave significantly higher yield than fallow. It also gave higher yield than with other green manures but the differences were not significant. The yields of wheat after green manuring with Sann were also significantly higher from the yields obtained after a catch crop of Urid. It may be mentioned here that during this season rainfall was quite favourable and the rains were received by the end of September. The study of their residual effect on succeeding Jowar was in progress.

(h) Mixed Cropping of Wheat and Gram

The experiments on wheat and gram grown pure and mixed with different proportions of the two components were conducted for four seasons (1953-56). Farm compost at 20 to 40 lbs N and superphosphate at 40 lbs P_2O_5 per acre singly and in combination were also applied to these crops. Manuring had no effect on the yield of either wheat or gram or their mixture. However, it was found that for mixed cropping of wheat and gram the two components should be mixed in the proportion of 2/3 : 1/3 by seed rate.

(i) Gram

In the year 1947-48 and 1949-50 Nitrogen and Phosphate each at 20 and 40 lbs per acre were applied to gram in rich and medium fields but the yield of gram was not increased by manuring.

(j) Linseed

In the same seasons (1947-48 and 1949-50) linseed was also applied N and P each at 20 and 40 lbs per acre in rich and medium fields. In rich field, the yield of linseed was significantly higher with the application of nitrogen than control while there was no response to phosphate applied alone or with nitrogen. In the medium field linseed did not respond to any maunrial treatment.

In the year 1952-53 four varieties of linseed IPI 6, IPI 11, IPI 65 and CP-55F were manured with Ammonium Sulphate at 20, 40 and 60 lbs N per acre and in the season 1953-54 two levels of phosphate 15 and 30 lbs per acre were also included in the experiment. The results have shown that the four varieties showed no differential response to manuring.

(k) Peas

Eight varieties of peas namely Lincoln, Delwiche Commendo, EC 956, NP-29, Early Badger, Luchnow Boniya, IC-1405, T-163 and control (two T-19 & Khaperkhera) T-19 and Local Khaperkhera were compared for their yield and sweetness. The experiments were repeated for two seasons (1954-55 and 1955-56). Considering the results of both and the seasons Local Khaperkhera was found to be the highest yielder and next was T. 19. For table quality and sweetness T. 19 and Delwiche Commando were found superior to others.

(l) Fodder Grasses and Legumes

For two seasons 1953-54 and 1955-56 the seeds of a few fodder grasses and legumes both for Kharif and Rabi seasons were tested for their suitability under local condition.

Amongst Kharif grasses and legumes *Pannisetum, pedicellatum* 2151, *Sorghum sudanis* 1840, *Cenchrus cilliaris, Bracharia* mutica, *Mucuna cochinchinensis, Mucuna rajada, Dolichos lab lab. Sesbania speciosa 1917, Glycine javanica* 2171, *Phaseolus lathyroides* 2308, *Glycine max* IC 212, *Clitoria ternatea, Desmodiam purpureum* and *Canavalia ensiformis* respectively proved quite promising.

Amongst Rabi grasses – Secale cereale, *Phalaris minor, Phalaris canariensis, Lobium rigidum, Lobium perenne, Phleum pratense 2268, Lobium multiflorum* 2274, *Lobium perenne* xL. *Multiflorum* 2279, *Agropyron cristatum, thrived nicely*, while amongst legumes, *Lathyrus ochrus*, *Trigonella foenum graccum* 2276, *melilotus alba*, *Medicago sativa* 1794, 2299, *Lathyrus sativus* PL, *Medicago hispida*, *Trifollium pratense* 2267 and 2270, *Triflollium sub-terraneum* 2322 were found quite sutitable for fodder purpose.

(m) Miscellaneous

i. Eradication of weeds

Eradication of kans *(Saccharum spontaneum)* : In the year 1954 CMU was applied on two Kans patches in doses of 4 and 10 lbs per acre. The surface vegetation was completely wiped out within a fortnight but it revived after 3 and 6 months with the lower and higher doses respectively. The trial was repeated in 1955 with 20 and 40 lbs CMU per acre on Kans patches in another field. The surface vegetation was killed but reappeared after one year though scarcely.

Other methods : Preliminary experiments on weedicides were in progress since 1953. During thisseason-YF. 2618 (5% 2, 4-D), YF 2619 (2, 4, 5-Tn butyl ester 25% and 2, 4-D butyle 25%), FY 2717 (2, 4, 5-Tn butyl ester 35%), YF 2631 (2, 4, 5-Tn butyl ester 17% and 2, 4-D butyl 35%), YF 2289 (IPPC) CMU, TCA and YF 2616 (IPPC) were tried in cotton and paddy before sowing and after 5 weeks of sowing. The last three tried in cotton and paddy before sowing and after 5 weeks of sowing. The last three weedicides being dusted were applied at 1 to 60 lbs per acre while the others were sprayed at ¼ and 1 gallon in 100 gallons of water per acre. By visual observation it was found that 2, 4-D CMU and TCA killed all vegetation with higher doses at post-emergence stage while the other chemicals did not give encouraging response. The toxic effect of CMU persisted for three years. During the seasons 1954 and 1955 CMU at ½ lbs and 1 lb. per acre, Kathon M/7 (2, 4-D amine), E 40 (2, 4-D ester) at ½ pint and 1 pint per acre; YF 2631 at 2 ½ and 5 lbs per acre; Fernoxone at 3 and 6 lbs per acre and TCA at 20 and 40 lbs per acre were applied at pre and post emergence stages in Paddy, Jowar, Cotton and Sugarcane. In paddy and Jowar application of CMU smothered out both monocot and dicot weeds without much injury to the crop plants. While other

weedicides killed only broad leaved plants. In Sugarcane two application of fernoxone followed with the application of TCA controlled more than 75% weeds while in cotton TCA at 20 lbs per acre gave encouraging results for controlling grass-weeds.

Entomology

(i) Cotton

Jassids appeared as a serious pest in cotton in the 3rd, week of July in 1949, 1st week of October in 1950, in August in 1952 and 1953 and in the 3rd week of July in 1954 and 1955, when a dry spell prevailed in the rainy season. During these periods on different occasions the following insecticides were tried against this pest:

(I)DDT 10 % dust, (2) DDT 5 % dust, (3) DDT 0.25% spray, (4) DDT C. 15 % spray, (5) BHC 5% dust, (6) BHC 0.25% spray, (7)BHC 0.1% spray; (8) Toxaphene 5 % dust, (9) DDT 5% dust + BHC 5 % dust, (10) DDT 0.15% + BHC 0.1% spray, (11) Endrin 0.03 to 0.06% spray, (12) Dieldrin 0.016 to 0.05% spray and (13) Folidol E. 605.0.03 to 0.06% spray. DDT in all the above forms was effective in controlling the insect, but the use of this insecticide alone, invariably brought about a heavy *aphid* infestation. Other insecticides were not very useful. Folidol and Endrin brought about a reduction in the infestation but only very temporarily. A combination of DDT and BHC as in No. 9 and 10 above could control both the pests, jassids and *aphid*. Two treatments at an interval of about 3 weeks were found necessary. The spray mixture was more effective than the dust mixture and with a longer residual effect. 1st treatment should be given assoon as the jassids begin to appear, generally at the end of July. Each treatment may cost about Rs. 6/- to Rs. 7/-per acre but the increase in the yield due to control of this. Pest can cover this cost and yield a fairly good profit. Greater benefit was obtained in the more susceptible varieties in the less susceptible, by this treatment.

(a) Leaf roller of cotton *(Sylepta derogate*, F.)

This pest appears in a virulent form in certain years. It was very bad in 1949 and in 1955 and appeared sporadically in 1951. In the remaining 6 years the attack was either nil or negligible. Its life history studies showed that its egg period lasted for 4 to 6 days, the

larval period 13 to 18 days and the pupal period 5 to 10 days. The moths were short lived, about 4 to 5 days in 1952 and 9 to 11 days in 1953 when they were bred in the laboratory. The caterpillar went into a resting stage in November in the leaf fold or fallen rubbish and emerged as a moth in next June or July and repeated its life cycle. No larva was found feeding between December and June. The larvae were found parasitised by two parasites, one Tachanid the other lchneumonid. Bhindi (Lady's finger) was found to be an important alternate host of this insect. It was not commonly found on other malvaceous palnts.

In the year 1949 this insect caused heavy damage. Most of the leaves on the plants were rolled and eaten away or damaged. The following insecticides were therefore tried against this pest. The number of living caterpillars per plant,a weekafter treatment, in each case is shown against each treatment (Table 35).

Table 35 : Control of leaf roller of cotton by different insecticides.

Treatment	Caterpillar population per plant (mean of 20)
BHC 0.1% spray	1.5
BHC 5% dust	1.8
DDT 10% dust	1.4
DDT 0.1% spray	5.8
Toxaphene 5% spray	4.4
Control (untreated)	12.4

BHC was very effective both as dust and spray and DDT 10 % dust was also good. The rest were found unsatisfactory.

(b) Semi-looper of cotton

A number of different species of semi-loopers were found damaging the cotton leaves e.g.*Cosmophila* indica G., *Acontia Sp*., *Tarache nitidula*, F., etc. Of these Cosmophila was the most common, occasionally this pest appeared in an epidemic form. In 1952 in August the attack was very heavy,so also in 1948. Generally a Tachanid parasite kept it under complete control, except in the above said two years, theinsect increased inspite of the parasite and did damage to the crop. The following insecticides were tried.

(1) DDT 10% dust, (2) BHC 5% dust, (3) DDT 25% spray and (4) BHC 0.25% spray. One strip was kept untreated as control. Everyone of, the treatment was effective. The caterpillars turned blackish, stopped feeding and died within a week. The effect of the sprays seemed to be more immediate and that of the dust rather delayed.

(c) The spotted boll-worm of cotton

The species concerned was Earias fabia, Stoll. E. insulana was also met with but in small numbers. During the years under report it was found in the field, firstly attacking the vegetable shoots and then buds, flowers and bolls. A large number of locks were found damaged. The exact loss due to this insect could not be estimated but form the shed material seen it could easily vary between 5 and 15% of the total corp. To try the effect of new insecticides against this pest and others occurring at the same time in cotton replicated experiments were laid out. In the first two years, 1952-53 and 1953-54 DDT, BHC, Ca arsenate and cotton dust supplied by the Imperial Chemical Industries were used in various forms.As more new insecticides appeared in the market after that, they were also tried in similar tests in 1954-55 and 1955-56. There were four to five replications each year with randomised plot treatments including a control in each block. Sufficient margins were left between the plots so that the treatment in one would not affect the other neighbouring plots. In the first two seasons, the first treatment was given in the middle of September when a large number of flower buds appeared in the crop, but in 1954-55 the September rains delayed the operations by about three to four weeks. In 1952-53 the treatments were given seven times in all at regular intervals of 10 days each time and in the next three years only four treatments were given strengths are shown in the table below. Regular eye observation was taken on the treated and untreated plots and the incidence of other pests etc, were noted. Plants were selected at random in each plot, each year and the kapas from these was completely harvested and the yield was analysed lock by lock for boll-worm damage.

(d) The treatment which had given better yields and better percentage of cleaner cotton (not affected by boll-worms) were continued to be tried for two or three years and those which were not promising or which were costly were dropped. From the above experiments, it was found that the

DDT 25% plus BHC 0.01% spray, Endrin and Dieldrin were the most promising. DDT 10% dust was rather costly though useful. Folidol, being an insecticide of phosphatic origin was risky to be handled by laymen.

In the 3rd week of September 1952, there was heavy attack of thrips and also of mites (Red spiders). Observation in the treated plot showed that, plots treated with DDT 0.25% spray and with cotton dust were completely free from their attack and those treated with DDT 10% dust and BHC 5% dust were partially free. Plots treated with Calcium arsenate were worst affected.

Generally three weeks after the treatment started the treated plots gave a higher number of flowers than the controls, those treated with DDT, BHC mixture, Endrin and Dieldrian showing a definitely better flowering. These plots also showed a number of small dead larvae of Earis on the plants. They remained better and more healthy than the controls and the dusted plants. One of the reasons for this may be the effect of the chemicals on the plants acting as hormones. Only single samples of the cotton from the plots treated with DDT, BHC mixture, Dieldrin and the control (untreated) were tested for technological qualities at the laboratory. It was found that cotton picked from the plots treated with DDT, BHC mixture was slightly inferior.

To try the effect of some of the insecticides on the spotted boll-worms a few laboratory observation were made. A few plants were sprayed in the field with each of the insecticides given in the table above and the buds plucked from these plants were fed to the larvae of the boll-worms reared in the laboratory. Results are summarised below.

i. Small and medium sized larvae got killed when fed on the buds of the treated plants within 3 to 4 days after the treatment. DDT, BHC mixture, Endrin and Dieldrin proved most effective but others were not so good. The grown-up larvae were not killed.

ii. Buds and flowers plucked from the same plants 8 to 10 days after spraying did not kill even the small larvae as they were produced by the plant after it got sprayed and so remained free from insecticides.

iii. *Rhogas testaceous*, an internal parasite on the larvae emerged successfully as adult from the caterpillar collected from the treated plants. The insecticides did not affect the parasites which were already in the body of the larva.

(ii) Sugarcane

On sugarcane only two important pests were noted. They were (1) Pyrilla and (2) Stem-borer. Observation taken are noted below.

(iii) *Pyrilla* (Leaf hopper): *Pyrilla perpusilla*, W. is a common pest in this tract. It appeared in September, on the leaves of sugarcane, in 1949 and 1951 and in October in 1950. From 1953 onwards, it did not appear as a pest in the Institute farm but was a serious pest outside.

Eggs are laid in the sheathes of dry and drying leaves. Many times these were found heavily attacked by Trichograma a hymenopterous parasite, but by themselves, they are unable to keep the pest under control. It was found that stripping of the cane of such leaves and then dusting the crop with BHC 7 to 10% strength can control the pest. The adults are not killed so easily but they stop laying eggs and die after a few days, where as the nymphs die in a short time. Of the four insecticides tried DDT dust and spray and BHC dust and spray, BHC dust gave the best results.

(iv) Stem borer: There are at least two species involved, (i) *Sesamia inferens* W and (ii) *Argyria sticticraspis* H. In Malwa the former seemed to be more common than the latter and accounting for 60 to 80 p.c. of the damage done. The pest appears in the crop almost every year and damages the crop in April and May. The attack varied from 18 to 60 p.c. in the seedlings. A Tachnid fly was found to parasitize both the caterpillars but the incidence was very low. There is not much difference between the two insects in their damage to the crop. A number of insecticides were tried against these pests in replicated test for three years. When the crop was about 5 to 6 weeks old and the stem borer had just begun its ravages these insecticides were used. The cane grown was Co. 419. The experimental area was divided in 4 to 5 blocks, each block consisting of 6 plots, each plot receiving a separate treatment. There was sufficient margin left out between plots to see that the treatment in one does not affect the other neighbouring plot. In all three to four treatments were given, each year, starting from the 6^{th} week after planting. A three weeks interval was kept between the treatments. Each time before giving the treatments, the affected plants, that is the dead hearts, were removed from the plots. The treatments tried during the 4 years were.

(a) BHC 5 p.c. dust
(b) BHC 0.25 p.c. spray
(c) DDT 5 p.c. dust
(d) DDT 10 p.c. dust

(e) DDT 0.25 p.c. spray (f) Folidol, E. 605. 0.06 p.c. spray
(g) Endrin 0.06 p.c. spray (h) Dieldrin 0.09 p.c. spray
(i) Malathion 0.06 p.c. spray (j) Untreated (Control)

The four years observations showed that DDT 0.25 p.c. spray was consistently good and controlled the stem borer to great extent. Endrin and Dieldrin and Folidol were also successful to a great extent.

To see it any of the insecticides above mentioned had any effect on the larvae which had already entered the stem a few plants were artificially infected with the borer *(Sesamia)* and the plants were sprayed and were examined a week later. Almost all were living and no dead larvae was recorded.

A few laboratory observations were made. Pieces of sprayed cane were fed to the 6 to 8 days old larvae. In DDT, Folidol and Endrin and Dieldrin treated pieces all the caterpillars died. The same king of larvae were fed with piece 8 days after the cane was sprayed. Only the DDT sprayed cane killed the larvae and other did not. DDT therefore seems to be best insecticide against this pest.

Some observations were taken, with regard to the intensity of attack in different strains of cane grown at the Institute. It was not a replicated experiment. Two years observation showed that Co. 213, Co. 312 an Co. 527 were more resistant to the borer attack than other varieties.

(iii) Jowar

In September 1951, the jowar crop was heavily attacked by the shoot borer, *Cirphis unipuncta* and the shoot bug, Pundalucye, due to the failure of rains. The Cirphis caterpillars went down by the end of October naturally but the bugs persisted. Dusting the plants with 5% BHC lessened the pest to some extent. Cirphus caterpillar again appeared in 1952 in August and damaged the crop. BHC sprayed at 0.2 p.c. suspension gave some relief in one field. Both the pests appeared again in 1954 and 1955.

