AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
BATCH #16

1. SUBJECT CLASSIFICATION

A. PRIMARY
Agriculture

AF00-1400-G635

B. SECONDARY
Plant production--Leguminous grains and vegetables--India

2. TITLE AND SUBTITLE
Proceedings

3. AUTHOR(S)
(101) Workshop Conf.on Pulse Crops.3d,Indian Agr.Research Inst.,New Delhi,1969

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1969	193p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
USDA/ARS

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*

9. ABSTRACT

10. CONTROL NUMBER
PN-RAA-916

11. PRICE OF DOCUMENT

12. DESCRIPTORS
Grain legumes
India
Meetings

13. PROJECT NUMBER

14. CONTRACT NUMBER
PASA RA(AJ)3-00 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

PROCEEDINGS

Third Annual
Workshop conference on pulse crops

February 3-5, 1969

Indian Agricultural Research Institute

New Delhi

In Cooperation with

REGIONAL PULSE IMPROVEMENT PROJECT, USAID/USDA

TABLE OF CONTENTS

			Pages
Agenda			i.
PLANT BREEDING AND GENETICS			
Daljit Singh and R.B. Mehra	-	Results of Coordinated Uniform Varietal Trials on Pulses (Kharif 1968)	1
Kenneth H. Evans	-	Progress in collection, introduction and evaluation of germ plasm of pulse crops.	6
V.R. Gadwal	-	Progress of work on pulses at IARI Regional Research Centre, Rajindernagar, Hyderabad.	7
V.R. Gadwal	-	Red Gram germ plasm	9
K.B. Singh	-	Recent plant breeding research with special reference to mung and urd.	12
R.C. Misra	-	Varietal performance of kharif pulses with special reference to Nayagarh condition.	18
J.P. Srivastava	-	Results of breeding work done at the Regional Centre, J.N.K.V.V. Jabalpur (M.P.)	22
P.C. Doloi	-	Report on the results of the coordinated varietal trials, 1967-68.	32
S.N. Joshi	-	Breeding work done during 1968-69 kharif at Pulse Research Station Baroda, Gujarat State.	33
AGRONOMY AND MICROBIOLOGY			
S.N. Kapoor	-	Agronomy work during rabi 1967-68.	34
A. Naryanan	-	A report on a weed control trial.	41
Anand Parkash	-	Soil and foliar application of phosphate.	44
C.S. Saraf	-	Results of coordinated agronomic trials - spring and kharif, 1968.	46
B.M. Sharma, S.L. Choudhury and P.C. Bhatia.	-	Effect of ridge planting and inter-spacing on the performance of arhar, urd and moong.	50
S.L. Choudhury	-	Summarization of agronomic research work on pulse crops during 1967-68.	52
S.L. Choudhury, R.J. Davis and P.C. Bhatia.	-	Results of trials on pigeon pea, conducted during kharif, 1968.	54

			Pages
M.C. Saxena	-	Work on rabi pulses in Pantnagar in 1967-68.	57
M.C. Saxena	-	Report of the experiments on kharif pulses conducted during 1968 at Pantnagar.	63
M.C. Saxena, D.S.Yadav and N.P. Singh.	-	Studies on the possibility of growing kharif pulses in the summer season at Pantnagar.	75
S.N. Joshi	-	Work done on agronomic aspects of pulses in Gujarat State.	83
S. Sen	-	Report on researches on pulse crops conducted in the University of Kalyani, West Bengal.	86
Ranbir Singh and S.L. Choudhury	-	Studies in weed control in rabi pulses with pre-planting herbicides.	90
V.S. Mani, S.L. Phatak and P.K. Chakraborty.	-	Some considerations pertaining to herbicide use in pulse crops.	94
R.B. Rewari and R.S. Bhatnagar	-	Report on the results of Coordinated Microbiological Trials, Rhizobial survey and isolation of Rhizobium of different pulse crops.	96
P. Nandi (Calcutta)	-	Studies on the Improvement of Efficiency of Rhizobium.	102
K.R. Daderwal and A.N. Sen	-	Effect of toxic seed diffusates on the Inoculation of Pulse crops.	111
G. Rangaswami	-	A note on improving the efficiency of rhizobial strains for pulse crops.	112
PLANT PATHOLOGY			
M.N.Khare, H.C. Sharma, R.P. Mishra and U.S. Kushwaha	-	Studies on the wilt of gram and lentil.	113
G.S. Verma, H.N. Verma and K.M. Srivastava	-	Studies on the virus diseases of pulse crops in Lucknow (U.P.) and its suburbs.	117
J.S.Grewal and Mahendra Pal	-	Screening of arhar varieties for resistance to wilt and of gram varieties to wilt.	124
F.J. Williams	-	Report on the coordinated fungicidal trial (1968)	127
S.P.Raychaudhuri	-	Possibility of detecting seed-borne viruses by serological techniques.	129
Dariush Danesh and Walter J. Kaiser	-	Virus diseases of chickpea (Cicer arietinum) in Iran.	130

			Pages
P.N.Patel and J.K. Nendal	-	Bacterial blight of cowpea	133
D.P. Misra and R.C.S. Mehra	-		134
ENTOMOLOGY			
M.G. Ramdas Menon and H.P. Saxena	-	A note on the identity of the common pulse galerucid beetles at Delhi.	136
H.D. Vasu	-	Field key for the quick identification of grasshopers damaging pulses at Delhi.	137
H.P. Saxena, Sunil Kumar and S.K.Parsad	-	Screening of germ plasm of pulse crops for insect resistance.	138
Kenneth Gibson	-	Possibilities of controlling losses due to Bruchid infestation at pre-harvest stage.	143
J.P. Singh and R.C. Chibber	-	Control of Pea stem borer, Melanagromyza phaseoli (Diptera: Agromyzidae) in peas, Pisum sativum by the use of systemic insecticides.	145
H.P. Saxena, Sunil Kumar and S.K. Parsad	-	Chemical control of Galerucid Beetle on Pulses viz. mung, urd and cowpea.	148
Kenneth Gibson	-	The pest problem in pulse crops present status and further line of work.	150
QUALITY ASPECTS OF PULSE CROPS			
O.A. Krober	-	Quality testing of materials from the coordinated variety field trials.	153
Y.R. Nerkar	-	Induced variability for neurotoxin content in Lathyrus sativus.	156
Y.P. Gupta	-	Protein Quality of Pulses.	157

-oOo-

INDIAN COUNCIL OF AGRICULTURAL RESEARCH

THIRD WORKSHOP CONFERENCE ON PULSE CROPS

Dates: February 3, 4 and 5, 1969

Location: Indian Agricultural Research Institute, New Delhi

A G E N D A

Monday, February 3, 1969:

0930 - 1030 Commencing Session

Chairman	-	Dr. A.B. Joshi
Welcome address	-	Dr. H.K. Jain
Chairman's remarks	-	Dr. A.B. Joshi
Vote of thanks	-	Shri S. Ramanuj

1030 - 1100 Coffee Break

1100 - 1330 Forenoon Session (Plant Breeding & Genetics)

Chairman	-	Dr. H.K. Jain
Convenor	-	Shri S. Ramanujam
1. Report on the results of the All India Coordinated Trials 1967-68	-	Shri Daljit Singh Shri R.B. Mehra
2. Progress in the collection, introduction and evaluation of germ plasm of pulse crops.	-	Dr. Kenneth H. Evans
3. Report on the progress of work (including basic work, initial evaluation trials, breeding work, isolation of donor parents other specific problems etc.) at different stations:	-	Dr. L.M. Jeswani Dr. V.R. Gadwal Dr. K.B. Singh Dr. D. Mukherjee Dr. R.C. Misra Dr. J.P. Shrivastave Dr. S. Chandra Dr. P.C. Doloi

a) Arhar
b) Mung and Urd
c) Gram
d) Other pulses

(Discussion after each presentation)

1330 - 1430 Lunch Break

1430 - 1700 Afternoon Session (Agronomy & Microbiology)

Chairman	-	Prof. S. Sen
Convenor	-	Dr. S.L. Choudhury
1. Coordinated Agronomic Trials	-	Dr. Robert J. Davis
2. Report on specific phases of research conducted at agronomic section of pulse project:		
a) Ridging Experiments on Kharif pulses.	-	Dr. B.M. Sharma

b) Report of 1967-68 rabi trials. - Dr. S.N. Kapoor

c) Herbicide and Foliar Spray Trials. - Dr. A. Narayanan

d) Report of 1968 summer pulse trials. - Mr. Anand Parkash

e) Report of 1968 kharif pulse trials. - Dr. C.S. Saraf

f) Report of 1968 arhar trials - Dr. S.L Choudhury

3. Overall summarization of research conducted by agronomic section of pulse project. - Dr. S.L. Choudhury

4. Report of agronomic investigations conducted by different stations in 1967-68. -) Dr. M.K. Mulani
) Dr. D.P. Motiramani
) Dr. M.C. Saxena
) Dr. S.N. Joshi
) Prof. S. Sen

TEA BREAK

5. Herbicidal control of weeds in Pulse Crops: -) Shri Ranbir Singh
) Shri V.S. Mani

6. Results of coordinated microbiological trials. -) Dr. R.B. Rewari
)

7. Improving the efficiency of rhizobial strains for pulse crops -) Dr. P.H. Graham
) Dr. P. Nandi
) Dr. A.N. Sen

Tuesday, February 4, 1969:

0900 - 1330 Forenoon Session

0900 - 1100 Plant Pathology

Chairman - Dr. S.P. Raychaudhury

Convenor - Dr. J.S. Grewal

1. Report on the screening for field-resistance to gram wilt. Dr. M.N. Khare

2. Virus diseases of mung and urd - Dr. G.S. Varma and Dr. H.N. Varma

3. Report on the screening of arhar varieties for resistance to stem rot and wilt and gram varieties to wilt. - Dr. J.S. Grewal

4. Report on the coordinated fungicidal trials. - Dr. Floyd J. Williams

5. Report on the possibility of detection of seed borne viruses by serological techniques. - Dr. S.P. Raychaudhury

6. Virus diseases of gram in Iran - Mr. Dariush Danesh

7. Bacterial diseases of cowpea and mung. - Dr. P.N. Patel

8. Virus diseases of peas - Dr. A. Varma

9. A new disease of arhar caused by Choanephora cucurbitraum - Dr. D.P. Misra

10. Discussion

1115 - 1245 (Entomology)

Chairman - Dr. O.S. Bindra

Convenor - Shri H.P. Saxena

1. A note on the identify of the common pulse galerucid beetles at Delhi. - Dr. M.G.R. Menon and Shri H.P. Saxena

2. Field key for the quick identification of grass hoppers damaging pulses at Delhi. - Shri H.D. Vasu

3. Screening of germ plasm of pulse crops for insect resistance. - Shri H.P. Saxena, Shri Sunil Kumar and Shri S.K. Prasad

4. Studies on the relative resistance of some varieties of Bengal gram to pulse beetle, Callosobruchus chinensis. - Shri D.S. Gupta, Shri R.S. Kashyap

5. Report on the possibilities of controlling losses due to bruchid infestation of pre-harvest stage. - Prof. K.E. Gibson

6. Control of pea stem borer, Melanagromyza phaseoli Coq. in pea by the use of systemic insecticides. - Dr. J.P. Singh, Shri R.C. Chhibber

7. Chemical control of galerucid beetle on pulses viz. cowpea, mung, and urd. - Shri H.P. Saxena, Shri Sunil Kumar, Shri S.K. Prasad

8. Pest problems in pulse crops present status and further line of work. - Prof. Kenneth E. Gibson

1245 - 1330 (Quality aspects of pulse crops)

Chairman - Dr. C. Gopalan

Convenor - Prof. Orland A. Krober

1. Quality testing of varietal trials materials from the coordinated varieties field trial. - Prof. Orland A. Krober

2. Protein quality of pulses - Shri Y.P. Gupta

3. Report on selection of low neurotoxin content in Lathyrus sativus. - Dr. B.M. Lal

4. Induced variability for neuro-toxin content in *Lathyrus sativus*. — Shri Y.R. Nerkar

1330 - 1430 Lunch Break

1430 - 1700 Afternoon Session (Plant Breeding & Genetics Contd.)

Chairman - Dr. A.B. Joshi

Convenor - Shri S. Ramanujam

GROUP DISCUSSION ON BREEDING FOR DISEASE-RESISTANCE IN PULSE CROPS

Wednesday, 5th February, 1969

0930 - 1300 Working groups for programme evaluation and planning:

1) Plant Breeding

2) Agronomy

3) Microbiology

4) Plant Pathology

5) Entomology

6) Quality

1300 - 1400 Lunch Break

1400 - 1730 Plenary Session

Chairman - Dr. A.B. Joshi

Report of Chairman of working groups.

1730 - 1800 Closing remarks by Dr. A.B. Joshi

Monday 3rd February: Forenoon Session

PLANT BREEDING AND GENETICS

The Inaugural session of the Workshop was presided over by Dr. A.B. Joshi, Deputy Director General (Crops) of the Indian Council of Agricultural Research. Dr. H.K. Jain, Head, Division of Genetics, welcoming the delegates to the Workshop, on behalf of the Director of the Institute, pointed out that though pulses were of great importance, especially in vegetarian diets, comparatively little attention has been paid to the amelioration of such crops. He emphasized the need to remedy this situation and noted that some hopeful results had been already obtained at the I.A.R.I. and other centres, especially in the development of short duration varieties of pulse crops which could be fitted into intensive multiple cropping systems. Dr. Joshi, in his Inaugural address, underlined the importance of the coordinated approach towards solving the many-faceted problems met with in crop improvement. He pointed out that the comparative position of pulses was becoming weaker in the face of the increasing productivity of the cereals and emphasized the need for concerted efforts to achieve a similar increase in productivity of the pulse crops. He expressed his confidence that a coordinated approach would lead to fruitful results. Dr. van Schaik, Coordinator, Regional Pulse Improvement Project, USAID, mentioned that Shri Ramanujam had recently taken position as Coordinator in the All India Coordinated Pulse Project; he also expressed the hope that the deliberations of this workshop would lead to a much needed intensification of the work on pulse improvement. Proposing a vote of thanks, Shri Ramanujam thanked Dr. Joshi for finding time to be present at the Workshop and Dr. Jain for his words of welcome and the various facilities given. He also expressed his gratefulness to Dr. Peter H. van Schaik, Coordinator, RPIP, for his cooperation in making the arrangements for the workshop and to the delegates from the various States who had arranged to attend the workshop inspite of the extremely short notice.

After a short coffee break, the Workshop reconvened under the chairmanship of Dr. H.K. Jain. Shri Daljit Singh, A.I.C.P.P., presented the results of the coordinated varietal trials on mung, urd and cowpea conducted under the project in 1968 kharif. He pointed out that the proportion of trials in respect of which data had been received was disappointing and further that, at many centres, all the varieties had not been included. Though the varietal differences had turned out to be significant in most of the trials, there was wide variability as shown by the coefficient of variability being as high as 100% in some cases. He then summarized the data on trials conducted in kharif 1968 in respect of mung, urd and cowpea and evaluated the varieties on the basis of their overall performance in the various locations. There was some discussion on the validity of such overall assessment of varieties and the opinion was expressed that statewise or zonewise appraisal would be desirable. Shri Ramanujam pointed out that the approach here was to assess in a preliminary way, the overall adaptability of the different entries which were all released varieties of different states. Another approach, would, of course, be to decide whether at any centre any variety was better than the recommended varieties but this could be done at the State level. The summarized data would be circulated to all pulse workers along with the proceedings.

Dr. Peter H. van Schaik stressed the need for ensuring that the complete set of varieties was included at all the locations and for ensuring that the results were sent to the coordinating unit from all the cooperating centres as soon as possible.

Dr. Kenneth H. Evans of the RPIP/USAID then gave an account of the progress in the collection, maintenance and evaluation of germ plasm in the different pulse crops. He mentioned that while a few new accessions had been added, a closer examination of the accessions

already available had enabled a large number of duplicates to be eliminated. Cataloguing of germ plasm has been taken up and progressed considerably in pigeon pea but failure of successive crops had delayed this process in other crops. Poor seed production has also been responsible for the difficulty in meeting all demands for germ plasm material. Dr. S.S. Saxena suggested that germ plasm of crops should be grown in areas of adaptation while Dr. J.P.Srivastava emphasized the difficulty of storage. Dr. van Schaik pointed out that the Cold Store at Delhi when energized would be able to take care of such requirements.

Reports on the progress of plant breeding work done at different stations were then taken up for consideration. Dr. L.M. Jeswani presenting the report of the work done at the Delhi Centre, referred to the attempt to evolve varieties of pulse crops, especially mung and arhar which would produce the maximum amount of usable dry matter per day and which could be fitted into various multiple cropping patterns. He also gave an account of the selection of lines of Lathyrus sativus with low neurotoxin content as well as the screening of germ plasm of different pulse crops for field resistance to disease. Dr. Floyd J. Williams pointed out the desirability of obtaining the cooperation of the pathologist while screening the germ plasm or segregating material for disease reaction.

Dr. V.R. Gadwal reported on the arhar germ plasm collection at Hyderabad which had been brought down to 1000+entires by the elimination of duplicates. More than 100 collections had been added from Maharashtra and Goa in 1968 as also a dwarf variety maturing in 140 days from Ceylon and the related taxa, Atylosia scarabaeoides. He reported that crosses between the dwarf culture P.4785 and N.P.69 were made in order to increase the seed size in the former.

Dr. K.B. Singh, reporting on the work done at Ludhiana, gave an account of the work of his group on the genetic variability and correlation studies in mung and urd as well as on the inheritance of qualitative characters such as seed coat colour, seed size etc. He reported that considerable heterotic vigour was noticed in some crosses. The two best combinations among the 20 studied were Hyb.45 x No.305 and T.51 x D.45-6. The F2 retained a considerable portion of the heterotic vigour suggesting appreciable additive genetic variance. He also discussed the future breeding programme. Dr. Williams pointed out the need for taking into account the disease reaction of varieties when planning hybridization programmes. Mung 24-2 and 24-3 were, from the available information, desirable parents from this view point.

Dr. D. Mukherjee reported the work done at Berhampore in West Bengal, particularly the varietal trials. Dr. R.C. Misra gave an account of the varietal trials conducted at Nayagarh, Orissa in 1967 and 1968 kharif. T.65 and T.27 of urd and T.2, T.44, T.51 and Hyb.45 of mung were better than the local varieties. Yellow mosaic and leaf spot were the important diseases noted on kharif mung. Dr. J.P. Srivastava presented the work done at JNKVV, Jabalpore in arhar, mung, urd, cowpea, bengal gram, pea, lentil and khesari. In addition to varietal trials under different agronomic conditions, Dr. Srivastava reported on the performance of some new strains as well as new genetic stocks including collections from different parts of M.P. In mung and urd selection was made in the genetic stocks for earliness, disease resistance, plant type, pod length and synchrony of fruiting among other characters. Dr. Satish Chandra described the work done on bengal gram in 1967-68 rabi, particularly the evaluation of the genotypes under different levels of fertility, including high fertility (100 kg./N per hectare). Dr. P.C. doloi presented the results of the varietal trials on mung and urd carried out during 1968 kharif at Nowgong in Assam.

Monday, 3rd February: Afternoon Session

ACRONOMY

The session presided over by Prof. S. Sen and with Dr. S.L. Choudhury as convenor commenced with introductory remarks by Dr. Robert J. Davis (USAID/RPIP) on the nature of coordinated agronomic trials; Dr. Davis said that though the term 'coordinator' may be reserved for the two overall coordinators, senior scientists in each discipline, should and actually do function as coordinators within their respective disciplines. The expeditious coordination of the countrywide effort on pulses by the group at the centre is a substantial contribution to this venture. He emphasized that quality of research will improve if planning sessions in Agronomy were attended by workers in other disciplines as well in view of the fact that only few agronomists from outstation were attending the conference. He further pointed out that at present agronomy trials were being conducted only at a few locations and that participation from more locations was desirable and should be sought within the frame work of limited resources at the centre.

Results of agronomic investigations on pulse crops conducted during the year 1967-68 were presented by members of the Agronomy Section of the AICPP/RPIP. These are summarized below:

1. Gram: Successful normal crops of gram could be raised at the Delhi location only. At Pantnagar, Ludhiana and Hissar, the crops failed due to wilt. In trials at Delhi it was found that an application of P_2O_5 @ 25 kg./ha. significantly increased the control yield of 12.9 q/ha. by about 3 q/ha. to 16.2 q/ha. Higher levels of this nutrient alone or in combination with N and K were found ineffective in benefiting the yield further. Methods of application (surface and deep placement) gave about the same yield. No material difference in yield was observed when the row and plant spacings were varied. Inoculation of the seed also fialed to influence the grain yield.

2. Peas: Yield data from Hissar and Pantnagar locations showed that the crop yields maximum when fertilized at the rate of 50 kg./ha. each of N, P_2O_5 and K_2O with rows spaced 45 cm. and plants 10 cm. apart (33.2 q/ha. at Hissar and 18.4 q/ha. at Pantnagar). Other fertility levels and spacings tried significantly reduced the grain yield.

3. Lentils: The crop growth was subnormal and yeild low. Even though some significant differences were observed in the fertility and spacings treatments, these were not very valid for meaningful interpretation.

4. Summer mung: An early March trial on the water needs of summer mung at Delhi suggested two irrigations as the optimal requirement of the crop. Increase in water supply beyond this only reduced the yield. Inoculation of the seed proved ineffective. Foliar and soil applications of phosphate raised the yeild level. Spacings-fertility trials with three mung varieties at Pantnagar, Hissar and Kanpur failed for want of irrigation. At Delhi varieties J-781 and T1 also succumbed to diseases. Only Pusa Baisakhi variety matured normally. No substantial yield differences were found among either fertility levels or row and plant spacings but the yeild trends were consistently in favour of 20 cm. spacing between rows and 5 cm. distance between plants. The yields ranged from 6 to 10 q/ha.

5. Kharif mung and urd: During this main season, trials were conducted on both crops at Delhi, Hissar, Ludhiana, Kanpur and Pant Nagar. The treatments consisted of three fertility levels (0, 50, and 100 kg./ha. each of N, P and K), three row spacings (15, 25 and 30 cm.) and three inter-plant spacings (2.5, 5.0 and 7.5 cm.) for

both crops for short-term varieties. For long-term crop varieties the row and plant spacings were 30, 45 and 60 cm. and 5, 10 and 15 cm. The mung crop failed at all locations due to disease and other factors. Useful yield data for urd could be collected at Hissar only. At this location the variety T.9 yield a maximum of 11.8 q/ha. with a spacing of 15 cm. between rows and 7.5 cm. between plants. With this spacing the yield of 5.8 q/ha. of the unfertilized crops also increased to 15.8 q/ha. when 100 kg/ha. each of N,P,K were applied. In a trial with urd T.27 at Delhi an increase of 4.3 q/ha. was obtained when the crop was planted on ridges (11.8 q/ha.) in comparison with the crop grown on flat beds (7.5 q/ha.).

6. Weed control in mung, cowpea and arhar:

Eight herbicides were tested in varying concentrations and combinations. The herbicides differed in their effects on the weeds but all were found to be injurious to the crop plants in their seedling stage. The seedlings affected by Eptam and its combination with Treflan recovered later but the injuries caused by knoxweed and Tok persisted. Further testing of these herbicides is necessary for drawing conclusions. Prof. V.S. Mani spoke on the need of correct use of the techniques for their effectiveness.

7. Pigeonpea (arhar): These trials on the fertility-spacing aspects of the crop were located at Delhi, Pant Nagar, Kanpur and Hyderabad. Three trials at Delhi were lost due to water-logging and diseases. The crop at Kanpur failed due to floods and at Hyderabad the early varieties trial was vitiated by drought and sterility mosaic.

At Pant Nagar the treatment effects were found to be in agreement with those obtained last year - that is, the crop yielded significantly higher with a plant population of 40,000/ha. or more than the usual rate of 30,000/ha. The best row spacing for this population was found to be 50 cm. This crop also suffered this year on account of an early October storm and the average yield was only 20 q./ha.

8. Effect of ridge planting: The ridge planted crop (T.21) at Delhi yielded substantially and significantly more than the crop planted on flat lands - 27.1 q/ha. and 21.1 q/ha. respectively. The narrower inter-plant distance of 20 cm. also yielded significantly higher (26.2 q/ha.) than the usual distance of 30 cm. (18.7 q/ha.). These are useful findings and may be tested further for confirmation.

9. Effect of Farm-yard Manure and Phosphorus:

In a trial with the variety T.21 at Delhi, very encouraging responses of the crop were obtained both to farmyard manure and phosphate applications. F.Y.M. was applied @ 15(F_1), 30(F_2) and 45(F_3) tonnes/ha. and the P_2O_5 level consisted of 33.3 (P_1), 66.7(P_2) and 100 (P_3) kg/ha. There was a control treatment. The results are tabulated below:

Yield in q/ha.

	P_1	P_2	P_3	Av. for F
F_1	14.69	16.69	18.70	16.68
F_2	17.28	22.47	26.05	21.85
F_3	24.63	27.13	31.22	27.52
Av. for P	18.84	22.10	25.35	

Control : 12.1 ± 0.91

S.Em for F and P ± 0.52 Interaction: Not Sig.

C.D. at 5% 1.55

The results indicate that on light sandy loam soils the crop responds admirably to both manure and phosphate applications. Increasing levels both of manure and phosphate upto the highest rates tried gave significantly higher yields and the combination (P_3 F_3) yielded the maximum of 31.2 q./ha. in comparison with the control yield of 12.1 q/ha. with the current input/output prices, these responses are also very highly profitable at all levels.

10. Experiments at UPAU, Pant Nagar:

Dr. M.C. Saxena reported the results of trial on mung and arhar conducted during 1967-68. The mung varieties tested in the main kharif season showed no substantial yield differences when planted at different dates, fertilized at varying levels of N, P and K nutrients or with variable spacings, Similarly, variations in population rates or methods of planting also did not produce noteworthy differences in yield.

Early plantings (end March) of summer mung varieties, however, gave almost twice the normal yield obtained from end-April plantings (J-781, 16.4 q. T.1, 25.8 q. and Pusa Baisakhi, 20.0 q.). Yield of all varieties declined as planting was delayed.

In trials on arhar (T.21) it was found that early planting (5th June) yielded significantly more (19.5 q.) than late planting (19th July) which gave only 12.9 q/ha. Planting rate of 60,000 plants/ha. also gave a significantly higher yield of 17.7 q/ha. than the rate of 40,000 plants/ha. - 16.5 q/ha. Row spacing, varying levels of nutrients or the use of inoculum did not show material differences in yield.

11. Experiments at University of Kalyani:

Prof. S. Sen reported the results of two years' trials on pulse varieties undertaken at Kalyani. It was observed that T.2, T.44 and T.51 of mung yielded much higher (8-10 q/ha.) than the local varieties of Sona mung and B-1(2-3 q./ha.) in about 90 days. Similarly, Mash-48 and T.9 were found to yield much higher (16-19 q/ha.) than other varieties tried (about 10 q/ha.).

12. Experiments at JNKVV Jabalpur:

Dr. J.P. Srivastave gave an account of the spacing trials on mung and urd conducted at his location. It was observed that a row to row spacing of 30 cm. and plant to plant spacing of 10 cm. was generally superior to other spacings in case of mung and urd. It was also noted that increase in population rate from 1 to 4 lakh plants per hectare also gave higher yield.

Summarising the research work in agronomy conducted during the year Dr. S.L. Choudhury observed that many more investigations on pulse crops were planned and initiated than the results reported. Many trials were vitiated by waterlogging, floods, drought and disease. Not all failures were inevitable. Given better land situations, several trials could have yielded the information we are so eager to obtain. However, some successes were also reported. For instance, (1) it is established that in peas, gram, mung and urd closer plantings than usual yield higher; (2) that ridge plantings of mung, urd and arhar on temporarily water-logged soils yield, 25 to 60% more; (3) that on low fertility sandy loam soils pigeon pea responds admirably to F.Y.M. and phosphate applications; (4) that very soon we may be able to recommend a chemical herbicide to tackle the weed problem in pulses and, (5) that early planting (end-March) of summer mung almost doubles the yield so far obtainable. He observed that researchers in pulse Agronomy were devoting their best effort in seeking and learing and that they intend to spend no more time for this process than was absolutely essential.

Work on Microbiology:

Dr. T.R. Graham, Expert from Australia, addressed the meeting and indicated the important areas of bacterial inoculation of legume which needed attention. He pointed out that in conducting experiments in pots, extreme care is necessary to ensure that temperature and other conditions are similar to that met with in the soil under field conditions.

Prof. P. Nandi described the work done at the Bose Institute, Calcutta, to improve the efficiency of Rhizobium strains. Mutants of efficient strains capable of resisting strains of rhixobiophage were obtained by exposure to phage as well as by UV treatment. UV induced as well as phage-screened resistant cultures were tested in pot experiments as well as field trials. The phage-resistant strains gave better nodulation especially in groundnut.

Dr. A.N. Sen reported on the toxic effect to Rhizobia of diffusates from gram and pea seeds. The quantum of inhibitory effect of the diffusates differed in the two cases; furthermore, such a quantitative difference was noted between varieties of the same crop, especially gram. One variety, N.59 of gram did not impart any toxicity to the diffusate at all. Soaking the seeds prior to inoculation resulted in the better survival of the bacteria and also gave appreciable increase in grain yield over inoculation of unsoaked seeds.

Tuesday, 4th February:

Forenoon Session

PLANT PATHOLOGY:

Dr. S.P. Raychaudhury, Head of the Division of Mycology and Plant Pathology, I.A.R.I., chaired the Session, and Dr. J.S. Grewal, Plant Pathologist acted as the Convenor. Altogether nine papers were presented during this session. Dr. Khare from Jabalpore gave a report on screening for resistance to gram wilt under field conditions. He pointed out that gram wilt is a complex disease and several pathogenic organisms like Rhizoctonia sp., Operculella padwickii and Sclerotia rolfsii are associated with it. He reported that variety T1 had the highest percentage of infection. Incidentally he also mentioned about wilt of lentil and rust on Lathyrus. None of the lentil varieties was resistant against wilt and in case of Lathyrus rust, out of 119 lines tested, one was found to be immune and 26 were susceptible. He also mentioned about blight of Lathyrus caused by Cercospora sp. on which work has been initiated at Jabalpur.

The next paper was by Drs. G.S. Verma and H.N. Verma on cowpea and urd viruses. Dr. Verma described different kinds of symptoms on both these crops due to virus infection. They reported different

methods of transmission of the disease including studies on aphid vectors and properties of the viruses. They also mentioned about the possibility of strain variation and testing of varieties on limited scale under glasshouse conditions. Dr. J.S. Grewal next spoke on arhar wilt caused by Fusarium udum. He reported experiments with five isolates maintained by him in respect of varietal resistance and also strain variation. Out of 75 collections tested at IARI for resistance to arhar wilt, he reported lowest incidence of 5% in variety NP (W.R)15. He also mentioned about Pythium stem rot, a new disease of arhar and projected slides to show the symptoms differentiating it from wilt. Dr. Grewal also spoke on gram blight which is a very serious disease in Northern India.

Dr. Floyd J. Williams reported that seed treatment of mung and urd were not significant statistically over control at the three locations. He informed that seed treatment of cowpea with Captan increased the germination at all locations. Dr. S.P. Raychaudhury mentioned the possibility of detection of seed borne viruses in legumes. He reported different techniques such as tissue and meristem cultures as well as fluorescent antibody technique and serological methods for detecting viruses in the seeds and the seedlings. He gave the example of barley stripe mosaic virus for which serological methods have already been developed to detect the virus in the seed. The next speaker, Mr. Dariush Danesh who came from Iran spoke on virus diseases of gram in Iran, he mentioned that in Iran 300,000 hectares are under pulse crops, out of which 1000,000 hectares are under chickpea. He described four virus diseases of chickpea namely; (i) bean yellow mosaic virus, (ii) alfalfa mosaic virus, (iii) cucumber mosaic virus, (iv) pea leaf roll virus. He also mentioned about agar-gel diffusion test and serological test conducted by him for detecting alfalfa mosaic virus.

Dr. P.N. Patel, spoke on bacterial blight of cowpea and mentioned about his observations on disease resistance in germ plasm collection. Dr. Anupam Varma spoke on virus diseases of pea. He specially mentioned about pea stunt virus which is prevalent in Ghaziabad, Lucknow, Varanasi etc. and causes a lot of damage to the crop. He described the symptomatology and also projected electron photographs to show the structure of virus. The last speaker, Dr. D.P. Misra gave a brief account of the new disease of arhar caused by Choanephora cucurbitraum. The fungus was noticed to infect young tender shoots at Pusa (Bihar) and kill the crop in seedling stage, This fungus was first reported on Capsicum by Prof. J.F. Dastur long ago. The meeting ended with vote of thanks to the chair.

ENTOMOLOGY:

Dr. O.S. Bindra, Entomologist, Punjab Agricultural University, Ludhiana and Shri H.P. Saxena, Entomologist (Pulses) Indian Agricultural Research Institute, New Delhi were the chairman and the convenor respectively.

Papers presented at the session along with the names of the authors has been indicated in the agenda. The following discussion took place during this session.

Dr. M.G. Ram Das Menon, I.A.R.I., stressed the need for correct identification of insect species. He discussed the tremendous similarity between Monolepta nigrobilineata and Madurasia obscurella, the two galerucid beetles on pulses. He requested that some insect specimens belonging to this group particularly from South India may be sent to him for quick identification.

Shri H.D. Vasu gave a key for quick identification of various species of grasshoppers which occur on pulse crops.

Shri Sunil Kumar gave an account of some resistant varieties of moong, urd and cowpea. Dr. Bindra suggested that the varieties which have been found to be highly resistant to various pests may be taken up in the breeding programme.

Dr. Bindra read a paper on the relative resistance of some varieties of Bengal gram to pulse beetles. The authors, Shri D.S.Gupta and R.S.Kashyap from Hissar, studied the reaction of 10 varieties of bengal gram to Callosobruchus chinensis, a serious pest of pulses during storage.

Prof. K.E.Gibson, RPIP/USAID, read a report on the possibilities of controlling losses due to bruchids by pre-harvest treatment. He stated that spraying the lentil crop with DDT + thiodan has given a good check of bruchid infestation. He based his observations on the catches of bruchids as a result of sweepings made in treated and untreated fields

Shri S.K. Prasad gave an account of the control trials against pests of mung, urd and cowpea with the granular insecticide namely phorate 10G, Tenink and Disulfoton applied at the time of sowing. Highest doses of these insecticides @ 2 kg./ha. proved effective in reducing the incidence of the galerucid beetle.

Dr. J.P.Singh from Pantnagar stated that he found phorate granules most effective for the control of pea stem borer, Melanagromyza obtusa Coq.

Prof. Gibson, speaking on pest problems stated that the biology of bruchids on pulses and of pod borer on gram need to be studied. He stated that foliar application of thiodan has proved very promising in reducing the population of lepidopterous larvae and bruchids in fields. Similarly, thiodan + DDT seemed to be promising for the control of flea beetle. He stated that flea beetles are nocturnal pests and these cause serious damage to the foliage of pulse crops.

Quality:

Dr. C. Gopalan of the Nutrition Research Laboratory, Hyderabad presided over the session and Prof. O.A. Krober acted as the convenor.

Prof. O.A. Krober presenting the results of the analysis of materials received from the Coordinated Trials, pointed out that two few samples had been received from too few locations to permit of any generalization. He presented data, limited as they were, on protein % in arhar, black gram and green gram as well as a few varieties of cowpea. He pointed out the difficulties of testing cookability objectively and also suggested that storage conditions might effect this characteristic.

Dr. Y.P. Gupta reported on the amino acid composition of the protein of different high yielding varieties of black gram and green gram, especially the methionine and tryphophane content. Methionine content ranged from 1.28-1.81% in urd and from 1.21-1.66% in mung and tryphophane content from 0.73-0.91% and 0.56-0.73% respectively.

The problem of neurotoxin in Lathyrus sativus (khesari) was discussed by Dr. B.M. Lal and Shri Y.R. Norkar. Dr. Lal reported on the screening of a large collection of germ plasm and isolation of certain genotypes with as low as 0.1% or less BOAA content. Shri Norkar reported his attempts to induce low neurotoxin content in four commercially grown varieties of khesari. His results indicated that it might be possible to isolate strains with low neurotoxin content (ca. 0.15%) in these strains. He reported that this appears to be quantitative trait and suggested recurrent mutagenic treatment

could help evolve strains with the toxin content further reduced.

The Chairman in his concluding remarks stressed the importance of available protein as also aminoacid composition of the protein. The question of the presence of trypsin inhibitors also needed attention. Another important aspect referred to was the difference in digestibility of different pulses. Dr. Gopalan said that this appeared to be related to the carbohydrate moiety and suggested varietal differences in digestability should be studied. With regard to lathyrism caused by khesari dal the chairman referred to the reports about the association with manganese intake and retention. Answering question raised by participants, he said that the ill effects of khesari dal did not appear if the dal did not exceed about 1/3 of the diet intake and suggested that even low toxin strains will be useful if toxin-free strains were not available. Processing of the dal, such as parboiling appears to render it harmless.

Tuesday, 4th February: Afternoon Session

As decided in the earlier session on Plant Breeding, a group discussion on breeding for disease resistance was arranged in this session. Dr. A.B.Joshi presided over this session.