The stem borer, *Chilo zonellus*, was seen attacking the crop in all the seasons. The attack did not go beyond 4 percent. There did not seen to be any difference in the attack of this pest in the 12 varieties being grown in the varietal trial at the Institute.

(iv) Maize

This crop was grown in a small area at little over an acre at the Institute farm in 1953. This was very badly attacked by *Cirphus unipureta*

(jowar shoot caterpillar) in August. There was also aphis attack in the same crop. These plants were sprayed with DDT 0.2 p.c., BHC 0.2 p.c. mixture spray suspension. The pests were broungt under control in one week. No further treatment was necessary.

The Cut-worm (Laphygma) infested the maize crop when it was only about a month old and hardly 6″ in height. The crop was sprayed with DDT 0.2% and the pest was brought under control.

(v) Potato

Cut-worm, *(agrotis yepsilon)* and thrips appeared in a pest form in potato in 1952. Poison baits with wheat bran with 4% sodium silico fluoride were effective in controlling the cut-worm. Gammexane D. 0.25 mixed in bran also proved useful. Against thrip Dusting the crop with 10% DDT was better than 5% BHC at about 15 lbs per acre.

(vi) Wheat

In the year 1952-53, the wheat stem borer *Sesamia* was 1.3% and increased to 5.6% in the middle of March. In 1951-52 also a similar attack was noticed. A braconid parasite was found keeping a check over this pest. In the middle of March 1952, an attempt was made to release the egg parasite Trichogramma in the affected field. The parasites were received from the Agricultural Research Institute, New Delhi. But due to very high temperatures at this time probably, this did not prove successful.

To see if the germination of wheat seed would be affected if treated by insecticides, small quantities of the wheat grain were treated with DDT 5%, DDT 10%, BHC 5% and Mergamna, a mercuric compound of the Imperial Chemical Industries and preserved for three months in the godown. The seed was then sown in a replicated test. The germination in all cases was quite good and never less than in control. Further growth was also not affected.

In January 1954 there was a heavy infestation of rats in the wheat field. The wheat ear heads were in the early stage at this time. As the soil was cracking cyonogas fumigation was not possible in all the fields. Only the irrigated fields, the bunds and the sugarcane plots had no cracks in the soil and so the rat burrows there were fumigated. Poison baits with wheat flour, gur, sweet oil and a little asafoetida with Barium Carbonate were also spread out in the infested fields, after prebaiting them without poison. All these efforts did not succeed toany great extent. Zinc phosphide was

used instead of Barium carbonate in a second set of baits used. This increased the death rate of the rats but no substantial reduction in the rat population or their destruction of wheat was noticed.

Store pests – Rats were a great nuisance in the stores during all the years under report. Cyanogas Fumigation of rat holes and poison baiting with Barium Carbonate or Zinc Phosphide reduced the damage for some time, but as the godown were of kacha type the pest again burrowed holes and entered the godowns.

Tomorin a rat killing powder supplied by the Giegy Insecticides was used in the godowns in 1952-53 and 1953-54. In the previous year a thin layer was spread out on the rat tracks but no dead rat was noticed. During the second year a thick layer of the same poison was laid out and 4 and 5 days after, rats began to die. In all 23 rats were found killed in a few days time. Most of them were small in size. Zelio poison grains supplied by Bayers were placed in the godowns. They eaten by rats for some days, but no dead rat was discovered and later they remained untouched.

Other pest in the store are the various beetles, weevils and the flour moth. Against these pest preventive measures were taken before storing the grains. The godowns were first fumigated with Gammexane smoke generators. The rooms were dusted slightly with BHC 5% dust. The grain to be stored were well dried in the sun and were filled in the gunny bags which were dusted with either 5% BHC or 5% DDT both inside and out. During both the years of trial (1952-53 and 1953-54) the stored products remained free from insect pests till the next sowing season.

(vii) Miscellaneous

(a) Trial of chemical weed killers: At the request of the Imperial Chemical Industries Ltd., two hormone weed killers Agroxone and Fernoxone were tried during the years 1949-50 and 1950-51. A solution of 0.1% of both the chemicals was successful in killing the Xanthium and Euphorbious weeds which infest the cultivated and uncultivated fields in Madhya Bharat. Ber *(Zizphus jujuba)* shrubs were also killed by 0.2% spray of either but fresh spouts came out after some time. 0.05% spray killed Sida but not *Cassia tarata*. They proved ineffective against 'motha' *Cyperus rotundus* and "Lawala Cyperus" serious.

(b) DDT spray at 0..2% strength proved successful against saw fly grubs in cauliflower, Epilachna beetles in bitter gourd and flea beetles in all the crops and vegetables.

(c) Nicotine sulphate at 0.2% had to be frequently sprayed against aphis in all legumes in 1953-54 seasons. A small quantity of Agral of the Imperial Chemical Industries added to it made more effective.

(d) A heavy attack of grass hoppers in Mung soyabean and wheat was noticed in 1952-53 and 1953-54. BHC 5 p.c. dust was used in the previous year against this pest. It proved fairly effective. In 1953-54 10 p.c. dust was used which proved very efficacious.

(e) A sample of 'Geigy vegetable dust' was received for trial in 1952. It was found to control Aulacophora beetles and aphis effectively in cucurbits and bhindi but the spotted boll-worms *(Earias Sp.)* remained almost unaffected by it in bhindi.

(f) A larger number of insect pests of local importance were collected and preserved and got identified. About 30 parasites on crop pests were also reared and preserved and got identified.

Plant Pathology

Systematic testing of the cotton strains for wilt resistance was started in 1946 with the establishment of the Plant Pathology Section.Considerable number of varieties and hybrids were tested. Till 1951-52, the strains evolved by the Plant Breeder were tested for wilt resistance in the constant temperature tanks and the resistant material was passed on to the breeder for further work. In 1952-53 the method was modified. The cotton strains were first tested in the 'Wilt Sick Plot' and highly field resistant material in tested was the glass house under optimum conditions of infection for evolving immune types.

In 1947-48 only two strains, Malvi 10 and cotton trial Prog. B-9 were found to be moderately resistant out of the 24 strains tested.

In 1948-49 progeny bulk 13 and Bhoj were found to be resistant out of 13 strains.

During 1949-50 seventy four strains of cotton were tested for wilt resistance, out of which the following were found to be resistant:-

M 14	Bhoj	1-46-3	1-46-10	1-46-18	1-46-22	1-46-38
		1-46-45	1-46-134	1-48-173	and 1-48-38	

In 1950-51, thirty seven cotton strains were tested. Strains viz. 1-16-1 (M9 x Jarila), 1-46-45 (M9 x Jarila) and 1-47-57 (Bhoj x Jarilla) were found to be resistant.

In 1951-52, out of the twenty one strains tested, none was found to be resistant.

In 1952-53, fifty two varieties of cotton from Economic Botanist were tested for wilt resistance in the 'Wilt Sick Plot'. Out of the 50 resistant plants got from this test, 14 plants from 14 strains were selected on the basis of fibre properties for further test in 1953-54.

In 1953-54, fourteen selected strains from last years test and 12 new strains from the Economic Botanist were put under test in the wilt plot. Out of the 14 strains, 12 were found to be resistant while 10 showed resistance out of the 12 new strains.

In 1954-55, 10 strains of the second lot and four which showed low resistance were tried in the wilt plot. Out of these 14 strains, 7 were found to be resistance, 6 were intermediate and 1 was susceptible.

In 1955-56, 13 selection of strains from the 14 tested last year and 6 new strains from the Economic Botanist were tested in the wilt plot. All of them have shown high degree of resistance.

Out of the strains tested so far, Malvi 10, Malvi 14, Malvi 15, Malvi 17, Malvi 20 and Malvi 21 have exhibited high degree of resistance in the wilt plot. Their mortality percentage is given below (Table 36) –

Table 36 : Mortality percent in different strains of Cotton.

S. No.	Strains	Parentage	Mortality %	
			1954-55	1955-56
1	Malvi 10 (1-52-1162)	Malvi 9 x Bani	31.9	3.1
2	Malvi 14 (1-52-1163)	Malvi 9 x V. 434	15.9	1.1
3	Malvi 15 (1-62-1164)	Jarilia x Bhoj	26.1	1.2
4	Malvi 17 (1-46-46)	Malvi 9 x Jarilia	30.9	12.0
5	Malvi 20 (1-52-1169)	Malvi 9-20 x V. 438	36.4	3.8
6	Malvi 21 (1-52-1171)	[(Jar x Bhoj) Jar] Bhoj	13.6	5.4
7	Malvi 9 (Control)	-	85.0	90.0

Highly field resistant strains with good fibre qualities would be tested in the glass house for evolving immune types.

(i) (a) Study of wilt resistance in linseed strains

In 1946-47, 25 linseed varieties from the various Central India States were tested for wilt resistance in small pots containing diseased soil. All of them were found to be susceptible.

In the test of 1949-50 none of the 14 linseed strains tested was found to be resistant. Three flax types-Dakota, Shyenne and B. 2158 were resistant.

In 1950-51 test RR 99 and the above mentioned flax varieties found to be resistant.

In 1951-52, out of the 19 varieties of linseed and flax tested for wilt resistance, RR 11, RR 99, RR 62 and the flax varieties Dakota and Shyenne showed resistance.

In 1953-54, highly wilt resistant strains of RR 99, RR 62, RR 11 and the two flax varieties Dakota and Shyenne were obtained by testing the resistant material of these strains from the last years test. I.P.I. 6, resistant strain was also tested and its resistance was confirmed.

(b)Study of rust resistance in linseed strains

In 1952-53, eleven varieties of linseed and flax were tested with 4 physiologic races of linseed rust prevalent at that time in India. Linseed types of RR 99 and RR 62 and the flax varieties, Shyenne, Dakota and Walsh were found to be highly resistant to all the races.

(ii) Physiologic specialization in *Fusarium oxysporum* f. lini-Wilt disease of linseed

Broadfoot, Boralaug and others found that the fusarium causing wilt of flax is composed of large number of pathogenic and cultural races. Similar studies were undertaken to observe the variations in the fusarium causing wilt of linseed in Madhya Bharat. A number of isolations showed that the fusarium varied appreciably in cultural characters and the isolates could be classified into six groups on this basis. An experiment was conducted in pots to study the pathogenecity of representative isolates from each group to five varieties of linseed. The results clearly indicated that the isolates vary in their pathogenecity to these five linseed varieties indicating thereby that there is physiologic specialization in the fusarium causing wilt disease of linseed in Madhya Bharat.

(iii) Study of seedling resistance of wheat strains with the four (15, 40, 42 and 75) races of black rust

In 1950-51, sixteen strains of wheat from the Economic Botanist were tested for seedling resistance against the four physiologic races mentioned above. Strain N. 24 x E 144 (84) was observed to be very resistant to races 15 and 75 and N. 24 x E. 145 (110) showed resistance to race 40. R. 12 was resistance race to 42 Wheats N. 24 x E. 117. A (120), N. 24 x E. 117 A (121) and R. 14 were found to be resistant to race 75 *Malvi* and *Pissi* varieties were susceptible to all the four races.

This work was transferred to the All India Co-ordinated Wheat Rust Control Scheme at the Institute.

(iv) *Oilseeds Scheme*: Started in May 1953.

(v) Study of wilt and rust resistant of linseed strains from different States.

Wilt – *Fusarium oxysporum* f. lini

In all 200 strains of linseed were tested for wilt resistant during the three years (1953-56). The number of strains obtained from different places and their reaction to wilt is given below (Table 37).

Table 37 : Reaction to wilt in different strains of Linseed.

Place	Resistant	Intermediate	Susceptible	Total
Bombay	-	2	-	2
Madhya Bharat	1	3	5	9
Uttar Pradesh	32	10	4	46
Madhya Pradesh	-	4	5	9
I.A.R.I. New Delhi	74	29	16	119
Punjab	2	2	-	4
Bihar	7	-	-	7
Bhopal	-	2	2	4

Rust-Melampsora lini Pers

During 1953-56 (3 years) 170 strains of linseed were tested for rust resistance with the five physiologic races of linseed rust present in India. Data is summarised as below (Table 38).

Table 38 : Reaction to rust in different strains of Linseed.

Place	Resistant	Semires stant	Susceptible	Total
Bombay	-	-	2	2
Madhya Bharat	1	-	8	9
Uttar Pradesh	24	16	6	46
Madhya Pradesh	1	3	5	9
I.A.R.I. New Delhi	78	-	10	88
Punjab	3	1	-	4
Bihar	-	-	8	8
Bhopal	-	-	4	4

Study of oil percentage and other economic characters of the resistant strain:

Twenty one varieties of linseed found resistant to wilt and rust are being further tested for oil percentage and other economic characters.

(vi) Miscellaneous

(a) Trial of fungicides

"Mergamma" an I.C.I. product was found to be effective against grain smut of jowar but did not control the Tikka disease of groundnut.

"Merfusan" a May and Baker product was tried against wilt disease of cotton. It did not control the disease.

"Diathane Z-78" a fungicide from Amritlal & Co., Bombay was not found to control wilt disease of cotton.

(b) Survey of Plant diseases

During 1947-48 Dhar and Ratlam in Central India and Kotah, Bundi and Udaipur in Rajputana were visited to survey the diseases of economic crops. Grain smut of jowar, rust and smut of wheat, wilt of cotton and linseed were commonly observed in these States. There after a number of places in Madhya Bharat were also visited and in addition to the above mentioned disease wilt of gram, wilt of betal vine and virus diseases were also noticed. Incidence of these varied from year to year.

(11) Abstract of M. Sc. (Ag), Thesis Research Work, College of Agriculture, Gwalior

(i) Agronomy Department

(a) During the year 1961

i. G.S. Bhardwaj – Manurial trial on Jowar fodder.

Application of 80 lb nitrogen and 20 lb. of P_2O_5 per acre showed higher production of green jowar fodder by 36%, total dry matter by 44% and total crude protein by 96% in comparison with other treatments.

ii. A.S. Agrawal –Manurial cum seed rate trial on Jowar.

Forty lb nitrogen per acre gave the highest yield of Jowar per acre i.e. 598.45 kg per acre. Keeping the economic consideration in view 12 lb. seedrate per acre was found to be the best.

iii. V.K. Saraswat –Spacing trial on Groundnut.

Six inch row spacing in combination with 6″ spacing in between the plants in the row gave the highest yield of Groundnut per acre. The yield per acre was found to be 943.74 kg.

iv. K.P. Gupta –Manurial trial on Berseem.

Highest yield of Berseem seed per acre was obtained by applying 20 lb nitrogen and 80 lb P_2O_5 per acre.

v. B.B. Singh –Irrigational trial on Berseem.

In the earlier stages 12 days frequency of irrigation was found to be the best in fodder yield per acre. From march onwards 8 days interval was observed to be the best. 4 acre inch irrigation produced the highest green fodder yield per acre.

vi. J.N. Khare –Manurial trial on Potato.

Maximum yield of potato was recorded by applying 60 kg of N and 40 Kg P_2O_5 per acre.

vii. C.M. Sawant –Varietal cum methods of planting trial on Potato.

Late variety P.S. 1021, ridge sowing method and 2 levels for earthing was found to be beneficial for increasing the growth, yield and tuberization of Potato.

viii. M.S. Upadhyay –Irrigation trial on wheat.

First irrigation four weeks after sowing and two subsequent irrigation appeared to be the best combination for highest yield of grain and straw per acre.

ix. D.P. Mishra –Varietal cum manurial trial on wheat.

The combination of 30 kg. N with hybrid 65 variety showed the highest yield of wheat per acre.

x. B.D. Sharma –Manurial trial on Groundnut.

It was found that the soil rich in nitrogen and phosphorus having light sandy loam texture, additional application of nitrogen, phosphorus and potassium are unnecessary (JCA, 1961-62).

(b) During the year 1962

i. G.S. Indrapurkar – Study of residual response to nitrogenous and phosphatic fertilizer, applied to berseem crop on the growth and yield of succeeding crop of jowar (fodder).

Application of nitrogenous and phosphatic fertilizers to berseem crop enriches the soil and it is possible to rase a profitable crop of jowar (fodder) without any additional supply of nutrients.

ii. R. K. Singh Raghuwanshi – Studies on the effect of chemical and cultural methods on the growth & yield of maize crop.

Post-emergence application of 2, 4-D at the rate of 1 lb per acre in combination with cultural treatment can safely be applied without leaving any detrimental effect on the maize crop.

iii. Rajendra Singh Tomar – Effect of varying spacing on growth and yield of Groundnut.

On the basis of present experiment, a combination of 18″ row to row spacing and 3″ spacing between plants in a row proved to the best for the groundnut (A, K, 12-24) crop in Gwalior region.

iv. Surendra Singh Rathore – Effect of varying spacing and levels of nitrogen & phosphorous supply on the growth and yield of maize.

The highest dose of 80 lb nitrogen per acre proved to be the best. Application of phosphorous does not appear to be beneficial for maize crop under conditions of the experiment. 9″ spacing between plants turned out to be the best spacing for maize crop.

v. Uday Kumar Yadav – Studies on the effect of Different levels of nitrogen, phosphorous and potassium on the growth, yield and quality of green jowar fodder.

A dose of 80 lb nitrogen seems to be optimum for jowar variety Gwalior – 304 under the conditions of experiment. Application of 80 lb nitrogen and 40 lb phosphorus per acre produced maximum dry matter. Thus, efficiency of nitrogen increased when applied in conjuction with phosphorus. Jowar crop did not respond to potash fertilizer.

vi. Yashwant Singh Tomar – Effect of varying seedrate and levels of nitrogen and phosphorus on the growth and yield of jowar.

A dose of 20 kg nitrogen per acre proved to be the optimum dose for jowar crop in Gwalior region. Application of phosphorus upto 10 kg P_2O_5 per acre is recommended in conjuction with nitrogen. A seedrate of 4 kg was found to be the best and resulted in significant yield increases.

(c) During the year 1964

i. G.V. Katti – Varietal-Cum-Manurial Trial on Hybrid Maize. (Guide- K.P. Garg)

Yield of Hybrid maize increased with the increase in the rate of nitrogen application. Significantly differences were, however, obtained between 120 lbs and 40 lbs rates and 160 lbs and 40 lbs rate per hectare. Ganga 101 variety turned out to be the highest yielder and gave 24.7% and 12.5% respective increase over local and Deccan hybrid varieties.

ii. O.P. Gour – Manurial Trial on Hybrid Maize. (Guide -K.P. Garg)

Yield increased significantly with the increase in the dose of nitrogen upto 80 lbs per hectare only. Further increase to 120 lbs per hectare did not result in significant increase. Doses of 40 lbs, 80 lbs, and 120 lbs gave respective yield increase of 98.8%, 219.5% and 234.4% over control. Split application of nitrogen in three equal doses was found to be the best method and gave significantly higher yield than single application at sowing.

iii. M.L. Gupta – NPK Trial on Bhindi (Guide - D.V.S. Chauhan)

Yield increased with increase in dose of nitrogen. P and K had no significant effect. 67.36 kg ,nitrogen dose gave significantly higher yield of Bhindi over 22.45 kg dose per hectare.

iv. P.R. Chavan – Cultural Cum-Manurial Trial on Potato (Guide-G.S. Bhardwaj)

The planting of whole tuber with a spacing of 9″ between plants with 98.8 kg. nitrogen per hectare was found to be the best combination so far as the yield of potato was concerned.

v. R.M. Mundi – Manurial Trial on Wheat. (Guide-M.K. Mishra)

Wheat grain yield was not affected significantly due to either doses of nitrogen (22.4, 44.8 and 67.2 kg. per hectare) or methods of its application (Foliar application, soil application, soil foliar application) tried. Compared to control the increase in yield with 67.2 kg. nitrogen dose worked out to 8.2%. Foliar application of the entire quantity of nitrogen resulted in 7.7% and 6.3% yield increase when compared to soil foliar application and soil application alone, respectively.

vi. R.C. Gupta – Manurial Trial on Berseem. (Guide-K.P. Garg)

Amongst the doses of P_2O_5 (O, 20, 40 and 60 kg. per hectare) and K_2O (O, 20 kg. per hectare) tried green fodder yield was affected significantly due to the levels of P_2O_5 only. Yield increased with each increase in the dose of P_2O_5.

vii. A.S. Gill – Manurial Trial on Cotton. (Guide-K.P. Garg)

Out of 4 doses of nitrogen tried, viz. O, 20, 40 and 60 lbs of nitrogen per acre, highest yield of seed cotton was obtained with 40 lbs of nitrogen rate. Regarding the time of application of nitrogen, application of full dose at the time of initiation of flowering was found to be superior than the application involving the entire dose of sowing or half the dose at sowing plus the remaining at flowering (JCA, 1964-65).

(ii) Botany Department

(a) During the year 1961

i. S.K. Nigam – To study the effect of Colchicine on *Pisum sativum.* L.

The variety *T. 19* was used for the experiment work. Acquous solution of colchicine in concentrations of 0.01, 0.025, 0.05, 0.075, 0.025, 0.5 and 1% with 3,6,12,18 and 24 hours duration combination were applied to the Dry, Soaked, Germinated seeds and to the Shoot apex. In case of Shoot apex treatment in addition to the above mentioned durations - duration of ½, 1 and 2 hours were also used. The following effects were recorded.

Low percentage of germination; slower growth, swollen radical and Shoot apex. Various abnormalities in leaf shape, size and flower parts-increase in size and number of anthers, sepals, petals, etc. Increase in the

size of stomata and pollen grains. Increase in pollen sterility. The tatraploidy was confirmed cytologically and was found to be 28% in the material treated with 0.01% concentration of colchicine and 6 hours duration.

ii. A.S. Tiwari –Effect of Colchicine on Seeds, Seedlings and Shoot of Guava (*Psidium guajava* Linn.)

Acquous colchicine solution was used for the seeds, seed-lings and shoot apex treatments.

Seeds - Soaked for 6 days and treated in 0.125, 0.25, 0.5 and 1% for 4, 8, 12 and 16 days.

Seedling - 0.1, 0.2, 0.4% plus the above mentioned concentrations and durations of 6, 12, 18, 24, 36, hours.

Shoot apex - Concentrations used were the same as were used for the seed treatment and duration of 6, 12, 24 and 36 hours.

Effect observed - Stunted growth of the treated material, low germination percentage and rate, deformed leaves, increase in size of leaves, floral parts, stomata and pollen grains. Increase in percentage of pollen sterility. The effective concentrations and duration in seed, seedlings and shoot apex were respectively as follows.

Seed treatment - 0.125% for 8, and 12 days and 0.25% for 4 and 8 days.

Seedling treatment - 0.1% for 24 hours, 0.2% for 18 and 24 hours, 0.4% for 18 hours.

Shoot apex treatment - The order of effectiveness was 0.5, 0.125, 0.25, 0.5% with 12 hours, 6 and 12 hrs, and 6, 12 and 24 hours, respectively.

iii. S.C. Goray –Effect of Colchicine, Auxins and Temperatures on The Viability and vitality of pollen grains of *Crotalaria juncea.* Linn and *Cajanus indicus.* Sprengl.

Maximum percentage of germination at room temperature was obtained in 12% sucrose solution in 3 hours of duration. Bursting of pollen grains was recorded in water and low concentration of sucrose. Concerntration of 0.25, 0.05 and 0.1 of both the auxins and concentration of 1, 2 and 4 PPM of Colchicine were found to be more effective at 16^0, 20^0, 24^0, 28^0, 32^0 and 36^0C. temperatures. 0.05 PPM concentration of both auxins was most effective at 24^0C. Best storage conditions were found to be 50% humidity and 5^0C temperature. On the 100^{th} day at the above

mentioned humidity and temperature the pollen viability was as high as 83.45% Pollen grains of *Cajanus indicus* gave no response to any treatment.

iv. S.K. Mehta –Effect of Auxius, Colchicine and temperature on the Viability and vitality of pollen grains of *Dolichos lablab.* L and *Pisum sativum* L.

Best concentration and duration at room temperature for maximum pollen germination was 17% and 6 hours and 24% and 5 hours for Bean and Pea respectively. 95.67% pollen germination and 279.3 M. pollen tube length for Bean and pea respectively. 95.61% pollen germination and 220.6 M. pollen tube length for pea was obtained in 0.05 of 3 I. A. A. and 0.08 of 3 I. A. A., respectively. 25% humidity and 5^0C temperature was found to be best for the storage of pollen grains of both the crops.

v. J.S. Kushwaha –Morphocytological studies in some of the important weeds of Gwalior region

Five important weeds namely *Asphodelus teniufolius, Cassia obtustfolia, Digera arvensis, Solanum xanthocarpum* and *Tribulus terrestris* belonging, respectively to the families *Liliaceae, Ceasalpinaeae, Amarantaceae,Solanaceae* and *Zygophyllaceae* were studied. The study includes external as well as internal morphology, floral biology, pollen grain morphology and cytology.

vi. B.B. Shahi –Comparative studies of 28 varieties of *Solanum tuberosum* Linn.

Variety 208 gave the maximum weight of tubers per plant while the variety *Satha A* showed the maximum number of tubers per plant. The maximum percentage of Corbohydrate as starch was obtained in the variety *Phulwa* while the variety 208 gave the highest percentage of dry matter. Varieties *Kufri Red, 3041 adn Satha A* were classified as having large medium and small size tubers, respectively. Varieties 416, 529 and 244 gave the maximum number of Starch grains per cell in the cortex, cuter and inner Medulla regions, respectively. Varieties 194 and 95 were noted to be Blight resistant.

vii. G.S. Tomar –A comparative study of the F3 and F4 population derived from 14 inter-variety crosses of *Triticum vulgar.*, Host

F3 and F4 plants of Cross No. 14 and 10, respectively gave 70.6 and 68.8% of germination. The maximum No. of tillers per plant (21.22 and 16.7, respectively) were recorded in the F3 and F4 plants obtained from cross No. 12 and 1. The maximum height of 177.9 and 163.5 cm. of the main shoot was obtained in the F3 and F4 plants of the cross No. 13 and 5, respectively while the maximum length of (16.33 and 17.76 cm.) of earhead was recorded in the F3 and F4 plants of the cross No. 8 and 1, respectively. The maximum No. of Spikelets (25.96 and 23.66) and grain per earhead (93.0 and 91.7) was obtained in the F3 and F4 plants belonging to cross No. 3 and 1, respectively. More than 50% plants of the F3 and F4 population obtained from cross No. 5 flowered in 66 and 68 days, respectively (JCA, 1961-62).

(b) During the year 1964

i. A.C. Kulshrestha – Effect of Colchicine treatment on *Momordica charantia* Linn. (Guide-S.K. Singh Gaur)

Dry seeds, germinated seeds and flower buds were treated with aquous solution of colchicine of five concentrations viz. 0.2%, 0.25%, 0.3%, 0.35% and 0.4% and with four different durations of 4, 8, 12 and 24 hours.

Treated plants showed character like slower rate of growth, lesser number of leaves, darker and thiner leaves, swelling of nodes, bigger flower etc. as compared to the control. Treated plants also showed bigger pollen grains (37.5% average increase). 0.25% concentration with 12 hours duration gave better results. Bigger stomata, bigger epidermal cells and decrease in the frequency of stomata per microscopic field were also recorded in treated plants.

Studies on anthesis and embryo development were also undertaken in control and treated plants.

ii. G.P. Verma – Comparative Cytomorphological Studies in four varieties of *Phaseolous vulgaris* L. and one variety of *Phaseolous multiflorous* L. (Guide-S.K. Singh Gour)

Comparative study of superlative Phonix claudia, Master piece: Local and earliest of all varieties were made in respect of the following characters:

Seed size; weight; volume and mode of germination plant height and number of leaves upto first flower. Besides anthesis; comparative anatomy in transverse section of stem, petiole, leaves, root, and petiole, longitudinal section of embryo were also studied.

The study in respect of the above points was quite detailed one.

iii. M.N. Shrivastava – Effect of alpha Naphthalene Acetic Acid, beta Indol Acetic Acid and Maleic Hydrazide on growth and development of two species of *Luffa*. (Guide-B.M. Gupta)

4 concentration viz. 5, 10, 20 and 50 ppm. of N.A.A. and I.A.A. and 50, 100, 200, 300 ppm. of M.H. were tried on *Luffa cylindrical* Roem. and the same concentrations of only NAA and IAA on *Luffa acutangula* Roxb. with a view to study the effect on various morphological characters, sex ratio parthenocarpy and quality of fruits.

Plant length decreased over control in both species with NAA and IAA. MH which is reported to be an antiauxin, on the contrary increased the plant length in *Luffa cylindricals*. The number and length of internodes reduced under NAA and IAA, but the branch number increased under most of the treatments. The originating node of female flower reduced under MH only. Initiation of the male flowers delayed while that of female flowers hastened under all treatments. The number of male flowers reduced and that of female flowers increased in most of the treatments and thus decreased male to female ratio. MH, however, reduced fruit set. Parthenocarpy could be induced by cut-end-style treatment with 1% NAA in Lanolin. Inter-specific crosses failed. NAA increased the protein and reducing and non-reducing sugar content in fruit but IAA reduced the same.

NAA 5 & 50 ppm. were found suitable for *Luffa cylindrical* and IAA 50 and 5 ppm for *L acutangula* from the point of view of increase in the total number of fruits.

iv. R.D. Khare – Effect of different concentrations of Gibberallic Acid, alpha Naphthalene-Acetic Acid and beta Indole Acetic Acid on growth and development of *Solanum melongena* Linn. (Guide-B.M. Gupta)

The effect of 4 concentrations viz. 25, 50, 75 and 100 ppm each in 1, 2, 4 and 6 spraying of the tree harmones G.A., N.A.A. and I.A.A. were

studied on growth and development of plants and the quality of fruits in Pusa Purple Round and Pusa Purple Long varieties of Brinjal.

The height and number of leaves and internodes per plant increased in all treatments, maximum being in 75 ppm. G.A. in 4 and 6 sprays. Increased branching occurred at lower concentrations with more number of sprays, or at higher concentrations with less number of sprays. It was significant to note that the leaves tended to be upright and glabrous in Pusa Purple Long variety under G.A. treatment. Flower initiation and fruiting hastened under all treatments except at higher concentrations and more number of sprays in all harmones. Maximum size and weight of the fruit was noted in lower concentrations with less number of sprays, but the number of seeds in them increased over controls.

Parthenocarpic development of the fruits could be induced by 1% IAA in la-nolin paste but the fruit remained small in size.

Reducing and non-reducing sugars increased under lower concentrations. Vitamin C and calcium content of fruits increased under high concentration of G.A. and IAA.

v. O.P. Jagia – Effect of different concentrations and number of sprayings of Gibberallic Acid on growth and development of *Arachis hypogea* Linn. (Guide- B.M. Gupta)

Four concentrations of G.A. viz. 5, 25, 50 and 100 ppm. each in 1, 2, 4 and 6 spraying were tried on Gangapuri, a semi spreading variety of Groundnut to determine most effective concentration and number of sprays most suitable for various aspects of growth, development and quality characters. The plan of layout was Randomised Block Design in three replications.

Height of plant and length and diameter of internodes and number of branches increased under all treatments, the maximum being in 100 ppm. with 6 sprays. Late spraying did not have much effect on number of leaves, number of flowers and pods per plant. The yield increased under all treatments, maximum being in 100 ppm. with 2 sprays. Shelling percentage improved in 1 to 2 sprays of 5 and 25 ppm., while mean test weight was maximum at 25 ppm. with 6 sprays. The fat percentage increased in all sprays of 25 ppm.

vi. I.P. Bopche – Effect of harmones on growth, development and quality of *Lycopersieum esculentun* Mill. (Guide-D.C. Beohar)

GA, NAA and 2, 4-D were tried on two varieties of tomato in Gwalior conditions as foliar spray. All the three hormones have greatly influenced the vegetative growth of the plants such as height of branches, number of leaves, etc. The plants flowered earlier and the fruits took at least 6 to 8 days less for ripening. The yield in the form of total fruit weight and number of fruits per plant was greatly increased. The foliar spray has also reduced the number of seeds per fruit, though no total parthenocarpy could be obtained. Hormone treatment has also improved the quality of fruits in terms of vitamin C and reducing sugar content.

vii. B.M. Moghe – Effect of Hormones, Colchicine and Temperature on Germination and of different Humidities and temperature on Longevity of Pollen Grains of *Cicer arietinum* L. and *Linum usitatisimum.* (Guide-D.C. Beohar)

Pollen grains of Gram failed to germinate in distilled water as well as in glucose solution, but germinated in sucrose solution ranging from 14% to 40% with 28% as the optimum concentration. Boric acid did not have any effect on the germination % though bursting of grains was distinctly reduced by 10% concentration with sucrose solution. The highest % of germination with longest tube was recorded at 23^{o}C. IAA and 2, 4, 5 – T had no effect on germination but in 2 ppm. of GA the germination % was higher than the control. Colchicine had depressing effect on germination as well as on tube length. Abnormalities like swelling of tube tips, rough membrane, stunted growth etc. were also recorded. These pollens could be stored for 61 days at 25 percent RH and 10^{o} C temperature without loosing viability.

Pollen grains of Linseed could not be germinated artificially in Sucrose or in Sucrose Boric acid solutions, even after adding stigmatic extract to the various solutions(JCA, 1964-65).

(iii) Chemistry Department

(a) During the year 1961

i. Gadkar, G.D. – The effect of ammonium sulphate on nitrogen and mineral contents of leaf and fruit of guava.

Nitrogen fertilization in guava gave a positive correlation with the leaf nitrogen, phosphorous, potassium and magnesium while calcium content of the leaf remained unaffected.

ii. Rathore, G.S. – The effect of organic matter on the loss of nitrogen from ammonium sulphate in soils of different $_{p}$H.

About 80 per cent of nitrogen from ammonium sulphate is lost in three months from alkaline soils. The loss of nitrogen decreased with decreasing $_{p}$H of the soil. Straw and farmyard manure were both effective in retarding the loss of nitrogen from ammonium sulphate soil but farmyard manure is more effective than straw in neutral and alkaline siols.

iii. Tiwari, A.K. – The distribution of naturally fixed ammonium and ammonium fixing capacity of soils and clay fraction of soils of M.P.