Dr. Williams of the RPIP/USAID initiated the discussion with an account of the problems met with in breeding for disease resistance in plants, especially those which arise from the capacity of the pathogen to mutate or otherwise undergo genetic alteration. Led by Dr. Joshi, the group then considered details of the programme of breeding for resistance important diseases of pulse crops to be taken up in the next year, especially those about which sufficient pathological and genetic knowlwedge was available.

1. Ascochyta blight of bengal gram

It was decided that resistant varieties (F.8, E.C.26446, E.C.26414, E.C. 26435, E.C. 26429) should be tested at Punjab, Haryana, West Bengal and Bihar for reaction to locally occurring races. This would need about 400z. of seeds of each variety. It was also decided that the reaction of these varieties to different isolates under epiphytotic conditions both under field and laboratory conditions should be obtained. Dr. Satish Chandra, Economic Botanist, Gram (Hissar), agreed to send (a) about 30 seeds of each of the blight resistant varieties to Dr. Grewal of I.A.R.I immediately and (b) about 200 seeds of the blight resistant varieties after harvest to Gurdaspur, Pusa (Bihar) and Berhampore (W.Bengal). The seeds of these could be multiplied in the off-season in Iran and 4 oz. made available to the Coordinator.

The need for conducting genetic studies wasaalso pointed out and it was suggested that cultivars C.235, R.S.11, B.75, 736-1 etc. could be used in making such crosses. The F_2 seed could be distributed to various areas for testing.

It was also decided that the entire germ plasm of gram available should be subjected to artificial epiphytotic using a mixture of available blight cultures and it was decided that this should be started this season (1968-69 rabi).

2. Arhar wilt: In view of the fact that varieties like NP(WR)15' and S.103 which were resistant at one location were reported to be susceptible at other locations, it was considered likely that physiological races of the pathogen might exist. To study this problem it was decided that a set of resistant varieties of arhar should be tested in wilt sick soils at different locations and also in the laboratory when inoculated with isolates collected from different centres.

Varieties: 1 kg. of seeds (harvested from plants grown in isolation) of: T.21 (to be supplied by Dr. S.S.Saxena), N.148 and C.11 (Shri Tatwawadi), F.18 and B.7 (Dr. D. Mukherjee) N.P.(WR)15, (Dr. D.P.Misra) Atylosia species (Dr. J.P.Shrivastava, V.R. Gadwal and Dr. L.M. Jeswani) to be sent so as to reach Coordinating Unit, Delhi not later than 15th April. Dr. Joshi suggested that Dr. L.S.S. Kumar and Dr. R.D.Cruz might have seeds of Atylosia spp. and requested Shri Tatwawadi to contact them.

Locations: Kanpur (Dr. S.S.Saxena, Parbhani (Shri Tatwawadi), Berhampore (Dr. D.Mukerjee) and Pusa (Dr. D.P.Misra) on wilt sick soils.

Laboratory evaluation: Dr. J.S. Grewal, IARI

Urd yellow mosaic: Donors of resistance: Mash 1-1, Mash 35-5 Mash 48.

Agronomic bases to be used in crosses: Type 9, T.65, No.55, Mash 35-5, Khargaon-3, Gwalior 18, Mash 1-1

Susceptible checks:

Sindhkheda 1-1, Khargaon-3, N.212, D.6-7, No.55.

Locations: Kanpur, Gurdaspur, Delhi, Berhampore, Pusa (Bihar).

It was also decided that Dr. Raychaudhuri (Head, Division of Mycology, IARI) may study these varieties under controlled conditions while genetic information may be obtained by Dr. L.M.Jeswani of IARI.

Wednesday, 5th February, 1969:

Morning Session: The workshop divided itself into six working groups, one each for the disciplines of Plant Breeding and Genetics, Agronomy, Plant Pathology, Entomology, Microbiology and Food quality. The working groups considered the action taken on the recommendations made in the last (second) workshop and the work done in 1968-69 and formulated suggestions regarding the work to be done in the next year as also the staffing of the Project.

Afternoon Session: The reports of the six working groups were presented by the respective chairmen. Those were discussed and amendments suggested wherever necessary. The finalized report of the proceedings of the working groups are attached.

In his concluding remarks, Dr. Joshi emphasized the salient points arising out of the considerations in the working groups and emphasized the need for a vigorous effort to implement their recommendations as closely as possible.

Proceedings of the working group on Plant Breeding and Genetics held on Wednesday, 5th February at the Genetics Division, I. A. R. I., D e l h i

Present

Dr. A.B.Joshi, Chairman
Dr. P.H.van Schaik
Dr. K.H. Evans
Dr. K.B. Singh
Dr. S.S. Saxena
Dr. J.P. Shrivastava
Dr. L.M. Jeswani
Dr. D.P. Misra
Dr. S.N. Joshi
Dr. R.C. Misra
Shri P.Venkateswarlu
Dr. P.C. Doloi
Dr. V.R. Gadwal
Dr. L.G. Kulkarni
Shri S.S. Rajan
Shri S. Ramanujam

There was brief discussion about the germ plasm collection. Dr. Evans and Dr. Gadwal of the RPIP/USAID reported that the arhar collection had been reduced to 1000+lines from 4500+ cultures as a result of elimination of duplicates. The need for a quick evaluation of these 1000+ types, as quick an evaluation as manpower and landpower would permit, was emphasized. It was decided that the maintenance should be entrusted to Hyderabad, Varanasi and Jabalpur. Maintenance of mung germ plasm was to be entrusted to Dr. K.B.Singh (Ludhiana) who should arrange to send atleast 100 gm. of clean, viable seed per entry back to the coordinator. Similarly Dr. J.P.Shrivastava of Jabalpur was entrusted with maintenance of urd germ plasm. The question of cataloguing the available germ plasm was also considered and Dr. Evans said that this work had proceeded to a fair extent in the case of arhar and it was hoped to have the same ready before the next workshop. In the meantime scientists interested in receiving germ plasm might contact Dr. Evans. The need to obtain a greater variability of the related genus Atylosia was pointed out and it was suggested that Drs. G.B. Deodikar, K.L. Mehra, R.D.Cruz and L.S.S. Kumar may be contacted. In considering screening for resistance to diseases, the importance of wilt and sterility mosaic of arhar was stressed.

Then, the details of the coordinated varietal trials were worked out. In considering the nomenclature to be adopted for entries it was suggested that the P nos. should be indicated in addition to the designation used by the experimenter. Recognized released varieties should, however, be given the accepted no. or designation always.

It was decided that the following coordinated varietal trials should be organized in the kharif pulses, mung, urd and arhar. The seeds of mung and urd should be sent so as to reach the coordinator, AICPIP, latest by 31.3.1969 while arhar seeds should reach by 1.6.1969.

ALL INDIA COORDINATED PULSE PROJECT

Coordinated Varietal Trials - 1968-69

A. Mung (MCT)

Early varieties		Medium varieties	
Shining mung	(Punjab)	No. 30	Punjab)
T.1	(U.P.)	54	(Punjab)
T.2	(U.P.)	L.24-2	(Rajasthan)
T.44	(U.P.)	R.S.4	(Rajasthan)
T.51	(U.P.)	T.51	(U.P.)
Pusa Baisakhi	(IARI)	N.P.18	(IARI)
B.1	(W.Bengal)	N.P.23	(IARI)
Hy.45	(M.P.)	Mg.636	(Assam)
Krishna 11	(M.P.)	Hd.45	(M.P.)
Khargaon-1	(M.P.)	D.45-6	Gujarat
Kopargaon-1	(Maharashtra)	525	(A.P.)
Jalgaon 781	(-do-)	B.R.2	

LOCATIONS

MCT-1 Early varieties sown in February-March

Kanpur, Varanasi, Hardoi (U.P.)
Berhampore, Malda (West Bengal)
Nayagarh, Sambalpur, Koraput (Orissa)
Dholi, Kanke, Purnea, Sahabad (Bihar)

MCT-2 Early varieties sown in July

Ludhiana, Gurdaspur, Hissar, Kulu (Panjab and Haryana)
Pantnagar, Kanpur, Etawah, Azamgarh, Charrora, Varanasi, Hardoi (U.P)
Kanke, Dholi, Patna (Bihar)
Berhampore, Malda (W. Bengal)
Nayagarh, Sambalpur, Koraput (Orissa)
Jabalpur, Gwalior, Khargaon, Raipur (M.P)
Baroda, Deesa, Kothara (Gujarat)
Badnapur, Amracti, Dhulia, Jalgaon (Maharashtra)
Madira, Peddapuram (A.P.)
Jaipur, Sumerpur, Banswara (Rajasthan)
Delhi.

MCT-3 Early varieties sown in August-September

Shillongani (Assam)
Nayagarh, Sambalpur, Korapur (Orissa)
Rajendranagar (A.P.)
Kanke, Dholi, Sabour, Patna (Bihar)

MCT-4 Early varieties sown in December

Nayagarh, Sambalpur, Koraput (Orissa)
Tirupati, Tenali (A.P.)
Kanke, Dholi (Bihar)

MCT-5 Medium varieties sown in July

Ludhiana, Gurdaspur, Hissar (Punjab)
Delhi
Pantnagar, Kanpur, Etawah, Asamgarh, Charrora, Varanasi, Hardoi (U.P.)
Jabalpur, Gwalior, Khargone, Raipur (M.P.)
Bardoa, Deesa, Kothara (Gujarat)
Madira, Peddapuram (A.P.)
Kanke, Dholi, Sabour, Patna (Bihar)

MCT-6 Medium varieties sown in August-September

Shillongani (Assam)
Raipur (M.P.)
Rajendranagar (A.P.)
Kanke, Dholi, Sabour, Patna (Bihar)

MCT-7 Medium varieties sown in December

Koraput (Orissa)

B. Urd (UCT)

Mash 1-1, 48, 35-5, 41-13, Mash 64
N.P.6, N.P. 14
Type 9, 27, 65, 71
BR.61 and BR.68
Khargaon-3
No.55, Sindkheda 1-1, D.6-7
T.122

LOCATIONS

UCT-1 Sown in June-July

Ludhiana, Gurdaspur, Hissar (Punjab)
Delhi
Pantnagar, Kanpur, Etawah, Azamgarh, Charrora, Varanasi and Hardoi (U.P.)
Pusa, Sabour, Kanke, Dholi, Patna (Bihar)
Berhampore, Malda (West Bengal)
Samabalpur, Koraput (Orissa)
Bardoa, Jamnagar, Dohad (Gujrat)
Badnapur, Amraoti, Dhulia, Jalgaon (Maharashtra)
Rajendranagar, Madira (A.P.)
Banswara, Kotah (Rajasthan)
Jabalpur, Gwalior, Khargaon (M.P)

UCT-2 Sown in August-September

Raipur (M.P.)
Berhampore, Malda (West Bengal)
Shillongani (Assam)
Nayagarh (Orissa)
Tenali, Rajendranagar, Peddapuram, Tirupati (A.P)
Kanke, Dholi, Sabour, Patna (Bihar)

UCT-3 December

Tenali (A.P)

C. Arhar (ACT)

ACT-1 Early varieties

P.4785, P-4758, P.4839
T.21
S.5, S.8, S.10, R.60
Khargaon-2
N.148
St.1
1141

Locations

Hissar
Pantnagar, Varanasi, Kanpur
Etawah
Pusa, Kanke, Dholi, Sabour, Patna
Berhampore, Purulia

ACT-1 Early varieties (contd)

Shillongani
Jabalpur, Indore, Raipur
Baroda, Talod
Badnapur, Amraoti, Digraj
Nayagarh, Sambalpur
Rajendranagar, Peddapuram, Lam

ACT-2 Medium varieties

R.3, R.10, S.28. R.8
C-11, Gw.3
15-15
13-7
PM.1
Pt. 301

LOCATIONS

Pantnagar, Etawah, Varanasi, Kanpur (U.P)
Pusa, Kanke, Dholi, Sabour, Patna (Bihar)
Berhampore (West Bengal)
Shillongani (Assam)
Jabalpur, Indore, Raipur (M.P)
Baroda, Talod (Rajasthan)
Badnapur, Amraoti, Digraj (Maharashtra)
Nayagarh, Sambalpur (Orissa)

ACT-3 Late Varieties	Locations
T.7	Etawah, Varanasi, Kanpur (U.P)
S.103	Pusa, Kanke, Dholi, Sabour, Patna (Bihar)
T.17	Jabalpur, Indore, Raipur (M.P)
N.P.69	Baroda (Gujarat)
7-S	Nayagarh (Orissa)
N.P.(WR)15	
R.7	
R.98	
S.29	

Proceeding of the Working Group in Agronomy constituted to recommend programme of research for 1969-70

Present

Dr. D.P. Motiramani	Chairman
Dr. S.L. Choudhury	Convenor
Dr. S.S. Bains	
Prof. S.Sen	
Dr. R.J. Davis	
Dr. Rajat De	
Dr. I.C. Mahapatra	
Dr. M.C. Saxena	
Dr. M.K. Moolani	
Prof. S.K. Aggarwal	
Dr. Rajendra Prasad	
Dr. V.H. Shah	
Shri A.G.Kavitkar	
Prof. V.S. Mani	
Prof. R.P. Singh	
Dr. Mahendra Pal	
Prof. S.R.Bapat	

A brief review of the recommendations made last year was done. It was noted that action on all the trials suggested had been taken and that the results have been well presented in the Agronomy Session of the Conference. The results of methods of planting kharif pulses on ridges and the response of arhar to farmyard manure and phosphorus have been particularly encouraging.

The committee approved and recommended the following programme of research for 1969-70. Full detailed designs and instructions on these trials will be soon prepared by the Delhi team and sent out to all participating institutes/stations/locations.

The trials were categorised into two groups. Group A is mainly for IARI centre. But participants were free to undertake any or all of these trials of interest to them. Group B is for all cooperating agencies.

Group A Trials:

(a) Summer Season

1) Response of mung varieties to fertility levels and inter-row and inter-plant spacings.

Treatments:

Main plot (Varieties x row spacings)

Varieties: V_1, V_2, V_3 } available improved varieties to be used.

Row spacings: R_1 - 20 cm.
R_2 - 30 cm.

Sub-plot (Fertility level x plant spacings)

Fertility levels: F_1 - Control
F_2 - 25 kg.N + 50 kg.P/ha.
F_3 - 50 kg.N + 100 kg.P/ha.
30 kg.K/ha. as basal dressing if soil tests show deficiency.

Plant Spacings: S_1 - 2.5 cm.
S_2 - 5.0 cm.
S_3 - 7.5 cm.

2) Water requirements of summer mung

Treatments:

Main-plot (Irrigation Schedules)

I_0 - No post-planting irrigation
I_{25} - Irrigation at 25% moisture depletion
I_{50} - " 50% " "
I_{75} - " 75% " "

Sub-plot (varieties)

V_1 - } available suitable varieties.
V_2 - }

Fertilization: Uniform dressing of 25 kg.N and 75 kg.P/ha.

3) Response of summer mung to soil and foliar application of phosphorus.

Treatments:

1. Check
2. 25 kg.P/ha. — Soil
3. 25 kg.P/ha. — Foliar
4. 50 kg.P/ha. — Soil
5. 50 kg.P/ha. — ½ soil, ½ foliar
6. 75 kg.P/ha. — soil
7. 75 kg.P/ha. — ½ soil, ½ foliar

over a basal dressing of 25 kg.N/ha.

4) Performance of summer mung under different methods of planting on moderately saline soils.

Treatments: Main plot (Methods of planting)

M_1 — standard methods, flat bed
M_2 — Ridge planting
M_3 — Planting on one side of ridge
M_4 — Planting on both sides of ridge
M_5 — Planting in furrows

Sub-plot (Inter-plant spacings)

S_1 — 5.0 cm.
S_2 — 7.5 cm.
S_3 — 10.0 cm.

Fertilization: 25 kg. N and 50 kg.P/ha.

(b) Kharif Season

1) Response of pigeon pea (short term) to three population rates, three row spacings and three fertility levels.

Treatments

Population rates.

R_1 -- 30,000 plants/ha.
R_2 -- 50,000 plants/ha.
R_3 -- 70,000 plants/ha.

Rowing spacings:

S_1 -- 50 cm.
S_2 -- 75 cm.
S_3 --100 cm.

Fertility levels

F_1 -- 25 kg.N + 50 kg.P + 25 kg.K/ha.
F_2 -- 50 kg.N +100 kg.P
F_3 -- 75 kg.N +150 kg.P

2) Response of pigeon pea (short term) to three levels each of N, P and K.

Treatment:

(a) Levels of N -- 25, 50 and 75 kg./ha.
(b) Levels of P -- 30, 60 and 90 kg./ha.
(c) Levels of K -- 25, 50 and 75 kg./ha.

With an additional control plot
Rows -- 75 cm. apart
Plants - 20 cm. apart

3) Response of three short term pigeon pea varieties to three rates of population and three row spacings.

Treatments

(a) Varieties - V_1, V_2 and V_3 (available improved varieties)
(b) Population rates - 30,000, 50,000 and 70,000 plants/ha.
(c) Row width - 50, 75 and 100 cm.

Fertilization: 25 kg.N + 75 kg.P + 25 kg.K/ha.

4) Performance of kharif pulses on flat and ridged plant beds.

Treatments

Crops: Mung, urd and arhar
Methods: M_1 -- flat bed
M_2 -- Ridged bed

5) Response of pigeon pea to varying levels of farmyard manure and phosphate.

Treatments

Combinations of F.Y.M. and P

(a) Levels of F.Y.M. -- 0, 15 and 30 t/ha.
(b) Levels of P --25, 50, 75, 100 kg.P/ha.

(6) Chemical weed control in kharif pulse crops

Treatments:

Crops: Mung, urd, pigeon pea and cowpea

Herbicides: Amiben, Balan, Chloropic, Eptan, Knoxweed, Randox, Tillam, Treflan & Vernam at two rates each.

(7) Studies in the economics of]
pulses and millets.

Treatments

1) Pure crop of pulse (dwarf arhar)
2) Pure crop of sorghum (CSH.1)
3) Mixed crop of arhar and sorghum in alternate rows.
4) Mixed crop of arhar and sorghum in reoriented close rows such that full population of each crop is accommodated.

Fertilization: Adequate for both crops.

(c) Rabi season:

1) Response of r
fertility.

Treatments:

Main-plot (varieties)

V_1)
V_2) Available number of varieties to be tested.
V_3)

Sub-plot (Fertility levels)

F_0 - Control
F_1 - 25 kg.N/ha.
F_2 - 25 kg.N + 25 kg.P/ha.
F_3 - 25 kg.N + 25 kg.P/ha.
F_4 - 25 kg.N + 50 kg.P/ha.
F_5 - 25 kg.N + 75 kg.P/ha.
F_6 - 25 kg.N +100 kg.P/ha.
F_7 - 25 kg.N +100 kg.P/ + 2

This trial will also be cond

2) Response of gram to levels a
application.

Treatments

Main-plot (Levels of phosphorus)

F_0 - Control
F_1 - 25 kg.P/ha.
F_2 - 50 kg.P/ha.
F_3 - 75 kg.P/ha.

Sub-plot (Methods of application)

M_1 -- Broadcast and mixed in 8-10 cm. top soil.
M_2 -- Placed at plough-sole.

(3) Chemical weed control in rabi pulses (gram, peas, lentils).

Treatments

1. Check
2. Treflan, 1 kg./ha.
3. Eptam, 4 kg./ha.
4. Tok E 25, 4 kg./ha.
5. Amiben, 6 kg./ha.
6. Knoxweed, 4 kg./ha.
7. Lasso, 5 l./ha. (worked in)
8. Lasso, 7 l./ha. (worked in)
9. Lasso, 5 l./ha. (not worked in).

(The above chemicals will be used in some combinations also)

10. Hand weeding.

Group B Trials

(a) Response of three pigeon pea varieties to three rates of population and three row spacings.

This trial will be conducted at I.A.R.I., Delhi, Jabalpur, Hyderabad, Kanpur and Pant Nagar.

Treatments

Varieties

V_1 -- T.21
V_2 -- P.4758
V_3 -- P.4785

Population rates

R_1-- 30,000 plants/ha.
R_2-- 50,000 plants/ha.
R_3-- 70,000 plants/ha.

Row spacing

S_1 -- 50 cm.
S_2 -- 75 cm.
S_3 -- 100 cm.

Fertilization: Uniform basal dressing @ 30 kg.N + 80 kg.P + 30 kg.K/ha.

(b) Response of pulse crops to three levels each of N, P and K with and without inoculum.

Treatments

Nutrient	kg./ha.	(levels)		
Nitrogen	0	50	100	Inoculum
P_2O_5	0	50	100	
K_2O	0	50	100	

This trial will be conducted at locations shown below for crops and varieties noted against each:

Crop	Locations/varieties								
	IARI DELHI	PANT-NAGAR	JABAL-PUR	HISSAR	LUDHIANA	KANPUR	HYDERA-BAD	KALYANI	VARA-NASI
Arhar	T.21	T.21	Khargaon-2	-	-	T.21	T.21	B.7	T.21
Mung	T.2	T.2	Hyb.45	J.781 T.54	T.54	T.2	-	T.2	T.2
Urd	T.9	T.9	T.9	1-1	1-1	T.9	-	T.9	T.65
Gram	G.24	G.24	G.62-404	G.24	-	T.3	T.2 T.3	BR.17	736-1
Peas	T.163	T.163	T.163	T.163	-	T.163	-	-	-
Lentils	L-9-12	L-9-12	-	-	L-9-12	T.8	-	B.62	-

(c) Response of gram to four levels of fertility and three spacing between and within row.

Treatments

Main-plot (fertility levels)

F -- Control
F -- 50 kg.N + 50 kg. P + 50 kg.K/ha.
F --100 kg.N +100 kg.P +100 kg.K/ha.
F -- Inoculum + 100 kg.P

Sub-plot (Between and within row spacings)

Between row	Within row
R_1 -- 20 cm.	S_1 -- 5 cm.
R_2 -- 30 cm.	S_2 -- 10 cm.
R_3 -- 40 cm.	S_3 -- 15 cm.

(d) Chemical weed control in pulse crops.

This trial is both for kharif and rabi pulses and may be conducted by locations able to muster needed resources).

Treatments

1. Control
2. Handweeding
3. Treflan @ 1 and 0.5 kg./ha.
4. Eptam @ 1 and 0.5 kg./ha.
5. Eptam + Treflan @ 0.5 and 0.5 kg./ha.
6. Propazine @ 0.5 and 0.25 kg./ha.
7. Linuron @ 0.5 and 0.25 kg./ha.

The recommendations of the Working Group on Microbiology which met on the 5th February, 1969 in the Division of Microbiology.

The following were present:

Dr. W.V.B. Sundra Rao — Chairman
Dr. C.A. Parker
Dr. P.H. Graham
Dr. P. Nandi
Dr. D.P. Motiramani
Dr. Rajendra Prasad
Dr. A.N. Sen
Dr. R.N. Rewari
Dr. P.K. Chhonkar
Shri Y.D. Gaur
Shri R.S. Bhatnagar

(1) The screening of different isolates of different pulse crops isolated according to the recommendation of the Second Workshop Committee is to be carried out in the coming season by the Microbiologists at the different centres. For this purpose the Microbiology Section at each centre must be strengthened.

(2) All the cultures which are collected different Centres, have to be tested with Ketolactase test in order to check if the Rhizobium is free from contamination by Agrobacterium. Later these organisms - Rhizobium are tested by the Microbiologist in Pot Culture and field trials. The uniform procedure is to be followed in conducting the field trials in different places. The Agronomist and other scientists may help in laying out the experiment. When the best strain is selected and recommended, it is to be included in the general agronomic trials at the different centres. It is necessary to test that the nodules found are mainly those formed by the introduced organism through serological test. Different centres may develop the serological testing unit. Till then they may be sent to I.A.R.I. Necessary equipment for this purpose is mostly available at the I.A.R.I and the Fluroscent attachment to the microscope is being obtained.

The uniform practice recommended is that in different rows, the different strains may be used and nitrogen at different levels may be tried. When high levels are used they may be applied on two stages. Uninoculated plant row may alternate with the inoculated ones.

A basal dressing of supperphosphate at the rate of 100 kg. P_2O_5 per hectare may be used. Wherever the plot is extremely different in organic matter farmyard manure may be added as per local practice.

(3) It is felt that more stress be laid on arhar, gram, urd, mung and pea.

(4) Work on seed coat toxicity of different pulses may be continued with different varieties of pulses.

(5) Root nodules of about 10 promising strains of gram in the germ plasm lines at Delhi may be surveyed.

Proceedings of the Plant Pathology Working Group which met on February 8, 1969 in the Division of Mycology and Plant Pathology.

Present

Dr. S.P. Raychaudhrui	Chairman
Dr. J.S. Grewal	Convenor
Dr. F.J. Williams	
Dr. K.D. Paharia	
Dr. G.S. Verma	
Dr. Y.L. Nene	
Dr. W.J. Kaiser	
Dr. M.N. Khare	
Dr. N.C. Joshi	
Dr. P.N. Patel	
Shri T.K. Nariani	
Dr. D. Danesh	
Dr. Anupam Varma	
Dr. T.N. Sreenivasan.	

In the proceedings that were prepared last year, all the items were considered and the work done at various centres was assessed and found to be highly satisfactory. The following points are of importance and the group felt that they should be brought to the notice in the Plenary Session.

(1) Gram wilt: Studies on the effect of soil temperature, salinity and disease interaction could not be carried out due to lack of glasshouse facilities and unless the same is provided in the immediate future, it will not be possible to do this important work. The screening of the germ plasm for field resistance will be continued at Delhi and Hissar.

(2) Virus diseases of mung and urd:

It was felt that Breeders should continue crossing of available resistant varieties and germ plasm with agronomically desirable ones and pass on the progenies to the Plant Pathologists at Delhi for further testing. However, for basic work of transmission and determination, identification of the viruses, the group felt that the work should be done only at three centres, under the supervision of trained Virologist, where currently active work is going on in respect of virus diseases of pulse crops and these centres areUPAU, Pantnagar, Botany Department, Lucknow University; Division of Mycology and Plant Pathology, IARI, New Delhi.

(3) Gram blight: The group felt that since this is a very important problem the work on screening varieties for resistance to blight should be continued.

(4) Arhar wilt: The work already being done at Delhi will be continued.

(5) Coordinated Fungicidal Trials

(a) Seed treatment: Since reports were not received from all the locations listed last year, it was decided by the group that those who are interested should take up this work so that we may not lose time and it was decided that the work on seed treatment on mung, urd, and cowpea will be conducted at Jabalpur, Pantnagar, Lucknow University, Ludhiana and Delhi.

(b) Spraying trials: It was decided by the group that at least for another year spraying trials should be continued at Pantnagar, Jabalpur, Gurdaspur, Hardoi and Delhi.

(c) Soil treatment: Experiments will be continued at Pantnagar and Delhi.

(6) Bacterial Blight of mung: The work will be continued at the Division of Mycology and Plant Pathology, I.A.R.I., New Delhi.

(7) Detection of known seed borne viruses in the pulse crops by serological and various other techniques:

The possibility of detecting known seed borne viruses in pulses by various methods will be worked out in the Division of Mycology and Plant Pathology, I.A.R.I., New Delhi.

(8) Seed supply: It is unfortunate that for certain reasons, seeds of pulse crops were not supplied to the Pathologists at their request. Unless seed is regularly supplied by the Coordinator work could not be continued uniformly at all the centres. It is, therefore, essential that supply of seed be maintained regularly. Dr. F.J. Williams has kindly agreed to be incharge of this aspect on behalf of plant pathologists.

Last year it was decided by the group that 100 gm. of each variety of all pulses grown under the Coordinated trials at different locations should be made available to Dr. F.J.Williams for sending to Dr. Paul Neergaard, Chief of the Seed Pathology Institute for Developing countries where work on seed health testing is being done at international level. So far only one sample has been sent through the courtesy of Dr. Y.L. Nene. The group, however, felt that it will be most essential and in our own interest that each Breeder from his own centre should send 100 gm. of pulse seeds to Dr. F.J. Williams at New Delhi for this purpose.

Staffing pattern

The pathologists group has been very grateful to the Indian Council of Agricultural Research for sanctioning one senior class I pathologist supported by two senior research assistants at the two regional research centres at Hyderabad and Jabalpur and one junior pathologist at each of the 4 regional stations. It is most essential that these posts should be filled up as early as possible in the interest of pulse work. In addition, the group strongly felt that since the work is considerably increasing at the I.A.R.I., New Delhi and currently there is only one Plant Pathologist in senior class I grade supported by one SRA (although 2 have been sanctioned), it is most essential to have at least one junior pathologist added to this group. It is also essential that like other Coordinated Projects for this important discipline, in the Pulse crops the Senior Class I Pathologist located at Delhi, who is virtually coordinating the pathological work throughout the country in collaboration with Dr. F.J. Williams be kindly given an additional allowance of Rs. 150/- which should be taken into account as additional special pay and as is currently in practice for other All India Coordinated Projects as well.

Recommendations of the Entomology work group for programme evaluation and planning, which met on 5.2.69 under the coordinated pulse project

Present

Dr. O.S. Bindra	Chairman
Shri H.P. Saxena	Convenor
Dr. A.R. Sheshadri	
Dr. M.G.R. Menon	
Prof. K.E. Gibson	
Dr. P.D. Srivastava	
Dr. M.G. Jotwani	
Shri G.R. Sethi	
Shri P.B. Mukerjee	
Shri J.P. Singh	
Shri J.S. Naresh	
Mr. Karim Kamali	
Mr. Shannon W. Wilson	
Mr. H.D. Vasu	
Shri Sunil Kumar	
Shri S.K. Prasad	
Shri P. Sircar	
Miss A.Phokela	
Shri A.K. Raina	

It was noted that now all the positions provided at the Headquarters have been filled. However, in spite of repeated recommendations made at the last two workshops, no entomological staff has yet been provided at the regional centres and sub-centres. The group felt that even though some research work on insect pests of pulse crops had been initiated recently at P.A.U and U.P.A.U., in order to handle the many entomological problems, it was absolutely necessary to provide entomological staff at the various regional centres and sub-centres on the lines recommended during the first pulse workshop held in March, 1967, as under:

a) Additional staff to be pr

Senior Research Assistant
Fieldman

b) Staff to be proved for each of the regional centres

Entom[illegible]
Senio[illegible]
Field[illegible]
Laboratory Attendant

c) Staff to be provided for each of the sub-centres

Entomologist Class II
Research Assistant
Laboratory Attendant

Progress of work vis-a-vis programme suggested for the year 1968-69 and future programme.

An experiment has been started to determine the intensity of pest infestation in gram and pea sown at fortnightly intervals from 15th October to 31st January. Observations are being recorded at weekly intervals. So far, only aphid (Aphis craccivora) has been noticed on gram and pea leaf-miner on pea.

It was decided that observations on this experiment should be continued and detailed information on the incidence of other pests and their natural enemies should be collected.

The methods of recording observations will be as follows:

a) Aphid: The percentage of plants infested and the population counts of aphids on 5 plants selected at random will be made. The population, the number and stages of different predators as well as percentage of mummified and fungus affected aphids will also be noted on these five plants.

b) Cut-worm: The number of plants cut as well as the number of branches cut will be counted and the number of branches per plant will be estimated by counting the branches of five healthy plants taken at random for computation of the damage on uniform basis of plants destroyed. These observations will be on the entire plot basis.

c) Gram-caterpillar: The number of caterpillars together with their stages of growth will be recorded in five random samples of one sq.m. each. The cocoons of parasites will also be counted. At harvest the percentage of pods damaged and loss on the basis of number and weight of grains will be determined by taking 10 plants at random in each plot.

d) Semi-looper: The population of this pest will be recorded in the same manner as that of gram caterpillar.

e) Pea pod borer: Pods of 10 plants taken at random will be examined to determine (i) the percentage of pods infested (ii) the percentage of seeds infested (iii) the percentage of loss in weight of seeds..

f) Pea leaf-miner: In five randomly selected plants the percentage of infested leaves, the number of larvae, live puparias and empty puparias per leaf will be determined. The extent of parasitisation will be studied by removing leaves containing 50 puparias and examining them for emergence of parasites in the laboratory.

Kharif pulses

For the kharif season it was decided that Baisakhi mung, and Pusa Phagumi cowpea should be used in similar trials beginning in April. In addition one recently recommended variety of mung (T.21), cowpea (Pusa Baisakhi) and urd T.9 should be included in a similar trial to be carried out in the regular kharif season.

The observations on pest of kharif pulses will be recorded as follows:

a) Galerucid beetle: The technique developed recently that is grouping into three categories viz., 'Slight', 'Moderate', and 'Heavy' will be used. Three random samples each consisting of five plants in a row will be taken.

b) Leaf-miner: The technique mentioned under pea-miner will be used in this case also.

c) Jassid: The number of nymphs and adults on one leaf from top, middle and bottom of each of the 5 plants selected at random will be recorded separately.

Since the staff provided in the project is very meagre, it may be necessary to record the observations outlined above at 10-day or fortnightly intervals instead of weekly intervals. It would be necessary to provide additional staff so that the observations could be more frequent and detailed. If additional staff is not provided

it may not be possible to carry out the work on all the crops and the work on urd may have to be postponed.

2. Bruchids: The experimental work to explore the possibilities of controlling storage loss due to Bruchid pests by pre-harvest control operation in the field where infestation starts at least in some crops were undertaken on gram, lentil and dry peas. It was reported that nine pesticidal chemicals were compared with untreated check. In case of lentil only two sprays were applied while on gram and peas three sprays were applied during December and January. It was reported that some of the insecticides, particularly endosulfan have given promising results. It is recommended that for the benefit of the pulse research workers the detailed report of the experiments should be included in the proceedings of this workshop.

It was decided that during the year 1969-70 two or three best material be tried on moong in the kharif season and arhar and lentil during the rabi season. It was also noted that the treatment of grain' with Bromodan which has a very high LD50 value for mammals has proved to be very effective in checking Bruchid infestation in storage. Since malathion has also proved to be effective in some other laboratories it was agreed that this will be included in future tests for comparison with Bromodan. It was further agreed that the samples of treated grains will be analysed for residues of these pesticides through the Agricultural Chemicals Division of the IARI & P.A.U.

It was also decided that in all the chemical control experiments, samples of seeds be analysed for pesticides residues and results be taken into consideration while making final recommendations.

3. Screening of varieties for pest resistance:

i) Field pests: It was noted that in case of moong, urd and cowpea 100, 104 and 132 lines, respectively, were screened for resistance to the galerucid beetle, jassid and leaf-miner. Currently, 364 lines of peas are being tested for their resistance to leaf-miner and pod borer. It was decided that the lines which were considered to be 'slightly affected' together with the lines which have not yet been tested yet, should be screened in the coming year.

ii) Storage pests: It was noted that 8 varieties of cowpea, 12 of moong and 16 of urd received from plant breeding trials are being screened for their resistance to Bruchids in storage. A detailed report of this may be included in the proceedings of this workshop. It was further decided that in future all the varieties included in the coordinated agronomic trials may be included in such studies.

4. Against the programme of evolution of crop-wise control schedule for growing pest free crops of moong, urd and cowpea, it was reported that of all the granular insecticides Phorate (Thimet) 10% granules at the rate of 20 kg./ha. proved to be most effective and kept the loss due to the galerucid beetle at a low level for six weeks. It was decided that this experiment should be repeated to work out the lowest effective dosage and to determine the economics of such treatments. Separate experiments for the chemical control of other pests of various pulse crops may also be undertaken.

5. Regarding the item 'identification and filling up of important lacunae in our knowledge of biology and bionomics of insect pests of pulse crops' it was reported that a critical study of the literature is being done to identify the lacunae. It was decided that after the lacunae are identified, various institutions should be requested to take up the work on these items in addition to the work which can be taken up at the Headquarters of this scheme.

6. The group reiterated last year's recommendations that the work should be done at the various regional centres and sub-centres on the following items:

a) The screening of lentil germ plasm for resistance to aphids and pod borer at Ludhiana.

b) Screening of the red-gram germplasm for resistance to pod-fly and the plume-moth at Jabalpore.

c) Screening of the germplasm of red-gram for resistance to pod borers and pod bug and cowpea for resistance to aphids at Coimbatore.

d) Screening of the germplasm of red-gram for resistance to flower thrips and of horse-gram for resistance to aphids at Hyderabad.

e) Screening of the germ plasm of red-gram for resistance to pod-fly and plume-moth at Varanasi.

7. The group reiterated the last year's recommendation that research work for evolution of cropwise control schedules for growing pest free crops should be carried out at the different centres as mentioned below:

a) Ludhiana: moong, urd and lentil
b) Coimbatore: Pea, red-gram and lentil,
c) Varanasi: Pea, red-gram and lentil,
d) Jabalpore: Bengal gram and red-gram
e) Hyderabad: Red-gram and black-gram/green gram.

The Entomologist at the headquarters should address letters to the entomologists of agricultural universities/colleges at the centres referred above in 6 and 7 for carrying out the programme of work on the above two items so long as entomological staff at these centres is not provided in the coordinated project.

8. Having noted that during the last kharif season cowpea, moong and urd were badly damaged by the nematodes at different places, especially at New Delhi, the group reiterates its last year's recommendations that a unit may be created in the Division of Nematology, IARI, New Delhi for carrying out studies on nematodes of pulse crops.

9. It was felt that there is need for strengthening the systematics section of Entomology Division of the I.A.R.I to render quick identification service.

10. It was felt that recommendations for pest control on pulse crops should be given by the regional entomologists for their respective regions until more information is available centrally. Malathion could be used for protection of seed, in storage and phorate granules (Thimet 10G @ 10 kg./ha) for control of field pests.