The naturally fixed ammonium as present of ammonium fixing capacity ranged between 27.3 to 70.6. the lowest figure for naturally fixed ammonium is found in Black soil of Chattarpur and highest in yellow soils. The average ammonium fixing capacity of clay in three profiles is Bhind 3.54 me/100 gm clay, Bagwai 2.79 me/100 gm clay and Indore 2.68 me/100 gm clay.

iv. Tiwari, Y.D. – The study of saline and alkaline soils of Gohad, Mehgoan tehsils (Bhind) and Banmore tehsil (Gwalior).

These soils had average $_{p}$H of 9.5 with varying salinity. The soils can be classified as saline-alkaline. The organic amendments bark of *Accassia sp.,* Neem leaf powder (Margosa indica) and Madar leaf powder (*Calotropis sp.*) were found to be effective in decreasing soil $_{p}$H and increasing conductivity (JCA, 1961-62).

(b) During the year 1964

i. R.G. Dixit – Studies on manganese in soils of Madhya Pradesh. (Guide-Dr. G.P. Verma)

Manganese status of different soil types from 18 districts was determined. On the basis of average values, Shehdol, Bhind, Devas and Indore districts were found to contain below 10 ppm. exchangeable manganes. On the basis of average values various soil types can be arranged in order of increasing manganese as follows:

Alluvial Medium Black, Deep Black, Shallow Black, Mixed Red and Black, Skeletal Red and Yellow.

The reduceable manganese status was also studied and the results of the analysis showed a wide variation from district to district and from

one sample to another within the same district. The shallow black soils showed the largest variation.

The co-relation between manganese status and soil $_{P}$H, calcium carbonate and organic matter was also worked out. Negative co-relation was found with $_{P}$H and calcium carbonate while there was positive co-relation with organic matter. Neubaur's technique was also tried to find out the suitable index for manganese availability and it was found that both exchangeable manganese and magnesium nitrate extracted manganese values are good index of manganese availability in M.P. soils. The probable manganese deficiency areas seem to be Indore, Devas, Bhind and Shehdol districts.

ii. R.B. Sharma – Zinc status in soils of Madhya Pradesh. (Guide-Dr. D.P. Motiramani)

Study on zinc status was made in 38 districts of Madhya Pradesh. The samples were analysed for available and total zinc, pH, calcium carbonate and organic matter.

On the basis of study, the different soil types showed the following zinc status.

Total	Medium Black	Deep Black	Shallow Black	Red and Yellow	Mixed Red and Black	Alluvial
Zinc in ppm.	70	65	-	48	40	32
Available zinc in ppm.	5.58	4.63	5.32	4.095	3.63	2.4

The study was also made with profile samples and it was observed that available zinc tends to decline with depth. Co-relation between available zinc and $_{P}$H, calcium carbonate and organic matter was studied. Negative co-relation with $_{P}$H, was observed in Deep Black, Shallow Black and Medium Black soils. No significant co-relation was observed with calcium carbonate. But there was positive co-relation between organic matter and available zinc.

iii. S. Kar – Boron status of M. P. soils. (Guide-Dr. D.P. Motiramani)

Available boron status in soils of Madhya Pradesh was studied in 312 soil samples comprising all districts covering 6 soil types of the state.

The available boron in ppm was found to be in the following descending order:

Medium Black	Mixed Red & Black	Mixed Red & Yellow	Alluvial	Shallow Black
0.646	0.472	0.386	0.304	0.279

In 35% of the total samples analysed, the available boron was found to be below 0.3 ppm, which is a critical limit for boron deficiency.

$_{P}$H, present calcium carbonate and per cent organic matter showed no significant co-relation, while available potassium and available boron showed a positive co-relation.

iv. D.P. Shitole – Available molybdenum in soils of M. P. (Guide-Dr. D.P. Motiramani)

Molybdenum status was studied in soils of 27 districts covering the 6 soil types of Madhya Pradesh. In the investigation improved acetone reduction method of Ellis & Olsen 1950 was followed. The available molybdenum in various soil types ranged from 0.3675 to 0.525 ppm. The Deep black and Medium black soil showed highest content while Shallow black had lowest figures. The available molybdenum in various soil types was as follows:-

Deep Black	Medium Black	Mixed Black	Red & Yellow	Alluvial	Shallow Black
0.525	0.502	-	0.393	0.376	0.3675

The available molybdenum was found to be co-related with total molybdenum and constituted about 1.25 to 5% of total. Using 0.050 ppm as critical limit for available molybdenum about 10% of the total samples were found to be deficient in alluvial, shallow black, red and yellow and medium black soils. No significant co-relation was observed between available molybdenum vs. calcium carbonate and organic matter. But significant co-relation with $_{P}$H was found in Alluvial, Shallow Black, Red & Yellow, Medium Black soils.

v. B.S. Solankey – Studies on phosphate availability and lime requirement. (Guide-Dr. D.P. Motiramani)

Lime requirement of acid soil from Baster, Raipur and Sarguja districts of Madhya Pradesh was determined by seven different procedures,

viz. Calcium Hydroxide Titration, Brown's, Vittor's, Hutchinsons, Bonnets, Puri's and Pratt's procedure.

Low value of lime requirement was obtained by calcium hydroxide titration, and Browns procedure and intermediate values by Vittor's & Hutchinson's procedure. The comparable values were obtained by Pratt's, Bonnet's and Puri's procedure. Pratt's method was found to be rapid and easy to apply for large scale work. Taking Pratt's procedure as standard, lime requirement was found to be significantly co-related with $_{p}$H, clay percentage, cation exchange capacity and per cent organic matter.

vi. O.P. Verma – Studies on potassium in soils of M.P. (Guide-Dr. D.P. Motiramani)

Exchangeable potassium and potassium fixation capacity was studied in different soil types of Madhya Pradesh. On the basis of soil types the alluvial soils showed the smallest amount of exchangeable potassium followed by Red and Yellow soils. The remaining soil types i.e. namely, Deep Black, Shallow Black, Mixed Red and Black, and Medium Black showed higher amount of exchangeable potassium in increasing order.

Highest fixation of the potassium was found in Deep Black soil followed by Red and Black. The K fixing capacity of the other soil types is as follow (in decreasing order):-

Medium Black Red & Yellow Shallow Black Alluvial

The co-relation of exchangeable potassium and potassium fixation with $_{p}$H, Calcium Carbonate and Organic matter contents was also worked out. The organic matter content showed a positive co-relation with exchangeable potassium & potassium fixation, with the exception of soil of Sagar district. In general the investigation point to the fact that the soils of Madhya Pradesh are well supplied with exchangeable potassium (JCA, 1964-65).

(iv) Department of Entomology

(a) During the year 1961

i. Vaishampayan S.M. –Studies on *Earias fabea* (Stall)., the spotted ball worm of cotton, on Bhindi.

The external morphology, internal anatomy, bionomics and life-history of this insect was studied.

Experiment on chemical control of this pest using aldrin, dieldrin, endrin, Folidol and Busudin at 0.02, 0.03, 0.04% were carried out. On the basis of these endrin was the best followed by Folidol 0.04% proved better than endrin.

ii. Upadhayay R.P. –Studies on *Leucinodes orbolalis.* Guen.,"Brinjal top shoot and fruit bore 3".

The external morphology, bionomics, life-history and seasonal history of this pest was studied. *Cremastus spp.* (Ichneumonidae) was for the first time recorded as a pupal parasite of this pest.

An insecticide trials with, endrin, Basudin, malathion (all at 0.04%) and DDT (0.06)% was carried out.

iii. Johari R.C. – Studies on *Carpomyia vesuviana.* Costa-The Ber fruit fly.

The chaetotaxy of head and thorax, bionomics and control were studied. Varieties with larger and pulpy and sweeter fruits were more heavily infested. The attack of pest started towards the end of November and continued to mid. of March. In a chemical control trial Folidol and endrin were found to be promising.

iv. Bhardwaj V.K. –Studies on *Coccinella septum-puneteta.* Linn, "A predator of mustard aphid *Liapaphis erysime (Kalt)*".

Studies on external morphology, internal anatomy, and life history were carried out.

A single predator was found to eat about 622 aphids during its life time.

The predator was active from mid. Dec. to mid April and during this period it went through two generations (JCA, 1961-62).

(b) During the year 1964

i. Surendra Kumar – Study of coparative external morophology and biometry of three species of Indian honey bees. (Guide-Shri U.S. Mishra)

The external morphology and the different average measurements of the body parts of 3 Indian species of honey bees have been given. The final conclusion derived were:

The conclusion of Narayanan etc. (1960) that the size of *Apis florae inhabiting* a dry and hot climate is bigger than that which lived in damp and cool climate is confirmed.

The tongue length alone is not a dependable character for identifying the different strains, for different strains, may have the same tongue length.

The conclusion of Trehan and Singh (1956) that *Aphis dorsata* does not have regional strains in India is not in keeping with the present findings.

the conclusion of Alpatov (1927) that the bees required to exert more for honey and pollen have more hamuly than those which are required to exert less.

The strain of *Apis indica* collected from Muzaffarnagar town is different from the strain of Allahabad studied by Kapil (1957). Both places are situated in the Indo-Gangetic plain of Uttar Pradesh.

ii. K.C. Sharma – The study of effect of seed treatment with some systemic insecticides on Jassid (*Emposca devestans.*) population in Bhindi.(Guide-Shri U.S. Mishra)

Metasystox 25% E.C.; Dipterex 80% Water soluble powder and thimet 10% granules were used for seed treatment in three ways namely seed soaking, seed coating and placement of insecticides with seed. The rates per acre of each of the 100% insecticides were as follows:-

S.No.	Name of Insecticide	Seed Soaking	Seed Coating	Placement with
1.	Metasystox	29 cc. 58 cc. 87 cc.	½ Litre 1 Litre 1 ½ Litre	
2.	Dipterex	29 Gms. 58 Gms. 87 Gms.	½ Kg. 1 Kg. 1 ½ Kg.	½ Kg. 1 Kg. 1 ½ Kg.
3.	Thimet	- - -	- - -	½ Kg. 1 Kg. 1 ½ Kg.

Result:- Placement of thimet with seed in all three doses proved nearly better in reducing the jassid population than any other dose and method of application of any insecticide used.

iii. V.K.R. Shinde - Studies on Bionomics, Morphology and control of *Bagrada cruciferarum* Kirk., the painted Bug. Hemiptera-Pantatomidae. (Guide- Shri N.K. Sood)

The external morophology of the adult bug was studied and described in detail and the various stages and the life cycle was measured and recorded. The bionomics was studied in both, laboratory and field conditions. The various periods pertaining to the life cycle of the pest were as follows:

The precopulation period-4 to 6 days, preoviposition period 4-6 days, incubation period 2.4-5.05 days, (An average of 20 observs.), I nymphal instar 2.25 to 5.2 days, II instar 3-5 days, III instar 4-4.8, IV instar 4.5 to 6.6 days, V instar 5.1 to 7 days, (An average of 20 observs.) Several overlapping gens were completed in the period, the peak period is November. Adults and nymphus of bug were noted to be attacked by an unidentified reduvid bug.

Four insecticides, each with 3 concentration replicated 4 times were tested on adults, reared in the Lab, and field and released in potted plants Insects were randomly sampled and mortality occurring after 48 hours of treatment was recorded and is shown in table below:-

Treatment	Percentage Mortality
Malathion .05%	100
Dipterex .05%	98
Malathion .0%	94
Endrin .3%	88
Malathion .02%	86
Dipterex .02%	84
Treatment	**Percentage Mortality**
Dipterex .03%	84
Endrin .05%	80
DDT .5%	78
DDT .4%	74
Endrin .02%	74
DDT .3%	70

iv. Prabha Shankar – Studies on *Plutella maculipennis* Curtis, Diamond Back Moth, Lepidoptera, Ditraysia, Plutellidae. (Guide-S.L. Bichoo)

The diamond back moth, *Plutell maculipennis* C was studied for its external morphology, bionomics and control.

External morphology of adult moth has been described in detail.

Copulation takes place just after emergence, small, oval greenish white eggs measuring 0.42 x 27 mm. are laid singly on the lower side of the leaf. Incubation period is 2-3 days. There are 4 larval instars, total larval period being 7-10 days in September, which in the peak period insect activity. Adult is nocturnal in habit and a week flier. Average longevity of male is 6-7 days and that of female 9-10 days. Sex ratio in Sept. was 1:1.6 and 1:1.9 in Jan and Feb. One life cycle is completed in 22-28 days.

The insects becomes active in August on early crucifiers, the activity is much retarted during winter, 6-7 generations are completed in one year.

Four insecticides each at 3 concentrations applied 2 times at 1 month interval were tested in a randomised block design with 4 replications. The results are tabulated below:

Treatment	**Percentage Mortality**	**Treatment**	**Percentage Mortality**
Malathion .06%	86.6	DDT .06%	71.1
Malathion .04%	78.8	DDT .04%	71.0
Lindane .08%	74.6	Nicotine Sulphate .08%	70.8
Nicotine Sulphate .1%	74.6	Lindane .04%	63.3
Lindane .05%	73.9	DDT .02%	59.7
Malathion .08%	73.6	Nicotine Sulphate .06%	54.4

(JCA, 1964-65).

(v) Department of Plant Pathology

(a) During the year 1961

i. S.I. Ahmed – Studies on some parasitic fungi collected in the vicinity of Gwalior.

A detailed survey of parasitic fungi occurring in the vicinity of Gwalior was made. The total number of species collected and identified was 124, out of which, 20 belonged to *Phycomycetes*, 7 to *Ascomycetes*, 28 to *Basidiomycetes* and 69 to *Fungi Imperfecti*. In *Basidiomycetes* 9 belonged to *Ustilaginales* and 19 to *Uredinales.*

ii. A.M. Bartaria – Studies on some *Cercospora* species from Gwalior.

Twenty five species of *Cercospora* were collected from 26 individual hosts and a detailed study of their morphological characters was made. During the course of the study, *C. canescens* Ellis and Martin on *Dolichos biflorus*L. and *C. celosicae* Sydow on *Celosia argentea* viz., *Pennisetum typhoidium* and *Zizyphus rotundifolia* were also discovered.

iii. B.S. Bhadoria – Studies on fungi associated with stored grains.

A survey of seed microflora associated with stored grains of ten types of crops viz., wheat, pea barley, paddy, jowar, bajra, pea, gram, moong, linseed and mustard collected from different conditions of storage from three different sources was made. In all 7 genera of fungi viz., *Alternaria, Aspergillus, Helminthosporium, Rhizopus, Colletotrichum Fusarium* and *Curvularia* were found to be associated with the grains.

iv. S.C. Vyas –Effect of some Copper, Mercury and Zine compounds on growth, sporulation and virulence of *Botrydiplodia theobramae* (Pat.) Griff, et Maubi.

Effect of some salts of Mercury, Copper and Zinc with their various concentrations incorporated in liquid and soil media on *Botryodiplodia theobromae,* isolated from rotted papaya fruit were studied to find out the best salt and concentration in so far as relative toxicity is concerned. Experiments on adaption gave some interesting results. The order of toxicity of salts seems to represent the following descending order – Hg > Cu > Zn. Virulence of the pathogen is found to be affected by the toxic chemicals.

v. **P.N. Saxena – Studies on seedling blight disease of some vegetables.**

The organisms causing the disease were isolated and identified as *Pythium aphanidermatu, Rhizactonia (Corticium) Solani*, and *R. Bataticola.* Several fungicides were tried in various ways to minimise the attack of seedling blight (JCA, 1961-62).

(b) During the year 1964

i. **B.S. Kiri – B-Vitamins in relation to *Sclerotium cepivorum* Berk. (Guide-L.K. Joshi)**

The fungus, *Sclerotium cepivorum* is found deficient for thiamine. The deficiency is not altered by time factor and is found complete. The fungus is found to respond well to even as low a dose as 1 mg. Per litre. The deficiency is not altered by change in reaction in the growing range of the fungus.

ii. **Rajendra Kumar – Studies on Pythium de Baryanum Hess with reference to damping off of the ornamentals (Guide- L.K. Joshi)**

The fungus isolated from diseased seedlings of Celosia was found to be pathogenic to balsam, zinnia, torenia, amaranthus, gillardia, wall flower and chrysenthemum.

In experiment pertaining to the disease, it was found that 9% Cuprous oxide as seed treatment, 20% formalin as soil treatment and 1% Bordeaux mixture as post-emergence spray were found to be better than other fungicides used for the purpose. The best results in checking the damping off were found by seed and soil treatment with Cuprous oxide (9%) and formalin (20%), respectively. Among the various media tried for growth, Czapeck's medium and potato dextrose medium supported best growth of the fungus.

Sucrose proved to be the most important constituent for the growth of the fungus. The second important constituent was sodium nitrate. The optimum reaction for the fungus was found to be pH 5.5. Sucrose proved to be the best source of carbon and ammonium-nitrate and potassium nitrate to be the best source of nitrogen. The fungus grew better at 25^{o} C than at 30^{o} C.

iii. Rajendra Prasad – Further studies on Ashy Stem Blight of Beans (Guide- L.K. Joshi)

Macrophomina phaseoli affects all parts of bean plant except roots. The disease occurs in two phases, viz., pre-emergence seed rot and post-emergence seedling blight. Black cankers appear on cotyledons, stem and petides.

The organism is found to be pathogenic to tomato, moong, urd, cowpea and cabbage in addition to beans.

In testing various types of beans for pathogenicity, it was found that the pathogen attacks thirty three types of beans out of 36 under trial. Sclerotia were noticed in all infected parts of the hosts but pycnidia were found only on dead seed, seed coat and cotyledons. In culture only sclerotia were found.

In various methods of inoculation, severe infection was found in the case of soil inoculation followed by seed inoculation. Deep sowing resulted in higher percentage of infection.

In controlling the disease Agroson GN (1%) was found to be the best as a seed-dressing fungicide.

Potash applied at the rate of 60 lbs per acre could practically fully control the disease.

The pathogen grew best in Richard's medium and in host-extract agar medium. The growth of the fungus was not affected significantly on different $_{P}H$ of the medium in the range of $_{P}H$ 4.0 to $_{P}H$ 8.5. Sucrose and potassium nitrate were the best sources of carbon and nitrogen, respectively.

Omission of carbon source (sucrose) from the Richard's medium resulted in poor growth of the fungus.

Omission of nitrogen, phosphorus and sulphur had little effect on the growth of the fungus as seen the linear growth. Omission of iron had no significant effect on the growth of the fungus. The optimum temperature for the growth was found to be $30^{o}C$.

iv. L.P. Bhargava – Physiological studies on three species of Colletotrichum (Guide- L.K. Joshi)

The effect of nutrition on growth and sporulation of three species of Colletotrichum viz., *C. falcatu, C. graminicolum* and *C. piperi* was studied.

Out of eight synthetic and non-synthetic media, Richards solution and host extract supported good mycelial growth of *C. falcatum;* Glucose peptone medium and host extract supported good growth of *C. graminicolum* and Richards medium and host extract supported good growth of *C. piperi.* With respect to sporulation, glucose peptone medium was found to be the best for *C. falcatum* and *C. graminicolum,* while malt extract was best for *C. piperi.* All the three species grew and sporulated within a $_{P}H$ range of 4-8 with an optimum as $_{P}H$ 5. *C. falcatum* grew and sporulated in presence of all the C sources used but the optimum growth and sporulation took place in presence of sucrose. *C. piperi* grew and sporulated best on malt extract solution.

Organic sources of C were better utilized for growth and sporulation than the inorganic ones by all the three species.

Out of eight N sources tried, peptone was found to be the best for growth and sporulation for all the three spp.

The optimum temperature for growth and sporulation of all the species was $25^{o}C$.

The optimum C/N ratio on which the three species grew and sporulation best was 5:1.

v. V.K. Jain – Survey of *Cercospora species* in the vicinity of Gwalior and their diagnosis. (Guide- L.K. Joshi)

Eighteen species of Cercospora were collected on 20 different hosts and detailed study of their morphological characteristics were made. Two new records of *Cercospora spp.* were made, one on *Rungia parviflora* and the other on *Cordia myxa* (JCA, 1964-65).

(vi) Department of Extension

(a) During the year 1964

i. T.N. Sharma – Impact of demonstration in influencing the farmers to adopt improved agricultural practices. (Guide-R.S. Misra)

The study was limited only in evaluating the extent of change in the attitude and behaviour of the respondents towards the improved practices demonstrated on their holdings. The following conclusions were reached:

Operational Technique: Two stage sampling system was adopted with stratification in the last stage and random selection in the second one.

a. The decision taking ability and risk bearing capacity were commonly found within a range group of 25 years to 45 years.

b. The farmers belonging to traditional agriculture community had shown maximum incentive comparatively. Of course they were found in the process of changing their traditional pattern.

c. Farmers having a farm-family-unit (20-40 acres) were found best adopters of improved practices due to the demonstration.

d. Irrigation was found one of the most important limiting factors in promoting improved practices. Highly significant correlation was noticed to this regard though it has an inverse-relationship with the size of holding.

e. Different number of exposures were required for different practices to make full conviction. Two to three exposures through demonstration were found necessary for the purpose done under ideal condition.

f. The study has revealed that more than 60% of the respondents had shown their willingness and have improved practices on their holdings under normal pattern, and that they had gained skill and knowledge to operate within the technical changes.

g. Better economic gains were found to be the best force for a change.

h. Lack of proper and timely finance at a cheap rate was found a limiting factor. In some cases lack of irrigation, technical know-how and uneconomic holding were found responsible for non-adopters.

ii. R.K. Saxena – Evaluation of Training Programme of Village Level Workers. (Guide-R.S. Misra)

Following conclusions were drawn:

a. The satisfaction of personal interest and service motto were the main criteria for acceptance of the job. Financial requirement happened to be the universal demand to take any job.

b. The syllabus taught at the training centres was found comprehensive, however it was lacking on giving practical aspects to the desired extent.

c. The deputation of officers was not in keeping with the aptitude of persons resulting in lowering their efficiencies.

d. Lack of proper and adequate teaching aid was also found an important factor in not creating effective training situations.

e. The village level workers were found lacking in practical and operational aspects of most of the improved agricultural practices in real situation and this had lowered the desired confidence. They could not act to the desired extent as an educator.

f. Farmers attitude -The village level workers could not create class confidence and awareness in the unpriviledged class of the society due to the poor and uneven spread of the development plans.

iii. G.I. Gurjar – A study of Social Strucutre of Badagaon Village. (Guide-R.S. Gauraha)

In the study an attempt has been made to understand the family types, interpersonal relations with the families and outside families, caste structure, inter-caste relationship, village factionalism, economic and ritual structure and local government. Questions had also been set to know villagers attitude towards block personnels, development activities and means of communication etc.

In the village Badagoan patriarchial and patrilocal families are common. Joint families in the village have shown a trend of disintegration, due to domestic quarrels, growing sense of individualism and fascination for urban way of living. The Panchayat elections have generated factions in the village.

The three basic institutions existing in Badgaon are the village council, a cooperative society and a middle school. The Panchayat in the village does not seem to have taken effective action in fulfilling the expected functions; the village cooperative too has made no significant impact on the village economy. The progress in the sphere of education of girls and adults is also unsatisfactory. Villagers in general, are apathetic towards caste, educating their daughters and female members, still plays a dominant role in determining the personal as well as social behaviour of the village people and its impact is seen in choice of profession, inter-caste relations, caste rituals and caste traditions.

iv. R.M. Shukla – A study of Progressive Farmers of Morar Block. (Guide-S.S. Thakur)

Following conclusion were arrived at:

a. A fairly high majority i.e. 88% of the progressive farmers under study belonged to categories of holding ranging from 15 to 45 acres.
b. Only 6% of the progressive farmers were illiterate. The rest had education upto primary and middle level.
c. Farmers belonging to younger age group i.e. 30 to 35 years stood first in the scale of progressiveness, with the advance in age the chance of getting a farmer progressive becomes remote.
d. A significant high majority i.e. 94% of the progressive farmers belonged to the upper caste such as Brahmins, Thakurs and Banias of course having an agricultural base.
e. Of the total, a high majority i.e. 86% reported to be using some or other means of irrigation. About 46% of the progressive farmers grow cash crops at least in 5% of the total holdings.
f. The progressive farmers in general were found to occupy one or other office in the rural organizations.
g. Main activities of the block in which the progressive farmers in general were found to have active part were construction of school building, cleaning of village lanes, village development programmes, cooperative activities, crop and cattle competitions and agricultural exhibitions.
h. Progressive farmers in fair majority were found to have been following improved farming practices such as improved implements, fertilizers, improved seeds, green manuring and intercultural operations (JCA, 1964-65).

Visitors

During the Year 1949-50

1. Shri R.K. Patil, the Food Production Commissioner, Government of India, paid a visit to the Madhya Bharat State to see the possibilities of growing more food and the progress so far made in the Food Production Drive. He conferred with officers of the Department and gave very valuable suggestions.
2. Hon'ble Dr. Punjab Rao Deshmukh, Member, Constituent Assembly visited Madhya Bharat and conferred with officers of Department in connection with the improvement of cotton and its trade.
3. Dr. Acharya, Compost Development Officer, Government of India visited Madhya Bharat, inspected work of compost making in

several districts of the State. He conferred with the officers of the Department in district places as well as at the headquarters & gave valuable guidance for organising work of preparation of compost.

4. Shri Ganga Saran "Kisan", Honorary Crop Competition Adviser, paid a visit to the Madhya Bharat State. He conferred with the officers of the Department and also held meetings with cultivators and local officers at several places and explained the methods of intensive cultivation.
5. Mr. Clifford Taylor, Agricultural Adviser and an Attachee to the American Embassy, New Delhi, paid a visit to the Central Experimental Farm, Gwalior and the Agricultural Research Laboratories.

The other notable visitors were –

(i) Shri Gajanan Naik, Palm Gur Adviser, Government of India.
(ii) Dr. V. G. Panse, Director, Institute of Plant Industry, Indore.
(iii) Dr. Bal, Ex Director, Institute of Plant Industry, Indore.
(iv) Shri Valunikar, Bone Meal Adviser to Government of India.
(v) The Plant Protection Adviser to Government of India.

A noteworthy feature of the year 1949-50 was a visit by Hon'ble Chief Minister to the Central Experimental Farm, the Research Laboratories and the Engineering Workshop at Gwalior where work carried out by each of these sections was explained in detail by the Sectional Heads. Hon'ble Chief Minister showed a very keen interest in the working of all the Sections that he saw and advised the workers to get on with the work with increased zeal and bring forth substantial results and show to the world what the youths of a free country could achieve(ARDA, 1949-50).

APPENDICES

Appendix – I

Improved Cultural Practices of the Principal Crops of the Tract

By S. S. Pathak, Agriculture Research Institute, Gwalior

Wheat

Sowing – For M. B. Region best time of sowing is between 20th October to 5th November. Early sowing provides a good start to the crop in dry cultivation because of higher moisture content.

Cultivation – 4 to 6 cultivation by *desi* plough prepares good-seed bed. In black soils, practice is to give one deep ploughing before monsoon followed by 3-4 bakharings. For dry crop one to three cultivation with soil inverting plough or harrowing may be given to the soil.

Spacing and seed rate – The crops should be sown by doofan or seed dril maintaining a spacing of 12″ from row to row under dry conditions and 9″ under irrigated conditions. Seed rates varying from 30 to 35 seers*. can be safely recommended under dry conditions. 25 seers* is found optimum under irrigated conditions.

Manurial – Under dry conditions application of 20 lbs of nitrogen before sowing by providing the same in the form of ammonium sulphate or urea in the soil is recommended. Under irrigated condition, green manuring will be the best form of manuring for increased production. 40 lbs of nitrogen per acre is recommended. An additional dose of 40 lbs of P_2O_5 per acre gave increased yield. Placement method of applying fertiliser two to three inches below the seed by drilling has found to give increased yield.

Irrigation – In all 2-3 irrigations are given; first irrigation at vegetation growth stage *i.e.* weeks after sowing, second at tillering stage and 3rd at earhead formation is recommended for increased yield.

Cotton

Tillage operation– 3-4 bakhar application in all, 2 during hot months and rest before sowing.

Sowing and spacing – The seed is sown by doofan by tying santa to the doofan. Spacing of 18″ row to row is maintained in the case of desi varities and 1 ½′ – 2′ in case of long staple of American varieties. Seed rate of 10 seers* per acre is the general practice.

Interculture – In all 4-5 hoeings by Akola hoe are given for producing a healthy, better yielding crop. The same is given at proper intervals till ball formation.

Manurial requirement – Twenty lbs of nitrogen per acre provided through ammon. sulphate or urea before sowing by broadcasting and thoroughly milling the same in the soil. 20 lbs of nitrogen through 5 cartloads of F. Y. M. or 4-5 maunds* of groundnut cake should be applied well before sowing. Normally a dose of 20 lbs N will be sufficient in lighter soils when the rainfall ranges from 25″-30″. In case of heavier soils with annual rainfall of 40″ this dose can be increased to 30 or even 40 lbs N.

Cotton preceded by groundnut can be safely recommended as it gives higher yield. Tuar-groundnut-cotton will also prove a good rotation. Berseem-chari-wheat will be ideal rotation.

Sugarcane

It is grown in medium loam to black soils with rich clay loams. Soils should invariably be well drained.

Cultivation – 4-5 ploughings are given in order to obtain a firm tilth. This can also be achieved by 1 to 2 deep ploughings followed by 2-3 bakharings and two additional ploughings before sowing.

Seedrate and planting material – It is generally planted from middle of Jan to middle of April. The optimum seedrate varies between 12-14 thousands sets per acre.

Interculture and irrigation – 2-3 hoeing during first 8-10 weeks followed by bullock- drawn implements at frequent intervals. Usually 8-10 irrigations should be given.

Manurial – On an average sugarcane requires 100-120 lbs of nitrogen which can be supplied in the form of (a) Green manure + 150 maunds* of compost + 3 maunds* of Ammon. sulphate.(b) Green manure + 150 maunds* of compost + 15 maunds* of G. N. cake.

The departmental recommendation is Ammon. sulphate, 750 lbs with 150 lbs of superphosphate per acre.

Irrigation – In all 8-10 irrigations are required both before and after the rainy season for higher yields.

Paddy

Soil and *cultivation* – Itis grown in sandy loam to heavy soils. Any number of cultivations may be given for broadcasting. Drill of transplanting methods of cultivation 1-2 deep summer ploughing by M. B. Plough followed by 3-4 ploughings by desi plough in case of broadcasted and drilled paddy. In transplanted paddy one summer ploughing by M. B. Plough followed by another at the beginning of rain adequate. This field is then further ploughed 2-3 times and puddle before planting.

Sowing and seedrate – Broadcasting method requires 30-35 seers* per acre of seed whereas 18-20 seers* in case of drilling. Seed requirement for raising nursery for one acre will be 7-10 seers*.

Manurial – Nitrogen requirement of the crop is 40-50 lbs N. per acre. The department recommendation is to manure at the rate of 100 lbs of Ammon. sulphate per acre applied equally in one before sowing and second at tillering stage with 120 lbs of P_2O_5applied to the field at the time of first ploughing can be adopted with advantage. One md. of compost or F. Y. M. for each 25′ length of nursery bed mixed with soil at preparing nursery beds will give higher yield.

Transplanting – In case of early transplanting or spacing of 6x6″ gave the highest yield whereas for long duration varieties 2x9″ was best. Transplanting gives 15-30% higher yield.

Jowar

Soil and cultivation – It canbe successfully grown on all types of soils. It is cultivated on both heavy and light soils. One or two ploughings on two-four bakharings are given followed by ploughing.

Method of sowing – Sowing by doofan or tifan is a better practice. Crop spacing of 18″ between rows recommended.

Seedrate – In Gwalior and Indore divisions 10 lbs and 12 lbs per acre of seed rate is recommended.

Interculture – In all 2-3 hoeing and/ or weedings are done.

Manurial – The nitrogen requirement is 20-30 lbs per acre. In case of areas with normal and well distributed rainfall nitrogen doses can be increased to 30 or 40 lbs per acre with profit. A dose of 30 lbs per acre in Gwalior Division and 20 lbs for Indore Division is recommended.

Groundnut

Soil – Sandy loam soils are the best for groundnut cultivation. It can however be grown in almost all soil types except stiff clayey, alkaline or acidic.

Preparation and tillage – 4 to 5 ploughings are necessary for most soils in Bombay, soil received one ploughing and 3 harrowings while black soils are harrowed a number of times to produce the desired tilth. One summer ploughing followed by 2-3 harrowing before sowing.

Seedrate and spacing – A spacing of 6″x6″ or (12″x16″) for the bunch and 9″x9″ for the spreading varieties has been found to be the optimum in most places. 30 seers*. of seed per acre with 18″ row to row spacing is recommended for general practices.

Manuring – Application of phosphate 20 lbsP_2O_5 per acre is generally given. In addition to phosphate 20 lbs per acre may also be applied to obtain higher yield.

Intercultivation– Two hoeing and weedings are necessary to stir the soils and remove the weeds for a better crop.

Irrigation – It is mostly a rainfed crop in M. P. in northern division one irrigation may be given, if the soils get too hard for digging the plants.

Mixed cropping – The common practices is to grow groundnut mixed with other crops like tuar, jowar, cotton and castor, etc.

Rotation – In M. B. Region groundnut-cotton-wheat-jowar rotation is followed.

Improved varieties – Improved varieties of short duration (3 ½ months) of bunch or erect types and long duration (4 ½ months) spreading are generally cultivated. In M. B. region the AK 12-24, R4, Ec 1704 and Gangapuri are very common(PFSCRC, 1959).

Appendix-II

Summary of results achieved on farms of Madhya Bharat region

By S. S. Pathak, Agronomist, Agricultural Research Institute, Gwalior.