Proceedings of the Working Group on Quality

Present

Dr. A.K. Kaul
Dr. Y.P. Abrol
Dr. A. Austin
Dr. B.M.Lal
Dr. Y.P.Gupta
Dr. O.A. Krober

We recommend:

1) That the screening of genetic material for protein content be continued.

2) That suitable methods of analysis be developed and evaluated for the determination of methionine and tryptophan in the pulses.

3) That high protein materials to be tested for methionine and tryptophan content.

4) That methods for the estimation of cooking quality in pulses be standardized.

5) That the work on screening of *Lathyrus* materials for low neurotoxin content be continued and that a study be made of the effect of environment and genotype on

6) That priority be given to the testing of nutritional quality of samples from the Coordinated Variety Field Trials.

7) That only sample of good seed quality and representative of the genetic materials being tested will be analysed.

Results of Coordinated Uniform Varietal Trials on Pulses (1968-69)

Daljit Singh and R.B. Mehra

Coordinating Unit, All India Coordinated Pulse Project
Division of Genetics, Indian Agricultural Research Institute
Delhi-12

During this year a total of 75 trials were sent for the three crops Moong, Urd and Cowpea. Upto the time of reporting, data from only 28 trials for the three crops was received for statistical analysis. As such no firm conclusions can be drawn. However, some broad indication of the varietal performances are available. A brief cropwise account of the results is given below:

(1) Moong (Green gram)

Out of 28 trials laid in different centres results from 12 were available for analysis. These trials were conducted with a set of 20 varieties. Locationwise results are given in table 1. All results but one showed significant differences between the varieties. The best five performers in descending order of rank were Hybrid-45 (7.61 q/ha.), Khargaon-1 (7.06 q./ha.), Krishna-11 (6.89 q./ha.), NP 18 (6.36 q./ha.) and No.305 (5.65 q./ha. Except for Hybrid-45 and No.305 which were included in 12 and 11 trials respectively the other three were included only in 2 trials. Therefore, no much reliance can be placed on the performance of these three varieties. Hybrid-45 was statistically at par with the best performer in 8 out of 12 trials while No.305 was in this group in 2 out of 11 trials.

It may be mentioned that some varieties not included in the set of 20 gave very good performance at some places. At Dholi the variety Moong Baisakhi was second in rank and yielded 11.58 q./ha. (the general average for Dholi being 9.11 q./ha.). Variety 14A-1-11 which yielded 2.08 q./ha. was the second best at Durgapura. The average yield at Durgapura was 1.17 q/ha.

The coefficient of variation in these trials ranged from 10% to 102%, the mean variation being 35%.

(2) Urid (Black gram)

Data from 11 trials out of 26 which were conducted were received. Significant varietal differences were revealed in all the 11 trials. These trials were conducted with a set of 16 varieties. Locationwise results are given in Table 2. The first four varieties in descending order of merit were No.55 (7.17 q./ha.), Mash 35-5 (7.02 q./ha.), No.1-1 (6.94 q./ha.) and Khargaon-3 (6.89 q./ha.). The performance of these varieties is not easily comparable. While No.55 gave the highest yield, it was tried in 7 centres and was in the top statistical group at 4 centres while Mash 35-5 and No.1-1 were 2nd and 3rd in rank respectively they were in the top group in 8 out of 10 and 7 out of 11 trials respectively.

The coefficient of variation for these 11 trials ranged from 10% to 83% with a mean of 36%.

(3) Cowpea

Out of 21 trials laid results were received from only five. Locationwise results are given in table 3. Significant varietal differences were obtained at all the five centres. The total number of varieties were 10. The four best yielders in descending order of merit were NP.2 (3.10 q./ha.), T.2 (2.77 q./ha.), K.11 (2.71 q./ha.) and J.C.10 (2.32 q./ha.). The variety K.11 was in the top group in 2 out of the five trials in which it was included and T.2 was in the group in 1 out of 4 trials in which it was included.

At Nayagarh SEB-2 which was not included in the set stood 1st with a yield of 6.18 q./ha. as compared to the average of 4.34 q./ha. at that place.

The coefficient of variation ranged from 11% to 64% with a mean of 34%.

Table 1

Coordinated Trials of Varieties released by different states (Yield in Q/Ha., Rank)

Crop: Moong

Year: 1968-69

Varieties	PUNJAB				HARYANA				RAJASTHAN		U.P.		M.P.		BIHAR		ORISSA		MADRAS		MAHARASHTRA				OVER ALL MEAN	RANK
	Gurdaspur		Ludhiana		Hissar		Gurgaon		Durgapura		Etawah		Gwalior		Dholi		Nayagarh		Coimbatore		Akola		Jalgaon			
	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R		
1. D-2-15	0.00	0	0.00	0	0.00	0	0.00	0.	0.00	0	0.00	0	0.00	0	0.00	0	2.33	15	0.00	0	0.00	0	7.62	8	4.98	12
2. D-45-6	0.00	0	5.07	3	21.97	3	0.89	3	1.32	7	2.46	13	3.99	6	4.86	14	3.32	13	1.73	1	7.25	5	8.63	3	5.59	7
3. B-1	0.00	0	0.18	14	9.02	13	0.07	12	1.71	4	3.05	12	2.85	11	9.73	5	8.43	5	1.43	4	3.83	8	5.24	14	4.32	15
4. T-2	0.17	8	4.44	5	13.80	6	0.17	11	0.84	9	6.60	2	5.24	2	10.65	4	9.33	4	0.61	13	5.69	9	6.48	11	5.34	9
5. T-44	0.21	7	1.47	11	9.51	12	0.21	10	0.31	12	9.57	1	3.65	7	11.35	3	11.74	1	1.17	7	6.61	6	9.03	1	5.40	8
6. T-51	0.00	0	4.61	4	9.92	10	0.73	4	1.32	7	4.69	6	2.57	12	12.27	1	10.63	2	0.68	12	7.61	4	7.04	9	5.64	6
7. Krishna-11	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	5.97	8	0.00	0	0.00	0	7.81	6	6.89	3
8. Khargaon-1	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	6.47	7	0.00	0	0.00	0	7.65	7	7.06	2
9. Hybrid-45	0.47	5	8.32	1	31.81	1	1.43	1	0.27	13	4.73	5	5.58	1	8.57	11	9.75	3	1.46	3	9.91	2	9.01	2	7.61	1
10. 24-2	2.19	1	2.79	7	11.88	8	0.64	5	0.20	14	3.24	11	4.45	4	9.73	5	0.00	0	0.78	11	2.44	11	2.97	18	3.76	18
11. 24-3	1.60	2	2.67	8	12.09	7	0.52	7	0.00	0	3.53	9	4.11	5	9.73	5	0.00	0	0.57	14	2.44	11	3.11	17	4.04	16
12. No.44	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	1.91	17	0.00	0	0.00	0	0.00	0	1.91	20
13. No.305	0.42	6	7.13	2	23.68	2	0.96	2	0.60	10	3.87	7	3.27	9	9.49	8	0.00	0	0.93	10	5.30	10	6.48	11	5.65	5
14. BR-2	0.78	3	0.93	13	9.80	11	0.29	9	0.00	0	0.00	0	3.25	10	9.26	10	0.00	0	1.41	5	0.56	13	0.77	19	3.09	19
15. J-781	0.00	0	1.85	9	10.21	9	0.35	8	1.45	6	5.74	4	1.67	14	5.33	13	4.22	11	1.54	2	10.61	1	8.00	5	4.63	14
16. Kopargaon	0.00	0	3.21	6	0.00	0	0.00	0	2.41	1	6.52	3	2.13	13	9.49	8	4.03	12	0.00	0	7.78	3	6.90	10	5.31	10
17. RS-4	0.00	0	1.82	10	19.23	4	0.60	6	1.52	5	3.44	10	4.50	3	5.56	12	1.73	18	0.94	9	5.97	7	8.20	4	4.86	13
18. ST-7	0.57	4	1.07	12	17.44	5	0.00	0	0.00	0	0.00	0	3.49	8	0.00	0	2.34	14	1.12	8	0.33	14	0.00	0	3.77	17
19. NP 18	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	6.63	6	0.00	0	0.00	0	6.08	13	6.36	4
20. NP 23	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	5.21	9	0.00	0	0.00	0	5.06	15	5.14	11
21. Sub.Var.(1)	0.00	0	0.00	0	0.00	0	0.00	0	1.78	3	3.83	8	0.00	0	11.58	2	2.11	16	1.25	6	0.00	0	5.03	16		
22. Sub.Var.(2)	0.00	0	0.00	0	0.00	0	0.00	0	0.60	10	0.00	0	0.00	0	0.00	0	5.04	10	0.00	0	0.00	0	0.00	0		
23. Sub.Var.(3)	0.00	0	0.00	0	0.00	0	0.00	0	2.08	2	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0		
G.M.	0.80		3.25		15.41		0.57		1.17		4.71		3.62		9.11		5.62		1.11		5.59		6.37			
S.E.(M)	0.047		0.683		1.657		0.199		0.598		0.790		0.487		0.456		0.999		0.217		0.408		0.633			
C.D.	0.14	Sig	1.95	Sig	4.76	Sig	0.57	Sig	1.71	NS	2.27	Sig	1.39	Sig	1.31	Sig	2.87	Sig	0.62	Sig	1.17	Sig	1.79	Sig		
C.V.	11.7		42.0		21.5		69.8		102.2		33.5		26.9		10.0		30.7		38.9		14.5		19.8			

Note: Y refers to Yield; R referes to Rank;
Zero yield and zero rank against a variety indicates its non inclusion in the experiment.

Table 2

Coordinated Trials of varieties released by different states (Yield in Q/Ha. and Rank)

Crop: Blackgram

Year: 1968-69

Varieties	Punjab				Haryana				U.P.		M.P.		Bihar				Orissa		Maharashtra				OVER ALL	
	Gurdaspur		Ludhiana		Hissar		Gurgaon		Etawah		Gwalior		Dholi		Pusa		Nayagarh		Akola		Jalgaon			
	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y	R	MEAN	RANK
1. T-9	2.50	8	5.62	1	13.96	12	2.37	7	2.77	11	2.63	16	8.57	10	2.07	1	0.00	0	3.25	14	4.30	11	4.80	13
2. T-27	5.49	3	1.64	6	16.20	8	2.71	6	5.16	8	5.78	6	10.88	1	1.20	5	14.09	2	5.13	6	1.88	16	6.38	6
3. T-65	3.19	7	0.64	8	16.15	9	3.07	3	8.71	5	7.26	1	9.49	5	0.66	10	14.90	1	3.61	13	2.19	14	6.35	7
4. No.1766	0.00	0	0.00	0	17.04	5	0.96	12	2.46	13	3.83	16	4.63	16	0.23	14	0.00	0	7.13	4	4.79	7	5.13	12
5. No.212	0.00	0	0.00	0	14.93	16	0.10	13	0.37	15	3.95	13	5.09	14	0.15	16	0.00	0	1.72	15	4.65	8	2.62	16
6. D 6-7	0.00	0	0.00	0	13.96	12	1.35	11	2.62	12	4.21	12	6.72	12	0.33	13	0.00	0	7.80	1	6.35	2	5.42	11
7. No.55	0.49	11	0.00	0	18.33	3	0.00	0	1.48	14	6.92	2	10.19	2	0.00	0	0.00	0	7.66	2	5.09	6	7.17	1
8. Sindhkheda	0.00	0	0.00	0	11.44	15	2.34	8	3.30	10	3.85	14	5.09	14	0.18	15	0.00	0	6.82	5	4.54	10	4.70	15
9. BR-61	1.81	10	0.49	10	16.71	7	0.00	0	0.00	0	5.20	11	6.25	13	0.66	10	5.53	6	1.55	16	0.00	0	4.78	14
10. BR-68	2.29	9	0.51	9	17.88	4	0.00	0	4.45	9	6.76	3	9.03	7	0.70	7	7.38	4	4.55	9	3.34	12	5.69	9
11. Khargaon-3	0.00	0	0.00	0	20.01	1	1.51	10	5.39	7	5.36	10	8.80	8	0.51	12	0.00	0	7.55	3	6.00	3	6.89	4
12. Mash-48	5.17	4	2.53	4	14.07	11	3.73	2	9.96	4	5.40	9	8.80	8	1.65	2	0.00	0	4.58	7	5.13	5	6.10	8
13. Mash-35-5	5.63	1	3.03	3	15.99	10	3.02	4	15.62	1	5.68	7	9.96	4	1.58	3	0.00	0	4.13	12	5.52	4	7.02	2
14. Mash-41-13	4.55	5	1.87	5	18.67	2	2.19	9	13.28	2	6.30	4	9.26	6	0.68	8	0.00	0	4.27	11	4.65	8	6.57	5
15. No.1-1	5.52	2	4.81	2	16.82	6	3.99	1	7.93	6	5.42	8	10.19	2	0.96	6	8.94	3	4.58	7	7.18	1	6.94	3
16. NP.14	3.75	6	0.92	7	13.12	14	2.89	5	10.58	3	5.84	5	8.11	11	0.68	8	0.00	0	4.33	10	0.00	0	5.58	10
17. Sub.Var.(1)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	1.21	4	6.83	5	0.00	0	2.51	13	0.00	0
18. Sub.Var.(2)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
19. Sub.Var.(3)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
20. Sub.Var.(4)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0
G.M.	3.67		2.20		15.22		2.32		6.27		5.27		8.19		0.84		9.61		4.91		4.54			
S.E.(M)	0.176		0.915		1.805		0.700		1.283		0.748		0.546		0.277		1.748		0.395		0.549			
C.D.	0.51	Sig	2.66	Sig	5.14	Sig	2.01	Sig	3.66	Sig	2.13	Sig	1.56	Sig	0.79	Sig	5.51	Sig	1.13	Sig	1.57	Sig		
C.V.	9.6		82.9		23.5		60.2		40.9		28.3		13.3		66.1		31.5		16.0		24.2			

Note: Y refers to Yield; R refers to Rank

Zero yield and zero rank against a variety indicates its non inclusion in the experiment.

Table 3

Coordinated Trials of Varieties released by different States (Yield in Q/Ha. and Rank)

Crop: Cowpea

Year: 1968-69

Varieties	Punjab		Rajasthan		M.P.		Orissa		Madras		OVER ALL	
	Gurdaspur		Durgapura		Gwalior		Nayagarh		Coimbatore			
	Y	R	Y	R	Y	R	Y	R	Y	R	MEAN	RANK
1. T.2	3.28	3	0.33	9	0.00	0	5.66	3	1.81	4	2.77	2
2. K.11	3.96	1	2.57	3	3.09	1	2.04	7	1.88	2	2.71	3
3. K.14	1.88	6	0.70	7	2.35	2	2.63	6	0.98	8	1.71	7
4. 5286-3	3.86	2	0.00	0	0.22	6	0.00	0	1.86	3	1.98	5
5. RS.9	2.19	4	2.48	4	0.99	3	0.00	0	0.73	10	1.60	9
6. Meshad	1.56	7	0.54	8	0.94	4	2.89	5	1.64	6	1.51	10
7. Black eye-7	0.39	9	0.00	0	0.09	7	5.84	2	0.99	8	1.83	6
8. E.Ramzhorn	0.44	8	1.32	5	0.49	5	5.15	4	1.09	7	1.70	8
9. JC-10	1.90	5	2.65	2	0.00	0	0.00	0	2.41	1	2.32	4
10. NP.2	0.00	0	4.44	1	0.00	0	0.00	0	1.76	5	3.10	1
Sub.Var.(1)	0.00	0	0.00	0	0.00	0	6.19	1	0.00	0		
Sub.Var.(2)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0		
Sub.Var.(3)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0		
Sub.Var.(4)	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0		
G.M.	2.16		1.78		1.16		4.34		1.51			
S.E.(M)	0.118		0.574		0.322		0.508		0.137			
C.D.	0.35 Sig		1.68 Sig		0.96 Sig		1.57 Sig		0.40 Sig			
C.V.	10.9		64.3		55.2		20.2		18.1			

Note: Y refers to Yield; R refers to Rank
Zero yield and zero rank against a variety indicates its non inclusion in the experiment.

Progress in collection, Introduction and evaluation of germplasm of pulse crops

Kenneth H. Evans
RPIP/USAID, New Delhi.

We probably have the most complete collection of pulse germ-plasm in the world. This collection includes about eight crops and material from several countries. In some crops, our collections are more complete than in others. In cowpeas, a crop of minor importance, we have material from about 50 countries. In pigeon pea we have more than 4,000 accessions, but most of them are from Indian sources.

In the past year, we have added a few new accessions. We have also removed some duplicates which probably offsets in numbers the new accessions. In chickpeas, we have bulked several accessions on the basis of similar origin and phenotypic character. This has reduced our chickpea collection from 6,000 + to 2,000 + accessions. We plan to reduce our collections in some other crops by this method.

The collection is not complete, but is probably more representative in some crops than in others. We do not have adequate collections from all countries where these crops are grown. Some Indian material may not be represented in the collection since we have relatively few accessions from some states.

Lists of accessions with their name or origin are being compiled. The list is completed in pigeon peas, but not printed. An effort is being made to complete lists in other crops as soon as possible.

A catalog of the germ-plasm needs to be compiled. This has been started with the data available. In some crops this data is very limited. We have raised a very poor crop of cowpea (I would say no crop) in two attempts at Delhi. Our mung and urd crop this past kharif season were also failures. Disease, probably nematodes and other factors made the past season's results very questionable.

A trial irrigated summer planting failed except for a few mungbean lines. The 1967-68 rabi season was somewhat better. Gram, Lathyrus and lentils produced a crop in Delhi.

Delhi does not have adequate facilities to maintain the germ-plasm collection. The land is often not suitable for pulse crops, poorly prepared for research plots, and limited in acreage for growing germ-plasm. Storage facilities could be adequate, with the present cold storage facilities, but power is not available and the seed deteriorates rapidly in the hot humid season.

With the poor seed production and poor storage conditions we are very low on seed of the germplasm material. Few seed requests can be filled for lack of seed.

Pigeon peas were grown at Hyderabad, Varanasi and Jabalpur; these crops looked good. Dr. Gadwal is going to give a more complete report on pigeon peas later.

I have probably outlined more problems than accomplishments, but I feel these may be more appropriate for a workshop.

PROGRESS OF WORK ON PULSES AT IARI REGIONAL RESEARCH CENTRE, RAJENDRANAGAR, HYDERABAD.

V.R. GADWAL
RPIP/USAID, HYDERABAD

The work on pulses at the IARI Regional Research Centre, Hyderabad was started in 1967-68 mainly with red gram (Cajanus cajan) germ plasm consisting of 5135 cultures. During the last workshop the ranges in the values of the several characters studied like plant height, days to flower, days to pod, days to mature, pod size, seed/pod and 100 grain weight were presented (see following paper). Besides, the variation observed in regard to flower, pod and seed color, plant type, and leaf shape were described. Three cultures namely P-4785 (Dwarf and early; maturing in 123 days); P-4758 (early, maturing in 108 days) and P-4839 (good plant type; compact and bearing pods in clusters) were considered as promising for further work. The progress of work this year is outlined below:

SEED SUPPLY:

Subsequent to the visit of several breeders last year, and on their and other individual requests, the following number of cultures were supplied.

Supplied to	Number of cultures
1. Pulses Specialist, Andhra Pradesh	79
2. Director Research J.N. Krishi Vishwa Vidyalaya Jabalpur, Madhya Pradesh	4277
3. Millet Specialist, Maharashtra	456
4. Plant Scientist (Oilseeds Raichur (Mysore State)	823
5. Pulses Specialist, Orissa	88
6. Associate Professor, Plant Pathology, U.P.A.U Pantnagar	1610
7. Economic Botanist, Kanpur (Uttar Pradesh)	4277
8. Economic Botanist, West Bengal	238

Besides about 100 selected cultures for preliminary trials in the lattice design and initial evaluation trial were sent to the Pulse Breeder, IARI. Seeds of a complete set of germ plasm was sent to Delhi for preserving in cold storage.

GERM PLASM:

Last year, it was observed that several cultures were exactly alike. Large groups of such cultures could also be seen. This year, therefore, all such duplicates were removed and brought down to 1008 cultures. To this an additional 108 collections from Maharastra and Goa were added and grown in a augmented design in twelve blocks with thirteen checks (Released varieties) repeated in all these blocks. This would enable multivariate analysis and facilitate further grouping of these cultures on the basis of genetic divergence present. Recently seeds of dwarf dhal (Arhar) were brought by Dr. S.V.S Shastry, Project Coordinator (Rice) from Ceylon. This is said to be a derivative of the cross Trinidad x Tenkasi-64 maturing in 140 days. The seed is being multiplied this rabi. This month small sample of Atylosia scarabacoides was obtained from Regional Research Centre, Raichur, (University of Agriculture Sciences, Bangalore).

DIALLEL CROSS:

A 10 x 10 diallel cross is being attempted with the following cultures P-4758; P-4839; P-4645-15 (bold seeds): P-3948 and P-2597 (small seeds) P-2889: (Semi dwarf and bold seed), NP 69; T21 and NP(WR)15. for the several characters. Extensive crossing is in progress with P-4785 and NP 69 with a view to breed P-4785 plant type with added 100 grain weight from NP69.

NATURAL OUTCROSSING

The natural outcrossing in the case of Arhar is reported to vary from 5 to 20% by various authors. A small experiment was laid out this year to find out the natural outcrossing at Hyderabad. P-3234 with purple stem, pink flower and Purplish black seed and P-3079 with green stem, yellow flower and white seeds are used for this purpose.

INITIAL EVALUATION TRIAL:

Unfortunately, the seeds of this trial got mixed up in the transit and hence very few seeds were available intact in each of the packet. On further request, extra seeds were not available. 90% of the stand obtained from those few seeds, (in some cases 100%) is very severely affected by a disease causing smalling and yellowing of the leaves accompanied with sterility (Plant Pathologist described this as something different from the typical sterility mosaic of arhar). It appears selection No. 1, 5, 9 are early in that order, Selection 2,4, 8,9 have just started flowring and the selection No. 3,6 and 7 are yet to flower.

The results from the lattice design experiment consisting of 100 entries would be available at a later date as 33 entries are yet to mature.

SEED INCREASE OF P-4785; and P-4758 and P-4839.

With a view to increase the seeds of these three cultures and also to get information on themoptimum plant population, an experiment was laid out with these three cultures with between row spacing of 60 cm.; 90 cm.; 120 cm. and within row spacing of 20 cm.; 40 cm.; and 60 cm. and all possible combination. P-4839 maturing later than the other two is being harvested and the data would be processed soon. Half an acre was sown on 31.12.69 with P-4785, as there is a growing demand for an early and dwarf culture. The produce of this should enable us to undertake extensive large scale testing on large plots to facilitate its early release. It is suggested that the other two cultures namely P-4788 and P-4839 should be included immediately in the initial evaluation trial.

-oOo-

RED GRAM GERM PLASM*

V.R. GADWAL
RPIP/USAID, HYDERABAD

The red gram germ plasm grown at IARI Regional Research Centre, Hyderabad consisted of 5135 cultures. Each culture was grown in a single unreplicated row of 15 ft. length. After about every seven hundred cultures a set of checks consisting of 16 varieties from the last year's co-ordinated varietal trial was grown.

SOURCE:

The collection included 107 exotic cultures from as many as fifteen countries and the rest indigenous material. The material obtained from the surveys especially conducted in Andhra Pradesh, Uttar Pradesh and Bihar formed the main bulk of the indigenous material. The details are presented in Table 1 and Table 2.

Table 1
Sources of the exotic cultures

S.No.	Source	No. of cultures
1.	Australia	2
2.	Brazil	1
3.	Burma	43
4.	Ceylon	9
5.	Fiji	5
6.	France	1
7.	Ghana	1
8.	Jamaica	7
9.	Kenya	1
10.	Nepal	6
11.	Nigeria	6
12.	Pakistan	18
13.	Puerte Rice	5
14.	South Africa	1
15.	U.S.A.	1
	Total:	107

Table 2
Sources of Indigenous cultures

S.No.	Sources	No. of cultures
1.	Andhra Pradesh	1461
2.	Assam	53
3.	Bihar	587
4.	Delhi	348
5.	Gujrat	10
6.	Madhya Pradesh	29
7.	Madras	231
8.	Maharashtra	259
9.	Mysore	128
10.	Orissa	55
11.	Punjab	2
12.	Rajasthan	6
13.	Uttar Pradesh	1714
14.	West Bengal	145
	Total:	5028

* Presented in Second Pulse Workshop, 1968.

OBSERVATIONS RECORDED:

i) Notes were taken on the following plant characters; Plant type, Plant size, Flower colour, date flower, date pod, date maturity, Pod colour, and pod size, seed/pod, seed size seed colour and uniformity. Besides, yield per plant is also being worked out to give a basis for comparison of the yield potential of the cultures.

ii) Broadly the cultures could be classified as spreading, semi-spreading correct and bushy, A very interesting plant type was observed where the leaves were packed up very closely giving a rosette appearance to the entire plant (P-604-67). The pods were borne all over the branches (evenly distribution) or concentrated at the top of the plant in clusters. It will be of interest to study the genetics of these characters.

iii) There was a quite a range in the flower colour as judged by the back of the standard petal-different shades of yellow, red and orange. The colour of the veins on this petal ranged from different shades of red and purple. Various combination of these petal and vein colours were also seen. With regards to the pod colour, only three major types could be seen green, purple and green with purple streaks. One culture had complete red pods (P-2561-67). Shades of pink light and dark purplish colour were also noticed. Again the seed colour ranged from brown, light brown, white, dull white, purple, dark purple, red grey and mosaic.
Lanceolate leaves are common but big elliptic leaves and oboordate leaves could be seen in few cultures. While the colour of the stem in most of the cases is green purple colour, green with purple tinge could also be seen.

MAGNITUDE OF VARIATION

The extreme values in the case of other characters are given in the table 3.

Table 3
Range of values of the various characters of Redgram cultures

S.No.	Character	Lowest value	Highest value
1.	Plant Height (cm.)	72.4	310.4
2.	Date flower (days)	66 days	230
3.	Date pod (")	86	238
4.	Date mature (")	108	more than 252
5.	Pod size (cm.)	2.5	8.5
6.	Seed/Pod	2-3	6-7
7.	100 grain wt.(gm.)	4.27 gms.	20.10

Table 3 reveals the magnitude of variation available in red gram material. The check T.21 is the earliest to flower (72 days) and mature (120 days) The corresponding values from the table 3 are 66 and 108 days respectively. Similarly the upper ranges of the values for seed/pod, pod size and 100 grain weight exceed that of the highest values of the check namely (N.P.69) which had 4-5 seed/pod, 18 gms. 100 grain weight and 7 cms. pod length. Dwarfness is again a very desirable character and none of the present checks are less than 135 cm. Very good dwarf types with 72.4 cm. height are available for study.

POTENTIAL VARIETIES:

The present red gram collection provided an invaluable source of important genes for earliness, seed weight, height etc.; there were few accessions which could be tried directly. Two such cultures are worth mentioning namely P-4839-67 and P-4785-67. The former is about 140 cm. erect in habit and had pods borne in clusters. It was an efficient plant in as much as there was very less vegetative growth as compared to the number of pods borne. The seeds are four per pod, brown and medium held. The average

plant yield was 55.55 gm. which works out to 605 kg/acres. Corresponding figures for T.21 check was 44.25 (482 kg/acre) and P-4785-67 is the dwarfest culture (72.4 cm. in height). In all other respects it is similar to P-4839 except in maturity; P-4785 matures in 123 days where as P-4839 in 156 days.

The present spacing given was 4 ft. between rows and 1 ft. between plants. (10.890 plants per acre). The spread of these cultures was 40 cm. (P-4839-67) and 50 cm. (P-4785-67) whereas the T.21 check had 150 cm. All cultures were grown under high fertility conditions. The yield of these two could be easily doubled just by reducing these spacing to 2 ft. between rows. Thus the need for finding out the optimum plant populations per acre is apparent in these cases. The 100 grain weight of these cultures is about 10 cm. this could be increased by suitable hybridization programme. Similarly there is enough scope, from the present gene pool to incorporate earliness, dwarfness, and seed weight in otherwise good yielding varieties which are already under distribution.

One of the main objectives of growing this germ plasm was to give an opportunity to the breeders all over the country to screen the germ plasm for specific requirements of their state. Up to date, specialists from five states namely Andhra Pradesh, Maharashtra, Mysore, West Bengal and Uttar Pradesh have visited Hyderabad and selected their choice material.

Off season multiplication of twenty seven promising early cultures has already been taken up at Coimbatore so as to produce enough seeds for preliminary trails at various locations during kharif 1968. Three cultures namely P-4785-67, P-4889-67, and P-4758-67 (earliest to mature is 108 days) are also grown at Hyderabad. Several late cultures are yet to mature. When all the observations for all the cultures are available, a complete classification of the present collection will be attempted.

-oOo-

RECENT PLANT BREEDING RESEARCH WITH SPECIAL REFERENCE TO MUNG AND URAD

K.B. SINGH
Punjab Agricultural University,
Ludhiana.

In recent years phenomenal increase in grain yield has been achieved in wheat, rice, maize, sorghum and bajra but yield of pulse crops remained more or less static. As a result, cereal and millet crops have become more remunerative and there is already an indication of diversion of areas from pulses to cereals. According to the report published by the WHO and FAO and other similar organizations, the Indian diet is deficient in protein and essential amine acids. This deficiency may be further aggravated if substantial gain in yield of pulses is not received by the multi-discipline cooperative research.

Mung and Urad are amongst the four most important pulse crops of India and are grown in four million hectares annually. The importance and problems of these crops have been discussed by Joshi (1968) and Wakankar (1968) in Second Workshop Conference on Pulse Crops. Inspite of the importance of these crops, their breeding and improvement remained largely neglected. The objective of this paper is to present some of the aspects and approaches of the breeding programme in progress for the last two years in mung and urad in Punjab, Haryana and Himachal Pradesh.

GENETIC STUDIES

Few genetical studies have been done on these crops. Till recently even the yield components in these crops were not known. The mode of inheritance of important qualitative and quantitative characters is still not thoroughly understood. This information is very important for deciding appropriate breeding technique. Systematic work to collect the valuable information has been initiated at P.A.U and the work completed is reported here.

i) Genetic variability and heritability estimates in mung:

Singh and Malhotra (1969) observed wide range of genotypic and phenotypic variability in their study of 75 indigenous and exotic strains. They found that 100-seed weight had highest heritability estimate, genetic variability and very high genetic advance. They suggested that the improvement in characters, like bunch number, pod number and seed yield, which had wide range, high coefficient of genetic variation and high genetic advance, could be possible through a selection programme. A close association between estimates of coefficient of genetic variation and genetic advance was observed.

ii) Correlation Studies in mung:

Correlation studies conducted on 75 mung varieties at Punjab Agricultural University, Ludhiana revealed that yield was strongly and positively associated with bunch number, pod number, pod length, seeds per pod and seed size. Path coefficient analysis suggested that pod number, seeds per pod and seed size directly influenced the yield. In view of the negative correlation of seed size with pod number and seeds per pod, it was recommended that a compromise must reach in selection programme so that the increase in one character may not be nullified by reduction in other characters. The multiple regression analysis indicated that seed size, pod number and seeds per pod are the yield contributing characters and these traits may be given priorities in breeding programme (Singh, 1969).

iii) Correlation studies in Urad:

Correlation studies were conducted on 25 varieties grown at two different locations viz., Ludhiana and Gurdaspur. This study showed that yield was strongly and positively associated with pod number, bunch number,

branch number, pod length and seed size. The correlation between seed yield and number of seeds per pod could not be estimated because the analysis of variances for this character was non-significant. The multiple regression analysis indicated that pod number, pod length and seed size are the important yield contributing characters and these characters deserves maximum attention in breeding of improved strains.

iv) Inheritance studies in mung:

The inheritance studies on qualitative characters completed at P.A.U revealed that green seed coat is dominant over yellow seed coat and is monogenically controlled. Similarly it was discovered that black spot on seed coat is conditioned by one gene and spotted character is dominant over non-spotted. In separate studies glaziness of seed coat was found to be controlled by single recessive gene. The inheritance studies of seed size was, however, found to be complex. Nevertheless, this character seems to be governed by smaller number of genes, small seed size being dominant over large one.

v) Studies on combining ability and genetic parameter:

A) mung: The data have been collected on 7 x 7 diallel set of mung and information on combining ability and inheritance of quantitative characters is being gathered. The data will be published soon.

B) Urad: The observations on 6 x 6 diallel set of urad have been collected to study the combining ability and inheritance of quantitative characters in this crop.

vI) Heterosis in mung:

Singh and Jain (1969) studied seven varieties, their 20 F_1 and 18 F_2 generations to find out the extent of heterosis. This study showed manifestation of hybrid vigour in F_1 hybrids over better parents for grain yield, seeds per pod, pod length, pod number, branch number and plant height. Negative heterosis was noted for seed size. The hybrid vigour for grain yield in F_1 generations over better parents was present to the extent of 173.0 per cent in 15 out of 20 crosses. The mean differences were, however, significant only in two cases. The two best hybrid combinations were Hyb.45 x No.305 and T 51 x D 45-6. It is worth mentioning that hybrid vigour present in F_1 generations/over better parents was retained in F_2 generations in large number of crosses. This indicates that a portion of hybrid vigour in F_1 hybrids was premominantly due to additive gene effects. Genetic diversity

in parents may be one factor for expression of heterosis for grain yield.

Although some valuable information such as components of yield and inheritance of some qualitative characters have been collected but still many problems need our immediate attention. Diseases, which are of vital importance in improvement of pulse crop, need prompt attention and the sources of resistance and its inheritance pattern need to be worked out.

BREEDING METHODS

The varieties in Punjab were evolved mainly through pure line selection method in the past. This method resulted in evolving three mung varieties viz., No. 54, No. 305 and Shining Mung No.1 and three varieties of Urad namely No. 48, Mash 1-1 and Kulu 4 which are widely cultivated in the state. Presently for developing an early maturing varieties of Mung and Urad for summer cultivation pure line selection is being practiced in the local collections.

Mung: In Punjab, Gurdaspur tract is traditionally known to grow sathi mung in summer. As many as 200 different strains were collected from this area and were grown in observational rows in 1967 at Gurdaspur sub-station. On the basis of earliness in maturity, disease resistance, seed size and colour and yield potential 20 strains were chosen. These strains were grown in replicated row trial at Gurdaspur and Ludhiana in 1968 summer and tested against Baisakhi Mung. Eight strains significantly out yielded Baisakhi Mung and one of them yielded as high as 12 quintals yield per hectare. It is proposed to test these strains in large scale trial at three locations viz., Ludhiana, Gurdaspur and Hissar. The seed of the promising lines would be made available for testing under All India Coordinated Scheme and to the interested breeders in 1970.

Urad: Over 400 collections of early maturing strains were made in the year 1967 from sub-montane region of Punjab which is traditionally known to grow sathi mash (Urad). On the basis of yield and other desirable traits 40 strains were selected from the observational rows. These strains were tested at two different locations viz., Ludhiana and Gurdaspur in the year 1968 in replicated row trial. Six strains have been found to yield between 7 and 8 quintals per hectare and it is proposed to test these lines in the year 1969 at three different locations in Punjab and Haryana. The seed of the promising lines would be made available to the interested Pulses Breeders in the year 1970.

Hybridization programme:

In case of self-pollinated crops the ultimate aim after hybridization has been the development of pure line as a variety. To achieve this goal three breeding methods have been successfully utilized in handling successive generation of a cross viz., (1) Pedgree method, (2) Bulk method and (3) Backcross method. Pedigree method: This method is extensively being used for producing superior strains of mung. In kharif 1967 as many as 55 crosses were made among promising lines to combine desirable characters of two different strains into one. Sufficient F_2 seeds were produced in off-season nursery in 1968. A large number of F_2 plants were raised in main season of 1968. Some of the crosses did not throw desirable segregates and hence discarded in beginning. Rigid selection pressure was applied in remaining crosses and 365 progenies have been selected for their test in F_3 progeny rows.

Simultaneously fresh crosses were resorted in 1968. Emphasis shifted in 1968 on making multiple crosses and some three way and double crosses

have been made with a view to combine desirable traits of 3 to 4 varieties into one strain.

Modified bulk method. This method is being used for evolving superior strains of urad. In this crop we have noticed very little variability for growth habit and many morphological characters, although differences in yield and number are present. This imposes restriction on individual plant selection. Several crosses are in advance generation.

Backcross method: A strain 24-2 of mung has been found to be very high yielding but has black spot on seed cost, small seed size and late in maturity. Another variety, Kopargan has non-spotted seed coat, bold seed size and early in maturity. A backcross programme has been initiated to incorporate desirable traits of Kopargaon, into 24-2.

FUTURE BREEDING PROCEDURE

Mung and Urad fall in category of autogamous species. This system of mating imposes restriction on the breeders in utilising the evalutionary breeding methology extensively used by maize breeders. The future breeding programme in case of these crops are however straight. These primarily involved the development of pure line varieties mainly through hybridization technique. A few important problems relating to this will be discussed here.

1) Collection of wide germ plasms: Dr. P.H.van Schaik and his team have placed great stress in collection of diverse material ever since the U.S.D.A. was involved in pulse improvement work but still the collection is not extensive and complete. Both mung and urad owe their origin to India and Central Asia. World collection of cultivated plants have been assembled primarily as a gene pool from where a plant breeder can directly draw the material for his use. Collection of widely divergent germsplasms should be considered as source of genetic material which would be useful in altering the course of further development. There is a great urgency to collect gene pool as soon asppossible from the places of extreme diversity before they are wiped out as the new varieties are replacing very fast the indigenous ones. It is emphasized that vigorous programme of exploration, collection and maintenance of germplasms and distribution to the interested plant breeders should be taken up.

2) Evaluation of varieties for different conditions: Pulses are by and large cultivated under residual fertility and moisture and poor crop management practices, whereas it is known that high yields are obtained under high fertility, better irrigation sources and other essential inputs. Consequently, major break through in yield can only come, if varieties are evolved suited for high fertility and irrigated conditions. In contrast pulses will continue to be grown under neglected conditions for many years to come. Under these situations the breeders will have to evolve varieties suited for high fertility and irrigated conditions on one hand and for poor fertility and unirrigated conditions on the other hand.

3) Hybridization work: The whole hybridization work should be mobilized in such a way that the superior varieties are evolved quickly and may be adopted to wide range of environmental conditions. I would offer the following suggestions on this aspect.

a) Facilities for raising off-season nursery: In northern India two crops in a year can be grown successfully while in southern part of the country these crops can be raised all the year round. The coordinated project should have a station somewhere in South exclusively for this purpose and meet the entire expenditure on staff and contingency. Similar facilities should be explored for winter crops as well.

b) Multiple crosses: The mung and Urad varieties evolved till date are deficient in many traits and it is hard to find out two best varieties which may possess all the desirable characters, therefore, the breeders are suggested to go for multiple crosses, incorporating three, four or

even more strains in the hybridization programme. While selecting strains for multiple crosses due considerations may be given to incorporate varieties of diverse genetic origin, wide adaptability and better combiners.

c) Dividing crops among different pulses breeders: Every pulses breeder in the country is working on a number of crops which becomes difficult to handle with same efficiency and urgency. It will be in the interest of the coordinated programme for speedy development that the crops are divided amongst the pulses breeders. While dividing the crops the choice of the breeder and the importance of a pulse crop in a state may be kept in mind. Division should not mean that a breeder would be debarred from working on other crops but certainly more emphasis may be on the crop which has been assigned to him.

4) Heterosis breeding: The successful utilization of hybrid vigour in cross-pollinated crops has focussed the attention of the breeders working on self-pollinated crop. In many self-pollinated crops like tomato, hybrid varieties have been evolved while in other crops like wheat a possibility exist which is being exploited. Similar attempts may be mobilized to receive phenomenal increase in mung and urad particularly when high percentage of heterosis has already been reported by Bhatanagar and Singh (1964) Singh and Jain (1969) in mung crop. The next step in this direction is to develop cytoplasmic male sterile and restorer lines through irradiation, chemical treatment and interspecific crosses. After CMS and restorers lines are developed, the information on cross-fertilization may be collected. Once these basic informations are available, the possibility of producing hybrid mung and urad varieties may not be remote.

5) Mutation breeding: Following discoveries of x-ray for induced mutation by Muller in 1927 and Stadler in 1928, this technique has been used extensively for plant improvement and many varieties have been evolved so far. This technique may be employed for two purposes: firstly, for creating genetic variability lacking in the germplasm collection and secondly, for removing certain bottlenecks such as susceptibility to various diseases and shattering, growth habit etc. of an otherwise desirable varieties.

6) Use of harmones: Dropping of 60-70 per cent flowers in mung and urad is a common phenomeno which results in reduction of grain yield. Application of certain harmones such as Indol Acetic Acid (IAA), 2-4-5-T and giberellic acid are known to check flower dropping to a considerable extent. The use of these harmones are worth/trying.

7) Breeding for quality: Pulses are included in our diet as a source of protein and essential amino-acids. Pulses are known to be rich in certain amino-acids while poor in others. Varieties possessing balanced amino-acids would go a long way in meeting our protein deficiency in diet. Easy cookability is another important consideration for judging the suitability of a variety. Facilities for quality breeding are lacking in almost all the state except I.A.R.I. It is suggested that such facilities may be extended to all the desirous pulse breeder in the country.

Such programmes cannot be effectively operated by one breeder in isolation or by a team of breeders but requires multi-discipline cooperative approach.

References

Bhatnagar, P.S. and Singh, B. 1964. Heterosis in mungbean. Indian J. Genet. 24: 89-91.

Joshi, S.N. 1968. Future varietal improvement programme of green gram. Paper presented in 2nd Annual Workshop Conference on Pulse Crops held in April 1-3, 1968 at I.A.R.I., New Delhi.

Singh. K.B. 1969. Genetic variability, correlation and selection indices in mung (Phaseolus aureus Roxb.) Proceeding of the 56th Session of Indian Science Congress held at Powai (Bombay) Part III Abstract.

Singh, K.B. and Malhotra, R.S. 1969. Estimates of genetic and environmental variability in mung (Phaseolus aureus Roxb.) P.A.U.J. Res. (In press)

Singh, K.B. and Jain, R.P. 1969. Heterosis in green gram. (Unpublished)

Wakanker, S.M. 1968. Future varietal improvement programme on black gram (Phaseolus mungo L.) Paper presented in 2nd Annual Workshop Conference on Pulse Crops held in April 1-3, 1968 at I.A.R.I New Delhi.

-oOo-

VARIETAL PERFORMANCES OF KHARIF PULSES WITH SPECIAL REFERENCE TO NAYAGARH CONDITION

R.C. Misra
Pulse Research Station, Nayagarh, Orissa

Pulses are grown in Orissa in both kharif and rabi seasons. Cultivation of kharif pulses are mostly confined to western hilly tracts while rabi pulses are grown in abundance in the eastern coastal belt. Area covered under kharif pulses is to the extent of 10,5900 hectares as revealed from 67-68 statistical report. The major kharif pulses are black gram, green gram and arhar. With a view to find out suitable, high yielding kharif pulses, trials on black gram, green gram and arhar, seeds of which received through the All India CO-ordinated Trial Project on pulses, were conducted for the last two seasons at Nayagarh pulse research station.

Nayagarh, a sub-division of Puri District, is situated at an elevation of 250'. The texture of the soil is sandy-clay-loam and the pH varies from 5.7 to 7.2. The average month-wise rainfall and temperature starting from June to October are given in Table 1.

The details of the varietal trials conducted on black gram and green gram during the periods 1967 and 1968 kharif are presented below:

Black gram: Varietal trial conducted on this pulse included the varieties namely T_{65}, T_{27}, BR61, BR68, T_9 No.1-1, Sindkheda 1-1, D_{6-7} No.55 and a local. Characters studied and yield obtained are given in the Table 2.

In the first year's trial it was observed that varieties Sindkheda 1-1, D_{6-7} and No. 55 were heavily infested with yellow mosaic while the remaining improved varieties remained completely free from it. These 3 varieties, therefore, were excluded from the subsequent year's trial.

It therefore appears from the above figures that T_{65} and T_{27} are much better than the local variety and would make a good substitute for local.

Green gram: Table 3 may be referred to for various morphological characters and yield of different varieties of green gram on which varietal trials were conducted during 1967 and 1968 kharif.

It is observed from the table that the varieties T_2, T_{44}, T_{51} and Hyb-45 are statistically significant over the remaining varieties in both the seasons and thus there appears great scope for recommendation of these varieties in the State. The deletion of the varieties 24-2, 24-3 and BR-2 in the second year trial was due to the fact that they are late varieties taking more than 100 days to flower and secondly they also yielded much less.

Disease: Primarily kharif mung suffers from two kinds of diseases, one is yellow mosaic and the other is leaf spot. Varieties Kopergaon and T_2 are free; Khargaon, B_1, NP 18, Hyb-45, T_{51} & T_{44} are moderately affected while the remaining varieties are servely infested with the yellow mosaic disease. Occurrence of leaf spot disease is moderately seen in all the varieties excepting the two local strains Angul 3-6(A) and Angul 3-6 (B) which suffer severely. But this disease does not appear to be so devasting like yellow mosaic as its incidence coincides with the fruiting stage.

Pests: The two major pests that come into the picture are aphids and stored grain pests. The former, though, is not a very severe problem and can very easily be checked by the application B.H.C dust but the latter pest appears to be serious.

....

Table-1

TEMPERATURE AND RAINFALL DATA

Month	1967			1968		
	Temperature in °C		Rainfall (mm)	Temperature in °C		Rainfall (mm)
	Minimum	Maximum		Minimum	Maximum	
June	25 - 32	31 - 41	315	27 - 31	30 - 38	161
July	26 - 30	28 - 33	298	26 - 29	29 - 33	389.5
August	25 - 29	27 - 32	467	26 - 28	29 - 32	215.5
September	26 - 29	28 - 33	288.5	25 - 29	27 - 34	253.5
October	24 - 29	29 - 32	9	24 - 27	23 - 32	438

...

Table - 2

VARIETAL TRIAL ON BLACK GRAM

Sl.No	Variety	Habit	Height in cm.	Branches	Days for maximum ripening	Days for maximum flowering	1000-seed weight	Yield/acre in kg.		Remarks
								1967	1968	
1.	T 65	Trailing	198	9	115-120	85	41.200	898	598	
2.	T 27	Trailing	296	8	115-120	85	36.300	850	565	
3.	BR 61	Trailing	116	14	135-140	105	32.700	842	222	
4.	BR 68	Trailing	167	8	110-115	80	36.200	821	296	
5.	NO 1-1	Trailing	178	7	95-100	65	40.480	742	358	
6.	Sindkheda 1-1	Trailing	COMPLETELY SPOILED DUE TO YELLOW MOSAIC ATTACK					219	—	
7.	D 6-7	Trailing						200	—	
8.	NO 55	Trailing						184	—	
9.	T - 9	Erect	51	4	70	35.	—	392	—	
10.	Local	Trailing	—	—	—	—	—	450	274	

Treatments significant at 5% level.

******

Table-3

VARIETAL TRIALS ON GREEN GRAM DURING "KHARIF" SEASONS

Sl.No	Variety	Morphological characters					Total yield in kgs/acre obtained from 2 flushes				Remarks
		Habit	Height in cm.	Branches	Days for maximum flowering	Days for maximum ripening of 1st flush	1967	1968			
								First Flush	Second Flush	Total	
1	T - 44	Erect	29	2.7	39	62	342	277	193	470	
2	T - 51	Erect	46	2.8	40	62	321	214	211	425	
3	Kopergaon	Erect	43	3.0	42	59	258	161	---	161	
4	K -11	Erect	42	3.9	44	62	257	146	90	236	
5	Hyb - 45	Semi erect	51	4.8	46	73	248	219	170	389	
6	Khargaon	Spreading	49	3.7	42	71	244	154	120	274	
7	T2	Erect	31	2.6	38	59	210	226	149	375	
8	Jalgaon	Spreading	36	3.5	44	62	187	135	102	237	
9	D 45 θ 6	Spreading	66	3.0	56	90	138	134	---	134	
10	NO 54	Spreading	79	4.9	56	90	133	76	---	76	
11	B_1	Erect	31	3.9	43	60	129	260	117	377	
12	D2-15	Spreading	84	3.2	56	90	128	79	---	79	
13	RS-4	Spreading	80	4.6	56	90	127	69	---	69	
14	NP-23	Erect	54	3.9	46	73	126	146	62	208	
15	NP-18	Erect	40	4.2	43	71	65	184	91	275	
16	NO-305	Spreading	64	4.9	70	90	21	---	---	---	
17	24 - 3	Spreading	87	7.4	84	above 100 days	16	---	---	---	
18	24 - 2	Spreading	79	6.5	84	above 100 days	14	---	---	---	
19	RS 5	---	--	---	--	--	--	93	---	93	
20	Angul 3-6(A)	---	--	---	--	--	--	84	---	84	
21	Angul 3-6(B)	---	--	---	--	--	--	178	---	178	

Treatments significant at 5 % level

....

RESULTS OF BREEDING WORK DONE AT THE REGIONAL CENTRE, J.N.K.V.V.JABALPUR,M.P.

J.P. Shrivastava
J.N.K.V.V. Jabalpur, M.P

1. Arhar (1967-68)

1. Varietal trial (without fertilizer) early group: - Nine varieties from M.P., U.P., Bengal, Delhi and other States were tried. The general growth of the crop was very poor due to water logging, hence the yield was affected adversely. (Table 1)

Variety C-11 was found to be the highest in yield (562.32 kg/ha.) followed by P.T. 301 (498.62 kg/ha.) and B-7 (416.35 kg/ha.) as compared to 337 kg/ha. of No. 148.

2. Varietal trial (without fertilizer) late group:- Nine varieties from all over India were tested. General growth of the crop was poor. However, variety 2-E gave the highest yield (1892 kg/ha) followed by 7-S (1838 kg/ha) and GW-3 (1914 kg/ha) (Table 2).

3. Varietal trial (with fertilizer, late group):- The same set of varieties was grown with a fertilizer dose of 20N, 100P, 20K kg/ha. Here again the general growth was not satisfactory. Variety 2-E gave the maximum yield of 2406 kg/ha. followed by 7-S (2356 kg/ha) (Table 3).

4. Preliminary strain test:- Seven promising strains along with two controls (No. 148 and Khargone-2) were tested in replicated plots. Strain 62-11 (maturity 165 days) gave the highest yield of 1433 kg/ha. followed by 1317 kg/ha. of No. 148 as compared to 1037 kg/ha. of Khargone-2(Table 4).

5. Local bulks:- 19 local bulk samples were tested in a single row replicated plot. Parsa and Jaswari were found to be promising in yield while sample Luma-Chouhan matured earliest (151 days).

II. Mung (1968)

1. Coordinated Varietal Trial:- Out of 24 varieties under trial, Hy.45, a strain of M.P. out yielded others giving 1430 kg/ha. Krishna-11, another M.P. variety which had given the highest yield last year, stood second this year (1191 kg/ha). Hy. 45 is a compact lodging resistant variety and early (64 days)in maturity. (Table 5).

2. Preliminary varietal trial:- Twelve strains including hybrids and selections made at Jabalpur and Gwalior were tried. Kopargaon, a bold, shining-seeded early variety gave the maximum yield of 1200 kg/ha. followed by 1130 kg/ha. of Khargaone-1 (Table 6).

3. Genetic stock:- 360 entries were grown in single lines; selections made included 6 for earliness, 12 for medium maturity one (line no. 327) for freedom from diseases and 9 for high yield based on pod length, profuse bearing, plant type etc. Thirty lines were very late but were comparatively free from diseases.

III. Urid (1968)

1. Coordinated Varietal Trial:- Among 21 varieties tried in randomised replicated plots, Type 9 the earliest strain (88 days) yielded the highest (1131 kg/ha) followed by 1047 kg/ha. of Man-2 and 1033 kg/ha. of No. 55. Type-9 was the second highest during 1967 (Table 7).

2. Preliminary Varietal Trial:- There were 12 strains under trial. A selection No. 62-6/5 (92 days maturity) gave the highest yield of 1383 kg./ha. followed by 1369 kg/ha. of Prog-121. (Table 8).

3. Genetic Stock:- Out of 225 lines of germ plasm grown in single lines, for the first time Nine selections were made for earliness, 28 for synchronous flowring and 2 for long pod. 28 cultures were found

least susceptible to diseases and 11 were comparatively free from insect damage.

IV. Cowpea (1968)

1. Coordinated Varietal Trial:- Out of 11 varieties under trial R.S. 9 a late variety (maturity 101 days) gave the highest yield of 1019 kg/ha. followed by 898 kg/ha. of K11, an early (77 days maturity) variety with compact habit of growth.

2. Preliminary Varietal Trial:- Among 24 strains tried during 1968, a strain G.C. 117 gave the maximum yield of 693 kg/ha. followed by 552 kg/ha. of K-14. Both matured at about the same time. (86-87 days).

3. Genetic Stock:- 824 entries were sown in single lines. Selections were made for grain, vegetable, fodder and also for double purposes.

V. Gram (1967-68)

1. Coordinated Variety Trial:- Twenty four varieties from U.P.,Punjab, Rajasthan, M.P., Andhra, Bengal and Bihar were grown in randomized replicated plots. The general growth of the crop was poor due to lack of moisture. G62-404 was found to be early maturing and high yielding (757 kg/ha) as compared to 614 kg/ha. of Adt. V (Table 11).

2. Genetic Stock:- A collection of 2404 types alongwith the check of some improved varieties was grown in a single row plot (Half row inoculated and half uninoculated). 35 lines were selected for earliness, high yield good plant type and profuse bearing. However no significant difference was found in yield between inoculated and uninoculated plots.

VI. Pea (1967-68)

1. Coordinated Varietal Trial:- Twelve varieties from U.P. and M.P. were grown in randomized replicated plots. Variety T-163 gave the highest yield, (741 kg/ha) though late in maturity. Gwalior crosses are earlier in maturity but poorer in yield (Table 12).

2. Genetic Stock:- 379 types were grown in rows 15' long along with 6 Gwalior crosses. % 31 selections were made for earliness, plant habit, yield, resistance to pests and diseases and seed size.

VII. Lentil

1. Coordinated Varietal Trial:- Ten varieties from U.P., Punjab, Maharashtra and I.A.R.I. were tested in randomised replicated plots (Table 13). The variety T-8 gave the highest yield of 451 kg/ha. followed by B-62 (386 kg/ha) and N.P.47 (378 kg/ha) T-8 was also found earliest in maturity (135 days).

2. Preliminary Varietal Trial:- 25 strains were tested in 4 row plot including some selections and some local collections Bahra-1 gave the highest yield of 1659 kg/ha. followed by selection J-61-73 (1558 kg/ha), J-66-55 (1551 kg/ha) and J-61-33 (1522 kg/ha). No significant difference was found in maturity (Table 14).

3. Genetic Stock:-Out of 140 collections, 12 good lines on the basis of growth habit, earliness and yield were selected. Rains at the time of pod formation affected the yield adversely, however L.E.125, C-31, L.E. 57, L.E. 45 were found to be higher yielding.

4. Observation Plots:- Seventy two types including some local collections and some selections were grown in replicated plots out of which S61-95,S.61.9 were found to be superior in yield.

VIII. Lathyrus (1967-68)

1. Varietal Trial:- Four varieties were tested in randomized replicated plots out of which Rewa-2 was found to be the highest yielder (244.4 kg/ha).1 No significant difference in maturity was found (Table 15).

2. Genetic Stock:- 504 lines were grown in single row . Ten promising lines on the basis of yield were selected L.S. 115 gave the highest yield.

Table -1

Performance of 9 varieties (early group - without fertilizer) of Arhar during kharif 1967

	Varieties	Days of flowering	Days to maturity	Yield in kg/ha.
1.	T-21	138	172	168.10
2.	B-7	158	190	416.35
3.	C-11	160	191	562.32
4.	N-84	165	191	240.30
5.	N-290-21	156	183	130.17
6.	P.T.301	163	101	498.62
7.	No.148	158	191	337.87
8.	Khargone-2	155	191	223.22
9.	T.5-15	168	202	126.85
S.E		-	-	120.153
C.D		-	-	243.910

Table - 2

Performance of varieties (late group - without fertilizer) of Arhar during kharif 1967.

	Varieties	Days to general flowering	Yield in kg/ha.
1.	2-E	176	1892.10
2.	7-S	177	1877.82
3.	GW.3	161	1813.56
4.	T.17	165	1699.32
5.	S-101	156	1659.32
6.	S-103	158	1656.48
7.	NPWR-15	164	1649.34
8.	T-7	169	1249.50
9.	NP-69	166	564.06
S.E.		-	200.634
C.D		-	584.052

Table - 3

Performance of 9 varieties (late group - with fertilizer) of Arhar during kharif 1967

	Varieties	Days to general flowering	Yield in kg/ha.
1.	2-E	174	2406.18
2.	7-S	175	2356.20
3.	T-7	175	2299.00
4.	T-17	172	2263.38
5.	GW.3	169	2256.20
6.	S-103	163	2249.10
7.	NPWR-15	172	2213.40
8.	S-101	169	1977.78
9.	NP-69	162	1642.20
S.E.			N.S
C.D			

Table - 4

Preliminary strain test of Arhar during kharif 1967.

Strains	Flower initiation (days)	General flowering (days)	Maturity (days)	Yield in kg/ha.
1. S 62-11	90	110	165	1432.600
2. No. 148	93	166	177	1316.510
3. S 62-24	88	120	185	1220.180
4. S 62-23	106	121	182	1189.305
5. Khargone-2	81	100	154	1037.400
6. S 62-14	92	112	160	1033.695
7. T 56-42	81	98	153	1026.285
8. T 56-253	85	98	154	971.945
9. T 56-56	81	96	152	901.550
S.E.	-	-	-	9.876
C.D.	-	-	-	22.838

Fertilizer - 20 N, 100 P, 20 K.

Table No. 5

Performance of 24 varieties of Mung tested under coordinated variety trial during kharif 1968

Variety	Days to maturity	Yield in kg/ha
1. Hyb. 45	64	1430
2. Krishna-11	62	1191
3. Jalgaon-731	65	1150
4. D - 45 - 6	62	1142
5. Khargone -1	63	1107
6. Pusa Baisakhi	61	1096
7. Type-44	62	1064
8. D-2-15	68	1011
9. Hyb. 4	62	1003
10. R.S. 5	74	935
11. Kopergaon	61	933
12. No. 54	74	930
13. Shining Mung No.1	62	894
14. No. 305	65	886
15. T-51	66	861
16. M-59-318	65	855
17. R.S.4	72	729
18. 24-2	69	657
19. NP - 23	73	636
20. B -1	62	632
21. Type-2	61	616
22. NP-18	68	598
23. 24-3	101	484
24. BR-2	108	247

Gross plot - 4m x 2.7m
Spacings 0 (1) Intrów 45 cm.
No. of row/plot-6

Net plot - 34m x 18m
(2) Introw 10 cm.
Fertilizer - 20N, 40 P_2O_5 kg/ha.

Table - 6

Performance of 12 Mung strains during kharif 1968

Variety	Days to general flowering	Days for 1st picking maturity	Average plot yield in Grams.	Yield in kg/ha.
1. Kopergaon	38	61	336.0	1200
2. Khargone-1	36	55	316.5	1130
3. Hyd. 64	41	59	300.5	1073
4. Hyd. 49	40	58	224.5	857
5. 46 - 64	37	55	223.5	853
6. Hyd.100	40	62	198.5	709
7. 79 - 64	42	57	161.5	577
8. T - 1	36	63	157.5	562
9. Hyd. 66	42	57	144.0	514
10.M-60-339	39	52	94.5	337
11.70 - 64	40	54	94.5	337
12.72 - 64	40	57	85.0	303

Net plot size - 3.1m x 0.9 m

Spacing - Row to row 45 cms.
Intra row 10 cms.

Fertilizer - 20N, 40P

Table - 7

Performance of 21 varieties of Urid under coordinated variety trial during kharif 1968

Variety	Days to maturity	Yield in kg/ha.
1. Type - 9	88	1131
2. Mah. 2	98	1047
3. No. 55	89	1033
4. 62 - 3 - 3	89	1003
5. D - 6 - 7/1	98	999
6. 62 - 3/2	89	974
7. Mash 35 - 5	99	956
8. Mash 41 - 13	99	826
9. Mash 48	94	806
10. D - 6 - 7	98	786
11. No. 1 - 1	98	785
12. Khargone - 3	91	749
13. Gwl. 18	98	723
14. Sindhukheda	92	701
15. BR - 61	109	488
16. NP - 6	108	474
17. No. 1766	109	376
18. Type - 27	108	371
19. Type - 65	108	278
20. BR - 68	121	278
21 N - 212	123	210

Gross plot - 4m x 2.7m
Net plot - 3.4m x 1.8m
Spacing - (1) Inter row 45 cms.
(2) Intra row 10 cms.
No. of rows/plot - 6
Fertilizer - 20N, 40 P_2O_5 kg/ha.

Table - 8

Preliminary variety trial of Urid during kharif 1968
yield per hectare in kgs. and days to maturity

Variety	Days to maturity	Yield in kg/ha.
1. 62 - 6/5	92	1382.9
2. Proj - 121	93	1369.0
3. L 26 - 59	93	1213.5
4. Jashpurnagar L	92	1194.1
5. No. 55	87	1188.5
6. No. 63/4	87	1116.3
7. 62 - 20/1	87	1041.4
8. I - 12	87	985.8
9. L 41 - 13	94	983.0
10. Mash - 48	94	896.9
11. Khargone - 3	93	835.8
12. Lailunga L	94	810.8

Net plot size - 4m x 0.9m
Fertilizer - Nitrogen 20 kg/ha
P_2O_5 40 kg/ha
Distance between rows - 45 cms.
Distance between plants - 15 cms.

Table - 9

COWPEA COORDINATED VARIETAL TRIAL - 1968 KHARIF

Variety	Yield/ha.in kg.	Days to 75% maturity
RS 9	1019.4	101.0
K 11	898.4	77.5
5286-3	853.1	78.1
J.C. 10	836.1	89.1
NP 2	515.2	76.6
K. 14	583.3	71.6
T. 2	555.5	92.5
Early Ramzhern	478.9	66.6
Meshed	370.8	68.0
Black Eye - 7	154.2	70.0

1. Design of experiment	-	Randomized Black
2. Treatments	-	10 varieties
3. Replications	-	6
4. Plot size	-	4 x 3.6 sq. m
5. Net Plot size	-	3 x 2.4 sq.m.
6. Inter Row Spacing	-	67 cm.
7. Intra Row Spacing	-	15 cm.
8. Conversion Factor	-	1388.8

Table - 10

PERFORMANCE OF 24 VARIETIES OF COWPEA TESTED IN PRELIMINARY VARIETAL TRIAL IN KHARIF 1968

S.No.	Variety	Maturity days	Yield in kg/ha.
1.	GC 117	87	692.7
2.	K - 14	86	552.0
3.	T2	81	528.6
4.	K 11	71	484.3
5.	GC 121	85	458.3
6.	GC 140	82	432.2
7.	GC 174	80	406.2
8.	GC 173	80	406.8
9.	GC 191	85	372.3
10.	GC 176	80	361.9
11.	K 313	62	354.1
12.	GC 185	82	341.1
13.	GC 163	70	328.1
14.	GC 184	84	309.8
15.	GC 180	79	291.6
16.	GC 183	86	286.4
17.	GC 161	81	285.3
18.	GC 148	80	270.8
19.	GC 149	81	268.0
20.	GC 189	65	252.6
21.	GC 170	85	212.5
22.	GC 164	84	208.3
23.	GC 118	81	195.3
24.	GC 165	82	156.2

Plot size - 4 x 2 m
Distance Row to Row - 60 cms.
Fertilizer 20 N: 40 P kg/ha.

Table - 11

PERFORMANCE OF 24 VARIETIES OF GRAM DURING RABI 1967-68

S.No.	Variety	Stand at harvest	Days to flower	Days to maturity	Average plot yield in grams.	Yield kg/ha.
1.	ST. 4	61	59	110	515	577
2.	T. 2	50	61	107	482	563
3.	G. 24	63	63	110	567	636
4.	G. 62-404	61	53	103	675	757
5.	Pb-7	61	65	109	633	710
6.	Chafa	60	46	104	543	609
7.	S - 26	50	67	110	485	561
8.	Gwl - 2	52	58	107	531	696
9.	Br. 77	59	62	110	494	526
10.	R.S. 10	53	62	110	528	590
11.	T. 1	63	56	104	517	579
12.	D.G. 482	61	51	104	589	661
13.	742 - 7	59	53	106	535	599
14.	B. 98	66	60	110	532	596
15.	R.S. 11	60	63	110	613	688
16.	C. 235	63	61	116	654	733
17.	N.P. 58	59	62	110	531	596
18.	Adt. 5	61	55	104	542	614
19.	B. 75	61	59	107	666	747
20.	B.R. 17	62	60	108	519	582
21.	Co.1	65	52	103	614	677
22.	N.P. 100	66	64	111	473	530
23.	D. yellow	59	53	102	459	515
24.	T.87	64	57	107	548	614

Yield non-significant

Spacing - Inter row - 2'

Table - 12

PERFORMANCE OF 12 VARIETIES OF PEA DURING RABI 1967-68

S.No.	Varieties	Days to maturity	Mean yield plots, in kgms.	Yield per hectare in kgms.
1.	T. 163	139	1.023	740.70
2.	Pea 6113	139	0.748	541.60
3.	T-19	124	0.513	372.44
4.	T-61	124	0.460	333.96
5.	Seoni L	131	0.299	217.07
6.	G.C. 468	124	0.255	185.13
7.	G.C. 477	125	0.249	180.77
8.	T-56	130	0.255	163.35
9.	Sarla	137	0.216	156.82
10.	G.C. 141	124	0.202	146.65
11.	G.C. 245	124	0.193	140.12
12.	G.C. 254	119	0.182	132.13

Non-significant

Plot size - 13' x 6'
Space - Between rows - 3'
- Intra rows - 9"
Fertilizer= - 20 N, 40 P lbs/acre

Table - 13

PERFORMANCE OF 10 VARIETIES OF LENTIL DURING RABI 1967-68

Varieties	No. of days flowering	No. of days maturity	Yield in kg/hac.
B. 25	73	140	193.8
B. 62	59	138	386.4
B. 77	63	135	251.3
C. 31	65	135	229.0
L-9-12	71	148	280.0
NP.11	99	147	42.1
NP.47	61	135	378.4
T. 3	58	135	305.4
T. 8	58	135	451.30
T. 36	87	141	197.4
S.E.			63.36
C.D.			130.12

Date of sowing	-	23.10.67
Net plot size	-	13' x 8'
Replication	-	4
Design	-	Randomized
Fertilizer	-	Non
Inter row	-	2'
Plant to Plant	-	6"

Table - 14

PERFORMANCE OF 25 STRAIN OF LENTIL TESTED UNDER PVT DURING RABI 1967-68

Varieties	Flowering No.of days	No. of days maturity	Yield in kg/hac.
J-61-31	50	136	957.00
J-61-33	48	136	1522.00
J-61-55	49	136	1551.00
J-61-73	48	136	1558.00
J-61-80	48	137	645.00
J-61-86	50	136	1168.00
J-61-97	52	137	991.00
J-61-99	48	136	1127.00
Jabalpur L.	49	136	1197.00
Bombay-18	51	136	766.00
Bombay-20	49	137	1127.00
Mahagaon-1	52	136	1183.00
Mahagaon-2	60	137	1428.00
Kishanpur	55	137	1260.00
Azeduo	55	136	1076.00
Alapuo	55	137	1024.00
Sheepur L.	56	136	1199.00
Tulwali	57	137	946.00
Total	56	137	1518.00
Bhind L.	57	135	939.00
C.S. Bhind-1	55	137	1390.00
C.S. Bhind-2	58	136	1009.00
Bahra-1	53	137	1659.00
Bahra-2	54	137	1457.00
Sagar L.	57	135	863.00

Spacing	Later	- 1' intra 6"
Plant size		- 12' x 2'
S.E.		- 93.6 kg/hac.
C.D.		- 193.81 kg/hac.

Table - 15

PERFORMANCE OF 4 VARIETIES OF LATHYRUS UNDER C.V.T. DURING RABI 1967-68

S.No.	Variety	Maturity	Yield/plot in gms.	Yield in kg/hac.
1.	LC 76	143.25	336.25	203.28
2.	T2-12	142.75	325.50	197.23
3.	Rewa-1	143.50	402.00	243.21
4.	Rewa-2	143.75	403.75	244.42

.....

REPORT ON THE RESULTS OF THE CO-ORDINATED VARIETAL TRIALS ON PULSES 1967-68

P.C. DOLOI
SHILLONGANI, NOWGONG, ASSAM

ARHAR

Two varietal trials on arhar, one early and one late, each consisting of 9 types, were taken up during the year, In the early group, the type Khargaon-2 gave the highest yield of 1517 kg. per hectare. It took 214 days for maturity. The next higher yielder was type T-21 with an average yield of 1425 kg. per hectare and a maturity period of 204 days. In the late group, the type NP 69 was the highest yielder with an average yield of 1425 kg. per hectare and a maturity period of 247 days.

GREEN GRAM

One varietal trial with 16 types, including two local types, was conducted and the type T-2 gave the highest yield of 594 kg. per hectare followed by Mg-63, a local, with an average yield of 536 per hectare. It is to be pointed out that the low yield per hectare is due to higher spacing of 2' from row to row as against the normal spacing of one foot between rows.

It was observed that broad leafed types like Jalgaon and Kapergaon were more susceptible to the attack of yellow mosaic and, conversely, less to Cercospora.

BLACK GRAM

The co-ordinated yield on black gram was not conducted in this station. However, a trial with 14 types received earlier from I.A.R.I., in which four types viz., T-9, T-27, BR-61 and BR-68 were common with the co-ordinated trial, was conducted. The type T-27 proved to be the highest yielder with an average yield of 2470 kg. per hectare.

This type was observed to be completely free from the attack of yellow mosaic while most other types in the station were affected by the virus during the year under report.

-oOo-

BREEDING WORK DONE DURING 1968-69 KHARIF AT PULSE RESEARCH STATION, BARODA, GUJARAT STATE.

S.N. JOSHI
College of Agriculture, Junagadh, Gujarat

1. During 1968-69 we had agreed for conducting certain All India Co-ordinated trials and evaluation of Tur material but unfortunately because of severe drought at many locations in the northern part of of state, trials could not be conducted. The results of co-ordinated trials on Urid at Baroda and Jamnagar and on Cowpeas at Baroda are submitted to the Coordinator.

2. As 30% of the acreage under mung as an entire crop is covered mostly on poor soils and under extremely low rainfall areas, it becomes necessary to breed for early maturing types that are hardy and fairly good yielders. Also as a large acreage in the state is under cotton, it offers a good opportunity to increase production of mung by intercropping this pulse between two rows of cotton and with a view to meeting with these breeding objectives for the present we have focussed our attention only on mung to:

(a) get early maturity with average yield and good grain quality.

(b) get a type suitable for intercropping

Local available material was tapped and some lines have been isolated that seem promising. These lines are under preliminary trials at Baroda. Among the many such lines, outstanding characteristics of a few are presented below:

Selection	Yield kg/ha.	Days to maturity	No. of seeds per pod	1000 seed weight gm.	Grain colour
Kutch-1	565	65	18	38.5	Lustrous green
Kutch-2	297	60	10	47.5	-do-
Khaira-10	438	60	18	35.0	Green
D.45-6(check)	225	89	12	29.0	Dull green

The above lines are hardy, short statured and bushy in habit and as such well suited for intercropping.

500 gms. seeds of each of the above selections has been collected by Dr. L.M. Jeswani personally during his visit to Baroda on January 14-15, 1969.

Similarly, efforts are under way to isolate promising lines in Moth, Tur and Guver according to the requirement of the agro-climatic conditions of the pulse growing tracts of the state.

-oOo-

AGRONOMY WORK DURING RABI - 1967-68

S.N. Kapoor
RPIP/USAID, New Delhi

I am presenting the report of the Agronomical work conducted during Rabi 1967-68 at Delhi, Pant Nagar, Hissar and Ludhiana on gram, peas and lentil.

There were two types of experiments on each crop: 1. Fertilizer - inoculation 2, Spacing fertility - Table 1 (experiments details) and Table 2 (treatments)

Useful data could be obtained only from gram experiments at Delhi, peas at Pant Nagar and Hissar and lentil from Ludhiana.

RESULTS:

S.F. Trial

Peas - Pant Nagar & Hissar:- Yield data of both the locations were collected and statistically analysed. And it was found that 10 cm. spacing gave the highest yield at both the locations and is significantly superior over 20 & 30 cm. at Hissar and Pant Nagar (Table 3).

Maximum yield was obtained in case of 45 cm. row to row with 50 kg. of N, P and K per hectare when within row spacing was 10 cm. At Hissar yield is 3323 kg. whereas at Pant Nagar 1840 kg/ha (Table 4).

Fertility Inoculation experiment at Hissar and Pant Nagar:- Yield of peas due to different fertility treatments varies from 2960 kg/ha. to 4366 kg/ha. at Hissar and from 1163 to 2496 kg/ha. at Pant Nagar location. Analysis shows further that in the absence of any nitrogen, there is response to K in spite of levels of P at both locations. With increase in the levels of N and P from 0 to 50 kg. per hectare, the yield of peas increased, though not significantly. However, with further increase in the levels N and P beyond 50 kg/ha. the yields shows decline with increase and levels of K, particularly at Pant Nagar.

Lentil:- We could obtained data on lentil from Ludhiana only and both the F.I and S.F. experiments were statistically analysed. Although the yield was poor at Ludhiana, effects due to different row spacing and fertility levels (main treatments) are significant.(Table 5).

With increasing levels of fertility in 30 cm. row spacing, the yield of lentil increased significantly. In 40 cm. row spacing, however, the yield decreased at 100 kilograms each of N, P & K, even though the yields did not differ significantly at 50 and 100 kg. if fertility levels. In 20 cm. row spacing though the yields increased with increase fertility, the yields at 50 kg. and 100 kg. fertility were at par.

Date-of fertility spacing experiment was statistically analysed and effects due to N, P and interaction between N and P and N, P and are found significant. Yield of the lentil was reduced/when 50 kg. of /significantl N/ha. was applied as compared to 0 kg/ha. There was no difference in yield in case of 0 kg./ha. and 100 kg/ha. of N. These two levels were superior over inoculum.

Effect of P on yield of lentil:

Yield was increased by the application of 50 kg. P/ha. and it is significantly superior over yield obtained in case of 0 kg.P/ha. At 100 kg/ha. no significant increase is obtained (Table 6). Effect due to interaction of N & P was also found significant.