Trial conducted so far have not completed that standard of normal duration or experiments which is very necessary to arrive at final conclusions in research. Therefore, a summary of results so far achieved is presented on the basis of significance in case of some and trends noted in other experiments.

Gwalior

Wheat

Seedrate and spacing trials have shown that higher seed rates and larger spacings do not produce more. 25 seers* seed with 12″ spacing between rows has given the highest yield.

Manurial – 40 lbs N/acre-20 lbs P_2O_5 gave best yield. Application of nitrogen through green manure was equally efficient.

Weed control –1. Sodium salt of 2, 4-D, 0.5% was found to be most effective in killing Adhasisi (*Xanthiumstrumarium*).

2. 60% sodium salt of T. C. A. gave 93.4% mortality of *Cynodondactylon* (Dub) after four weeks.

3. A combination of sodium salt of 2, 4-D (Fernoxone I.C.I.) eith 16 oz. Dose gave 95.04% mortality of Bathua (*Chenopodiumalbum*) in irrigated wheat.

4. Post emergence application once @ 1 lb. acid equivalent of Fernoxone 60 gallons of water per acre gave significantly higher yield of wheat.

5. 3 lb. acid equivalent doses of M. C. P. A. and Fernoxone sprayed twice at an interval of two weeks had equally good effect in killing all broad leaved kharif weeds including dub and motha.

6. 20 Oz. acid equivalent doses of M. C. P. A. and Fernoxone controlled very prominent local weed "Gothri" in paddy fields at Bagwai.

Residual response – Application of phosphate to Berseen not only increased its green fodder yield by 50% but increased the yield of subsequent maize crop also through residual response. A doze of 50 lbsP_2O_5 per acre gave the highest yield of maize.

Jowar

Seedrate of 5 seers* per acre and a spacing of 24″ between rows was found best.

Manurial –20 lbs N with 20 lbs P gave the highest yield.

Weed control –As shown at item 5 under weed control.

A mixed crop of groundnut and arhar was sown, where one row of arhar was provided after every 5 rows of groundnut. Spacing of 1 ½′

between the rows was kept. Groundnut was harvested in the last week of October giving an yield of 10 maunds* per acre of early type Gangapuri variety. This gave a spacing of 9 feet between two arhar rows. Arhar with this large spacing and one irrigation developed immensely and gave an yield of 10-12 maunds* per acre when harvested in March. Arhar with larger growth also provided fuelwood. Cultivation was started between the arhar rows after one irrigation given in October end. This 9 feet space was converted into three trenches, wherein sugarcane was planted in the end of February. This sugarcane crop gave 900 maunds* of canes in the first year and 500 maunds* in the second year as ratoon. In the fourth year a wheat or pea crop is taken. It is apparent that total production of four years is 200 maunds* per acre, *i.e.* 50 maunds* per year, whereas under normal cultivation practices yield do not go above 25 maunds* per acre per year. The experimental is in progress for confirmation of above findings. It is anticipated that it will give an increase in per acre production in terms of cash return by 100-150%.

Institute of Plant Industry, Indore

1. ***Cotton***

Rotation : Groundnut-cotton-wheat-Jowar.

Seedrate : 10 seers*.

Spacing : 14″ between rows, 6″-9″ between plants.

(i) Desi

(ii) American

Long staple 18″ between rows and 12″-18″ between plants.

Manurial – Five cartloads of F. Y. M. per acre to be applied 2-3 weeks before sowing. 2 ½ maunds* of superphosphate drilled two weeks before sowing and 2 maunds* ammonium sulphate broadcasted at the time of sowing.

Sowing time : Outbreak of monsoon.

Interculture. Daura or ridger twice or thrice in the session.

2. ***Wheat***

Rotation	....	Groundnut- cotton-early moong-wheat-jowar.
Seedrate	....	30 seers*.
Spacing	....	14″ between rows by drilling.
Sowing time	....	Middle of October.
Manurial	....	20 lbs of nitrogen through Ammon.sulphatebefore sowingwith 20 lbs of P_2O_5 through superphosphate by drilling 2″

below seed, if no legume or green manuring with sanai is done.

3. ***Groundnut***

Seedrate	....	30 seers* of kernel per acre; seed treatment with cerseon forbetter germination.
Spacing	....	14″ between rows by drilling.
Manuring	....	1 ½ maunds* of superphosphate drilled before sowing.
Interculture	....	weeding once followed by hoeing with daura.

4. ***Jowar***

Seedrate	....	5 seers*.
Spacing	....	14″rows by drill 9″ between plants by thinning.
Manurial	....	1 ½ maunds* ammon. sulphate broadcasted before sowing.
Interculture	....	Thinning followed by daura or ridger once. Additional hoeing give better growth, twice or thrice in the season. (treatment of seed with 10 oz. of sulphur for every 5 seers*seed recommended.)

5. ***Paddy***

Rotation	....	Paddy-wheat (Coarse, early maturing)
Seedrate	....	18-20 seers*.
Spacing	....	14″ between rows by drilling.
Manurial	....	3 ½ maunds* ammon. sulphate broadbasted at the time of sowing.
Interculture	....	Weeding followed by daura and ridger before tillering.

6. ***Sugarcane***

Sowing time	....	Middle or end of February in trench with eye to eye system.
Seedrate	....	1600 to 2000 canes or 40-60 maunds* of stripped cane.
Seed treatment	....	Sets to be soaked in 1% lime water for 12 hrs. to preventredroot and stemborer in the new crop.
Spacing	....	3 ft. apart in trenches.
Manurial	....	10 cartloads (60-80 lbs N) farm compost applied at preparatory stage then a mixture of Ammon. sulphate and cake as 1 ½ maunds* ammon. sulphate + 4 ½ maunds* groundnut

cake one month after germination. Same to be repeated at earthing in June.

Ujjain

1. ***Jowar***

Manurial	..	20 lbs nitrogen as ammon. sulphate + 20 lbs P_2O_5 as superphosphate (all forms of nitrogenous manures were equally efficient).
Seedrate	..	5. seers* Per acre.
Spacing	..	18″ from row to row with 9″ from plant to plant by sub- sequent thinning.
Interculture	..	2-3 interculture with daura recommended.

2. ***Cotton***

Seedrate	....	10 seers* per acre.
Spacing	....	18″ row to row and 9″ plant to plant.
Manurial	....	40 lbs of nitrogen as ammon. sulphate in two doses 20 lbsat sowing and 20 lbs at flowering to be applied in rows and mixing by daura.
Interculture	....	twice or thrice by daura.

3. ***Groundnut***

Seedrate	....	30-35 seers*.
Spacing	....	18″ row to row.
Manurial	....	20 lbs P_2O_5 per acre by drilling between the row before sowing.
Interculture	....	hoeing and earthing with Akola hoe and Daura 2-3 times.

4. ***Wheat***

Sowing date	....	25^{th} to 29^{th} October.
Seedrate	....	30 seers* per acre.
Spacing	....	12″ row to row by drill.
Manurial	....	20 lbs N. through ammon. sulphate before sowing with 40 lbs of P_2O_5 to be drilled into the soil 2″ below the seed.

Khargone

Jowar

Spacing	....	18″ to 24″ spacing between rows have given good results. 9″ from plant to plant should be maintained.
Seedrate	....	6 seers* per acre.
Manurial	....	20 lbs N+ 20 lbs P_2O_5 has given highest yield both applied before sowing P_2O_5 is drilled into the soil.

Groundnut

Seedrate	....	30 seers*.
Spacing	....	16″ between rows.
Manuring	....	20 lbs N+ 40 lbs P_2O_5 +20 lbs K_2O have given best results all applied, before sowing, P_2O_5 applied by drilling. (Application of nitrogen is subject to confirmation.)

Cotton

Seedrate	....	18-20 lbs per acre.
Spacing	....	18″ between rows.
Manurial	....	20 lbs N has given highest yield when given in two equal doses half before sowing and half at flowering.

Weed control

1. 25 lbs acid equivalent of sodium salt of 2, 4-D (Fernoxone) was found to be most effective in killing *Zizyphusrotundifolia* (Jhadberi). Experiment continued.

2. Spraying Jhadberi with 30% Fernoxone (2, 4-D sodium salt) gave encouraging results. The experimental is being continued.

Mahagarh (Dist. Mandsaur)

Jowar

Seedrate of 6 seers* per acre and a spacing of 18″ between rows has given the highest yield. There is a trend of better yield with 24″ between rows. Plants are subsequently thinned to 9″ apart in rows. Manurial : 20 lbs nitrogen per acre with 40 lbs P_2O_5 has given the highest yield. P_2O_5 was applied by drilling before sowing.

Jowar mixed cropping with Arhar and Moong : Equal proportion when each row of jowar is followed a row of arhar and moong have given the highest yield. It was found better than Jowar single crop.

Groundnut

Seedrate : 35 seers* per acre and spacing of 18″ between rows gave the highest yield.

Manurial : 20 lbs nitrogen, 40 lbs P_2O_5 and 20 lbs K_2O per acre when P_2O_5 was drilled into the soil and all three applied before sowing have given the best result.

Cotton

Seedrate : 12 seers* with 24″ spacing have given the best result.

Jhabua

Maize

Seedrate : 12 seers* per acre and spacing of 18″ with subsequent thinning of plants. A trend of 24″ spacing giving higher yield is noticed.

Manurial : 40 lbs nitrogen, 40 lbs P_2O_5 and 40 lbs K_2O has given the highest yield.

Groundnut

Seedrate : 35 seers* per acre with spacing of 18″ between rows gave better results.

Manurial : Nitrogen application at lower level help in increasing yield. High doses have adverse effect. 20 lbs of superphosphate increased yield by about 20%. Additional dose of 20 lbs of K_2O increased the yield by another 10%.

Maize and groundnut mixed crop trial, where different number of rows and patterns were tried, have given interesting result but are subject to confirmation next year (PFSCRC, 1959).

Appendix – III
Varieties recommended for different regions *

Name of the Crop	Region		
	Gwalior	Malwa	Nimar
1. Jowar	1. Gwalior 82	1. Indore 3	1. Ujjain 8
	2. Gwalior 304	2. Indore 9	2. 123 A
		3. Ujjain 6	3. NJ 171
		4. Ujjain 8	
2. Moong	1. Krishna 11	1. Kopergaon	1. Kopergaon
	2. Gwalior 3		
3. Urid	1. Gwalior 2		
4. Arhar	1. Gwalior 3	1. Type 5	E. B. 38
5. Lobia	1. Phillipine early		
	2. Gwalior K. 33.		
	3. Gwalior K. 11		
	4. Gwalior K. 14		
6. Til	1. N. P. 6		
	2. Gwalior 5		
7. Groundnut	1. R 4	1. A. K. 12-24	1. A. K. 12-24
	2. E. C. 1704		
	3. Gangapuri		
	4. A. K. 12-24		
	5. A. K. 10		
8. Wheat	1. C. 281	1. N. P. 710	No. 65
	2. N. P. 710	2. N. P. 718	No. 11
	3. R. S. 31	3. C. 591	No. 12
	4. C. 591	4. Hy. 65	No. 38
	5. G. D. 11	5. Ujjain 2	
	6. N. P. 718	6. Ujjain 6	
	7. Ujjain 6	7. Ujjain 22	
	8. Hy. 65	8. N. 111	
		9. G. D. 11	
		10. EKD 69	
9. Linseed	1. Hy. 603	1. E. B. 3	
	2. Hy. 627		
	3. N.P. (R.R.) 204		
10. Gram	1. Gwalior 2	1. Ujjain 24	
	2. Type 1	2. Ujjain 21	
	3. Type 87	3. Chafa	
	4. Gwalior 75	4. 707	
	5. U. 24.		

Name of the Crop	Region		
	Gwalior	Malwa	Nimar
11. Peas	1. T. 19	1. K. K. Peas	1. K. K. Peas
	2. T. 163	2. T. 19.	
	3. T. 17	3. I. P. 29.	
	4. K. K. Peas		
12. Paddy	1. N. 22	1. Barwani 22	
	2. T. 9	2. Basmati.	
	3. Langi		
	4. T. 21		
	5. Bhopalpatti		
	6. Basmati		
13. Cotton		1. 197-3	1. Maljari
		2. Bhoj	2. 0394
		3. Indore 2	3. 51-9
			4. H 420
14. Sugarcane	1. Co510	1. Co419	1. Co419
	2. Co245	2. Co421	2. Co421
	3. Co321	3. Co453	
	4. Co453		

(PFSCRC, 1959).

Description of Varieties of Crops Recommended for Gwalior Division

Jowar

1. Gwalior 82- It is a yellow grained variety. Glume colour is brown. Cob type is semi-compact. Average yield of grain is 8-10 maunds* per acre. Grains are bold. Weight of 100 grains is 34.0g. The crop takes 110 days to mature.
2. Gwalior 304-it is a variety with bold chalky white grains which are very attractive. Cobs are lax. Glume colour is brown. Average yield of grain is 8-10 maunds* per acre. Weight of 1000 grains is 34.0g. The crop ripens in 120 days. This variety is easy to thrash.

Mung

1. Krishna 11- It is an early ripening strain of mung. The seeds are bold. Colour of seed is light green. Weight of 1000 grains is 34 g. Average yield per acre is 6 maunds* Crop takes 65 days to mature. With this variety it is possible to take a second crop of wheat. Protein content is 24.6%.

2. Gwalior 3- It is a late maturing variety which takes 110 days to mature. Seeds are bold and colour of the seed is deep green. Weight of 1000 grains is 34 g. Protein content is 24.8% Average yield is 6 maunds* per acre.

Urad

1. Gwalior 2- It is a late maturing variety taking 105 days to mature. It has medium sized grains. Weight of 1000 grains is 45 g. Colour of seed is black. Average yield is 8 maunds* per acre.

Arhar

1. Gwalior 3- It is a late maturing vigorous variety of Arhar. It has got bold grains and it takes 240 days to mature. Weight of 1000 grains is 80 g. Colour of seed is brown. Protein content is 21.4%. Average yield is 15 maunds* per acre.

Lobia

1. Philippines early- It is a very early maturing variety for vegetable purposes. Yield of green pods is 15-20 maunds* per acre. Yield of seeds is 5 maunds* per acre. The pods are ready for picking from the 40^{th} day of sowing. The pods are delicious white in colour and with very little fibres. This variety ripens in 55 days.
2. Gwalior k.3- It is medium ripening variety with bold and attractive seeds. It takes 65 days to mature. Seed colour is creamy white with brown hilum. Average yield per acre is 15 maunds* Weight of grains is 124 g.
3. Gwalior k.11- It is a medium ripening variety with small seeds. It takes 65 days to mature. Seeds colour is creamy white with brown hilum. Average yield per acre is 15 maunds* Weight of 1000 seeds is 70.8 g.
4. Gwalior k.14- It is a medium ripening variety with bold seeds. It takes 65 days to mature. Seed colour is creamy white with black hilum. Average yield of seeds is 15 maunds* per acre. Weight of 1000 seeds is 105.5 g.

Except Philippines early all the three varieties are suitable for grains as well as for forage, green manuring and soil conservation purpose.

Sesamum

1. N.P.6- It is a medium ripening bunch type variety. It takes 110 days to mature. Weight of 100 kernals is 64.4 g. The colour of the kernel is light pink. Average yield of pods is 18-20 maunds* per acre.
2. E.C.1704- It is a medium ripening bunch type variety. It takes 110 days to ripen. Weight of 100 kernals is 50.5 g. The colour of the kernel is light pink. Average yield of pods is 16-18 maunds* per acre.
3. Gangapuri- It is an early maturing bunch type variety which takes 100 days to mature. The kernels are bold. Weight of 100 kernels is 46.5g. The colour of the kernel is deep pink. Average yield of pods is 10-12 maunds* per acre.

Wheat

1. C.281-It is a mid early ripening variety. The seeds are medium sized having amber colour. Weight of 1000 grains is 39.4 g. It takes 135 days to mature. It escapes rust and free from rust. Average yield is 25 maunds* per acre. The ears are impressive.
2. N.P.710- It is a mid early maturing variety. It takes 135 days to ripen. Grains are amber coloured and medium sized. Weight of 1000 grains is 36.2 g. It is tolerant to rust and highly resistant to loose smut. Average yield is 20 maunds* per acre.
3. R.S.31-1-It is an early maturing variety. It takes 130 days to ripen. It is suitable for unirrigated condition also. The grain is amber coloured and the size of grain is bold. Weight of 1000 grains is 46.4%. Average yield is 20 maunds* per acre under irrigation and 12 maunds* per acre under dry condition.

Gram

1. Gwalior 2- It is a medium in maturity strain of gram with bold grains. Weight of 1000 seeds is 131 g. It takes 125 days to ripen. Protein content is 19%. Average yield of grain is 14 maunds* per acre. Grain colour is reddish brown.
2. Type 1- It is a medium in maturity strain of gram with bold grain. Weight of 1000 grains is 176g. Average yield of grain is 14 maunds* per acre. Grain colour is reddish brown. It takes 125 days to ripen.

3. Type 87- It is a late maturing variety with bold grains. It takes 135 days to mature. Weight of 1000 grains is 166 g. Average yield per acre is 13 maunds* Grain colour is reddish brown.