It is observed that yield of lentil was 560 kg/ha. at 50 kg. per ha. of P in the absence of N. With further increase in the levels of P in the absence of any/N, yield was reduced significantly. Even with 50 and 100 kg. of N yield is only increased upto 50 kg. P per ha. There is significant

decline in yield with 100 P and 100 N/ha. (Table-7).

The highest yield obtained was 742 kg/ha. from N100, P100 and K0 treatment. Increase levels of K without any nitrogen has depressing effect on yield.

Gram -

S.F. Experiment:- Delhi data was statistically analysed and it was observed that in case of G-24 variety planted at Delhi location there was no significant difference either in main treatment, e.g., Row Spacing x Fertilizer levels nor in sub-treatments, e.g., within row spacing.

There was, however no significant difference between row and plant spacing of 60x15, 60x10, 45x10, 30x15, 30x10 and 30x5 cm. with any level of fertilizer.

F.I. Experiment:- In fertility-inoculum experiment on Gram at Delhi location there was effect due to N, P and the interaction of P and K are statistically significant. Positive effect was obtained with N, P and K. Yield of gram was increased with the application of 50 kg.N/ha. but yield is significantly reduced when it is increased to 100 kg/ha. There was no significant difference between 0 and 50 kg.N/ha. There was no effect of inoculation on yield of gram (Table 8).

Effect due to P application

There was no effect of application of P on gram yield (Table 9). Yield at 0 and 100 kg/ha. levels are same but at 50 kg/ha. it is significantly reduced.

Data in Table 10 show that in the absence of any, P increasing levels of K had a depressing effect on yield of chickpea. There appears to be some affect of P & K on yield at higher levels of these two nutrients (P 100 & K 100). Highest yield was obtained at P_0 & K_0 levels.

Table - 1

Location	Crops	Trial	Remarks.
DELHI	Gram (G-24)	FI*; SF**	
PANT NAGAR	Gram (G-24, T-730)	2FI; 2SF	not successful
	Peas (T-163)	FI; SF	
	Lentil (9-12)	FI; SF	not successful
HISSAR	Gram (G-24)	FI; SF	not successful
	Peas (T-163)	FI; SF	
LUDHIANA	Gram (G-24)	FI; SF	not successful
	Lentil (9-12)	FI; SF	

* Fertility inoculum — R.B.D Factorial

** Spacing Fertility — & Split plot design

Plot size = 4. x 3.6 M

Table - 2

Crop	Trial	Row to Row (Cm)	Plant to Plant (cm)
Gram	F.I	30	5
	S.F.	(30, 45, 60)	(5, 10, 15)
K. Gram	F.I.	45	10
Peas	S.F.	(30, 45, 60)	(10, 20, 30)
Lentil	F.I	30	5
	S.F.	(20, 30, 40)	(5, 10, 15)

Treatments	Treatments in kg/ha. of actual elements				
	N	0	50	100	Inoculum
	P_2O_5	0	50	100	
	K_2O	0	50	100	

Table - 3

Effect due to plant spacing with in row (sub treatment) on yield (kg/ha) of Peas at Hissar and Pant Nagar.

Rabi - 1967-68

Treatments (in cm.)	Location: Hissar	Pant Nagar
	Yield kg/ha.	
10	2957 a	1443 a
20	2748 b	1332 ab
30	2632 b	1121 b
	53 kg/ha.	50 kg/ha.
C.D. 5%	147	139

Table - 4

Interaction effect (main treatment and sub-treatment) on yield (kg/ha) at Hissar and Pant Nagar.

(Row spacing in cm. and fertilizer) N.P.K/ha. in kg.

	Hissar with row spacing			Pant Nagar with row spacing		
	10	20	30	10	20	30
$S_{30} F_0$	2624	2598	2207	1548	1479	1131
$S_{30} F_{50}$	2832	2515	2374	1583	861	1298
$S_{30} F_{100}$	2790	2748	2390	1180	1395	1402
$S_{45} F_0$	2973	2857	3023	1250	1430	1277
$S_{45} F_{50}$	3323	2424	2582	1840	1263	1284
$S_{45} F_{100}$	2840	2515	2840	1493	1347	937
$S_{60} F_0$	3248	3432	2807	1458	1268	1388
$S_{60} F_{50}$	3123	2707	2673	1354	1381	1076
$S_{60} F_{100}$	2915	2949	3015	1319	1590	1208
S.Em.±		160 kg/ha.			150 kg/ha.	
C.D. 5%		444 kg/ha.			417 kg/ha.	

Table - 5

Effect of different row spacing and fertility levels (main treatments) on yield (kg/ha) of lentils.

Treatments

Row Spacing in cm. & fertilizer in kg/ha. (N,P,K)	Yield (kg/ha)
$S_{20}F_0$	165 d
$S_{20}F_{50}$	300 b
$S_{20}F_{100}$	316 b
$S_{30}F_0$	206 cd
$S_{30}F_{50}$	323 d
$S_{30}F_{100}$	383 a
$S_{40}F_0$	100
$S_{40}F_{50}$	249 c
$S_4 F_{100}$	236 c

S.Em. ± 16 kg/ha.

C.D 5% = 47

Table - 6

Effect of P on Lentil

Levels of P in kg/ha.	Yield in kg/ha.
0	287
50	419 a
100	429 a

S.Em. ± = 26 kg/ha.

C.D. = 71

Table - 7

Effect of N & P interaction on Lentil

Levels P in kg/ha	Levels of N kg/ha.			inoculum
	0	50	100	
0	356	227	303	265
50	560	409	409	303
100	333	334	418	342

S.Em. ± - 51 kg/ha.

C.D.5% - 72

Table - 8

Effect of N on Yield of gram

Levels of N kg/ha.	Yield in kg/ha.
0	1437 a
50	1447 a
100	1240 b
Inoculation	1364 ab
S.Em. ±	56 (kg/ha.)
C.D. 5%	158

Table - 9

Effect of P on Gram

Levels P (kg/ha)	Yield kg/ha.	
0	1510	a
50	1240	
100	1385	a

S.Em. ± - 49

C.D. 5% - 137

Table - 10

Effect of P x K interaction on yield of gram

Levels of P kg/ha.	K (Kg/ha)		
	0	50	100
0	1677	1250	1375
50	1458	1385	1292
100	1396	1083	1479

S.Em. ± - 85 kg/ha.

C.D. 5% - 238

A REPORT ON A WEED CONTROL TRIAL

A. Narayanan
RPIP/USAID, New Delhi

Chemical weed control in various pulses needs a careful screening and testing of the available herbicides in the market. With this objective in view, a trial was conducted in kharif 1968 at the I.A.R.I. farm.

Three cops - Mung (J-781), Cowpea (Black eye-7) and Arhar (T-21) were planted on August 1, 1968. Twenty treatments consisting of 8 herbicides at different doses and combinations were duplicated for each crop.

The first observation on crop injury was taken ten days after planting. The results are presented as percentage over control in Table - 1.

In Mung, Eptam, Tok and Treflan plus Eptam caused severe injury. Although knoxweed did not show a specific injury, it delayed emergence of seedlings which were small in stature as compared to control. No injury was noticed with other herbicides.

In Cowpea, severe injury was caused by Tok, Knoxweed and Treflan plus Eptam. Slight to moderate injury was noticed in the case of other herbicide treatments.

In Arhar, high doses of Amiben, Eptam, Tok and Treflan plus Eptam induced severe injury. Even at low dose, Knoxweed was very noxious to seedlings.

In general, Knoxweed, Eptam, Tok and a combination of Treflan and Eptam were much injurious to all the three crops tested. However, the injury caused by Eptam and Treflan plus Eptam was much injurious to all the three crops tested. However, the injury caused by Eptam and Treflan plus Eptam was transcent as the seedlings grew whereas the knoxweed and Tok - caused injury was persistent.

Weed control rating was taken 45 days after planting and herbicide spray. The results are presented as percentage over control in Table - 2.

Amiben (6 lb./ac.), Eptam (2 & 6 lb./ac.), Treflan (1 lb./ac.), Tok (2 & 6 lb./ac.) Knoxweed (2 & 6 lb./ac) and Treflan plus Eptam controlled the weed more effectively than other herbicides tested.

Since the problem of nutgrass was a major one during the kharif season it was thought desirable to observe how much each herbicide can control nutgrass, monocots other than nutgrass and dicot weeds. The count was taken per unit area and the results are presented as percentage over control.

It is evident from Table 3 that an effective control of nutgrass was obtained with the application of Eptam (6 lb./ac.) and a combination with Treflan. But these two treatments failed to control the monocot weeds other than nutgrass. However, Tok brought down the monocot weeds to a considerable extent. Tok (2 & 6 lb./ac.), Treflan (1 lb./ac) and its combination with Eptam (6 lb./ac.) could control dicot weeds more efficiently.

The four major common weeds in the control plots were Cyperus rotundus (monocot); Eleocharis atropurpurea (monocot); Trianthema portulacastrum (dicot); Digera arvensis (dicot);

The presence of more nutgrass in Tok, Treflan and Amiben plots shows that these herbicides are not effective in controlling this particular weed. Here again Treflan plus Eptam combination, Eptam, Randox and Knoxweed showed a good control over nutgrass.

A large number of Eleocharis atropurpurea was found in Treflan and Eptam plots. This weed infestation was much less in other plots of Knoxweed, Eptam, Treflan and Amiben.

The plots of Randox and Eptam had a good amount of Digera arvensis as compared to Knoxweed, Vernam and Treflan plus Eptam plots.

A good number of Trianthema portulacastrum was present in Eptam, Treflan, Tok, Vernam, Tillam and Treflan plus Eptam plots.

In general, Eptam, Treflan plus Eptam treatments controlled nutgrass more effectively but they could not control Eleocaris atropurpurea, which is a very small monocot weed compared to the crop plants - mung, cowpea and arhar. The effectiveness of various herbicides to Trianthema and Digera were not very much clear from our data.

The yield of these crops were not recorded because of the crop failure due to i. disease, ii. inclement of weather and iii. unknown factors.

However, the present study could throw us some interesting results from which we could select certain herbicides like Eptam, a combination of Treflan and Eptam and low doses of Tok and Knoxweed. These will be tried in kharif 1969.

HERBICIDAL TRIAL: Table - 1 August 9, 1968

CROP INJURY RATING

	Moong	Cowpea	Arhar
A1	0	2.0	1.5
A2	2.5	3.5	5.0
E1	4.0	2.0	1.5
E2	6.5	4.0	8.0
Tr1	0	0	0
Tr2	0	2.0	1.0
R1	0	2.5	0
R2	0	0	0
TOK1	4	3.5	2.5
TOK2	9	9.0	9.0
Tr1+E1	1.5	2.5	2.5
Tr2+E2	4.0	7.5	6.5
V1	0	2.5	0
V2	0	0	1
K1	No injury,Delayed	8.5	8.5
K2	Germination,Small plants	10.0	10.0
Ti1	0	2.0	1
Ti2	0	3.0	1
Hand weeding	0	0	0
No weeding	0	0	0

0 - No injury
1-3 - Slight
4-6 - Moderate
7-9 - Severe
10 - Death

September 11, 1968

Table -2

0 - 0% weed control
10 - 100% weed control

Treatment	R 1	R 2	R 3	R 4	R 5	R 6	Total	% over control
A_1	6	3	3	4	1	3	20	6.7
A_2	6	5	3	8	4	5	31	4.9
E_1	6	7	7	1	1	5	27	5.5
E_2	8	3	7	8	1	3	30	5.0
Tr_1	6	4	1	0	0	5	16	7.3
Tr_2	8	9	8	7	6	1	39	3.5
R_1	2	3	7	6	0	0	18	7.0
R_2	1	5	6	0	0	0	12	8.0
Tok_1	9	7	9	3	3	5	36	4.0
Tok_2	10	9	7	8	9	9	52	1.2
$Tr_1 + E_1$	2	9	8	9	1	2	31	4.9
$Tr_2 + E_2$	9	8	9	9	8	1	44	2.7
V_1	0	1	0	7	0	0	8	8.7
V_2	2	4	0	1	1	0	8	8.7
K_1	5	6	6	3	0	3	23	6.2
K_2	4	6	6	8	5	2	31	4.9
Ti_1	4	5	1	2	0	3	15	7.5
Ti_2	5	2	4	4	0	0	15	7.5
H W	10	10	10	10	10	10	60	0
Control	0	0	0	0	0	0	0	100
Total:	103	106	102	98	50	57 =	516	

Table - 3

MEAN NUMBER OF WEEDS PER 4 Sq. Feet

	Nutgrass	% over control	Other monocot	% over control	Broad leave	% over control	Total weeds
A1	25	104	43	94	10	63	78
A2	21	87.5	48	104	9	56	78
E1	18	75.0	36	78	11	68	65
E2	11	45.8	41	89	11	68	63
Tr1	31	129.2	53	115	12	75	96
Tr2	25	104	44	96	4	25	73
R1	27	112.5	44	96	14	88	85
R2	13	54.2	47	102	13	81	73
Tok1	25	104	20	44	8	50	53
Tok2	24	100	4	87	3	19	31
$Tr_1 + E_1$	15	62.5	55	119.5	8	50	79
$Tr_2 + E_2$	12	50.0	58	126	7	44	77
V_1	18	75	42	91	16	100	76
V_2	18	75	39	85	15	94	72
K_1	19	79	47	102	13	81	79
K_2	17	71	48	104	11	68	76
Ti_1	18	75	33	72	16	100	67
Ti_2	21	87.5	48	104	17	106	86
H W	15	0	47	0	12	0	83
Control	24	100	46	100	16	100	77
Total	398		843		226		1467

SOIL AND FOLIAR APPLICATION OF PHOSPHATE

Anand Prakash
USAID/RPIP, New Delhi

Two trials were conducted to study the response to soil and foliar application of phosphate in Moong (Pusa Baisaki) and Urd (T-65) during summer and kharif respectively 1968 at the I.A.R.I Farm (Main Block-2, Middle Block).

Treatment (kg/ha.)

Soil applications	Foliar application	Soil & Foliar application
50	25	25 + 25
75	50	37.5 + 37.5
100	-	50 + 50

Gross plot size of 3.0 M x 1.8 M and simple R.B.D was used with four replications. 25 kg. N/ha. was applied as a basal dose and phosphorous was applied in the form of single superphosphate. The plantings were done on 16 May, 1968 and 1st August, 1968.

In Moong (Table 1) it was found that application of 75 kg. P/ha. half through soil and the half through foliage gave highest yield of 803.41 kg./ha. as compared to 623.85 kg./ha. in control. However, the difference was not found to be statistically significant. The probable reasons for not getting a good response may be:

i. Initial fertility status.

(Summer Av.P. 35 lb./acre)
(Kharif Av.P. 38 lb./acre)

ii. Coating of insoluble salts in the foliage.

In Urd (Table 2) soil application of 75 kg.P/ha. gave maximum yield of 869.02 kg/ha. as compared to 835.96 kg/ha. in control. Treatment differences was significant.

In summer crop (Pusa Baisaki) we got maximum yield with 75kg.P/ha. (1/2 soil + 1/2 foliage), but in kharif with the same treatment combination, in urd, we got same yield as in the summer. Phosphate alone (foliar) did not give good response in moong and urd. But when 75 kg. P/ha. was applied through soil and foliage, the yield of both moong and urd was satisfactorily higher than control.

Table -1

RESPONSE OF MOONG (PUSA BAISAKHI) TO VARYING LEVELS OF PHOSPHATE

Treatments	Yield kg/ha.
Control	623.85
25 F	688.44
50 F	724.25
50 S	762.58
75 S	663.22
100 S	718.01
25 F + 25 S	674.47
37.5F + 37.5 S	803.41
50 F + 50 S	721.75

Table - 2

RESPONSE OF URD (T-65) TO VARYING LEVELS OF PHOSPHATE

Treatments	Yields kg/ha.
Control	835.96
25 F	357.91
50 F	642.03
50 S	697.57
75 S	869.02
100 S	541.03
25 F + 25 S	805.96
37.5 F + 37.5 S	831.03
50 F + 50 S	740.50
C.D. at 5%	279.78 kg/ha.

RESULTS OF CO-ORDINATED AGRONOMIC TRIALS - SPRING & KHARIF, 1968

C.S.Saraf
RPIP/USAID, New Delhi

1. Response of three varieties of moong (Phaseolus aureus) to different row and plant spacings and fertility levels.

An experiment was conducted during the summer season of 1968 on mung beans (Phaseolus aureus) to study the response of three varieties to different row and plant spacings and fertility levels at Delhi, Hissar, Kanpur and Pant Nagar. The varieties included were Type-1, Jalgaon 781 and Pusa Baisakhi. The row spacings were 20 cm. and 30 cm. Plant to Plant spacings were maintained at 2.5 cm., 5.0 cm. and 7.5 cm. Fertility levels were no nitrogen and no phosphate, 50 kg. N per hectare and 50 kg. P_2O_5/ha., 100kg. N/ha. + 100 kg. P_2O_5/ha. and inoculum + 100 kg. P_2O_5 per hectare. A split plot design was used with varieties and row spacings in main plots and plant spacings and fertility levels in sub plots. Plot size used was 3.0 M x 1.8 M with three replicates.

The trials at Pantnagar, Hissar and Kanpur did not come up well, because these crops did not get irrigation water in the hot summer. Crop at Delhi, however, was successful partially.

The crop was sown on May 16, 1968. The crop progressed satisfactorily in the beginning, but at a later stage, variety Jalgaon 781 was affected by virus and Type-1 did not yield anything.

Data in Pusa Baisakhi was collected in four pickings and was analysed as split plot design and is considered in the following pages.

Table - 1

Effect of different row and plant spacings and fertility levels on yield (kg/ha.) of moong beans (Phaseolus aureus)

Delhi - Spring, 1968

Sub-treatment (Fertility in kg/ha. and plant spacing in cm.)	Yield (kg/ha.) Row spacing 20 cm.	30 cm.
F_0 $S_{2.5}$	950	664
F_0 $S_{5.0}$	955	646
F_0 $S_{7.5}$	874	526
F_{50} $N_{50}P$ $S_{2.5}$	855	409
F_{50} $N_{50}P$ $S_{5.0}$	806	376
F_{50} $N_{50}P$ $S_{7.5}$	645	679
$F_{100}N_{100}$ $PS_{2.5}$	874	551
$F_{100}N_{100}$ $PS_{5.0}$	751	553
$F_{100}N_{100}$ $PS_{7.5}$	598	377

Data indicate that the yield of moong beans (var. - Pusa Baisakhi) in 20 cm. row spacing varied from 598 kg. per hectare to 955 kg. per hectare in different treatments. In 30 cm. row spacing, the yield ranged from 376 kg. per hectare to 679 kg. per hectare. The results are not statistically significant.

Kharif, 1968 -

During kharif season of 1968, the soil and crop management discipline designed experiments concerning fertilization, row and plant spacing and rhizobial inoculation. The trials were conducted at Delhi, Hissar, Kanpur, Ludhiana and Pant Nagar. I shall be discussing with you only the results of fertility-inoculum and fertility-spacing trials with particular reference to moong beans (Phaseolus aureus) and urd beans - (Phaseolus mungo). Only the highlights of the results are presented here.

A. Fertility Spacing Trials:

Fertilization spacing experiment on mung beans (Phaseolus aureus) and urd beans (Phaseolus mungo) was planted at Delhi, Hissar, Ludhiana and Pant Nagar. At Delhi and Hissar, short term varieties were tried. While at Ludhiana and Pant Nagar, trials were conducted using long term varieties and moong beans and urd beans.

The experiment for short term varieties consisted of three row spacings (15, 25 and 35 cm.) and three plant spacings within row (2.5, 5 and 7.5 cm.) (three fertility levels N,P and K at the rate of 0, 50 and 100 kg/ha. each of actual element). A split plot design was used with fertility levels as main plot treatments and row and plant spacing as sub-plot treatments. All the treatments were replicated four times. In long term varieties, the row spacings were 30, 45 and 60 cm. while within row spacing was maintained at 5, 10 and 15 cm. All other treatments and design was same as that of short term varieties.

At Hissar, J-781 moong beans was tried and urd (var. T-9) was tested. At Pant Nagar, T-6009 moong late was tried and at Ludhiana No. 54 moong late and No. 64 and 1-1 urd late were tried.

Data in Table - 2 show that within row spacing of 2.5 cm. has yielded only 834 and 623 in 15 cm. and 25 cm. spacing compared to yields in $S_{15}P_5$, $S_{15}P_{7.5}$ and $S_{25}P_5$ (1009, 1179 and 1053 kg/ha) respectively. Because of high population in 2.5 cm. spacing, the competition increases and, therefore, yields are low in this treatment.

Data in Table - 3 reveal that with high fertility and low population (2-2-0) the yield is 1200 kg/ha compared to low fertility and high population (000) 857 kg/ha. The reason is self-explanatory. Secondly, with high fertility and high population (0-2-0) urd beans yielded 1026 kg/ha. The main reason for this significantly higher yield is that the initial status of the experimental field was very high.

Data in Table - 4 show that the interaction effect of N and K are statistically significant. Response to 100 kg/ha. of potash was significantly superior to other treatments.

Table - 2

Effects due to Between row and within row spacings on the yield of Urd (Phaseolus mungo) at Hissar, Kharif - 1968.

Treatments (cm)	Yield of Urd Beans(kg/ha)	
S_{15} $P_{2.5}$	834	a
S_{15} P_5	1009	ab
S_{15} $P_{7.5}$	1179	ab
S_{25} $P_{2.5}$	623	
S_{25} P_5	1053	ab
S_{25} $P_{7.5}$	972	ab
S_{35} $P_{2.5}$	935	ab
S_{35} P_5	845	b
S_{35} $P_{7.5}$	1099	ab
C.D. 5%	318	

Table - 3

Effects due to different fertility levels (Main Treatments) and row and plant spacings (sub-treatments) on the yield of urd beans (Phaseolus mungo) at Hissar, Kharif - 1968.

Yield in kg/ha.

Row & Plant Spacing (cm.)	Fertility Levels (kg/ha.) each of N, P205 & K20 of actual element		
	0	50	100
S_{15} $P_{2.5}$	857	620	1026
S_{15} P_5	679	1072	1275
S_{15} $P_{7.5}$	579	1379	1579
S_{25} $P_{2.5}$	662	558	646
S_{25} P_5	873	1320	966
S_{25} $P_{7.5}$	906	948	1062
S_{35} $P_{2.5}$	863	743	1200
S_{35} P_5	1002	632	901
S_{35} $P_{7.5}$	1633	637	1027
C.D. 5%		551 kg/ha.	

Table - 4

Interaction effect due to different levels of N and K_2O on the yield (kg/ha) of Urd beans (Phaseolus mungo) at Hissar, Kharif - 1968.

Levels of K_2O (kg/ha)	Levels of N (kg/ha)			
	N_o	N_{50}	N_{100}	NI
K_0	902	898	979	773
K_{50}	748	929	666	875
K_{100}	1193	937	736	752

S.Em ± 54 kg/ha.

C.D. 5% 148 kg/ha.

At Ludhiana, in urd late (var. No. 64), the interaction effect in F-I trial is significant. Treatment 2-0-1 yielded highest (638 kg/ha) as against 260 kg/ha, in 2-0-0 in this trial.

Besides these trials, a fungicide - nematicide trial was planned and conducted at Ludhiana to determine the cause of crop failure in 1967 in Pulse Block. The experiment consisted of following soil treatments -

PCNB (Brassicol) @ 20 kg/ha. (Fungicide)
Nemagon @ 7.5 gal/ha. (Nematicide)

PCNB+NEH
Methyl - Bromide - Soil sterilant @ 1 lb/100 sq.ft. and control.

This was applied 2 weeks before planting (June 19, 1968). Since Methyl Bromide needs complete seal, we used plastic sheets (10'x50'). Applicators were used for Methyl Bromide treatment.

These soil treatment plots were further divided into two sub plots each No fertilizer and 100 kg/ha. each of N,P and K. These sub plots were further sub divided into four plots to test the effect of the following treatments -

Control,

Irrigation - Irrigate weekly or often if need be to keep all of the root zone at or near field capacity.

Minor elements - Commercial minor element mixture Nuthomin 6 containing Mn, Fe, Cu, Zn, B, & Mo was used.

F.Y.M. - Enough was put

None of the effects were significantly different.

Methyl Bromide treatment yielded 763 kg/ha. of urd beans, even though it had some injurious effect on plants in the beginning, The control treatment has hoever, yielded 673 kg/ha. Brassical treatment had depressed the yield (486 kg/ha).

.....

Effect of ridge planting and inter-plant spacing on the performance of Arhar, Urd and Moong

B.M. Sharma and S.L. Chowdhury & P.C. Bhatia

Past experi[illegible] in the Project has shown that kharif crops suffer heavily due to wet con[illegible]ons which often coincide with the early growth of these crops. It was, therefore, considered desirable that these crops should be planted on ridges, as this practice makes for a better rooting medium for the young seedlings to a considerable extent.

The experiment consisted of three methods of sowing - ridge planting, flat planting and flat planting followed by subsequent ridging along with three inter-plant spacings, i.e. 5, 10 and 15 cm. for urd and moong and 20, 30 and 40 cm. for arhar. The crops were fertilized with 30 kg. nitrogen and 75 kg. P_2O_5 per hectare at the time of sowing. Arhar, variety T 21 was sown on 11th July and rows were spaced at 75 cm. apart. While urd (T-27) and moong (T-1) were sown on 12th July, 1968 with an inter-row spacing of 30 cm.

Results:

1. Method of Sowing:

It is seen from Table 1 that the highest grain yield of 27.12 q./ha. of arhar was obtained from the crop planted on ridges. This was significantly more in comparison to either flat planting or subsequent ridging. The increase due to ridging was of the order of 6 and 9 quintals per hectare respectively. Grain yields of urd and moong were also increased significantly when the sowing was done on ridges than by the other two methods. Ridge planting increased yield by about 4.2 and 2 quintals per hectare of urd and moong respectively in comparison to flat planting. It seems that these crops having a short growth period had no time to regain vigour and hence suffered more.

Table 1.

Effect of method of sowing on grain yield of Arhar, Urd and Moong.

Treatments	Yield in Q/ha.		
	Arhar	Urd	Moong
Ridge planting	27.12	11.82	5.29
Flat planting	21.11	7.49	3.33
Flat planting followed by subsequent ridging	18.22	7.67	3.23
S.Em ±	1.53	0.52	0.60
L.S.D 5%	4.57	1.57	1.81

2. Inter-plant spacings

Table 2.

Effect of inter-plant spacings on grain yield of Arhar, Urd and Moong

Treatments	Grain yield q/ha.		
	Arhar	Urd	Moong
S_1	26.23	10.12	4.58
S_2	18.67	8.54	3.85
S_3	21.58	8.34	3.43
S.Em. ±	1.53	0.52	0.60
L.S.D.5%	4.57	N.S.	N.S.

It may be observed from Table 2 that reduction in the inter-plant spacing generally tended to give higher yields. In case of arhar, this increase in yield was substantial amounting to 7.5 and 4.6 q/ha. when the spacing was reduced to 20 cm. from 30 and 40 cm. respectively.

Conclusion:

The experiment has shown that in areas where the kharif pulse crops are subject to initial temporary waterlogging, their yields could be considerably enhanced by planting on ridges. It has also been observed that a closer inter-plant spacing than that usually practised gives higher yield of kharif pulse crops like arhar, urd and moong.

-oOo-

SUMMARISATION OF AGRONOMIC RESEARCH WORK ON PULSE CROPS DURING 1967-68

S.L. CHOWDHURY
All India Coordinated Pulse Project, Delhi Centre

You have already heard a detailed account of the investigations on the various agronomic aspects of pulse crops undertaken during the year by the centre team. They planned and initiated many trials on Bengal gram lentils, pea, mung, urad and pigeon pea. There were failures and successes. If failures have been more numerous than successes, not all failures were inevitable. Within the overall considerations of agricultural research and the constraints imposed by these considerations the land allotted to the Pulse Project happened to be such that in the kharif season we started work with a belief to fail. This area at the Institute Middle Block B & C, gets waterlogged for the complete month of August and longer. We lost our crops here last year. The fears came true this year as well. It is here that last season we lost all our agronomic trials on pigeon pea, mung and urad. These were extremely important trials designed to yield the most-needed information on the optimal levels of population and fertility requirements of the available improved varieties of kharif pulses. May be, and hopefully, a suitable land area will be made available for the work in the coming season. Some setbacks to work are inevitable like the one at Pant Nagar where our good crop of pigeon pea suffered heavily due to an early - October storm. Likewise this crop at Hyderabad was practically lost to drought and a simultaneous closure of the irrigation canal.

Undismayed by these setbacks, we are working hard, seeking and learning. And in this process we were blessed with some achievements. For instance, we have found:

1. that in gram, mung, urad and pigeon pea closer row plantings yield higher than the usual spacings irrespective of the fertility status of the soil.

2. that under temporary waterlogging conditions of soil, mung, urad and pigeon pea fair much better if planted on ridges than the usual method of sowing these crops. The increases in yield may range from 25 to 60 per cent.

3. that pigeon pea, on soils of low fertility, responds admirably to applications of both farmyard manure and phosphatic fertilizer. Even the highest levels used gave highly profitable returns. This crop appears to have a very high yield potential. Variety T_{21} of this crop yield 51 quintals of grain per hectare last year at Pant Nagar with needed adjustments in planting rates and inter-row spacings. This is higher than any yield reported so far.

4. that with similar adjustments in planting rates and fertiliser application, the pea crop could yield as high as 43.6 quintals/hectare as it did in the season under report at Hissar.

5. that very soon we may be in a position to recommend a chemical for weed control in pulse crops. The results of trials have been very encouraging.

6. that summer mung wh[illegible]nted in early April yields twice as much as it does when plant[illegible] early May (Pant Nagar experiment). Some irrigated land from sugarcane, vegetables, peas, fodders, etc. is always available for this early planting.

It is however, clearly understood that the results will not be immediately usable for direct and universal application all over the country since local factors of crop production vary widely. It is, therefore, imperative that the trials be conducted on more locations than at present. At present our work is confined to only Delhi, Hissar, Ludhiana, Pant-Nagar, Kanpur and Hyderabad. The Eastern, Western, Central and Coastal regions are still not participating. We propose to finalise plans of work and send these out to all willing to participate. It will be helpful if a restricted gathering of agronomists and others willing to cooperate in the agronomic research work could be arranged some time early March next.

I also wish to avail this opportunity to express our gratitude to all our friends at Hissar, Ludhiana, Pant Nagar, Kanpur, and Hyderabad whose cooperation we had in full measure.

-oOo-

WORK ON RABI PULSES IN PANTNAGAR IN 1967-68

M.C. Saxena
U.P. Agricultural University
Pantnagar

Lentil:

I. Comparative performance of some varieties of lentil for grain production.

The yield performances of 10 varieties of lentil (B.77, C. 31 T-8, B-25, N.P-11, B-62, N.P-47, T-36, L.9-12 and T-3) were evaluated through this experiment. The experiment was planted on 27th October, 1967 in rows 30 cm. apart and with plant spacing of 5 cm. A basal dressing of fertilizer was applied at the rate of 38.72 kg. N and 80 kg. P_2O_5 per hectare or diammonium phosphate. The experiment was laid out in a randomised block design and data on flowering behaviour, height of plants and grain yield were recorded. Data regarding height and lateral spread of plants, yield and test weight are presented in Table 1.

Table -1. Varietal effect on the performance of lentil

Varieties	Height of plants at full flowering stage(cm)	Lateral spread at full flowering stage(cm)	Yield per plant gm.	1000-grain weight gm.	Yield q/ha.
1. B-77	22.16	25.00	4.2	16.4	22.15
2. C-31	23.68	21.16	3.3	18.4	21.40
3. T-8	26.16	15.83	2.6	25.4	12.68
4. B-25	21.00	23.50	5.6	17.2	26.70
5. N.P-11	12.00	13.83	3.2	16.2	16.47
6. B-62	18.00	24.66	5.5	16.2	21.40
7. N.P-47	20.68	26.66	3.3	16.4	22.53
8. T-36	18.83	20.66	3.5	17.8	25.94
9. L.9-12	14.50	18.16	3.3	17.8	30.68
10. T-3	25.50	19.83	4.3	22.8	14.77
'F' test					Significant
S.Em.					± 1.39
C.D. at 5%					4.128

The data presented in above Table clearly indicate that maximum height of plants was recorded with variety T-8 and the minimum with variety N.P-11. Variety N.P-47 was found to be more spreading type closely followed by variety B-77.

As regards the grain yield, variety B-25 produced the highest yield per plant, while T-8 produced the lowest. Variety L 9-12 produced significantly higher grain yield (30.68 q/ha) than all other varieties. Minimum grain yield of 12.68 q/ha was recorded with variety T-8. Varieties B-77, C-31, B-62 and N.P.-47 were found to be at par as regard their yield performance. The maximum test weight was recorded with Variety -8 and the minimum with variety N.P.-11.

II. Effect of fertility levels, row and plant spacing on the yield of lentil (Var. L.9-12)

This experiment was conducted to determine the optimum fertility level and to work out the best row and plant spacing under different fertility conditions. The treatments consisted of nine combinations of three row spacing (20, 30 and 40 cm) and three fertility levels.

F_0 = N_0 fertilizer.
F_1 = 50 kg. N + 50 kg. P_2O_5 + 50 kg. K_2O/ha.
F_2 = 100 kg. N + 100 kg. P_2O_5 + 100 kg. K_2O/ha.

The crop was planted on 15th October, 1967 and took about 175 days for its maturity. The experiment was laid out in a Split plot Design taking the combinations of fertility levels and row spacings as mai plot treatments and plant spacing as sub plot treatments. The main effects of various treatments are presented in Table - 2.

Data presented in the following Table clearly indicate that almost grain yield of lentil was recorded under all fertility lev Different row spacings also did not have any differential grain yield of lentil. Closer plant population tended to grain yield. Highest yield of 18.55 quintal per hectare w in plots with a plant spacing 5 cm., while the lowest was with plant spacing of 15 cm.

Table - 2. Effect of fertility level, row and plant spacings on the grain yield q/ha. of lentil (Var. L.9-12).

Row Spacing cm.	Plant spacing cm.	F_0 N,P_2O_5,K_2O kg/ha 0 - 0 - 0	F_1 N,P_2O_5,K_2O kg/ha 50-50-50	F_2 N,P_2O_5,K_2O kg/ha 100-100-100	Row spacing effect	Plant spacing effect Spacing cm.	Yield
20	5	22.30	18.73	23.19			
	10	11.77	22.47	14.27	17.34	5	18.55
	15	14.71	14.09	14.53			
30	5	18.82	16.14	16.05			
	10	16.94	2.42	20.51	16.88	10	17.11
	15	14.71	11.86	16.50			
40	5	19.44	16.68	15.61			
	10	19.35	16.32	11.95	17.95	15	16.51
	15	21.22	21.40	19.62			
		17.69	17.56	16.91			

III. Effect of different levels N,P,K and inoculum on the grain yield of lentil (Var. L.9-12).

The experiment was conducted to work out the optimum combination of N, phosphorus and potassium levels of fertilization and to study the effectiveness of Rhizobium inoculum for lentil. All the 36 combinations of three levels of nitrogen (0, 50, 100 kg N/ha) and inoculation with Rhizobium culture, three levels of phosphoric acid (0, 50, 100 kg P_2O_5/ha) and three levels of potash (0, 50, 100 kg K_2O/ha) were tested in randomised block design with 4 replications. The experimental crop was planted on 14th October, 1967 and took about 175 days for its maturity. The data regarding the effect of different treatments on grain yield of lentil are presented in Table 3.

The following Table clearly indicates that the increasing levels of N from 0 to 100 kg per hectare resulted in the reduction of grain yield. Seed treatment with rhizobium culture also failed to have any beneficial effect on the grain yield of lentil. Almost equal grain yield was recorded with different levels of phosphoric acid tried. A reduction in grain yield was also recorded with the increased levels of K_2O from 0 to 100 kg. per hectare.

Table III. Effect of different levels of N,P,K and inoculum on the grain yield q/ha. of lentil (L.9-12)

P_2O_5 levels	K_2O levels	N levels N_0	N_{50}	N_{100}	INOCULUM	Effects	K effects levels	K effects Yield
P_0	K_0	20.46	22.65	16.37	22.84	20.65	K_0	21.24
	K_{50}	22.94	17.04	19.89	26.08			
	K_{100}	22.61	21.42	14.94	20.65			
P_{50}	K_0	21.89	17.32	21.61	20.56	20.72	K_{50}	20.71
	K_{50}	25.89	23.32	18.57	21.32			
	K_{100}	18.65	21.99	20.37	17.23			
P_{100}	K_0	21.51	28.46	17.70	23.51	20.15	K_{100}	19.57
	K_{50}	19.13	17.99	17.51	18.94			
	K_{100}	20.27	18.27	18.94	19.61			
Average		21.48	20.94	18.43	21.19			

PEAS

I. Comparative performance of some varieties of vegetable pea

Yield performances of nine pea varieties (NLP., P.326 P. Kaip, Boneville, Bridger, Early December, T-19, T-56 and T-61) were evaluated in this experiment. The crop was planted on 21st October, 1967, in rows 45 cm. apart with plant spacing of 10 cm. The fertilizer mixture was placed in side bands @ 30 kg. N. 80 kg. P_2O_5 and 40 kg. K_2Oper hectare. The experiment was laid out in a randomised block design and the data regarding flowering behaviour, height of plants and yield of green pods were recorded. The data on yield of green pods are presented in Table 1.

Table - 1: Varietal effect on the production of green pods of peas.

Varieties	Days taken to 1 picking	Yield in I picking	Yield in II picking kg/plot	Yield in III picking kg/plot.	Yield in IV picking kg/plot	Yield in V picking kg/plot	Total yield q/ha.
NLP	91	1.49	2.45	3.33	1.57	0.37	97.66
P. 326	91	2.02	2.60	2.75	1.25	-	91.35
P. Kaip	101	1.75	2.08	1.86	0.54	-	66.12
Bonnevilla	91	1.17	1.98	2.19	0.85	-	65.71
Bridger	86	1.42	3.06	1.05	-	-	58.12
Early December	77	1.77	2.55	1.10	1.59	-	69.12
T-19	118	2.62	4.32	2.25	-	-	97.41
T-56	101	2.24	4.20	4.04	1.35	-	125.34
T-61	128	7.75	3.58	-	-	-	123.20
F test	-	-	-	-	-	-	Significant
S.Em.	-	-	-	-	-	-	± 6.97
C.D.at 5%	-	-	-	-	-	-	19.46

The above table clearly indicates that the highest yield of green pods was recorded with variety T-56 closely followed by T-61 and the lowest yield was recorded by bridger. Varieties N.L.P. and T-1, P.Kaip and Bonneville were found to be at par as regards their yield potentiality. Variety T-56, T-61, N.L.P, T-19 and D-326 yielded significantly higher than the varieties P.Kaip and Early December.

As regards the days taken to first picking, it would be clear from the Table that variety Early December took least number of days (77 days) and T-61 took the maximum (128 days) for their first picking. Varieties N.L.P P.326, P.Kaip, Bonneville and bridger were found to be the medium type in respect of the number of days taken to maturity.

II. Effect of molybdenum treatments on the performance of peas for pods .

This experiment was conducted to determine the effect of molybdenum application on growth and yield of Peas (P.326) taken for green pods. The crop was planted on 29th Octo., 1967 in rows 40 cm. apart with a plant spacing of 10 cm. A basal dressing of fertilizer was done at the rate of 30 kg. N, 80 kg. P_2O_5 and 40 kg. K_2O per hectare. Two extra plots i.e. absolute control and $N_{30}P_{80}$ treatments were also included in each replication. Different rates of molybdenum over the basal dressing of N,P,K were tried for seed treatment and foliar spray. The experiment was conducted in a randomised block design. The data regarding flowering behavior, height of plants at different stages of growth and yield of green pods were recorded. The yield of green pods as affected by various treatments in presented in Table 2. The statistical analysis of the data revealed that the yield of green pods was not significantly affected by various treatments.

Table 2: Effect of molybdenum treatments on the performance of Pea (P-326) for pods

Treatments	Yield of green pods q/ha.
Absolute control	84.01
$N_{30}P_{80}$	63.21
$N_{30}P_{80}K_{40}$	82.58
N.P.K. + 0.025 kg. MO seed treatment	76.69
N.P.K. + 0.050 kg. MO " "	83.03
N.P.K. + 0.10 kg. MO " "	72.05
N.P.K. + 0.20 kg. MO " "	75.80
N.P.K. + 0.05 kg. MO foliar spray at flower initiation.	76.42
F test	Not significant
S.Em.	± 9.27
C.V.	24.24%

In view of a very high magnitude of coefficient of variation and absence of any definite trend in the response of crop to various treatments, not much validity could be given to the results of this experiment.

III. Performance of three varieties of Pea for grain production:

Yield performance of 3 pea varieties (T-163, T-6113 and T-197) were tested in this experiment. The crop was planted on 21st October, 1967 in rows 45 cm. apart with plant spacing of 10 cm. The fertilizer mixture was placed in side bands @ 30 kg. N + 80 kg. P_2O_5 + 40 kg. K_2O/ha. The experiment was laid out in randomised block design and data on height of plants, flowering behaviour and grain yield were recorded. The date on the grain yield are presented in Table 3.

Table 3: Grain yield of three pea varieties

Varieties	Grain yield q/ha.
T-163	14.49
T-6113	8.80
T-197	11.11
F test	Not significant
S.Em.	± 0.21

The above table clearly indicates that highest grain yield was recorded with variety T-163 and variety T-6113 produced the minimum, differences were not statistically significant.

IV. Effect of rates of N,P,K fertilization and inoculation with Rhizobium culture on the grain yield of peas.

This experiment was conducted to find out the optimum combination of nitrogen, phosphorus and potash fertilization and to study the effectiveness of Rhizobium inoculum for peas. All the 36 combination of three levels of nitrogen (0, 50 and 100 kg. per hectare) and inoculation of seed with Rhizobium), three levels of phosphoric acid (0, 50, 100 kg P_2O_5/ha.) and three levels of K_2O (0,50,100 kg/ha) were tested in Randomised block design with 4 replications. The experimental crop was planted on 13th October, 1967 and took about 150 days for its maturity. The results of statistical analysis of data revealed that all the main effects and interactions were non-significant. The main effects of different treatments are presented in Table 4.

Table 4: Effect of different levels of N,P and K and inoculum on the grain yield of peas (T-163).

q/ha.

N levels kg/ha.	Grain yield	P_2O_5 levels kg/ha	Grain yield	K_2O levels kg/ha.	Grain yield
0	18.12	0	19.43	0	19.30
50	18.42	50	18.08	50	18.68
100	19.77	100	20.00	100	19.82
inoculum	20.30	-	-	-	-
F test	N.Sig.	-	N.Sig.	-	N.Sig.
S.Em.	± 2.97		± 2.53		± 2.53

Although grain yield of peas was not affected significantly by the levels of nitrogen tried, inoculation of seed with Rhizobium culture tended to push up the grain yield to some extent which was more pronounced than the effect of nitrogen fertilization. Increased levels of P_2O_5 and K_2O did not bring any significant increase in the grain yield of peas.

V. The Effect of different fertility levels and row and plant spacings on the grain yield of peas (T-163).

This experiment was conducted to determine the optimum fertility level and to work out the best plant population under different fertility condition. The treatments consisted of nine combinations of three row spacings (30, 45 and 60 cm) and three fertility levels: F_1 = No fertilizer; F_1 = 50 kg N+50 kg P_2O_5+ 50 kg K_2O/ha; F_2 = 100 kg N + 100 kg P_2O_5+100 kg K_2O/ha;

The experiment was laid out in a split plot design taking the combination of fertility levels and row spacings as the main plot treatments and plant spacings as sub-plot treatments. The experimental crop was planted on 14th October, 1967 and took about 150 days for its maturity. The main effects of various treatments are given in Table 5.

Table 5. Effect of different fertility levels, row and plant spacings on the grain yield of peas.

Fertility levels $N.P_2O_5$, K_2O (kg/ha)	Grain yield q/ha	row spacing cm.	Grain yd. q/ha	Plant spacing cm.	Grain yield q/ha
F_0 -0, 0, 0	20.88	30	17.22	10	22.18
F_1, 50, 50, 50	20.53	45	20.52	20	20.63
F_2, 100, 100, 100,	20.17	60	22.96	30	18.77
F test	N.Sig.		Sig.		N.Sig.
S. Em.	± 0.97		± 0.97		± 1.03
C.D. at 5%	-	-	2.83	-	-

The grain yield of peas was not affected significantly by soil fertility levels and different plant spacings. Increasing row spacing up to 60 cm. however, increased the grain yield to a considerable degree. The highest yield of 22.96 q/ha was recorded in plots with 60 cm. row spacing and the minimu, (17.22 q/ha) from the plots with 30 cm. row spacing. A closer plant spacing tended to increase grain yield of peas. Highest yield of 22.18 q/ha was recorded with 10 cm. spacing and the minimum with a plant spacing of 30 cm.

Thus it is evident from the results that wider row spacing and closer plant spacing led to increased grain yield of peas.

-oOo-

Report of the experiments on kharif pulses conducted during 1968 at Pantnagar

M.C. Saxena

U.P. Agricultural University, Pantnagar

Pulses have an important role to play in human nutrition for the majority of vegetarian people in our country as they are the major source of protein. From the point of view of simultaneous soil enrichment for the subsequent crop, pulses assume further a position of significance in all cropping patterns followed in our country. Tarai region poses special problems with respect to cultivation of pulse crops because of relatively excessive rains and high humidity in kharif season conductive to build up of large population of insect pests and disease. Further, the tract being especially good for production of cereal crops for seed purposes, the cereals enter in to an active competition with pulses for the land area. In spite of these factors, inclusion of pulses in the cropping patterns is vital. Hence, keeping in view the ever increasing demand for protein food, we have to find out ways and means of increasing the productivity of pulse crops making judicious use of all our Agricultural inputs. This would be possible, if by suitable experimentation we find out the promising planting material and work-out the optimum agronomy for these pulses. This project has been taken up mainly to achieve the above objectives.

Location: The experiments were conducted in Block E of the Crop Research Farm of the University.

Soil: The experimental site has a silty loam soil with a pH of 6.5, an organic matter content of 0.79% and the available P content of 49 kg P_2O_5/ha.

Cropping History of the Experimental Plot: The crops grown in experimental field prior to the experimental crop are listed below:

Experimental crop	Previous crop
Moong	Spring Maize
Moong	Wheat
Arhar	Wheat

Weather: Data on maximum and minimum temperature, rainfall, and relative humidity for the experimental period are presented in Table 1.

Experimental results:

Moong:

1. Effect of date of planting and plant population on the performance of two Moong varieties

This study was carried out to assess the optimum time planting and plant population for Jalgaon-781 and T-6009 varieties of Moong. Planting dates tried were 20th June, 5th July and 20th July and populations maintained were 180,000

Table 1

Weather Data (June-Dec.1968)

Months	Weeks	Rainfall m.m.	Maximum temp. °C	Minimum temp. °C	Relative humidity %
June	4-10	14.8	36.3	24.5	75
	11-17	46.6	33.8	24.8	84
	18-24	47.0	33.7	24.5	92
	25-1	31.6	32.8	24.8	89
July	2-8	84.4	32.9	25.1	93
	16-22	228.0	30.7	24.7	95
	23-29	71.2	32.2	24.3	94
	9-15	136.3	32.5	25.6	91
August	30-5	71.1	33.7	25.5	88
	6-12	71.9	32.3	24.1	95
	13-19	138.6	32.4	24.5	93
	20-26	119.9	31.7	23.9	96
	27-2	-	33.7	22.9	94
September	3-9	-	34.3	22.3	93
	10-16	36.2	34.8	23.4	90
	17-23	203.2	31.8	22.6	96
	24-30	26.0	34.0	22.0	89
October	1-7	106.0	32.3	20.0	93
	8-14	-	31.1	15.3	89
	15-21	0.4	31.2	14.8	87
	22-28	-	30.9	13.8	82
November	29-4	1.4	30.0	13.4	83
	5-11	-	28.8	12.6	81
	12-18	-	28.0	12.3	86
	19-25	-	27.1	10.8	89
	26-2	-	25.3	8.1	90
December	3-9	-	25.0	6.3	89
	10-16	-	25.0	7.3	87
	17-23	-	28.6	3.9	93
	24-31	0.1	20.5	6.5	87

and 360,000 plants per hectare with 30 cm. and 45 cm. row spacings. The grain yield obtained in general was very low primarily because of the incidence of diseases particularly virus and bacterial leaf spot. The Statistical analysis of data on grain yield revealed that neither the main effects nor interactions among various treatments proved significants. The main effects of various treatments are presented in Table 2.

Table 2

Effect of data of planting, row spacings and plant population on the grain yield of two Moong varieties

Date of planting	Grain yield q./ha.	Row spacing	Grain yield	Plant population /ha.	Grain yield
20th June	5.05	30 cm.	4.78	180,000	4.71
5th July	4.55	45 cm.	5.16	360,000	5.23
20th July	5.61	—	—	—	—
F test	N.Sig.	—	N.Sig.	—	N.Sig
S.Em.	± 0.34	—	± 0.34	—	± 0.34
Varieties					
Jalgaon 781	4.40				
T-6009	5.35				
F test	N.Sig.				
S.Em.	± 0.34				

In the case of Jalgaon-781 the earliest sowing i.e. on 20th June led to the production of highest grain yield. The late sown crop of this variety suffered a great deal on account of the incidence of diseases particularly yellow virus and bacterial leaf spot. In case of T-6009, however, planting done on later two dates i.e. on 5th July appeared to be better than planting on 20th June.

As regards the effect of plant population, it was observed that increasing the plant population from 180,000 to 360,000 plants per hectare did not result in significant increase in grain yield in any of the varieties. However, 45 cm. spacing seemed to be slighly better than planting at 30 cm. None of the interaction effects turned out to be significant.

II. Effect of different levels of N, P, K and inoculum on the grain yield of Moong.

This experiment was conducted to find out the optimum N, P and K requirement of Moong variety T-6009. Three levels each of N and P_2O_5 and two levels of K_2O were tried. The crop was planted on 9th July and harvested on 31st October. The statistical analysis of data revealed that the levels of N, P and K did not have any differential effect on the grain yield of Moong. The main effect of various treatments are presented in Table 3.

Table 3

Effects of N, P and K on grain yield (q./ha.) on Moong

N levels (kg./ha.)	Grain yield	P_2O_5 levels	Grain yield	K_2O levels Kg/ha.	Grain yield
0	6.20	0	6.31	0.	6.47
25	5.86	50	6.38	50	6.20
50	6.29	100	6.08	-	-
Inoculum	6.98		-	-	-
F test.	N. Sig.		N.Sig.		N. Sig.
S.Em.	±0.35		±0.31		±0.25
C.V.	23.68%				

It would be clear from the above table that increased doses of nitrogen did not have any beneficial effect on grain yield of Moong. Inoculation of seed, however, tended to improve the yield level although the over all differences were not significant. Application of phosphorus also failed to have any beneficial effect on the yield. Increasing the rate of potash fertilization from 0 to 50 kg./K_2O per hectare, on the other hand depressed the grain yield. Absence of response to N, P and K may be attributed to the higher fertility status of the soil. It may be mentioned that the preceding spring maize crop was heavily fertilized with N, P and K the residual effect of which could have masked the real effect of N,P and K levels applied to Moong.

III. Effect of fertility levels, row spacing and plant population on growth and yield of moong (T-6009)

The experiment was conducted to find out the optimum fertility level, row spacing and plant population for moong variety T-6009. The experiment was laid out in a single split plot design with three levels of each factor. Observations on the number of primary branches per plant, number of grains and length per pod, 1000-grain weight etc. were recorded. The data on the effect of fertility levels on growth, yield and yield contributing factors are presented in Table 4.

.....Table 4

Table 4

Effect of fertility levels on growth, yield and yield contributing characters

Treatment	Grain Yd. q./ha.	Grain Yd. /plant gm.	Pods per plant	Length of pod cm.	1000 grain Wt.gm.	No.of grains /pod	No.of primary branches /plant
N, P_2O_5, K_2O (Kg./ha.)							
0 0 0	5.47	5.13	24.82	5.40	22.77	10.30	5.69
25 50 25	5.17	5.06	23.90	5.40	21.43	10.60	5.44
50 100 50	4.75	5.05	22.49	5.30	21.62	11.70	5.38
'F' test	Significant	-	-	-	-	-	-
S.Em.	±0.141	-	-	-	-	-	-
C.D. at 5%	0.244	-	-	-	-	-	-
C.V. = 7.95%							

It is clear from the above table that maximum grain yield i.e. 5.47 q./ha. was recorded from the plots where no fertilizer was applied. The increasing fertility levels led to significant reduction in grain yield. The same trend of reduction was also noted with respect to grain yield per plant, number of pods per plant, 1000-grain weight and number of primary branches per plant. Length of pods remained unaffected by different fertility levels. An increase in number of grains per pod was, however, observed with increase in fertility levels. The ultimate reduction in grain yield might have accured due to reduction in number of pods per plant and also the test weight of grain.

The data regarding the effect of row spacing on growth, yield and yield contributing characters are given in Table 5.

Table 5

Effect of row spacing on growth, yield and yield contributing characters

Row spacing cm.	Grain yield q./ha.	Grain yield /plant gm.	Pods per plant	Length of pod	1000-grain wiehgt gm.	No.of grains /pod	No. of primary branches per plant
30	4.85	4.86	23.49	5.4	21.63	10.30	5.02
45	5.06	5.12	23.55	5.3	21.31	11.50	5.67
60	5.49	5.27	28.19	5.5	20.87	11.90	5.75
'F' test	Significant	-	-	-	-	-	-
S.Em.	± 0.02	-	-	-	-	-	-
C.D. at 5%	0.09	-	-	-	-	-	-
C.V.	7.95						

The above table indicates that increasing row spacing from 30 cm to 60 cm resulted in a significant increase in the grain yield of moong. Similar increase due to increase in row spacing was also noted in grain yield per plant, number of pods per plant, number of grains per pod and number of primary branches per plant. Length of pods remained unaffected due to increase in row spacing.

The data regarding the effect of different plant populations on growth grain yield and yield contributing factors are presented in Table 6.

Table 6

Effect of plant population on growth, yield and yield contributing characters

Plant population per hectare	Grain yield q./ha.	Grain yield /plant gms.	Pods per plant	Length of pod cm.	1000-grain Wt gms.	No.of grain /pod	No.of primary branches /plant
180,000	5.26	5.42	26.48	5.6	21.10	11.3	6.04
240,000	4.97	5.03	24.20	5.3	21.46	10.9	5.35
360,000	5.16	4.79	24.52	5.2	21.25	21.25	5.09
'F' test	Significant	-	-	-	-	-	-
S.Em.	±0.020	-	-	-	-	-	-
C.D. at 5%	0.088	-	-	-	-	-	-
C.V. = 7.95%							

Data presented in the above table clearly indicate that the highest grain yield (5.26 q./ha.) was recorded in the plots with lowest population (180,000 plants/ha.). An increase in plant population beyond 180,000 resulted in significant reduction in grain yield. Similar reduction due to increase in plant population was also noted in respect of other growth and yield contributing characters except test weight where slight increase was noted due to increase in plant population.

IV. Effect of method of planting and levels of phosphorus and zinc on the performance of moong (T-6009)

This experiment was conducted to determine the optimum level of phosphorus and zinc application and also to find out the relative usefulness of flat and ridge sowing of moong. The experiment was laid out in Randomised Block Design. The experimental crop was planted on 23rd July and took about 100 days dor its maturity. The statistical analysis of the data revealed that the grain yield remained unaffected by the levels of various factors. The data regarding the effect of main treatments are presented in Table 7.

It may be seen from Table 7 that ridge planting recorded slightly better yield as compared to flat planting although the differences were not significant. Increasing doses of phosphorus and sinc did not appear to increase the grain yield.

Table 7

Effect of method of planting and levels of phosphorus and zinc on the grain yield of moong

Q/Ha.

Planting method	Grain yield	Levels of P_2O_5 Kg/ha.	Grain yield	Levels of zinc kg/ha.	Grain yield
Flat method	5.22	0	5.33	0	5.32
Ridge method	5.48	40	5.55	10	5.42
		80	5.18	20	5.32
'F' test	N.Sig.	-	N.Sig.	-	N.Sig.
S.Em.	± 0.126		± 0.163		± 0.163
C.V. = 14.64%					

Arhar

I. Effect of date of planting, plant population and row spacing on the performance of arhar (var. T 21)

The above study was carried out to assess the optimum time of planting and plant population and row spacing for arhar variety T.21. Planting dates tried were 5th June, 20th June, 7th July and 19th July and plant populations maintained were 40,000, 50,000 and 60,000 plants/ha.

The three different row spacings tried were 50 cm. 75 cm. and 100 cm. The experiment was laid out in a split plot design taking the dates of planting as main plots and the combinations of plant population and row spacings as sub-plots with three replications. The main effects of different treatments on the growth, yield and yield contributing characters are presented in Table 8.

The data regarding the grain yield only were subjected to statistical analysis. It would appear from Table 8 that the date of planting and plant population had significantly influenced the grain yield of arhar. The different row spacings, however, failed to have any effect on the grain yield. A significant reduction in the grain yield was observed as the sowing of arhar was delayed. It may be seen from Table 8 that the planting done on 19th July recorded an average yield of 12.90 quintals as compared to 19.51 quintals/ha. recorded with the planting done on 5th June. The maximum grain yield was obtained with a population maintained at 60,000 plants/ha. The widest row spacing i.e. 100 cm. tended to decrease the grain yield in comparison with 50 cm. and 75 cm. row spacings although the overall differences were statistically non-significant.

Table 8

Effect of data of planting, plant population and row spacing on growth, yield and yield contributing characters of arhar

Characters / Treatments	75% flowering Days	Days for maturity	Plants per plot	No.of primary branches	Pods per plant	Grains per pod	1000 grain weight	Height /plant (Cm.)	Grain yield/ plant	Dry leaves (q./ha.)	Grain Yield/ plot(q./ha.)
Dates:											
D_1	90	190	97.18	25.71	381.83	4.2	80.9	275.51	83.11	43.05	19.51
D_2	87	171	123.03	26.68	320.75	4.4	78.8	251.78	76.70	34.32	18.62
D_3	79	165	89.85	26.89	266.19	4.2	75.5	214.29	69.12	23.51	16.72
D_4	77	152	92.51	26.30	317.46	4.0	69.2	181.02	66.57	19.56	12.90
'F' test	-	-	-	-	-	-	-	-	-	-	Significant
S.Em.	-	-	-	-	-	-	-	-	-	-	± 0.40
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	1.39
Row Spacings											
50 cm.	83	169	117.11	26.17	316.53	4.2	76.5	229.25	73.90	28.22	17.17
75 cm.	83	169	102.05	25.69	315.68	4.2	76.5	233.30	71.02	31.68	17.21
100 cm.	83	169	82.77	27.34	330.96	4.0	75.3	230.33	76.72	28.90	16.41
'F' test	-	-	-	-	-	-	-	-	-	-	N.significant
S.Em.	-	-	-	-	-	-	-	-	-	-	± 0.34
C.D. at 5%	-	-	-	-	-	-	-	-	-	-	1.01
Plant population/ha.											
40,000	83	169	84.83	26.25	344.86	4.2	75.7	227.97	80.36	29.85	16.53
50,000	83	169	101.90	27.12	313.31	4.2	76.8	232.25	72.67	31.87	16.55
60,000	83	169	115.86	25.82	306.50	4.0	75.8	232.20	68.60	28.61	17.73
'F' test	-	-	-	-	-	-	-	-	-	-	Significant
S.Em.	-	-	-	-	-	-	-	-	-	-	± 0.34
C.D.	-	-	-	-	-	-	-	-	-	-	1.01
C.V.%		12.26%									

It is also apparant from Table 8 that as the planting date of arhar was delayed the number of days taken to 75% flowering and the total number of days taken to maturity were reduced. The average height of plants, grain yield per plant and the 1000-grain weight also decreased as the planting was delayed. Increasing the plant population from 40,000 to 60,000 per hectare appeared to decrease the number of pods per plant as well as the grain yield per plant.

II. Effect of fertility levels, row and plant spacings on the performance of arhar (T-21)

The experiment was conducted to find out the optimum fertility level, row spacing and plant population for arhar. The experimental crop was planted on 14th June and took about 179 days for its maturity. Observations regarding flowering behaviour, plant height, number of primary branches and pods per plant, number of grains per pod, grain yield per plant and per plot and 1000-grain weight were recorded. The data on the effect of different treatments on the growth, yield and yield contributing characters are presented in Table 9.

The Table 9 clearly indicates that the increased plant population from 30,000 to 40,000 plants per hectare resulted in a significant increase in the grain yield of arhar. A further increase in plant population did not produce any significant increase in yield. A reduction in the number of pods per plant and number of grains per pod was noted due to increase in plant population. Number of days taken to flowering and maturity and height, number of primary branches per plant and 1000-grain weight remained unaffected due to various plant population levels.

As regards the effect of row spacing, it was noted that an increase in row spacing from 50 cm. to 100 cm. resulted in a significant reduction in the grain yield of arhar. An increase in the number of primary branches and pods per plant was, however, noted due to increase in row spacings. Other growth and yield contributing characters remained unaffected due to different row spacings.

As would appear from the Table increased levels of fertility did not have any beneficial effect on grain yield. Other growth and yield contributing characters also reamined unaffected by different fertility levels.

III. Effect of nitrogen and phosphorus levels and rhizobium inoculation on the performance of arhar variety T.21

This study was conducted to work out the optimum rate of nitrogen and phosphorus fertilization for arhar and also to assess the effectiveness of rhizobium inoculation. The treatments consisted of five levels of nitrogen including inoculation and four levels of phosphorus as given below:

Nitrogen treatments: (i) N_0 : 0 kg N/ha, (ii) N_1 : Inoculation, (iii) N_2 : 40 kg N + Inoculation, (iv) N_3 : 40 kg N/ha, (v) N_4: 80 kg N/ha.

Phosphorus treatments: (i) P_0: 0 kg P_2O_5/ha, (ii) P_1 : 50 kg P_2O_5/ha, (iii) P_2 : 100 kg P_2O_5/ha., (iv) P_3 : 150 kg P_2O_5/ha.

Table 9

Effect of fertility levels, row and plant spacings on growth, yield and yield contributing characters

Characters / Treatments	75% flowering (Days)	Days for maturity	Height /plant (cm)	Plants per plot	Primary branches /plant	Pods per plant	Grains per plant	1000-grain wieght (gm)	Grain Yield/ plant	Grain yield per plot (q./ha.)
Plant population/ha.										
30,000	99	179	262.91	74.64	30.34	391.83	4.4	80.6	94.53	19.04
40,000	99	179	259.55	93.11	29.14	329.68	4.2	80.2	82.17	20.31
50,000	99	179	265.75	111.22	28.05	301.77	4.2	79.4	76.93	20.50
'F' test	-	-	-	-	-	-	-	-	-	Significant
S.Em.	-	-	-	-	-	-	-	-	-	± 0.35
C.D. at 5%	-	-	-	-	-	-	-	-	-	1.01
Row spacings										
50 cm	99	179	262.03	105.00	28.21	329.49	4.2	78.9	83.88	21.08
75 cm	99	179	262.87	93.82	29.25	331.03	4.0	80.4	83.36	20.36
100 cm	99	179	262.97	79.55	29.42	342.45	4.2	80.5	87.16	18.50
'F' test	-	-	-	-	-	-	-	-	-	Significant
S.Em.	-	-	-	-	-	-	-	-	-	± 0.35
C.D. at 5%	-	-	-	-	-	-	-	-	-	1.05
Fertility levels										
N_{30} P_{40} K_{20}	99	179	264.62	87.64	29.13	326.01	4.2	80.1	85.80	19.61
N_{60} P_{80} K_{40}	99	179	256.88	96.11	28.38	351.16	4.0	78.9	84.40	20.16
N_{90} P_{120} K_{60}	99	179	266.81	95.83	29.95	342.45	4.2	81.1	86.80	20.16
'F' test	-	-	-	-	-	-	-	-	-	Significant
S.Em.	-	-	-	-	-	-	-	-	-	± 0.35
C.D. at 5%	-	-	-	-	-	-	-	-	-	1.01

The experiment was laid out in a randomized block design with four replications. The planting was done on 14th June, 1968 and the crop was harvested on 18th and 19th of December 1968. The main effects of different treatments are presented in Table 10.

As it is apparant from the Table 10, none of the treatments had any significant differential effects on the grain yield of arhar. Neither the rhizobium inoculum nor the increasing levels of nitrogen appeared to have any beneficial effect on the grain yield. Increased levels of nitrogen fertilization on the other hand tended to lower the grain yield although the differences were not significant. The absence of a response to nitrogen and phosphorus fertilization in the present experiment may be attributed to the relatively higher fertility status of the soil with regard to nitrogen and phosphorus.

Table 10

Effect of fertility levels on growth, yield and yield contributing characters

Characters / Treatments	75% flowering (Days)	Days for maturity	Plants per Plot	Height/ plant (cm)	Primary branches /plant	Pods per plant	Grains per pod	1000grain weight (gm)	Grain yield per plant (gm)	Grain yield per plot (q/ha.)
N_0	99	179	98.2	258.11	31.37	281.7	4.1	78.3	64.65	18.38
N_1	99	179	91.2	254.43	32.06	287.6	4.1	87.5	67.55	15.47
N_2	99	179	91.8	262.80	32.05	272.6	3.7	77.7	64.61	18.40
N_3	99	179	105.1	272.90	32.05	291.36	4.0	78.7	66.55	17.72
N_4	99	179	93.7	260.62	31.80	282.00	4.1	78.6	69.63	17.68
'F' test	-	-	-	-	-	-	-	-	-	N.Significnat
S.Em.	-	-	-	-	-	-	-	-	-	± 0.45
P_0	99	179	119.3	262.09	32.02	307.4	4.1	76.4	66.63	18.18
P_1	99	179	123.5	261.16	31.41	256.5	4.1	80.2	71.28	17.60
P_2	99	179	116.8	259.65	30.57	265.6	3.7	80.5	64.11	18.18
P_3	99	179	120.4	264.59	33.47	302.7	4.1	76.4	64.37	18.17
'F' test	-	-	-	-	-	-	-	-	-	N.Significant
S.Em.	-	-	-	-	-	-	-	-	-	± 0.45

Studies on the possibility of growing kharif pulses in the Summer season at Pantnagar[1]

M.C. Saxena, D.S. Yadav and N.P. Singh[2]

Pulses such as moong and lobia are commonly grown as kharif crops because mostly their varieties are photoperiodically sensitive and behave as short day plants. With the introduction of high yielding kharif cereals, however, the continuance of kharif pulses in the cropping pattern has become less remunerative and there is a possibility that the area and consequently the production of these pulses may decrease. This would have far reaching implication in view of the fact that these pulses contribute a great deal to the protein nutrition of predominantly vegetarian masses of this country. The need has, therefore, been felt to grow these pulses in the 'catch' period available after harvest of rabi crops and before the planting of kharif crops, as the land is otherwise free and inclusion of a crop in this period will increase the intensity of cropping and raise the productivity of the holding in terms of yield per unit area per day. However, this would only be possible, if short duration varieties of above pulses are available which could perform well in the type of thermo-photoperiodic conditions existing during this period, namely, increasing photoperiod and very high temperatures. There was, therefore, a need for testing the performance of some short duration varieties of moong and lobia, when planted on different dates in the summer season so as to simulate the situation which would arise when rabi crops of differing maturity length were to be followed by the pulses. From such a study, specific variety recommendation for summer planting could become available. The present paper embodies the results of such trials.

METHODS AND MATERIALS

In one trial three moong varieties, viz., Jalgaon-781, Moong Type-1 and Pusa Baisakhi were planted on five different dates (March 31, April 10, April 20, May 4 and May 12, 1968). In the other trial two cultivars, viz., Moong Type-2 and Pusa Phalguni lobia, were planted on four dates (April 10, April 20, May 4 and May 12, 1968). In both the cases a split plot design ('dates' in main plots and 'varieties' in sub plots) with four replications was followed. Because of limited seed the plot size had to be kept small (sub-plot size 3 x 1.8 m.). The planting was done in rows 30 cm. apart with a plant to plant distance adjusted 5 cm. after emergence. The crop was fertilized with 100 kg. per hectare of diammonium phosphate and sprayed with zinc sulphate + lime solution about 25 days after emergence. The weather data for the duration of the experiment are given in Table 1. The maximum temperature increased till the end of May and then decreased the difference between the maximum and minimum temperature started becoming less with the advancing season.

---

1. A contribution from the U.P.Agricultural University, Pantnagar, Experiment Station, under the research series Paper No._____

2. Associate Professor, Senior Research Assistant. and Research Assistant respectively.

Table 1

WEATHER DATA (April-July, 1968)

Months	Weekly dates	Weekly mean temperature °C		Weekly total rainfal m.m.	Humidity%	
		Maximum	Minimum		7:12 AM	2:12 PM
April	1- 7	31.5	13.6	-	69.5	28.7
	8-14	35.8	16.0	-	64.7	21.8
	15-21	36.3	15.7	1.0	57.5	16.8
	22-28	38.1	20.3	-	54.7	21.5
	29- 5	39.0	23.7	-	50.7	22.1
May	6-12	38.1	16.2	-	42.8	10.0
	13-19	39.4	20.9	-	48.2	23.4
	20-26	41.5	21.0	-	47.1	12.4
	27- 2	42.9	21.4	32.2	50.4	19.1
June	3- 9	36.2	24.3	14.8	73.1	43.8
	10-16	34.0	24.9	45.6	84.1	62.1
	17-23	33.8	24.4	45.7	89.2	69.0
	24-30	32.4	24.4	34.8	90.4	74.0
July	1- 7	33.4	25.3	49.4	90.7	76.4
	8-14	32.5	25.5	166.4	91.5	75.6

EXPERIMENTAL FINDINGS

The data on time taken for emergence, 75% plants to come in flower, appearance of first matured pod and for each picking, as well as the data on pickingwise and total grain yield for three moong varieties are given in Table 2, and for moong Type 2 and Pusa Phalguni Lobia in Table 3.

Emergence:

Among the moong varieties, Type-1 was slowest to emerge, the others being at par. Delaying the planting hastened the emergence, perhpas, becauase of higher temperatures. Pusa Phalguni Lobia took lesser time for emergence than moong varieties.

Flowering and maturation:

The moong varieties differed in duration taken by them for flowering. Jalgaon-781 was earliest to flower in the first two dates of planting. Planting on 20 April delayed the flowering considerably and the crops from subsequent planting did not come into flower and pod in the season. Amongst Type-1 and Pusa Baisakhi there was not much difference, although, by and large, Type-1 was earlier to flower than Pusa Baisakhi. In the latter variety as also in Type-2 there was consistent increase in the time taken for flowering as the planting was delayed. Time taken for first matured pod to appear was shortest in Moong Type-1

Table 2

Effects of dates of planting on the comparative performance of three moong varieties in the summer of 1968 at Pantnagar

TREATMENT Variety and Date of planting	Days to G	F	P	Grain yield (q/ha) at each picking (days taken for each picking are in brackets) I	II	III	IV	Total grain yield (q/ha.)
Jalgaon 781								
31st March	6	37	51	12.89 (71)	1.34 (83)	2.17 (93)	-	16.40
10th April	6	38	50	1.57 (73)	0.64 (83)	-	-	2.18
20th April	5	46	54	-	-	-	-	-
4th May	4	-	-	-	-	-	-	-
12th May	4	-	-	-	-	-	-	-
Moong Type 1								
13th March	8	37	48	10.11 (71)	8.69 (83)	2.46 (93)	4.59 (115)	25.85
10th April	7	43	48	9.05 (68)	2.29 (75)	4.65 (82)	2.18 (107)	18.17
20th April	6	42	48	3.17 (65)	3.38 (73)	2.24 (96)	-	8.79
4th May	5	40	48	5.86 (59)	2.71 (82)	-	-	8.57
12th May	5	41	51	8.24 (74)	-	-	-	8.24
Pusa Baisakhi								
31st March	6	41	51	12.24 (71)	4.51 (83)	2.09 (93)	0.64 (115)	19.98
10th April	5	42	50	9.79 (68)	2.27 (75)	3.67 (82)	1.27 (107)	17.00
20th April	5	44	50	6.41 (65)	1.86 (73)	2.48 (96)	-	10.75
4th May	4	44	53	10.45 (82)	-	-	-	10.45
12th May	4	46	59	3.98 (74)	-	-	-	3.98
C.V.				19.0%	23.7%			
For comparison of two variety means at one date of planting	S.Em. ±			0.75	0.36			
	C.D.5%			2.28	1.05			

G = Germination; F = 75% plants in flower;

P = Ist matured pod.

Table 3

Effect of date of planting on the comparative performance of T_2 moong and Pusa Phalguni Lobia in the summer of 1968

Variety and Date of planting	Days to G	Days to F	Days to P	Grain yield (q/ha) at each picking (days taken for each picking are in brackets) I	II	III	IV	Total grain yield q/ha.
Moong Type 2								
10th April	6	48	58	3.09(85)	-	-	-	3.09
20th April	6	50	59	1.91(72)	-	-	-	1.91
4th May	5	59	-	-	-	-	-	-
12th May	4	-	-	-	-	-	-	-
Pusa Phalguni Lobia								
10th April	4	44	53	12.68(83)	3.25(92)	5.38(116)	-	22.31
20th April	4	45	64	9.36(72)	4.43(96)	-	-	13.79
4th May	4	44	56	11.43(82)	-	-	-	11.43
12th May	3	49	60	11.12(74)	-	-	-	11.12

G = Germination; F = 75% plants in flower; P = Ist matured pod.

and did not differ with delay in planting till 4th May. There was a general tendency for delayed appearance of 1st matured pod in plantings done after 20th April in case of Pusa Baisakhi and after 10th April in .....
Jalgaon-781 as well as Moong Type-2 got their first matured pod later than in other moong varieties. Grain could be harvested in only two out of five planting dates in case of Jalgaon-781 and in two out of four planting dates in Moong Type-2. In case of Moong Type-1 and Pusa Baisakhi all the five dates yielded grain. Similarly, in Pusa Phalguni Lobia, all the four dates produced pods and gave grain yield. Several picking (a maximum of four) had to be made in each of the cultivars but as the planting was delayed the number of pickings decreased. Jalgaon-781, Moong Type-1 and Pusa Baisakhi when planted on 31st March, took exactly same period for each of the peikings, however, in Jalgaon-781 only three pickings could be done. In the next date (10th April) Jalgaon-781 was conspicuously late as compared to Type-1 and Pusa Baisakhi. The latter two varieties took equal time for each picking. Type-2 moong and Pusa Phalguni lobia were conspicuously later to be picked than others.