Linseed

1. H.603- It is a medium in maturity variety of linseed with bold seeds. Colour of the seed is dark brown. Crop takes 110 days to ripen. Average yield per acre is 10-12 maunds* It is resistant to rust.
2. H.627- It is a medium in maturity with bold seeds. Colour of the seed is dark brown. Crop takes 110 days to mature. Average yield is 10-12 maunds* per acre. It is resistant to rust.
3. N.P.(PR) 204-It is a variety which is medium in maturity. Colour of the seed is dark brown. Crop takes 115 days to ripen. Average yield per acre is 12-13 maunds*. It is also a rust resistant variety.

Peas

1. Type 19- It is a mid early variety quality pea for table purpose. The seeds are sweet in taste. Seeds are wrinkled. Pods are ready for picking in 70 days. It takes 105days to mature. Average yield of green pods per acre is 50 maunds*. Average yield of seed per acre is 12 maunds*.

2. Type 163- It is a late maturing variety suitable for seed purpose and dal making. Seeds are round and smooth. Average yield per acre is 15 maunds*. It takes 110 days to ripen.

Appendix – IV

Mechanical Analysis of Sheopur and other soils (22 samples)

Analysis results on original air dry samples in per cent

S. No.	Location (Village and District)	Revenue Classific-ation	Stones and Gravel (above 3 mm)	Fine Gravel (1-3 mm)	Coarse sand (0.2-1 mm)	Fine Sand (0.04-0.02 mm)	Silt (0.01-0.04 mm)	Fine silt (0.002-0.01)	Clay (Less than 0.002 mm)	Moisture and loss on ignition etc.
1	Ugar District Bhilsa	Mar	0.45	0.37	0.24	16.63	23.18	18.41	36.07	4.65
2	Ugar District Bhilsa	Padua	1.33	0.86	0.25	17.13	17.08	18.31	36.93	8.11
3	Ugar District Bhilsa	Khera	5.81	3.22	4.42	28.79	16.02	15.52	16.12	10.11
4	Ugar District Bhilsa	Pathar	0.59	1.05	0.79	15.25	15.81	17.66	38.21	10.64
5	Kanad District Shajapur	Kali	3.38	8.21	2.93	11.24	10.59	13.25	34.96	15.44
6	Kanad District Shajapur	Bada	7.99	6.66	5.91	23.68	12.51	17.84	13.39	12.02
7	Kanad District Shajapur	Dhamni	3.70	2.81	4.69	30.50	13.27	12.45	18.19	14.39
8	Kanad District Shajapur	Fardia	3.38	8.40	2.87	13.04	11.96	15.86	28.98	15.51
9	Kanad District Shajapur	Adan	6.83	5.50	5.10	29.36	12.80	15.55	10.41	14.48
10	Sheopur District Sheopur	Irrigation	2.04	1.18	1.84	25.14	9.17	33.64	15.56	11.43
11	Sheopur District Sheopur	Kachchar	0.11	0.14	1.56	57.33	13.53	10.56	16.55	0.12
12	Sheopur District Sheopur	Padua	0.06	0.12	0.41	39.43	10.55	33.88	10.97	14.58
13	Sheopur District Sheopur	Danda	1.48	0.32	1.50	64.34	5.77	12.18	14.03	0.43
14	Utanwar District Sheopur	Mar	0.90	1.50	0.62	22.73	8.09	21.13	40.52	4.51

S. No.	Location (Village and District)	Revenue Classific-ation	Stones and Gravel (above 3 mm)	Fine Gravel (1-3 mm)	Coarse sand (0.2-1 mm)	Fine Sand (0.04-0.02 mm)	Silt (0.01-0.04 mm)	Fine silt (0.002-0.01)	Clay (Less than 0.002 mm)	Moisture and less on ignition etc.
15	Utanwar District Sheopur	Dumat	3.14	2.01	1.29	31.66	9.61	19.31	36.64	6.27
16	Utanwar District Sheopur	Gohar	0.18	0.82	1.02	21.89	18.66	29.59	12.28	15.56
17	Pahargarh District Sheopur	Rankad	34.25	3.35	4.13	28.09	7.78	10.85	8.17	3.36
18	Pahargarh District Sheopur	Padua	0.81	0.43	3.72	29.62	14.63	9.79	15.05	25.75
19	Pahargarh District Sheopur	Danda	0.42	0.21	2.73	51.37	11.85	8.23	7.84	17.35
20	Pahargarh District Sheopur	Kachchar	14.20	1.72	6.55	23.17	15.84	14.96	16.73	6.83
21	Kunwarpura District Sheopur	Mar	0.06	0.10	0.20	22.72	15.96	18.17	39.37	3.24
22	Kunwarpura District Sheopur	Dumat	0.00	0.20	0.10	21.43	13.92	17.30	37.85	9.20

Appendix – V
Protein Analysis
(Factor used for converting N into Protein 6.25)

S. No	Name of the sample	Protein %
Early Urid		
1	Jora 4	21.87
2	Shivpuri 19	23.19
3	Bijeypur 21	25.56
4	Shivpuri 5	25.81
5	Shivpuri 22	23.81
6	Local	22.50
7	Shivpuri 3	24.06
8	Shajapur 10	22.31
9	Shajapur 8	22.87
Late Mung		
10	Jugandan 17 (Ujjain)	23.81
11	E.B. 160	24.06
12	Local	25.50
13	Sardarpur 10	25.37
14	Bhilsa Green 16	23.50
15	Sardarpur 15	25.37
16	New Khachrod 3	24.06
New Late Mung		
17	Mungaoli	26.03
18	Shivpuri 10	22.50
Early Arhar (Ujjain)		
19	E.B. 3 (Earbhani)	19.68
20	E.B. 3 (Nagpur)	18.75
21	C.F.	20.56
22	Shivpuri 6	20.31
23	Ujjain 7	20.70
24	Local	20.31
25	E.B. No. 1723	20.78
26	Sardarpur 2	21.87
27	E.B. 38	21.21
28	Coimbatore 2900	20.78
Late Urid (Ujjain Block 5)		
29	Bhilsa	29.75
30	E.B. 110	28.43
31	Bhilsa Green 15	27.78
32	Local	28.43
Late Urid		
33	Guna 2	28.54
34	Bhind 17	23.50
35	Sheopur 7	22.96
36	Mungaoli 7	26.68
S. No	**Name of the sample**	**Protein %**
37	Sheopur 2	24.06
Late Arhar (Ujjain)		
38	Local	21.21
39	Bhind 8	20.12
40	Broach 1	21.65
41	Bijaipur 2	21.43
42	Jora 3	21.0
43	Shivpuri 3	20.56
44	Bhind 1	19.68
Early Gram		
45	Sardarpur 1	20.70
46	Ujjain Local (Katila)	22.50
47	Sabour 2	19.68
48	Sardarpur 21	20.78
49	Sardarpur 20	14.87
50	Ujjain 14	20.12
Late Gram		
51	Chanderi 24	18.12
52	Bhind 19	18.12
53	Local	20.78
54	C.F. Yellow	18.75
55	B 18	19.59
56	Pachhar 10	20.31
57	Shivpuri 4	21.0
58	J.B. Ujjain 11	20.12
Commercial Gram (Ujjain)		
59	Bhilsa Gulabi 18	21.21
60	Local	23.19
62	D 8	20.70
63	Bhilsa Gulabi 2	20.31
64	Bhilsa Green 2	20.0
Early Arhar (Gwalior)		

S. No	Name of the sample	Protein %
65	Ambah 3	19.68
66	Ambah 1	22.75
67	Gwalior 7	20.31
68	Bhind 7	22.09
69	Jora 4	23.19
70	Jora 9	21.43
71	Local	22.96
72	Bhind 7 N	23.19
73	Bhind 4	22.96
74	Bhind 9	23.40
Late Arhar		
75	Khachrod 7	21.87
76	Vijaipur 7	23.81
77	Gwalior 9	20.12
78	Coimbatore 2900	26.46
79	E.B. Nag. 38	22.33
80	Local	23.19
81	Shivpuri 2	26.46
82	Shivpuri 9	23.19
Early Urid		
83	Shajapur 15	24.06
84	Shajapur 17	26.15
85	Khachrod 18	20.78
86	Ujjain 8	23.50
87	Morena 23	24.54
88	Local	20.12
89	Morena 2	25.81
Early Urid (Gwalior)		
90	Morena 7	26.46
91	Bhind 2	24.50
Late Urid (Gwalior)		
92	Jora 25	24.54
93	Mungaoli 4	26.25
94	Sheopur 17	22.09
95	Isagarh 24	28.23
96	E.B. Nagpur 110	23.81
97	Local	25.15
98	Morena	22.96
99	Bhind 8	20.62
100	Bhind 10	25.81
Early Mung		
101	Sardarpur 4	25.81
102	Sardarpur 16	24.93
103	Krishna 11	24.0
104	Krishna 20	24.93
105	Krishna 14	22.09
106	Local	22.09
107	Shivpuri 9	25.15
108	Shivpuri 8	26.90
109	Shivpuri 6	24.93
Late Mung (Gwalior)		
110	Khachrod 5	23.50
111	Bhind 2	21.0
112	Morena 5	20.12
113	Morena 3	26.68
114	E.B. Nag 160	23.50
115	Local	24.54
116	Morena 10	22.96
117	Bhind 3	20.70
Early Gram		
118	Gwalior 2	16.62
119	Bhilsa 6	17.06
120	Vijaipur 3	15.62
121	Vijaipur 5	16.40
122	Morena 6	25.81
123	Early Gram Local	20.31
Late Gram		
124	G 15 (Gwalior)	18.59
125	Ambah 3	17.50
126	E.B. Nag. 352	18.12
127	Niphad 816	19.46
128	Bhind 2	17.93
129	Gwalior 1	18.59
130	Gwalior 3	22.50
131	Local	16.42
132	Morena 3	16.42
133	Morena 6	16.42
134	Shivpuri 3	16.42
135	Shivpuri 10	18.12
136	Sheopur 2	18.59

Appendix – VI
Protein Analysis

(Factor used for converting N into Protein 6.25)

S. No.	Name of the sample	Protein %
Commercial Gram		
1	Local Gulabi	18.37
2	Bhilsa Gulabi 18	19.03
3	D. 8	17.71
4	Bhilsa Gulabi 2	19.03
5	Bhilsa Green 22	19.46
Early Urid		
6	Local	21.93
7	Shivpuri 8	22.81
8	Jora 4	21.93
9	Shivpuri 10	21.93
10	Shivpuri 19	21.00
11	Shivpuri 51	21.00
Gram		
12	Ujjain 14	20.56
13	Sardarpur 20	19.68
14	Local	20.46
15	Sardarpur 1	19.68
16	Sardarpur 21	20.58
Late Arhar		
17	Local	24.50
18	Broach 2	21.56
19	Bhind 8	19.75
20	Jora 3	18.59
21	Vijaiypur 2	23.62
Late Urid		
22	Local	25.15
23	E.B. 10	25.81
24	Bhilsa Green 15	25.15
25	Guna 2	23.62
26	Bhilsa Black 5	24.06
27	Mungaoli 7	22.31
Late Mung		
28	Shivpuri 10	23.62
29	E.B. 160	22.31
30	Sardarpur 10	24.71
31	Local	23.62
32	Bhilsa green 16	23.62
33	Jagudan 17	24.06
Late Gram		
34	Local	20.12
35	Ujjain 1	22.75
36	Chanderi	22.75
37	Ujjain Sel 11	22.53
38	Pachhar 10	23.40
39	Bhind 19	22.75
Early Arhar		
40	Ujjain 7	23.62
41	Local	19.68
42	C.F. Ujjain	22.75
43	E.B. 3	21.43
44	Shivpuri 6	19.46

45	Sardarpur 2	20.34
Early Gram		
46	Gwalior 2	19.25
47	Morena 6/A	18.37
48	Bijaipur 3	17.93
49	Local	19.68
50	Sardarpur 21	18.37
51	Sardarpur 1	19.68
Late Gram		
52	Gwalior 75	21.56
53	Morena 6/B	19.68
54	Ambah 3	18.37
55	Local	19.90
56	Gwalior 1	18.59
57	Bhind 2	17.50
Late Mung		
58	Morena 5	27.34
59	Bhind 3	26.46
60	Khachrod 5	24.28
61	E.B. 160	26.46
62	Morena 3	26.68
63	E.N. Sheopur 6	23.41
64	E.M.S. 20	20.78
65	E.M. Sardarpur 16	25.15
66	Krishna L. 11	24.54
67	Sardarpur 4	24.93
68	Local	24.54
Late Urid		
69	E.B. 110	26.46
70	Sheopur 17	23.19
71	Bhind 2	26.03
72	Mungaoli 4	26.03
73	Morena 1	25.56
74	Jora 25	25.15
75	Bhind 8	25.56
Early Urid		
76	Ujjain 8	25.56
77	Khachrod 18	25.37
78	Shajapur 17	25.15
79	Morena 2	24.54
80	Bhind 2	24.54
81	Local	25.81

Appendix VII

Soil testing service in Madhya Pradesh

By Y. P. Bali

Soil Chemist, Soil Testing Service, Gwalior

Summary of "A note on progress and programme in Gwalior and Indore Divisions"

Gwalior Soil Testing Service Laboratory of Government of India envisages to give proper fertiliser recommendations based upon soil tests and to prepare soil test summaries area wise indicating their fertility level.

Since August 1956, the laboratories had recorded 6100 soil samples up to 31st March 1959. Out of these about 2550 and 1600 samples had come from Gwalior and Indore divisions, respectively. Soil test summaries showing fertility levels, blocks and districts wise, were presented. Comparatively speaking, soils of Indore divisions are high in organic carbon and potash contents than those of Gwalior division. Phosphorous content is almost similar in both the divisions.

All concerned were requested to send larger number of soil samples regularly so that many more cultivators could get benefit out of this free service. The necessity of following up fertiliser recommendations were also stressed (PFSCRC, 1959).

Appendix – VIII

Analytical resultsof the soils of Alirajpur (District Jhabua), M. B.

S. No.	Place	Depth of Soil-Sample	pH	CaCO3 %	T. S. S. Parts per 1,00,000	Clay %	Silt %	Sand %
1	Village-Godat	0″-9″	8.0	7.5	29	25.24		
		9″-18″	8.15	0.0	23	20.92		
		18″-27″	8.15	0.5	23	17.32		
		27″-36″	8.0	0.5	34	26.56		
2	Village-Godat	0″”-9″	7.82	0.0	58	6.44		
		9″-18″	8.0	0.5	49	0.80		
		18″-27″	8.27	0.5		1.42		
		27″-36″	8.19	0.0		7.32		
3	Village-Godat	0″-9″	8.5	0.5	23	7.08		
		9″-18″	8.24	1.0	101	6.90		
		18″-27″	8.41	0.5	135	7.14		
		27″-36″	8.40	1.5	41	1.68		
4	Village-Kathiwada	0″-9″”	7.45	0.5	83	2.88		
		9″-18″	7.29	0.5		2.70		
		18″-27″	6.65	1.5		2.16		
		27″-36″	6.79	2.5		3.12		
5	Village-Jobat	0″-9″	6.49	1.5	119	20.52	30.28	49.91
		9″-18″	7.29	1.5	55	23.88	18.28	47.02
		18″-27”	7.24	6.0	41	23.04	32.16	44.02
		27”-36″	7.10	9.5	31	26.16	25.20	47.02
6	Village-Koocdia	0″-9″	8.0	15.5		22.00	38.40	21.08
		9″-18″	8.2	16.0	39	20.80	21.36	59.35
		18″-27″	8.0	15.5				
		27″-36″	8.2	16.0				
7	Village-Koocdia	0″-9″	6.7	11.0				
		9″-18″	7.6	10.0				
		18″-27″	7.65	10.5				
		27″-36″	7.70	10.0				

Appendix – IX

Analytical results of soils samples from Lahar, Pargana (District Bhind), M. B.