Yield in different picking:

From yield point of view moong Type-2 proved to be unsuitable for inclusion in summer season, as with slight advancement in the season it started making enormous vegetative growth and failed to produce enough grains. Jalgaon-781 behaved in the same way when planting was delayed beyond 10th April. However, this variety could be compared with the others (Type-1 and Pusa Baisakhi) when planted on 31st March. In this planting, the yield in first picking was higher in Jalgaon-781 and Pusa Baisakhi than in Type-1, in the second picking Type-1 was at top followed by Pusa Baisakhi and Jalgaon-781 and in subsequent pickings this trend was maintained. At other dates, the comparison was only between Pusa Baisakhi and Type-1. In case of 10th April and 20th April planting, the yields in first picking were higher in Pusa Baisakhi and in second third and fourth pickings in case of Type-1. Tendency was evident that Pusa Baisakhi produced a greater portion of its total yield in the first two pickings than did Type-1.

Grain yield-total of all pickings:

When plated on 31st March, Moong Type-1 exceeded all other moong varieties because of its superiority over others in yielding during II, III and IV pickings. In 10th April plantings, although Type-1 was still higher yielding, the difference between this and Pusa Baisakhi was narrowed down. In 20th April and 4th May plantings however, Pusa Baisakhi yielded higher than Type-1. Although it would not be a very valid comparison, Pusa Phalguni Lobia (Table 3) yielded higher than both the moong varieties in all the four dates of planting. With delay in planting date there was decrease in the total yield of all cultivars.

Yield contributory characters:

The data on yield contributory characters have been given Table 4. Number of pods per plant appeared to be the most important single factor which brought about differences in the final yield. Jalgaon-781 produced lesser number of pods per plant, grains per pod but bolder grains as compared

Table 4

Effect of date of planting on the comparative performance on three cultivers of Mung grown in summer, 1968 at Pantnagar

Treatments Variety x Date	Total grain yield (q/ha)	Number of pods per plant	Number of grains /pod	1000 grain weight (g)	Dry wt./plants at 75% flowering	Yield per plant (g)
Jalgaon-781						
31st March	16.40	9.9	7.6	5.3	11.9	4.96
10th April	2.18	5.0	7.5	5.1	11.2	2.00
Type-1						
31st March	25.85	29.7	9.0	3.5	9.3	7.6
10th April	18.17	23,5	8.8	3.6	10.7	6.1
20th April	8.79	14.9	8.6	3.4	8.3	5.4
4th May	8.57	15.1	8.9	3.4	11.7	4.2
12th May	8.24	9.6	9.7	3.4	8.0	3.4
Pusa Baisakhi						
31st March	19.98	14.6	8.8	3.7	8.5	7.3
10th April	17.00	11.9	9.2	3.5	7.7	5.6
20th April	10.75	9.7	9.4	3.7	10.6	4.1
4th May	10.45	10.1	8.7	3.7	7.8	3.4
12th May	3.98	8.4	9.1	3.6	8.1	2.7
Dates						
31st March +	20.74	18.1	8.4	4.1	10.2	6.8
10th April +	12.45	13.4	8.5	4.0	9.8	4.6
20th April ++	9.77	12.3	9.0	3.5	10.0	4.8
4th May ++	9.51	12.6	8.8	3.5	6.5	3.8
12th May ++	6.11	9.0	9.4	3.5	5.3	3.0
Variety						
Jalgaon-781*	9.29	7.5	7.5	5.2	11.5	3.4
Typo-1**	13.92	18.5	9.0	3.4	9.6	5.3
Pusa Baisakhi**	12.41	10.9	9.0	3.6	8.5	4.6

\+ means over all the three varieties

++ means over only two varieties

* means over only two dates of planting

** means over all the five dates of planting

Table 5

Productivity analysis of four cultivars of pulses grown in summer 1968 at Pantnagar to fit in the period between Rabi harvest and Kharif planting

Particulars of cultivars etc.	Date of planting		
	31 March	10 April	20 April
JALGAON-781 Moong			
Grain yield (kg/ha)			
I picking	1289	157	-
II picking	134	61	-
Total	1423	218	
Date of 2nd picking	22nd June	2nd July	-
Days taken for two pickings	83	83	
Grain yield per day (kg)	17.1	2.6	-
TYPE-1 Moong			
Grain yield (kg/ha)			
I picking	1011	905	317
II picking	869	229	338
Total	1880	1134	655
Date of 2nd picking	22nd June	24th June	2nd July
Days taken for two pickings	83	75	73
Grain yield per day (kg)	22.6	15.1	8.9
PUSA BAISAKHI MOONG			
Grain yield (kg/ha)			
I picking	1224	979	641
II picking	451	227	186
Total	1675	1206	827
Date of 2nd picking	22nd June	24th June	2nd July
Days taken for two pickings	83	75	73
Grain yield per day (kg)	20.1	16.1	11.3
PUSA PHALGUNI - LOBIA			
Grain yield (kg/ha)			
I picking	-	1268	936
II picking	-	325	-
		1593	
Date of 2nd picking	-	1st July	(First picking on 1st July taking 72 days)
Days taken for two pickings	-	82	
Grain yield per day (kg)	-	19.4	13.0

to Type-1 and Pusa Baisakhi. Moong Type-1 out yielded Pusa Baisakhi in total yield primarily because of higher number of grains per plant.

DISCUSSION

It has become evident from the results that only three planting dates (31st March, 10th April and 20th April) would be suitable for summer plantings of pulses. If planting could be done on 31st March, all the three moong varieties (Jalgaon-781; Type-1 and Pusa Baisakhi) could be used. Lobia was not included in this date in the experiment but from the growth behaviour of subsequent dates it could be expected that it would have performed well. In case the planting had to be done on 10th or 20th April only Type-1 and Pusa Baisakhi moong varieties and Pusa Phalguni Lobia would be suitable. A maximum of two pickings can be taken in each case in order to be able to plant the subsequent kharif crop in time. An extract from Table 2 and Table 3 and some productivity calculations have been given in Table 5 to illustrate above point, as well as, to have a final comparison of the cultivars included with respect to their performance in the limited span of time available because of the restrictions imposed by time of harvesting of rabi and planting of kharif crop. It is evident that moong Type-1 is best suited for 31st March planting, whereas for 10th April and 20th April planting, Pusa Phalguni Lobia and Pusa Baisakhi Moong are better suited.

SUMMARY

Of the four moong varieties (Moong Type-1, Type-2, Jalgaon-781 and Pusa Baisakhi) tested only Type-1 and Pusa Baisakhi were found to be suitable for summer plantings after the harvest of Rabi crops. Jalgaon-781 could be grown only if planting were possible on 31st March but at this date the performance of Type-1 was far superior. When planted on 10th April or 20th April, the usual time by which land may become available for summer pulse in intensive cropping - Pusa Baisakhi yielding 12 and 8 quintals per hectare respectively by 24th June was superior to Type-1. Pusa Phalguni Lobia was, however, having highest productivity for these two dates of planting hence could be useful material for summer season.

WORK DONE ON AGRONOMIC ASPECTS OF PULSES IN GUJARAT STATE

S.N. Joshi
College of Agriculture, Junagadh

Different pulses are cultivated to the tune of 400,000 hectares in Gujarat State giving a total produce of 120,000 tonnes annually. Of these hectares under pulses, nearly 30% is under mung, 20% under tur, 10% under gram, 11% under wal (Dolichos spp.), 5% under lang (Lathyrus sativus) 5% under urd and the rest under math, guar, cowpeas and others.

The main kharif pulses are grown entirely as rainfed crops are mung, urd, math and tur and during rabi gram and wal are also cultivated as dry crops on the residual moisture available. Thus, very little irrigation potential is being used for pulses, except for mung crop grown as a catch crop in summer on small area. Because of the poor soil condition and uncertain monsoon, the yield of these crops per unit area is very low and requires to be stepped up through better crop husbandry.

Broadly classifying, Agronomy includes application of fertilizers, irrigation, tillage practices and meeting of proper spacing requirements for the crop or even a variety. As the pulse crops remained neglected till recently, no planned efforts were made in the state for improvement of these crops as well as improving their cultivation practices until 1966 when a scheme for improvement of pulses was initiated at Baroda on a very small scale. I shall review whatever little work is done so far on this group of crops.

Fertilizer experiments were initiated on mung, math, urd, and tur from 1966-67 at different locations situated in the main pulse growing areas of the state. A fertilizer experiment on cowpeas was started from 1967-68 at Baroda. I am presenting results on mung and arhar only as these two are important kharif crops of the state.

MUNG:

A fertilizer experiment was conducted at Baroda, Talod, Deesa and Vijapur in RCBD with 4 replicates on a net plot of 6.10 m x 4.88 m. The spacings between rows was 45 cm. Treatments comprised 3 levels of N and 3 levels of P_2O_5 at the rates of 0, 25, 50 kg. and 0, 50, and 100 kg. per ha. respectively. Variety used was D.45-6.

During 1966, kharif, the results were not significant on any of the locations and the average response for all places for N and P was not very marked. The yields due to N0, N25 and N50 were 621, 623 and 632 kg./ha. and for P0, P50 and P100 were 607, 653 and 616 kg/ha. respectively.

During 1967, the results were significant at Baroda only, and the average yield for N0, N25 and N50 were 477, 492 and 506 kg./ha. and for P0, P50 and P100 were 464, 482 and 530 kg/ha. respectively.

The two years data at Baroda and Talod (Table 1 a & b) indicated response to both N and P and the average increase due to 50N+100P/ha at Baroda was upto 30%.

Yield of grains kg/ha.

		N0	N25	N50	Av.for P	Av.of 2 yrs.
P0	1966	868	973	916	919	
	1967	706	764	922	797	858
P50	66	954	1029	1089	1024	
	67	706	803	740	750	887
P100	66	979	1014	1004	999	
	67	842	795	1044	894	947
Av.for N						
	1966	934	1005	1003		
	1967	752	787	901		
Av.of 2 yrs		843	896	953		

Table 1b. Fertilizer response of Mung at Talod.

Yield of grains kg/ha.

		N0	N25	N50	Av.for P	Av.of 2 years
P0	1966	243	278	279	267	
	1967	405	489	346	413	340
P50	66	344	299	368	337	
	67	519	489	501	503	420
P100	66	267	270	258	265	
	67	580	565	474	540	402
Av.for N						
	1966	285	282	302		
	1967	501	511	485		
Av.for 2 yrs.		393	397	364		

There was no response due to application of N and P at Vijapur and Deesa during any of these two years. The pooled data for two years at four locations gave average yields of 549,557 and 569 kg/ha. for 3 levels of N and 535,567 and 573 kg/ha. for P respectively.

The experiment is continued at Baroda.

TUR:

A similar experiment was conducted on tur during 1966 at two locations and during 1967 at four places.

The average response for Baroda and Vijapur during 1966 was: N0,N25 and N50 gave 606,751 and 720 kg/ha. and P0,P50 and P100 gave 640,682 and 755 kg/ha. respectively.

The response during 1967-68 was: N0-1024, N25-1043,N50-1084 kg./ha; P0-1047,P50-1031,P100-1072 kg/ha.

The average response for two years: N0-815,N25-897,N50-902 kg./ha; P0-843,P50-856,P100-913 kg/ha.

The two years data at Baroda are presented in Table 2a.

Table 2a. Response to fertilizers of Tur at Baroda.

Yield of grainskg/ha.

		N0	N25	N50	Av.for P	Av.of 2 yrs.
P0	1966	895	1166	1136	1066	
	1967	1913	2207	2239	2120	1585
P50	1966	1013	1355	1148	1172	
	1967	2254	2143	2054	2150	1661
P100	1966	977	1260	1406	1214	
	1967	2013	2191	2331	2178	1730
Av.for P	66	962	1244	1230		
	67	2060	2180	2208		
Av.of 2 yrs.		1511	1712	1719		

During 1966 the response due to 25 kg. N was marked about 30% over no nitrogen, whereas response due to P was small. During 1967 the response due to N was smaller than for the previous year, whereas response due to P was much reduced. The experiment is continued.

Mung is cultivated to some extent as a catch crop in summer wherever irrigation facilities exist and the farmers inclined to follow crop rotation practices. With a view to taking advantage of such assured irrigation, preliminary, preliminary trial was taken up to investigate whether fertilization of such a crop after rabi wheat can be advantageous The results have been encouraging and the application of 25 kg/ha. enhanced yield by 23% over no fertilizer application on average of two years, but no response to application of P was noticed, however, a combination of 25N+50P recorded 40% higher yield over control.

With the expansion of the Pulse Research Scheme which is entirely a State government undertaking during the IV Plan period, a more extensive research programme can be taken on hand.

REPORT ON RESEARCHES ON PULSE CROPS CONDUCTED IN THE UNIVERSITY OF KALYANI, WEST BENGAL

S. Sen
Dept. of Agronomy
University of Kalyani, W.Bengal

The experimental farm is located at 23.5°N latitude and 89°E longitude with an elevation of 9.75 m. In the year 1967-68, four varietal trials one each on green gram, black gram, bengal gram and lentil were conducted. Green gram and black gram trials were conducted in a sandy loam soil with pH 5.1 after neutralising with lime and the other two trials on rabi pulses were conducted in a silty loam soil with neutral soil reaction after jute. All the crops received manuring at the rate of 10 kg. N and 40 kg. P_2O_5 per hectare. Under similar conditions, trials on green gram and black gram were conducted in the year 1968-69.

The temperature and rainfall figures for the period of work are presented in Table - 1.

Table-1: Meteorological data for the year 1967-68 and 1968-69

Month	Temperature °C						Rainfall (mm)		
	Maximum			Minimum					
	Normal (11yrs)	1967-68	1968-69	Normal (11yrs)	1967-68	1968-69	Normal 11 yrs	1967-68	1968-69
June	33.5	35.1	32.1	24.5	25.5	22.3	171.8	150.8	365.0
July	32.1	32.4	32.1	24.5	25.1	26.9	194.6	281.2	224.8
August	32.5	31.5	31.8	25.0	25.4	26.5	141.0	322.6	280.1
September	32.5	31.7	32.9	25.0	25.1	27.1	138.0	269.2	145.4
October	26.9	31.6	30.9	23.0	21.3	23.3	102.6	37.8	130.6
November	29.0	29.1	28.2	13.5	13.8	17.3	5.4	nil	40.4
December	26.0	26.5		13.0	12.5	17.3	0.3	nil	
January	25.5	24.4		10.5	10.5		12.8	0.6	
February	27.5	28.3		12.5	12.0		18.4	25.8	
March	34.0	34.9		18.5	20.0		16.0	36.8	
April	37.0	36.5		22.5	15.0		33.2	51.0	
May	36.5	38.5		24.5	24.0		57.2	79.4	
Total:							1442.3	1255.2	

The green gram crop was not as good as in the previous year (1966-67); the crop suffered from insufficient rainfall and high day temperatures at the time of maturity in 1967-68. During kharif 1968-69, the rainfall was high; the growth of green gram and black gram was, however, quite good. Bengal gram also had good growth, but the yield was not as good as in the previous year; the winter was relatively milder and shorter than in the year 1966-67. The yields of lentil was satisfactory. Both bengal gram and lentil received supplemental irrigations.

Results

Green gram varietal trial:

As in 1966-67, this year (1967-68) also type 1 (Table-2) gave the maximum yield of 8 q/ha. All the improved varieties outyielded the two local varieties, Sonamoong and B-1. Sonamoong and B-1 also appeared to be more susceptible to diseases than the other improved types.

Table -2

Results of Green gram varietal trial (1967-68)

Variety	Days to mature (harvest)	Grain yield (q/ha)
Type-1	85	8.33
Type-2 90	90	7.25
Type-44	89	7.20
Type-51	89	7.73
Sonamoong	80	2.20
Local (B-1)	80	1.86
S.Em		± 0.710
C.D 5%		2.080
C.D 1%		2.840

In the green gram varietal trial of 1968-69 (Table - 3) the yields of the varieties T-2, T-44, Hyb-44, T-51, were high.

Table - 3

Results of Green gram varietal trial (1968-69)

Variety	Days to flower	Days to mature (Harvest)	Grain yield (q/ha)
R.S. -4	54	90	6.31
T-44	35	89	10.82
N-305	54	85	7.87
24-3	52	89	4.12
Jalgaon-781	39	90	9.00
T-2	50	90	10.99
Hyb-45	55	90	10.58
BR-2	60	89	2.15
24-2	42	90	3.78
T-51	45	89	10.28
B-1	45	89	5.94
S.T	50	90	1.91
D.45-6	45	89	5.01
S.Em.			± 1.10
CD 5%			3.195
CD 1%			4.408

Black gram varietal trial

The variety T-9 (Table - 4) with semidwarf, erect, non-viny plant type gave spectacularly high yields as compared to other varieties. The performance of N-212 was very poor due to virus infection as was the case with Gwalior 18.

Table - 4

Results of Black gram varietal trial (1967-68)

Variety	Days to flower	Days to mature	Grain yield (q/ha)
T-9	52	110	19.51
Gwalior 18	58	110	6.03
N-212	59	112	1.00
NO-1766	65	111	12.40
Khargaon-3	50	110	7.78
Mash-48	50	101	10.76
Mash-35-5	60	110	9.97
Mash-41-13	63	110	12.29
S.Em.			± 0.65
CD 5%			1.91

In 1968-69 (Table - 5), Mash-48 gave the maximum yield (16 q/ha) followed by T-21 (14 q/ha) No-1-1 (13 q/ha) and No 35-5 and T_9 (12 q/ha)

Table - 5

Results of Black gram varietal Trial (1968-69)

Variety	Days to flower	Days to mature	Yield (q/ha)
No. 35-5	45	111	12.07
Khargaon	50	111	10.30
BR-61	50	101	9.97
D-6-7	65	111	10.07
No-1766	65	111	11.35
T-27	42	111	13.71
Mash 41-13	63	111	9.80
Mash-48	50	101	16.23
BR-68	63	111	12.11
Sindkhedal-1	45	111	9.54
No-1-1	52	111	12.89
T-65	51	111	17.35
T-9	53	111	12.00
S.Em			± 2.59
CD 5%			7.35
CD 1%			10.36

Lentil varietal trial:

In the lentil varietal trial (Table - 6), the local varieties B.77 and B.62 showed the best performance. The yields of NP-11 and NP-47 were low due to poor stand.

Table - 6

Results of lentil varietal trial (1967-68)

Variety	Days to flower	Days to mature	Yield (q/ha)
B-25	71	131	6.15
B-77	60	120	9.48
C-31	60	120	8.16
T-36	70	130	5.20
NP-11	65	135	0.82
T-3	59	131	2.09
B-62	64	122	9.98
T-8	64	131	4.45
NP-47	64	120	1.59
L-9-12	65	130	3.88
S.Em.			± 0.867
CD at 5%			2.54
CD at 1%			3.47

Bengal gram varietal trial

BR-17 followed by the strain 736-1 (Table - 7) outyielded all other varieties including the two local varieties B.75 and B.98.

Table - 7

Results of Bengal gram varietal trial (1967-68)

Varieties	Days to flower	Days to mature	Yield in q/ha.
BG-482	55	136	5.91
CO.1	54	136	4.21
Chaffa	54	136	5.61
Dohad yellow	54	136	6.00
Gwalior-2	61	143	5.95
S.T.4	63	143	4.61
B.R.77	67	143	6.15
B.R.17	59	136	8.05
R.S.10	67	138	6.68
R.S.11	67	138	6.66
Pb.7	66	138	4.47
C.235	66	143	5.29
G.24	66	143	6.42
S.26	69	136	6.17
G.62-404	55	137	5.40
NP 100	69	143	5.87
742-7	61	136	4.91
B-75	54	136	5.43
B-98	65	143	5.27
T-2	60	136	6.19
736-1	69	136	7.43
T_1	56	136	4.89
S.Em.			± 0.749
CD at 5%			2.19
CD at 1%			3.80

Conclusions

Pulse crop occupies the second largest area (after paddy) in West Bengal. These experiments have been repeated during 1968-69 also and it will be possible to draw valid conclusions from the 3 years' trials. A few more trials on cowpeas and Cajanus cajan have also been conducted in the year 1968-69, It is intended to embark upon a number of crop and soil management trials on pulse crops to maximise the yields from some of the improved varieties so far evaluated at this place. The high yields in the short duration varieties of green gram and black gram have enabled us to obtain an yield of 9 to 10 q/ha. when grown after jute or paddy before a rabi crop is sown under West Bengal condition. Next year (1969-70), it is proposed to undertake some work on the manuring (both major and minor elements), liming, mulching, stand establishment and seed innoculation with effect Rhizobium cultures.

From the last three years" results of green gram varietal trials, it was observed that the varieties, Type 2, T 44 and T.51 yielded much higher than the local varieties B-1 and Sonamoong. The quality analysis of those types have not yet been done.

The black gram varietal trial is to be conducted for one more year to draw valid conclusion; however, the two years' results have shown that varieties Mash 48 and T-9 are very promising.

-oOo-

STUDIES IN WEED CONTROL IN RABI PULSES WITH PRE-EMERGENCE AND PRE-PLANTING HERBICIDES

Ranbir Singh and S.L. Chowdhury
Agronomy Division
All India Coordinated Pulse Project, Delhi Centre, IARI, N.Delhi-12

Rabi pulse crops are often subjected to severe competition from unchecked weed growth mainly because of lack of knowledge about the magnitude of the losses caused by weeds. This situation is to a great extent responsible for the generally held belief that pulses are poor man's crop and do not respond to good agronomic practices.

Randomised and replicated preliminary trials were laid out during rabi 1967-68 to assess the losses due to unrestricted weed competition in four important rabi pulse crops, viz., lentil, peas, gram and lathyrus under irrigated condition and also to study the effect of treflan (triflouro, 2, 6 dinitro, N-N-dipropyl-p-toluidine), Balan(2,6 dinitro-p-toluidine), Eptam (S-ethyldipropylthiolcarbamate), Knoxweed (S-ethyl dipropyl thiolcarbamate 46.9% + Isooctyl ester of 2,4-D 35.4%) and Amiben (3 amino 2,5 - dichloro benzoic acid)

All the herbicides, except Amiben, were used as pre-planting application before the final cultivation was given while the later was applied as pre-emergence with respect to weeds and incorporated by shallow cultivation.

Treatments comprised of the following: 1. Unweeded control; 2. Hand weeding once; 3. Hand weeding twice; 4. Treflan at 1 kg. per ha.; 5. Balan at 1 kg. per ha; 6. Eptam at 1 kg. per ha; 7. Knox weed at 3 kg. per ha; 8. Amiben at 3 kg. per ha. These treatments were replicated twice in each of the four crops.

Soil of the experimental site was clay loam and the field was heavily infested with weeds. Wild oats (Avena fatua), senji (Miliolotus parviflora) and Medicage denticulata were the dominant species. Other weed species occuring were Chenopodium album. Spergula arvensis, Coronopus didymus, Fumaria parviflora and Anagallis arvensis.

The germination of these pulses was not affected by any of the herbicides. Eptam and Knox-weed resulted in slight crinkling of the leaves but the symptoms disappeared after sometime.

Weed population count data taken from 5 spots at random in each plot are given in Table 1. Figures in parenthesis devote number of weed plants in herbicide treated plots expressed as percentage of populat on under plots nottreated with herbicide.

Gram and Lathyrus plants in treatments other than hand weedings were completely smothered by weeds so data pertaining to lentil and peas has been presented.

Discussion

A perusal of the data given in Table 1 shows that Treflan and Knoxweed were the most effective of the herbicides in reducing weed infestation. Weed population under these two treatments varied from 38.9 to 43.9 and 38.9 to 57.4 per cent respectively. Reduction in the population of monocotlyedonous weeds consisting mostly of wild oats (Avena fatua) was more pronounced than of dicotyledonous weeds. Amongst the dicot weeds, resistance to herbicides varied greatly. Leguminous weeds were not affected by herbicides and in many cases their number was more in chemically treated plots because of reduced competition from weeds.

An idea about the competition offered by weeds to peas and lentil plants can be had from the weight of fresh green weeds removed in the second week' of March, 1968 (about 5 months after sowing) given in Table 2.

When weeds were allowed to grow unchecked none of the four pulse crops under study could compete successfully. Till growing weeds like wild oats and senji choked to death the plants of gram and Lathyrus even in plots treated with herbicides.

Good results both in respect of weed control and grain yield were obtained with mechanical method weed control, that is, weeding with khurpi in all the cases. In case of peas where the crop could compete successfully with weeds, excellent results were obtained with knoxweed, Balan and Treflan. (Table 2). Yield differences were significant both in lentil and peas.

.....

Table 1

Weed population per 2.5 sq. mtrs.

	Lentil				Peas			
	Dicot		Monocot	G.T.	Dicot		Monocot	G.T.
	Non Leg.	Legume			Non Leg.	Legume		
Average of plots receiving no herbicides	117.6	54.3	40.3	212.3	87.3	62.8	40.6	190.3
Treflan	12 (10.2)	70 (128.9)	11 (27.3)	93 (43.9)	11 (12.6)	62 (99.5)	1 (2.5)	74 (38.9)
Balan	40 (34.0)	52 (95.7)	24 (59.5)	116 (54.6)	43 (49.2)	63 (101.1)	31 (76.3)	137 (72.0)
Eptam	31 (26.3)	85 (156.5)	6 (14.9)	122 (57.4)	53 (60.7)	62 (99.5)	5 (12.3)	[illegible] (33.0)
Knoxweed	55 (46.8)	57 (104.9)	10 (24.8)	122 (57.4)	27 (30.9)	38 (61.0)	9 (22.2)	74 (38.9)
Amiben	53 (45.0)	66 (121.5)	44 (109.1)	163 (76.7)	78 (89.3)	57 (91.5)	28 (69.0)	163 (85.6)

* Figures in parantheses denote number of weeds expressed as a % of weed number in untreated plots in first row.

.....

Table 2

Weight of fresh green weeds and grain yield of pulse in quintals per hectare

Treatment	Lentils		Peas	
	Weed wt.*	Grain yield	Weed wt.*	Grain yield
Unweeded control	573.3	0.50	133.3	1.89
Hand weeding once	104.7	3.61	29.5	20.54
Hand weeding twice	4.5	8.07	Not included	
Treflan	310.5	4.70	19.0	11.24
Balan	382.8	3.02	41.9	17.68
Eptam	499.0	1.26	60.0	2.92
Knoxweed	411.4	2.04	80.0	23.20
Amiben	628.6	2.44	102.8	8.70
'F' test		Sig.	-	Sig.
S.Em		± 2.75	-	± 4.44
C.D. at 5%		9.20	-	11.82

* Green wt., about 5 months after sowing.

SOME CONSIDERATIONS PERTAINING TO HERBICIDE USE IN PULSE CROPS

V.S. Mani, S.L. Phatak and T.K.Chakraborty
Division of Agronomy, I.A.R.I.,Delhi-12

The characteristic slow seedling growth of legumes necessitates adoption of measures to protect those from weeds from the time of sowing of the crops. Freedom from weed growth in the luvenile stages of crop growth is possible through utilisation of the pre-sowing and pre-emergence application of herbicides. The post-emergence technique is designed to deal with weeds that come up late in the season.

Effects produced by these techniques: In the pre-sowing and pre-emergence techniques, herbicides are either sprayed on or incorporated into the soil while the post-emergence technique involves spraying of herbicides on standing vegetation. The former two techniques are helpful in two ways: (1) conditions provided to crop, for its growth in a weed-free environment from the time the crop seeds are sown, maintain the yield at the highest pitch and (ii) fertilisers applied to the soil are utilised by the crop only, due to restricted weed growth from herbicide treatment. The effects of a post-emergence application of herbicides are: (1) application made prior to flowering of weeds leads to gradual mortality of susceptible weeds or prevents the weed seedlings from flowering and (ii) application made subsequent to flowering of weeds may prove inhibitory to formation, filling and viability of weed seeds.

Effects on soil-microflora: Herbicide application to soil (pre-sowing and pre-emergence) raises some important issues. Herbicides may affect soil microflora whose activities are of paramount importance in maintaining fertility and productivity of arable soils. Microbial activity is largely responsible for the decomposition of herbicides in soils, thereby preventing a possible build up of toxic residues. Soil-applied herbicides may also interfere with the formation and functioning of nodule organisms associated with legumes.

The effects of soil-applied herbicides on soil microflora were assessed at I.A.R.I by periodical bacterial counts in the soil samples collected from the field experimental plots. *In vitro* tolerance of nodule bacteria to Lenuron and Propazine was studied by isolating the nodule bacteria (*Rhizobium leguminosarum*) from the crop (pea-variety Bonneville). Pre-emergence application of herbicides did not show any effect on total bacterial counts in soil. *In vitro* studies revealed that Linuron and Propazine upto a concentration of 25 ppm in the culture medium did not depress the growth of the nodule bacterial (Table 1 & 2).

Another equally important aspect that deserves careful attention is concerned with the effect of herbicides on nematodes. There is no escape from undertaking careful and critical research into all these aspects in order that herbicides are employed effectively and safely, keeping in view the soil health. In regard to post-emergence spray with herb-icides the question of accumulation of residues inside plant parts (foliage and seed) needs meticulous study.

Effect of herbicides on quality: Herbicides in sub-lethal doses are being employed to improve the nutritional quality of crop. A product of high quality does not signify only increase in the total protein values. The amino-acid composition must be balanced. There should be an increase in particular aminoacids as lysine and tryptophan. Herbicides in sub-lethal doses may also prove valuable in reducing the neurotoxic principle as in *Lathyrus*. Careful and critical experiments should be carried out for elucidation of the physiological and biochemical mechanisms that determine the beneficial effect of low doses of herbicides on nutritional quality.

Herbicide residues in plants: Notwithstanding the improvement in nutritional quality resulting from application of sub-lethal doses of herbicides, experiments should be taken up to prove that the seed and foliage of treated crops do not carry herbicide residues so as to affect the health of man and animal.

Research on all the above aspects (proper techniques of herbicide application, crop and soil residues) is of a sophisticated nature that needs intensive research by a team of competent plant physiologists, biochemists, microbiologists, residue chemists, agronomists, horticulturists, geneticists, toxicologists and engineers..

Table - 1

Mean total bacterial counts per plate (Dilution $1:10^5$)

Treatments (T)	1965-66 Days after spraying (D) (7)	(35)	(65)	Mean	1966-67 Days after spraying (D) (5)	(35)	(70)	Mean
Control	60.1	63.3	62.3	61.9	70.6	88.3	89.4	82.7
TL pr	59.3	62.4	60.8	60.8	-	-	-	-
TH pr	55.9	58.4	59.3	57.8	-	-	-	-
L pr	60.4	61.4	60.8	60.8	70.9	90.1	90.0	83.6
P pr	58.3	59.3	60.3	59.3	71.4	85.4	90.0	82.2
Mean	58.8	60.9	60.7	-	70.9	87.9	89.8	-
	T	D	D x T		T	D	D x T	
'F' test	N.S	N.S	N.S		N.S	**	N.S	
S.Em±	1.4	1.1	2.4		1.7	1.7	2.4	
C.D. 5%	-	-	-		-	10.3	-	

Table - 2

Mean number of colonies of Rhizobium leguminosarum per plate

Concentration in ppm (C)

Treatment (T)	0.0	1.0	2.5	5.0	10.0	25.0	Mean
Propazine	21.6	20.6	24.0	23.6	21.3	22.6	22.8
Linuron	21.6	22.3	22.0	23.3	21.0	21.3	21.9
Mean	21.6	21.4	23.0	23.4	21.1	21.9	

	C	T	C x T
'F' test	N.S	N.S	N.S
S.Em±	1.37	0.79	1.93

....

Report on the results of Coordinated Microbiological trials, Rhizobial survey and isolation of Rhizobium of different pulse crops

R.E. Rewari and R.S. Bhatnagar

Division of Microbiology
Indian Agricultural Research Institute
New Delhi

A. Inoculation Experiments: During rabi 1967-68, inoculation experiments on gram were conducted at Delhi, Kanpur, Jabalpur, Hyderabad and Coimbatore and those on pea were conducted at Delhi.

The crops were sown with a basal dressing of superphosphate @ 100 kg P_2O_5/hectare. The treatment schedule was as follows:

1. Control
2. Rhizobium
3. 15 kg.N/Hectare
4. 15 kg.N + Rhizobium
5. 30 kg.N/Hectare
6. 30 kg.N + Rhizobium

(Nitrogen was applied in the form of Ammonium sulphate and Rhizobium strains GA and P2 were used in the case of gram and pea respectively).

Replications - 6; Plot size 25' x 20' (1/215 hectare)

The results of the trials at Hyderabad and Coimbatore were already reported in the last Workshop. The results from other places i.e. Delhi, Kanpur and Jabalpur are given in Table I.

From the data in table I it is clear that gram yield was significantly increased due to inoculation at Delhi and the increase was of the order of 28% over control. At Kanpur and Jabalpur the yields were not improved, not only with the inoculation but even by the application of nitrogen @ 30 kg.N/Hectare. Nodulation study revealed that the inoculated series was better nodulated than uninoculated.

The inoculation trials with Pea at Delhi did not show any improvement due to inoculation. This might be due to the fact that yields obtained (2150 kg./hectare) are about the maximum and that is why there was no improvement by any treatment including 30 kg.N/Hectare.

.....Table 1

Table 1

Inoculation trials on gram and pea. (Gram Yield kg./plot) average of 6 replications: 1/215 of hectare).

Treatments

Place	Control	Rhizobium	15 Kg.N	15 Kg.N+R	30 Kg.N	30 Kg.N+R
Crop-Gram						
Delhi	4.80 (1032.0)*	6.15 (1322.2)	3.90 (838.5)	4.15 (892.2)	4.36 (937.4)	5.15 (1107.2)
	Significant at 5% level. C.D. at 5% - 0.723					
Kanpur	4.62 (993.3)	4.10 (881.5)	4.25 (913.7)	3.47 (746.0)	2.90 (623.5)	3.21 (690.1)
	Not significant					
Jabalpur	3.64 (774.0)	3.11 (668.6)	3.23 (694.4)	3.47 (746.0)	3.17 (681.5)	3.40 (731.0)
	Not significant					
Crop-Pea						
Delhi	10.0 (2150.0)	8.9 (1913.5)	10.4 (2236.0)	9.3 (1999.5)	10.3 (2214.5)	9.0 (1935.0)
	Not significant					

* Figures in parenthesis indicate yields per hectare.

The reports from the other areas where the cultures were supplied are very encouraging. Shri R.N.Kaul, Head of the Division, Resource Utilisation Studies, Central Arid Zone Research Institute, Jodhpur observed that though the yield of moong grain was low due to prolonged drought conditions in kharif 1968, the inoculation had definitely given an increase of 14.2 per cent, over control. Further Shri M.Lakshmikantham, Sugarcane Specialist, Anakapalle, reports high increase over control due to inoculation in the case of moong crop. He writes that in the uninoculated plot sown with the local variety germination was found to be comparatively poor and the few plants that came up failed to establish. Leaves of the uninoculated plants began curling, and growth was stunted and finally they perished. In the case of local variety inoculated with rhizobium culture yield was 231 kg./ha., while uninoculated gave only 4.4 kg./ha. One of the reasons for perishing of the plants may be attributed to the absence of native rhizobium strains, and low available nitrogen status of the soil. Though this is an extreme case, it stresses the need for locating areas of rhizobial deficiency and inoculation since most of the tracts where pulses are grown do not normally receive adequate manuring.

B. Screening of strains:

Experiment on screening of different Rhizobium strains of Lathyrus sativus (Khesari) was conducted in pot culture at Delhi with a basal dressing of superphosphate @ 100 kg. P205/ha.

The experimental schedule was as follows:

Treatment:
1. Control
2. Khesari - 1
3. Khesari - 2
4. Khesari - 3
5. Khesari - 4
6. Khesari - 5
7. Khesari - 6
8. Khesari - 7

Inoculum of Rhizonium strains.

Replications: 6 (for the observation of yield)

No. of plants per plot : 4

Table 2

Screening of Rhizobium strains of Khesari Rabi 1967-68 Delhi (Grain yield - gms; average of 6 replications, Pot experiment)

	Control	Strain 1	Strain 2	Strain 3	Strain 4	Strain 5	Strain 6	Strain 7
Yield	6.998	9.845	12.938	9.779	13.339	12.173	18.281	20.423
	(Significant at 5%, C.D. 8.0121)							
Nodule No.	311	802	1103	748	1025	1347	924	645

From Table 2 it is evident that two strains 6 and 7 of Rhizobium gave significantly higher yield than the control and the number of root nodules was more in all the inoculation treatments than the control.

C. Survey of Root Nodules for Isolation of Rhizobium strains:

As decided in the last Pulse Workshop held at I.A.R.I., New Delhi on 1st April, 1968, survey of root nodules for isolation of Rhibozium strains of different pulse crops was conducted at Delhi, Jabalpur and Hyderabad. In kharif crops, varieties of Phaseolus mungo (Black gram, urd), P.aureus (green gram, mung), Vigna sinensis (Cowpea, lobia) and Cajanus cajan (Pigeon Pea, Rahar) growing at the above centres were surveyed and nodulation was examined. Nodules for isolation purpose were collected from those varieties in which nodulation was best at the respective places. At Hyderabad survey of kharif pulses was conducted twice, i.e. in September, 1968 and January, 1969.

In urd crop at Delhi variety BR-61, at Jabalpur variety T-27 and at Hyderabad variety T-27, N 212, BG 189, PU 369 Khargaon 3 and 1766 were found to be best nodulating and showed good, moderate and moderate grade of nodulation at respective centres (Table 3).