S. No.	Lab No.	Village	Depth	Moisture %	N %	Organic Carbon %	Clay %	T. S. S. %	CaCO3 %	Available P2O5	Conductivity in millimhos	pH 1:2.5	Ex. Calcium
1	89	Ruri	0-6″	2.24	0.05	0.12	14.4	0.098	6.5	0.0012	0.45	7.4	0.75
2	90	Ruri	0-6″	1.34	0.05	0.117	14.4	0.038	1.0	0.084	0.46	7.52	0.34
3	91	Rari	0-1″	1.33	0.04	0.114	16.76	0.040	1.0	0.062	0.57	7.80	0.42
4	92	Amah	0-6″	1.25	0.03	0.093	16.56	0.941	5.5	0.065	2.6	7.32	0.67
5	93	Amah	0-6″	1.11	0.01	0.18	17.12	0.051	2.5	0.0499	1.9	7.6	0.49
6	94	Exp. Plot Lahar	0-6″	1.86	0.05	0.126	26.72	0.232	4.5	0.045	0.88	7.50	0.72
7	95	Prithvipura	0-6″	2.24	0.03	0.18	25.28	0.030	2.0	0.045	0.91	7.40	

Appendix- X
Analytical results of the soils of Dabra Sugarcane Farm

Plot No.	Depth	Clay %	Silt %	Sand %	CaCo3 %	T. S. S. %	pH	Total P2O5 %	Avail P2O5 %	Ex. Ca M. Eq.	Total N %	Org. C %	C:N	Org. Matter %	Mg %
25	0″-9″	28.52	14.72	54.68	1.0	0.112	6.85	0.0367	0.0015	7.0	0.0406	0.6857	16.88	1.18	0.44
	9″-18″	35.96	18.24	41.15	1.0	0.154	7.0	0.03788	0.0015	13.3	0.0630	0.7394	11.70	1.27	0.59
	18-27″	37.92	20.12	35.27	2.0	0.174	7.5	0.0304	0.0015	9.5	0.0406	0.8394	20.67	1.44	0.31
65	0″-9″	42.32	21.62	32.50	1.0	0.058	7.75	0.0373	0.0015	8.9	0.0294	0.6054	20.59	1.04	0.33
	9″-18″	54.44	24.60	33.42	1.0	0.176	8.15	0.0395	0.0015	7.85	0.0294	0.6246	21.25	1.07	0.09

Appendix – XI

Analytical results of the soils of Chambal Commanded Area

S. No.	Depth of Soil Sample	Moisture %	Total Soluble Salts parts per 1,00,000	CaCO3 %	Gravel %	Clay %	Silt %	Sand %	pH	N %
Bhind										
1	0″-9″	2.4	27	0.5	Nil	20.12	34.22	45.66	7.0	0.036
2	9″-18″	0.1	49	1.0	Nil	28.64	26.07	45.28	7.0	0.036
3	18″-27″	5.8	58	1.0	Nil	30.13	27.66	42.20	7.0	0.035
4	27″-36″	5.3	41	0.5	Nil	30.60	36.41	32.98	7.0	0.035
5	36″45″	4.2	36	1.0	Nil	31.44	31.45	37.10	7.0	0.021
Jora										
6	0″-9″	1.43	0.139	Nil	Nil	17.72	16.88	61.13	7.45	0.1365
7	9″-18″	3.51	0.103	Nil	Nil	N. D.	N. D.	59.23	7.60	0.1295
8	18″-27”	5.61	0.083	Nil	Nil	31.64	15.48	49.37	7.80	0.119
9	27″-36″	6.83	0.102	Nil	Nil	34.12	15.08	47.73	7.90	0.115
10	36″-45″	3.10	1.104	Nil	Nil	26.56	27.64	48.81	8.0	0.105
Baroda										
11	0″-9″	4.6	N. D.	0.0	Nil	40.68	21.72	37.61	8.25	0.014
12	9″-18″	5.43	N. D.	0.5	Nil	41.76	21.00	32.17	8.50	N. D.
13	18″-27″	6.90	N. D.	1.0	2.5	43.40	19.00	29.88	8.60	N. D.
14	27″-36″	7.81	N. D.	33.5	30.0	43.84	20.00	28.24	8.70	N. D.

N. D. - Not Determined

Appendix – XII

Summary of the talk on "Soil Conservation Programme and Increased Production" (Original talk in Hindi)

By Shri Khanwilkar, Assistant Soil Conservation Officer

Soil erosion is a serious problem all over the country. Effective measures must be adopted to check soil erosion. Erosion due to water is more in slopy fields. There bunding round the fields is very effective and should be practised. Bunding is desirable even in relatively level fields for maintaining the fertility of the soil. The field should not be kept fallow particularly during rainy season and erosion checking crops like mung, sanai, groundnut and other legumes should be grown. Similarly afforestation of waste lands and maintenance of protected pastures is also very necessary for each village. The cultivation in the field should be done on the basis of modern dry farming methods.

Bunding should be done according to the type of soil, nature and extent of slope. Contour bunding should be done, which is more useful and of a permanent value. After the bunding is done, then dry farming measures should be adopted. Dry farming measures include ploughing the fields along contours ploughing just after the harvest of kharif crops, bakharing during summers (in every rabi field at least twice), line sowing using low seedrate and sowing in strips with the help of dufan or tifan, adding organic manures during summers followed by bakhring and intercultivating the crops. Our bunding costs at present on an average Rs. 50 per acre (minimum Rs. 30 and maximum Rs. 80 per acre).

In general, the annual precipitation in the State ranges from 15 to 75 inches, Contour bunding will be very useful in areas having rainfall from 15 to 30 inches. For these regions bunds of 12 to 15 sq. ft. cross section are generally recommended subject to the types of soil. In region having 30 to 50 inches annual rainfall, bund sections of 15 to 20 sq. ft. will be suitable particularly in black soils. Planting of grasses on bunds and thereafter care particularly during monsoon season is very essential, for

areas having higher rainfall, graded bunding will be more suitable. The surplus water from the graded fields should for draining out the surplus water. Growing of castor on bunds is very useful and remunerative as well.

Ravine reclamation work should be undertaken on a community basis. After necessary surveying, plugs and check dams with suitable waste weirs should be constructed in small nallas at intervals of 300 to 500 ft. length. Experience has shown that construction of concrete weirs at the outlet of nallas must proceed with the construction of plugs and check dams on contours on an average height of 8-10 ft. from the outlet. This necessitates the use of bulldozers. Contour bunding should also simultaneously be adopted from the start of a ravine up to the point of steep slopes. At the end of contour bunds and before the start of actual ravine, a peripheral bund should also be constructed. The space between them should be utilised in planting trees, etc. On the basin of rivers walling deep ravines planting of trees and grasses in strips of about 100 yards will be very useful for checking further erosion (PFSCRC, 1959).

Appendix XIII

Summary of talk on "Role of Microorganisms in Building up Soil Fertility"

By G. P. Verma
Lecturer in Agricultural Chemistry, College of Agriculture & I/c Chief Chemist, Gwalior

The soil is not a mass of dead debris but is teeming with life. The living forms in the soil ranges from sub microscopic viruses and phases through the microscopic bacteria, etc., to the lower animal forms, the worms, etc., which can be seen and recognised with the naked eye. The important contributions of microorganisms in building up soil-fertility are (a) making all plant nutrients available by decomposing organic matter, (b) volatilising excess of toxic nutrients from the soil, e.g. arsenic as arsine, (c) fixation of nitrogen, (d) formation of mycorrhizal associations essential for certain higher plants, (e) solubilisation of minerals from complex inorganic compounds, (f) favourable effect on germination and plant growth by producing auximones, etc., and neutralizing toxic substances in soil, (g) conservation of plant nutrients and (h) improvement of physical condition of the soil.

In short, micro-organisms are highly indispensable for our existence (PFSCRC, 1959).

Appendix XIV

Summary of Talk on Important Plant Diseases and their Practical Control Measures

By Dr. A. C. Jain, Plant Pathologist, Gwalior

There is from 10 to 20% loss in our agricultural produce due to various diseases and hence there is necessity for protecting of crops from these diseases. The science of plant pathology is new and till very recently the control measures practiced so far were based on hit and try method; but with the advance of science a more intelligent approach is made through a study of (a) the nature of disease, (b) the life history and variability of the causal agent, (c) the relation of the environment to host parasite interaction and the defence reactions of the host.

The plant diseases are caused by either parasitic invasion or unfavourable nutrient and environmental conditions. The latter type of malady can be corrected by supply of the nutrients required or by removing the unfavourable conditions. The science of plant pathology and the simple rules of Economics show that the practical method of parasitic plant disease control lies in preventing the crop from infection. The cure techniques have not been worked out and wherever possible are economically impracticable.

The crop can be protected from getting infected either by prophylaxes, e.g. exclusion of the pathogen by quarantine laws or eradication of pathogen by rotation, sterilisation, sanitation, etc., or direct protection of cops by seed treatment spraying and dusting. It is to be borne in mind that for the practical method of control the life history of host and parasite, the nature of disease and the study of resistance of varieties was necessary but this has not been successful on large scale because of the long period required by the breeder and the production of new physiological races of casual agents.

The important diseases of important crops were shown, when and why a particular control operation should be adopted for a particular disease.

A list of important diseases of important crops of this region with their main symptoms and necessary control measures recommended has been given (PFSCRC, 1959).

Appendix –XV
Rejuvenation of Old Orchards

By Dr. P. S. Parsai

A target of rejuvenation of 42,000 acres under old orchards has been set for M. P. in the present five year plan and a loan of Rs. 15,000 per acre from the Central funds through the State Government has been provided as an aid for this purpose.

The methods to be adopted for rejuvenation of the orchards are –

(a) Heavy manuring with N. P. K. and organic matter. F. Y. M. or compost should be spread at the rate of 20 to 25 carts per acre in the summer months and ploughed in during the rains. In its absence G. M. has been recommended. Ammonium Sulphate and bonemeal, superphosphate at the rate of 3 maunds* each per acre may be applied and should be applied again during the winter season. Alternatively manure or oilcake, if cheap, can be applied at the rate of 5 maunds* per acre.

(b) Provision of irrigation at monthly and fortnightly intervals during the winter and summer months respectively.

(c) Control of insect pests and diseases, the important pests and diseases are Bark borer, gummosis and citrus canker. Methods for the control of these are quite well-known. But testing has been recommended in cases where the bark has been completely destroyed by gummosis.

(d) Removal of other causes of deterioration : (i) Lack of drainage – improve the drainage by opening the land. (b) Close planting-root out a few trees and provide enough space to each plant. (c) Lack of minor elements- spray the salts of deficient elements, i.e., Zn, Mg. Mn. Cu. etc. Their deficiencies will be corrected. (d) Inferior trees- such trees can be improved by top working by budding or side grafting (PFSCRC, 1959).

Appendix –XVI

Problem of Fruit & Vegetable Cultivation in M. P.

By Shri G. S. Yadav, H. D. O., Indore

The problems have been classified into three major heads –

(a) Problems relating to the technical aspect of the subject.
(b) Problems connected with supply of fruit plants & vegetable seeds.
(c) Marketing problems.

(a) The problems arising due to the lack of the knowledge about the suitable varieties and their rootstock, manurial and irrigation requirements for various kinds of fruits and vegetables and proper cultural practices, etc. There is no ready answer for these and many other problems like those, e.g. Control of diseases, insect pests, etc., which are causing extensive damage to the plantations.

A way of tackling the problems of selection of suitable variety for a particular tract has been suggested and co-operation has been requested from the extension workers for achieving this end.

The cultivator should be provided correct and timely advice regarding the selection of the field, planting of the appropriate plants, their after care and a number of other important horticultural practices. Since these instructions will be given by the extension staff, they should have a more thorough knowledge about these. So refresher courses for these may be started.

(b) This problem is being tackled quickly and by the end of the current year, i.e. 1959-60. Twenty nurseries in this region will be supplying quality fruit plants and vegetable seeds to the growers. Last year out of 40,000 trees distributed 39,000 were raised at the Government nursery (excluding papaya).

Since the present demand is almost twice and more than the supply, certified private nurseries need to be encouraged and a nursery act should soon be passed through the State Legislature.

(c) Marketing presents a big problem and it is time to start work with co-operative societies and provision for cold storage be made so that the professional contractors may not have the upper hand and the grower may get a suitable return for his labour (PFSCRC, 1959).

Appendix – XVII

Problems of Fruit Growing in the Region

By R. C. Srivastava, Horticulturist, Gwalior

The region has been divided into five distinct zones accordingly to the climate and soil type –

(a) Northern, semi-dry, very hot and cold region.
(b) Central hot and cool region.
(c) Southern part of Shivpuri district.
(d) Very hot and warm Nimar region.
(e) Exceptional situations.

The climate and soil features of these regions have been described and the problems arising due to these factors have been discussed.

The two charts provided in the paper give workable solutions for such problems and are quite useful for general guidance.

Under general problems common all over the region, first importance has been given to the supply of quality fruit plants and their quick delivery. The other problems of importance are control of insect pests and diseases, lack of trained personnel for guidance to the growers and lack of sufficient knowledge for giving to the growers. The problems have been discussed thoroughly in the paper and suggestions for the same have also been made for improving over the present situation (PFSCRC, 1959).

Appendix – XVIII

Summary of the talk on improvement in Indigenous Implements for increasing their efficiency

By V. G. Deshmukh, Asstt. Agril. Engineer,
I/C Implements, Gwalior, M. P.

As means of production, the use of efficient implements is as vitally necessary as other improved technique for increasing the production. But it is miserably low in our agriculture and so has to be increased. The improved implements of imported design are not suiting to our village set-up and conditions. Indigenous implements, though inefficient, are very useful as they fit in the village conditions. So improving their efficiency will be more advantageous and useful in present conditions. The line of their improvement is as follows –

Desi plough will work more if it is made to draw a rectangular furrow. Similarly the Bakhar will work more efficiently if its clogging is reduced and blades of bigger lengths are attached on the same body for lighter work. Time and labour also will be saved if weeds stuck are collected simultaneously by a simple attachment on bakhar. The pata will work better if it is made to roll with corrugated face.

The present two and three tined seed drills prevalent in southern districts are pretty efficient to be popularised in northern districts with due modifications. Their automatic working for drilling and dibbling and also for fertiliser placement is the pressing need, but it is rather difficult. Attempts are going on in this direction. Hoes require variety of shapes and sizes in the blades.

Only these improvement varieties of shapes not solve all the various problems in implements and so either improved implements will have to be simplified or some will have to be designed newly to suit indigenous fabrication in order to give a set of implements to out cultivators for every farm operation (PFSCRC, 1959).

Appendix – XIX

Extension Methods for Dissemination of Knowledge to Farmers

By O. P. Dahama, College of Agriculture, Gwalior

The methods of extension can be studied under 3 heads –

(a) Methods of approach. (b) Extension technique.

(c) Methods of enlisting Farmers Co-operation.

Methods of Approach : It differs from class room instructions and grows out of felt needs and interest of the farmers.

Direct Contact : Improvement points for making direct contacts more effective are -

(i) Making it clear that we understand and like the farmers and that we are really out to help them.

(ii) We should develop the art of listening.

(iii) We should be sure of the facts, avoid arguments and should strive to create a desire on the part of the farmers to want us, i.e. extension workers soon and often.

Extension Technique : We can study the fact under 7 heads, namely

(i) Objective illustration (ii) Oral presentation

(iii) Written and printed material (iv) Songs and dramas

(v) Tours (Exhibitions) (vi) Information centre in Block

(vii) Visual Aids : These included –

a. Photographs b. Posters

c. Black-board d. Bulletin board

e. Flash cards f. Flannel graphs

g. Slides and h. Filmstrips

(a) Objective Extension Method : Divided into two –

i. Method demonstration and ii. Result demonstration

(b) Oral Presentation : It includes our visits with farmers on their lands cattle sheds, general or group meetings and radio talks, personal visit give first hand information. There should be a definite purpose with visit, should be considerate of time of the farmer and his family, arrange scheduled visits and should leave clear impression of the objects of visits. Holding of general meeting affords an opportunity for discussions and questions and facilitates action through group psychology promotes general acquaintance between us and farmers.

(c) Written and Printed Matter : This Includes -

(i) Newspapers (ii) Wall newspapers

(iii) Leaflets and pamphlets (iv) Circular letters, etc.

Methods of enlisting Farmers Co-operation: It is needed for two reasons –

(i) The real and felt needs of the farmers should receive the fullest consideration in the extension work

(ii) In the implementation of the plans and scheme of extension, the farmers have a great part to play. They should be, made conscious of it and condition should be created enabling them to make their atmost contribution for developing the economic strength of the country and ensuring its social progress in every field.

With the programme local leadership should also be created because the local leaders can better explain many needs and improved practices to other farmers. It develops abilities of the leaders, produces self-confidence and satisfaction. It increases the contact and influences more people and brings out more favourable attitude towards the work (PFSCRC, 1959).

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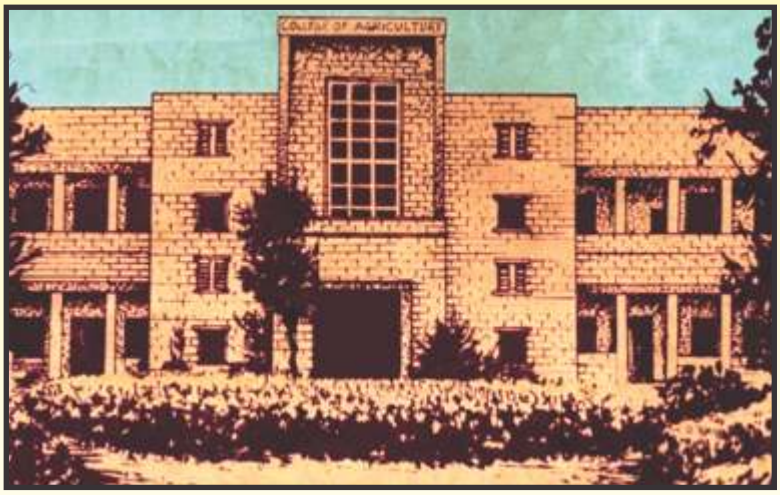

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