Variety T-27, showed moderate type of nodulation throughout at all the three places.

In mung, varieties T-2, 305, 24-2, BR-2 and HYB-45 at Delhi, varieties Mung 305, N-54 and NP-23 at Jabalpur and varieties T-2, HYB-45, Black, Mung 305, BR-2 and PB-4 at Hyderabad were found to be best nodulating in comparison to other varieties and had moderate, good and moderate type of nodulation respectively (Table 4).

Varieties T-2, 305, and Hyb.45 appear to be moderately nodulating at all the three places (Table 4).

In cowpea at Delhi, variety NP-2, at Jabalpur, variety Meshad and NP-2, and at Hyderabad variety Local, Early Bold, and Early Ramjan, showed good type of nodulation (Table 5).

Variety N.P.-2 showed good nodulation at Delhi and Jabalpur.

At Jabalpur out of 16 varieties of Rahar crop only two varieties: NP7-5 and Khargaon were found to be nodulating and that too poorly. At Hyderabad out of 17 varieties, varieties Coimbatore 1141, T-7 and ST-1 showed good to moderate type of nodulation. The rest showed either no nodulation or very poor (Table 6).

Among rabi pulses, Cicer arietinum, and Pisum sativum at Delhi and Hyderabad and Lathyrus sativus at Delhi only were surveyed in January, 1969.

In gram at Delhi best type of nodulation was of moderate type and was found in varieties 736-1, NP-53, C-235 and S-1 and in rest of the varieties was poor to nil (Table 7).

At Hyderabad varieties GWL-2, G-62-404, T-1 and T-2 showed good type of nodulation and in rest 15 varieties it varies from poor to moderate (Table 7).

Variety Kanpur Selection of Pea could nodulate moderately at Delhi and Hyderabad both while rest of the varieties at Delhi did not nodulate and at Hyderabad nodulated very poorly to nil (Table 8).

Six varieties of Khesari were surveyed at Delhi and out of these variety P9-68 showed good type of nodulation (Table 9).

D. Isolation of Rhizobium...

Out of all the varieties of different kharif and rabi pulses, 6 strains of Rhizobium, from the best nodulating variety of each place were isolated and are under further purification and tests. Thus 168 strains of 25 varieties of 7 pulse crops from Delhi, Jabalpur and Hyderabad soils were isolated (Table 10).

If the varieties for different pulse crops suitable to different tracts are fixed, then the different isolates obtained may be tried in areas deficient in Rhizobium so that best strains suited for different crops can be selected. Such advantage was experienced in Delhi where the variety (NP-53) in the varietal trials was found to nddulate moderately responded well to inoculation in the field trial (Tables 1 & 7).

Table.3

Nodulation patter in *Phaseolus mungo* (Urid, black gram)

Sl.No.	Variety	Nodulation pattern			
		DELHI	JABALPUR	HYDERABAD (Summer	(Winter)
1.	T-9	-	-		Very poor
2.	T-27	Moderate	Moderate*	Moderate	-
3.	T-65	Moderate	Poor	-	-
4.	No.-1-1	Moderate	-	-	-
5.	No.35-5	Very poor	-	-	-
6.	No.212	-	Poor	-	Moderate*
7.	M760	-	Poor	-	-
8.	BR-61	Good*	Poor	-	-
9.	BR-68	Moderate	Poor	-	Very poor
10	BG-189	-	-	Moderate	-
11.	BG-369	-	-	-	Moderate*
12.	D6-7	-	Poor	-	-
13.	NP-50	-	Poor	-	-
14.	Mash-48	Poor	-	-	-
15.	Khargaon-3	-	-	-	Moderate*
16.	Sindh-Khadal-1	-	-	-	Poor
17.	1766	-	-	-	Moderate*
18.	55	-	-	-	Poor

Table 4

Nodulation Pattern in *P.aureus* (Mung, Green gram)

S. No.	Varieties	Nodulation			
		DELHI	JABALPUR	HYDERABAD	
				Summer	Winter
1.	T-2	Moderate*	-	Moderate	-
2.	T-44	-	-	[illegible]	Poor
3.	T-51	-	Poor	Poor	Poor
4.	T-45-6	Poor	Moderate	-	-
5.	Mung-305	Moderate	Good*	-	Moderate*
6.	24-2	Moderate	-	-	-
7.	BR-2	Moderate	Poor	[illegible]	Moderate*
8.	Hyb-45	Moderate	Moderate	Moderate	Poor
9.	B-1	poor	-	-	-
10.	24-3	-	Moddfate	-	-
11.	N-54	-	Good*	-	-
12.	RS-4	-	Poor	-	-
13.	RS-5	-	Poor*	-	-
14.	NP-23	-	Good*	-	-
15.	Black	-	-	Moderate	-
16.	GG 525	-	-	-	Poor
17.	PB.M.	-	-	-	Moderate

Table 5

Nodulation pattern in *Vigna sinensis* (Lobia, Cowpea)

S. No.	Variety	Nodulation			
		DELHI	JABALPUR	HYDERABAD	
				Summer	Winter
1.	T-2	Poor	Moderate	-	Moderate
2.	Local	-	-	-	Good*
3.	5286-3	Moderate	Moderate	-	-
4.	Early bold	-	-	-	Good*
5.	K-11	Poor	Moderate	-	Moderate
6.	K-14	-	-	-	Moderate
7.	NP-2	Good*	Good*	-	-
8.	K 313	-	-	-	Moderate
9.	25	-	Poor	-	-
10.	T-19	-	Moderate	-	-
11.	Meshad	-	Good*	-	Moderate
12.	Mustak	-	-	Poor	-
13.	21	-	Poor	-	-
14.	Early Ramjan	-	Poor	-	Good*
15.	Black eye	-	Poor	Poor	-
16.	16	-	Poor	-	-
17.	23	-	poor	-	-
18.	14	-	Poor	-	-
19.	11	-	Nil	-	-
20.	19	-	Moderate	-	-
21.	8	-	Poor	-	-
22.	9	-	Poor	-	-
23.	5		Poor	-	-
24.	12		Poor	-	-
25.	18		Nil	-	-
26.	3		Poor	-	-
27.	Russin Giant (RSG)		-	Moderate	Moderate
28.	RS-9		Moderate	-	-
29.	15		Poor	-	-
30.	K-41		Moderate	-	-
31.	JC-10		Poor	-	-

Table 56

Nodulation pattern in *Cajanus cajan* (Arhar, Pigeon pea)

S. No.	Variety	Nodulation		
		JABALPUR	HYDERABAD	
			[illegible]	Summer
1.	T-17	Nil		Poor
2.	S-103	Nil		Very poor
3.	B-7	Nil		Very poor
4.	BR-60	Nil		-
5.	GWL-3	Nil		Poor
6.	T-7	Nil		Moderate
7.	NRW-5	Poor		-
8.	T-21	Nil		Very poor
9.	BG-72	Nil		Poor
10.	148	Nil		Nil
11.	2E	Nil		-
12.	75	Nil		-
13.	N-84	Nil		-
14.	C-11	Poor		Very poor
15.	BR-183	-		-
16.	Khargaon	-		-
17.	NP-69	-		Poor
18.	S 101	-		Nil
19.	PT 301	-		Nil
20.	P 4839-67	-		Poor
21.	P 4785-67	-		Nil
22.	P 4759-67	-		Very poor
23.	Coimbatore 1141	-		Good*
24.	ST-1	-		Moderate

Table 7

Nodulation pattern in *Cicer arietinum* (Chana, Gram)

S. No.	Variety	Nodulation	
		DELHI	HYDERABAD
1.	742-7	Poor	Moderate
2.	B-9	-	Poor
3.	736-1	Good*	Moderate
4.	NP-53	Moderate	-
5.	GWL-2	Poor	Good*
6.	C-235	Moderate	Moderate
7.	BEG-64	-	Moderate
8.	Dohad Yellow	Very poor	-
9.	Pb-7	Moderate	Moderate
10.	S-26	Very poor	Moderate
11.	BR-77	Poor	Moderate
12.	ST-8	-	Poor
13.	S-1	Moderate	-
14.	Chatta	-	Poor
15.	B-98	Poor	-
16.	G-62-404	-	Good*
17.	PG-432	Nil	Poor
18.	ST-4	Nil	-
19.	NP-58	-	Moderate
20.	RS-11	Poor	Poor
21.	PEG-35	-	Moderate
22.	G-24	Poor	Moderate
23.	T-1	-	Good*
24.	T-2	-	Good*
25.	RS-10	Very poor	Poor

Table 8

Nodulation pattern in *Pisum sativum* (Matar, Pea)

S. No.	Variety	Nodulation	
		DELHI	HYDERABAD
1.	Kanpur selection	Moderate*	Moderate*
2.	Early December	Nil	Nil
3.	T-163	Nil	
4.	T-61	Nil	Very poor
5.	Bonnivilla	Nil	Very poor
6.	T-56	Nil	Very poor
7.	Patna Queen	Nil	Very poor
8.	T-19	Nil	Nil
9.	T 6113	Nil	Very poor
10.	BR-12	Nil	Very poor

Table 9

Nodulation in *Lathyrus sativus* (Grass Pea - Khesari)

S. No.	Variety	Nodulation
		DELHI
1.	P6-68	Moderate
2.	P9-68	Good*
3.	P10-68	Moderate
4.	P11-68	Moderate
5.	P13-68	Moderate
6.	P41-68	Moderate

Table 10

Rhizobium strains isolated from varieties of Pulses.
Nodulating best at Delhi, Jabalpur and Hyderabad, 1968-69

Crop	Varieties from which Rhizobium strains isolated			Total
	Delhi	Jabalpur	Hyderabad	
Phaseolus mungo	BR-61	T-27	N212, Khargaon-3, BG 369 1766	6
P. aureus	T-2	Mung 305, N-54, NP-23	Mung 305, BR-2, PB-M	7
Vigna sinensis	NP-2	NP-2, Meshad	Local, Early bold, Early Ranjan	6
Cajanus cajan	-	-	Coimbatore 1141	1
Cicer arietinum	736-1	-	GWL-2, G-62-404, T-1, T-2	5
Pisum sativum	Kanpur selection	-	Kanpur selection	2
Lathyrus sativus	P9-68	-		1
			Grand total	28 (25)

Total strains : 28 x 6 = 168

STUDIES ON THE IMPROVEMENT OF EFFICIENCY OF RHIZOBIUM

P.Nandi (Calcutta)

Studies on the improvement of efficiency of Rhizobium strains isolated from 11 tropical pulse and other legume crops were undertaken. The cultures of Rhizobium were prepared from nodulated root of the legumes and the area of collection of samples covered, West Bengal and some parts of Assam and Orissa. The hill district of Darjeeling was included in the survey.

The rhizobial cultures were purified and tested in pot culture to determine their efficiency. The weekly active strains were rejected; of the selected strains, 5 from each group was studied to determine if they are sensitive to the heterogenous Rhizobiophage isolated and purified before. The phages showed specificity against bacterial strains.

The development of phage-resistant strain was then undertaken by specific treatment; resistant mutants were isolated, characterised and their effectivity with regard to the fixation of atmospheric nitrogen was studied. Experiments on induced mutation showed that the UV treatment induced the character for resistance in some mutants. These mutants were later tested by pot culture and finally in field trial to evaluate their effectivity. Both the phage-induced and UV-induced mutants were tested in potculture and some of the strains were finally selected for field experiments.

From the data collected in field experiment (Table 1) it was shown that phage-resistant strains of Rhizobia for Cicer aeritinum and Arachis hypogeae showed significant improvement in nitrogen fixing efficiency over the non-resistant ones. The same effect was observed in the case of Lens esculenta and Phaseolus radiatus. In the other 3 legumes e.g., Lathyrus sativus, Cajanus indicus and Trigonella faenum graecum the difference in nodulation was less significant. In the field trial, the data was collected on the number of nodules dry wt. of plant material and yield of fruits.

It was observed that inoculation of seeds with both resistant and non-resistant strains of Rhizobium produced nodules and the crop was healthy. The controls in many cases do not develop any nodule (Cicer aeritinum). The field trial experiments were later extended to different parts of West Bengal with different soil conditions.

The selected rhizobia were applied as seed inoculant in all cases and the results show that groundnut bacteria performed uniformly in most soil with adequate nutrition and pH condition. Large-scale application of groundnut bacteria is now in progress over an area of nearly 2000 acres in different states. The results are now being compiled by the individual field stations.

...

Table 1

Host Legume	Av. No. of nodules per plant	Av. No. of fruits per plant
(1) *T.faenum-graecum*	18(R)/14(NR)	20(R)/16(NR)
(2) *Lens esculents*	16(R)/9(NR)	11(R)/ 8(NR)
(3) *Phaseolus radiatus*	8(R)/6(NR)	7(R)/ 5(NR)
(4) *Archis hypogeae*	129(R)/64(NR)	49(R)/31(NR)
(5) *Cicer aeritinum*	15(R)/ 6(NR)	13(R)/ 6(NR)
(6) *Cajanus indicus*	6(R)/ 4(NR)	41(R)/30(NR)
(7) *Lathyrus sativus*	14(R)/11(NR)	12(R)/ 9(NR)

EFFECT OF TOXIC SEED DIFFUSATES ON THE INOCULATION OF PULSE CROPS

K.R. Daderwal and A.N. Sen
Division of Microbiology
Indian Agricultural Research Institute
New Delhi.

For the success of Rhizobium inoculation of pulse crops it is necessary that a large population of the bacteria should survive on the surface of theseeds, till they infect the root hairs and produce nodules. But recent works of Jacob and Dodd (1958), Thompson (1960) and Bowen (1961) showed that seed coats of some of the leguminous and non-leguminous crops contain soluble antibacterial substances which inhibit the growth of many bacterial species including rhizobia. Studies were therefore, conducted to examine whether such antibacterial substances on the seed surface influence the Rhizobium population inoculated in the seeds of pea (Pisum sativum) and gram (Cicer arietinum).

The inhibitory effects of seed coat diffusates of different varieties of pea (Pisum sativum) gram (Cices arietinum) on their respective Rhizobium was found to differ widely. For instance, whereas 0.4 ml. of gram seed diffusate was found to be sufficient to almost completely inhibit the growth of corresponding Rhizobium. The same amount of pea seed diffusates affected only about 30% inhibition on the growth of pea Rhizobium (Figs. 1 & 2.)

It was further observed that pea seeds required 6 hours soaking for the complete elimination of the toxic substance while 16-24 hours soaking was required in case of gram and moong seeds. Present studies also revealed that even different varieties of the same species of pulses varied in the extent of toxicity of seed coat. This varietal difference was more pronounced in case of gram and moong seeds than in pea seeds. For example, though most of the varieties of gram required 24 hours soaking for complete removal of the toxicity, one variety of gram (N-59), did not contain any toxicity at all. Similarly different variation of moong (Ph. aureus) required 16-24 hours soaking for complete removal of toxicity.

Examination of survival of Rhizobium population on the inoculated pea and gram seeds revealed that soaking of the seeds prior to inoculation resulted in the survival of a large population of Rhizobium upto 7 days whereas in the unsoaked seeds the inoculated Rhizobium population rapidly declined (40-80%) after 24 hrs. (Fig. 3).

Further, in pot culture experiment with gram and pea it was found that significant (at 5% level) increase in the yield of grains can be obtained by soaking the seeds in water for the removal of toxic compounds prior to inoculation.

In case of pea and gram inoculation of unsoaked seeds, 41.7 and 26.8% increase in the yield was obtained, whereas with the inoculation of soaked seeds the percentage increase in the yield amounted to 87.0% and 67.8% respectively.

-oOo-

A NOTE ON IMPROVING THE EFFICIENCY OF RHIZOBIAL STRAINS FOR PULSE CROPS

G. Rangaswami
University of Agricultural Sciences, Bangalore

In the past we have emphasised on the need for obtaining large collections of different strains of Rhizobia from different parts of India and from different host plants, and select the most efficient strains for use in legume seed inoculation. It has also been emphasised that any one single strain suitable for a given crop in one locality may not be suitable for another locality with different climatic conditions and soil types. It has been shown by some workers that a rhizobial strain may not be effective in nodulating all the different varieties of a given plant species. Thus, there seems to be need for a better understanding of the complexities of Rhizobium - variety relationships.

It is to be realised that we may not be able to obtain one single strain of Rhizobium to nodulate all the varieties of a given crop, even for a limited tract of a State or District. Therefore, when we are planning to multiply rhizobial strains and distribute them for use by farmers all over India, we have to think in terms of producing composite cultures. Steps need to be taken under the co-ordinated programme to obtain composite cultures for different pulse crops or groups of crops for a given tracts. In other countries composite cultures for (a) cowpea group, (b) pea group, (c) soyabean group, etc., have been developed. In India also there is need for such an approach.

Under the co-ordinated project, steps may be taken to obtain different strains of Rhizobia for a given legume group, test them for their nodulating capacity on different varieties of pulses and in different soil types. This work has to be carried out on zonal basis, in different parts of India. After evaluating the nodulating capacity of different strains under different environmental conditions, the best strains may be selected and grouped for regions as well as varieties. The selected strains with diverse qualities may then be mixed together and prepared as composite cultures. When such composite strains are prepared they may be tried in a limited number of selected farmers fields all over the country before advocating their wide use.

It is possible that we may get one or two composite cultures for all the pulse crops grown in India. Each composite culture may consist of about 10 to 15 strains of diverse qualities. If such composite strains are obtained it can then go into commercial hands for multiplication and distribution. Furthermore, the following lines of studies may be taken up under the co-ordinated project.

(i) When incompatible strain of Rhizobia are mixed there may be inhibition of nodulation, resulting in a great damage. Therefore, careful screening and testing of mixed strains is necessary.

(ii) Steps may also be taken to obtain induced mutants from the efficient strains so as to improve the nodulating and nitrogen fixing qualities.

(iii) Techniques may have to be developed to carry out quick and large scale laboratory tests to screen large collections of rhizobial strains for efficiency to nodulate as well as for better nitrogen fixation.

Since the above work need to be carried out of different centres in India the possibility of appointing additional staff at two or three more centres other than I.A.R.I may be examined.

-oOo-

STUDIES ON THE WILT OF GRAM AND LENTIL

M.N.Khare, H.C. Sharma,
R.P.Mishra and U.S.Kushwaha

Department of Plant Pathology
J.N.K.V.V.,Jabalpur

Bengal gram (Cicer arietinum) and lentil are major pulse crops of Madhya Pradesh, occupying 1.47 and 0.28 million hectares respectively. Both the crops are subject to various diseases out of which wilt is the most important as it causes heavy losses. Twenty four varieties of Bengal gram and and ten varieties of lentil in coordinated varietal trial and seventy two lentil varieties in observation plots were screened for wilt disease.

Wilt of Bengal gram:

Wilt of Bengal gram has been investigated by many pathologists time to time and has proved to be a problem of complex nature involving several pathogenic fungi Fusarium sp. ; Operculela padwickii; Rhizoctonia sp.;Sclerotium sp. Neocosmospora sp. etc.

In the present studies in 24 varieties of Bengal gram, Fusarium sp. and Rhizoctonia sp. were found to be associated with wilt disease. In some of the varieties only one of the fungi was obtained whereas from some both the fungi were isolated. The percentage of both these fungi isolated from different varieties is given in Table 1.

Table - 1: Percentage of Fusarium sp. and Rhizoctonia sp. isolated from the roots of wilted plants.

S.No.	Variety	Rhizoctonia sp.	Fusarium sp.
1.	736-1	40	60
2.	T-87	-	100
3.	G-4	-	100
4.	B-75	50	50
5.	BG 482	-	100
6.	RS 11	85	15
7.	RS 10	-	100
8.	T-2	-	100
9.	Adt 5	6	100
10.	Pb 7	-	100
11	NP 100	80	20
12.	B 98	-	100
13.	BR 17	80	20
14.	Early gram 742-7	-	100
15.	C 235	100	-
16.	BR 77	-	100
17.	G-62-404	-	100
18.	St-4	45	55
19.	J-1	30	70
20	Chaffa	45	55
21.	Gwalior-2	45	55
22.	Dohad Yellow	60	40
23.	CO-1	42	58
24.	3-26	20	80

All the isolates proved to be pathogenic.
The field screening of 24 varieties was done in the coordinated varietal trial. The data are presented in Table 2.

Table - 2. Percentage of wilted gram plants in the coordinated varietal trial.

S.No.	Variety	Mean of 4 replications	S.No.	Variety	Mean of 4 replications
1.	736-1	0.43	13.	BR 17	2.38
2.	T-87	5.49	14.	E.Gr.642-7	3.09
3.	G-4	1.51	15.	C.235	0.89
4.	B.75	1.31	16.	BR 77	1.97
5.	BG 482	2.77	17.	G.62-404	1.39
6.	RS.11	3.13	18	ST-4	2.47
7.	RS.10	2.10	19.	T-1	7.53
8.	T-2	2.26	20.	Chaffa	3.42
9.	Adt 5	0.84	21.	Gwalior 2	3.27
10.	Pb.7	1.39	22.	Dohad Yell.	2.60
11.	NP 100	2.57	23.	Co.1	3.92
12.	B 98	2.94	24.	3-26	1.87

The data were statistically analysed and the differences between the varieties were found significant. The least incidence was recorded in varieties 736-1, C 235, Adt 5, B 75, G-62-404, G 4 and Pb.7 and the highest incidence was recorded in Chaffa, T-87, and T-1.

Sixteen varieties were screened against Fusarium sp. by pot culture technique. The fungus was grown in soil maize medium. A quantity of 200 gms. of the inoculum was mixed in the sterilized soil in each pot (9"). In each pot 15 seeds were planted. The experiment was replicated four times. The first appearance of the disease was noted after one month of sowing in the varieties T-87, Gwalior 19, Adt 5, and hybrid 694. All the tested varieties were found to be susceptible. The percentage of wilting is given in table 3. The maximum incidence was not in the local, and the minimum in Strain 76 having 82% and 18% wilting respectively.

Table - 3. Percentage of wilting in different varieties of gram.

S. No.	Variety	Mean of 4 replications	S.No.	Variety	Mean of 4 replications
1.	Type 87	45.9	9.	GO-19	55.0
2.	Adt-5	27.4	10.	Warrangal	61.8
3.	T-1	38.6	11.	Strain 76	18.0
4.	Ujjain 24	50.0	12.	Chaffa	60.7
5.	Indore 707	41.0	13.	Indore 22	19.0
6.	CT 8	59.0	14.	Dacca	69.0
7.	Gwalior 2	60.0	15.	T.710-4	61.0
8.	Hybrid 694	48.0	16.	Local	82.0

Recently, Sclerotium rolfsil has been isolated from wilted gram plants around Jabalpur and the fungus has been proved pathogenic. At Gwalior Operculela padwickii is the major casual agent responsible for the wilt of gram. In the screening studies all the 16 varieties tried were found to be susceptible.

Wilt of Lentil.

Incidence of wilt was recorded on ten varieties grown in varietal trial at Jabalpur and 72 varieties were screened for wilt disease which were grown in observation plots. The data are given in Table-4.

Table-4. Percentage of wilt incidence in different Varieties of lentil in coordinated trials.

S.No.	Variety	Mean of 4 replications	S.No.	Variety	Mean of 4 replications.
1.	C-31	8.71	6.	NP 11	3.12
2.	B.77	9.99	7.	T.3	8.56
3.	T.36	3.55	8.	B.62	6.85
4.	T.8	9.04	9.	NP.4	10.48
5.	B.25	2.75	10.	L G.12	1.82

Data were statistically analysed. Varieties differ significantly in their susceptibility to wilt. The varieties LG 12, B-25, NP-11, and T-36 appear to be promising from the point of view of wilt resistance and are being tested under artificial conditions.

Table-5. Percentage of wilt incidence in different varieties of Lentil in the observation plot.

S.No.	Variety	Mean %	S.No.	Variety	Mean %
1.	S 61-7	1.01	37.	S 61-69	5.54
2.	Pushore-1	4.03	38.	Damoh 2	7.58
3.	Kewlari-3	5.02	39.	S 61-39	7.05
4.	S 64-376	4.63	40.	Damoh 1	7.04
5.	Vidisha 9	6.17	41.	S 61-92	8.46
6.	S 61-96	5.08	42.	Chapara 5	7.98
7.	Kewlari-1	5.50	43.	S 64-397	7.79
8.	S 61-19	5.96	44.	Khandwa 1	8.44
9.	S 61-51	5.23	45.	Vidisha 11	8.29
10.	S 61-31	6.60	46.	S 61-88	8.36
11.	S 61-20	5.71	47.	Vidisha 8	7.82
12.	Pushore 2	4.03	48.	S 61-27	8.87
13.	Vijaygram	6.54	49.	Vidisha 6	9.00
14.	Khandwa 2	7.00	50.	Biora 1	9.54
15.	S 61-48	6.38	51.	Kewlari 2	9.80
16.	Sagar 3	7.33	52.	Vidisha-7	8.58
17.	S 61-85	7.24	53.	S 61-58	9.05
18.	S 64-370	7.74	54.	S 61-78	10.04
19.	S 61-33	9.07	55.	Biora 3	13.81
20.	S 61-38	8.03	56.	Chapara 4	12.61
21.	S 61-10	7.26	57.	S 61-93	13.92
22.	S 64-399	8.27	58.	S 61-43	14.23
23.	S 61-13	6.48	59.	Vidisha 2	17.85
24.	Sagar 2	8.68	60.	S 61-61	20.13
25.	S 64-388	3.08	61.	S 61-28	9.09
26.	Kewlari-4	7.60	62.	Vidisha 10	8.80
27.	Vidisha-4	4.83	63.	S 64-33	10.03
28.	Vidisha 1	5.20	64.	S 61-54	10.65
29.	S 61-34	5.25	65.	S 61-17	9.14
30.	S 61-83	6.78	66.	Jabalpur	10.10
31.	S 61-95	6.13	67.	S 61-104	10.67
32.	S 61-94	6.18	68.	Chappara 6	12.14
33.	S 61-41	5.71	69.	Panna	13.02
34.	S 61-402	5.93	70.	Vidisha 3	13.00
35.	Chapara-3	6.92	71.	S 61-3	16.45
36.	Chapara 2	5.62	72.	S 61-11	19.34

In all the cases Fusarium spp. were found to be associated with wilted roots. The pathogenicity was proved in all the cases.

The least incidence was recorded in the variety S 61-7 (1.01%) and the highest was recorded in S61-61 (20.13%).

Lathyrus:

Lathyrus germ plasm was screened against rust caused by Uromyces fabae. In all 119 lines were examined and classified into five groups as given below:

1. Rust free (Immune).....One (1).
2. Trace (Resistant).....43
3. Light (Semi-resistant).....23
4. Moderate (moderately susceptible)....26
5. Heavy (Susceptible).....26

A blight caused by Cercospora sp. was observed on several lines of L. sativus. Under field conditions L.aphaca; Lo 95: Lo 96; Lo 97; Lo 98; Lo 99; Lo 100; and Lo 101 were found to be resistant, LS-1; LS-2, LS-3; LS-5; LS 369 were found to be semi-resistant; and other 82 germ plasm collections of L.sativus lines have exhibited moderate to highly susceptible reaction to the disease.

-oOo-

STUDIES ON THE VIRUS DISEASES OF PULSE CROPS IN LUCKNOW AND ITS SUBURBS

G.S.Verma, H.N. Verma and K.M. Srivastava
Department of Botany, University of Lucknow, Lucknow

I am presented before you some observations which we have made during last three years on virus diseases of pulse crops in localities of Lucknow and its suburbs. An extensive survey of these localities revealed that a number of pulse crops (e.g. urd, moong, arhar, pea, beans, soyabean, lobia) showed symptoms of disease which were suspected to be of viral nature. The incidence of the disease was variable from season to season, and symptoms observed on various plants were as follows:-

1. Phaseolus mungo

Three types of disease symptoms were observed on urd, plants collected from different localities.

(a) The symptoms appeared as chlorotic spots on the leaves, which coalesced later on and produced yellow patches. In extreme cases complete yellowing of leaves was noticed and the size of the plants was drastically reduced - 'Yellow Chlorosis of Urd'.

(b) The lower leaves of plants showed dark green mosaic symptoms, while the newly emerging leaves showed severe mosaic symptoms. The plant growth was checked and the size of the pods was reduced - 'Mosaic of urd'.

(c) Diseased plants in the earlier stages showed mild mosaic symptoms. The mosaic symptoms were followed by deformation, curling and rolling of leaves - 'Distortion mosaic of urd'.

2. Phaseolus lunatus var. macrocarpus (Lima bean) -

The diseased plants showed dark green vein banding of the leaves and the size of the plants was extremely reduced.

3. Cajanus cajan (Arhar)-

Lower leaves of the diseased plants showed mild mosaic symptoms while the young leaves were symptomless.

4. Dolichos lablab (Sem) -

Severe yellow mosaic symptoms associated with several necrotic brown spots on the leaves were observed.

5. Pisum sativum (Pea) -

The leaves showed chlorosis along the veins. The margins of the leaves were rolled upwards and the size of the leaves was reduced and their shape became linear. The plant growth was checked.

Besides above symptoms, pea plants also showed necrotic mild mosaic and severe mosaic symptoms. The incidence of the disease was, however, very low.

6. Glycine max (Soyabean) -

The diseased plants showed severe mosaic symptoms. The newly emerging leaves were puckered and reduced in size. In advanced stage of disease the leaves turned chlorotic and their size was extremely reduced. The growth of the plants was also retarded.

7. Vigna sinensis (Lobia) -

Two types of symptoms were recorded on Lobia plants.

(a) Leaves of the plants showed severe mosaic symptoms. Leaf lamina was variously deformed and the size was also reduced. 'Mosaic of Lobia'.

(b) The diseased plants showed yellow necrotic rings on the leaves. The size and shape of the leaves was, however, not affected = 'Necrosis of Lobia'.

Thus survey results revealed that a large number of pulse crops showed disease symptoms which were suspected to be of viral nature. It is, therefore, proposed to investigate systematically various aspects of virus diseases of some important pulse crops. It is also proposed to study measures of control of these diseases by fertilizer treatment, spray of chemicals and by controlling the different insect vectors of these diseases in subsequent studies.

The diseased specimens were brought to the laboratory and tested for presence of different pathogens. Crude sap from diseased leaves was inoculated to healthy, virorously growing seedlings.

Insect transmission tests were done by using different aphid species. Seed transmission tests were also done. For seed transmission studies, seeds were collected from the severely infected plants and sown in pots, and the symptoms of virus were looked for on young seedlings. The viral nature of the disease was confirmed by serial transmission tests theereafter.

Experimental Results

Out of the various diseases recorded on pulse crops only the mosaic disease of cowpea and urd were found to be mechanically transmissible, and hence these two diseases were taken up for detailed studies.

1. Mosaic Disease of Cowpea (Vigna sinensis) Red

This disease was characterized by severe mosaic symptoms and blistering of leaves. The leaf lamina was variously deformed and the plant growth was retarded. Symptoms were comparable to those of Nariani and Kendaswamy's virus (1961).

The disease was found to be mechanically transmissible to cowpea plants. Transmission tests to following hosts were negative:

LEGUMINOSAE: Phaseolus aureus, P. mungo, P. lunatus, P. aconitifolius, Dolichos lablab, D. biflorus, Pisum sativum, Lathyrus odoratus, Vicia faba, Trifolium alexandarium, Medicago sativa, Melilotus alba, Crotolaria juncea, Glycine max, Cyamopsis tetragonoloba, Vigna sinensis (White, Black seeds) and Lobia T2.

SOLANACEAE: Datura metal, D. stramonium, Capsicum annuum, Lycopersicon esculentum, Petunia hybrida, N. glutinosa, N. tabacum spp., N. rustica spp. Solanum melongena.

Zinnia elegans; Viola sp., Brassica oleracea var. Knol khol.

Nariani and Kandaswamy's virus (1961) differs from the virus described here in being transmitted to Vigna spp. and Phaseolus sp., and in producing local lesions on V. vexillata.

Symptoms on Lobia plants (Red)-

The symptom appearance and the incubation period of the virus varied significantly with the climatic conditions and temperature.

Symptoms at high temperature (above 35°C - in summers) -

The incubation period ranged from 6 to 8 days. The inoculated leaves showed chlorotic lesions, while the newly emerging leaves showed mild mosaic symptoms. Subsequently, the leaves showed chlorotic patches of light green to light yellow colour. The leaves gradually turned yellow and finally dried. The plant growth was checked and pod size was reduced.

Symptoms at low temperature (Below 30°C - in winters)

The incubation period ranged from 10 to 12 days. The inoculated leaves did not show any symptoms. The newly developing leaves showed mild mosaic symptoms. The subsequent leaves showed chlorotic patches of light green colour, which increased in size and finally coalesced with each other. In later stages, leaves became variously deformed, reduced in size, and gave a blistered appearance. Their margins rolled downward and subsequently whole leaf turned yellow.

Attempts to transmit the virus by aphids, *Myzus persicae* Sulz. and *Aphis gossypii* Glov. were unsuccessful.

Physical Properties -

The properties of the standard clarified sap were tested on young, virorously growing seedlings of *Vigna sinensis* (Savi.)

Thermal inactivation point - The sap was infective upto 80°C. and beyond this temperature it was inactivated.

Dilution end point - The standard sap when tested at different dilution, retained infectivity upto a dilution of 1/1,000.

Longevity in vitro -

The standard extract was infective upto 2 days when stored at room temperature (30°C) but not after 4 days. At freezing temperature virus could withstand storage for 210 days and probably more.

Nariani and Kandaswamy's virus differs with the present virus in physical properties also.

Affinities of the virus -

A large number of viruses reported have been found to produce yellowing and mosaic mottle symptoms on cowpea, e.g., *Marmor vignae* var. catajang (Capoor and Varma, 1947, 1956), cowpea strain of TMV (Lister and Thresh, 1955), cowpea yellow mosaic virus (Chant, 1959), cowpea strain of Southern bean mosaic virus (Kuhn, 1963), Bean pod mottle virus (Dale, 1949 and Shephered, 1964) and cowpea chlorotic mottle virus (Kuhn, 1964).

However, the virus reported herein differs from above mentioned viruses in physical properties in being highly specific in its host range and in producing characteristic yellow mosaic on the leaves. Although the casual virus shows resemblance with cowpea yellow mosaic virus (Chant, 1959) and a virus causing mosaic disease of cowpea (Vasudeva, 1942) in producing yellow mosaic mottling on the leaves, it differs in physical properties and host range. Cowpea mosaic, Alfalfa mosaic and Aster yellow viruses (from Iran) are known to cause infection to cowpeas but they have wide host range.

The viruses occurring on cowpeas (Anderson, 1955; McLean, 1941, Snyder, 1942 and Yu, 1946) resemble each other and have been designated as *Marmor vignae* (Nariani and Kandaswamy, 1961). The casual virus closely resembles in physical properties the above mentioned virus but differs from it in not being seed transmitted, neither transmissible to any other host, and in producing yellow mosaic on leaves.

The Asparagus Bean Mosaic Virus (Snyder, 1942) which is confined only Vigna spp. differs from the present virus in physical properties.

Another virus described on cowpea from I.A.R.I. (1964) has different physical properties and could be transmitted to C.album and C.amaranticolor, while the present virus was confined only to V. sinensis (Red).

A Mosaic Disease of urd (Phaseolus mungo).

The disease was characterised by mosaic mottle symptoms on leaves. The newly emerging leaves showed severe mosaic symptoms and were reduced in size.

Host Range -

Out of several hosts tested, the virus could only be transmitted to Phaseolus mungo, P.aureus, Cyamopsis tetragonoloba and Dolichos-biflorus. The following plants of widely divergent taxonomic families could not be infected by the casual virus.

P.lunatus var. macrocarpus, Dolichos lablab, D.biflorus, Pisum sativum, Vicia faba, Cyamopsis tetragonoloba, Melilotus alba, Vigna sinensis, Glycine max, N. glutinosa, N. tabacum spp., N. rustica spp., Solanum melongena, Lycopersicon esculentum, Chenopodium amaranticolor, C.album, Trichosanthes anguina, Cucumis sativus, Luffa acutangula and Lagenaria vulgaris.

Symptoms on inoculated plants -

P.mungo - The symptoms appeared after 5-6 days of inoculation. No symptoms appeared on the inoculated leaves while the young leaves showed severe mosaic symptoms. The newly emerging leaves were smaller and narrower in size. The number and size of pods was also reduced. Mosaic disease of urd, described by Sahare and Raychaudhury (1963), produces light and dark patches and also blistering of leaves, which were not observed in the present case.

Two black varieties of urd - T9 and T27 - were highly susceptible whereas green varieties - T65 and T77 - were more or less resistant.

P.aureus - Symptoms appeared after 7 to 8 days of inoculation. Young leaves showed mild mosaic symptoms and there was no reduction in the leaf and plant size.

Cyamopsis tetragonoloba - After 4 days of inoculation, inoculated leaves showed dark brown necrotic lesions. Irregular necrotic spots also developed on the uninoculated leaves. Leaf size and pod number was extremely reduced and the plants were stunted in growth.

Dolichos biflorus - Inoculated leaves showed necrotic irregular spots 7 to 8 days after inoculation. No systemic symptoms were observed.

Physical Properties -

Young, virorously growing seedlings of urd having 3 to 4 leaves were generally used for the tests.

Thermal inactivation point - Between 90° to 95°C.

Dilution end point - Between 10^{-5} and 10^{-6}.

Longevity in vitro - Between 8 to 10 days at room temperature (30°C).

Affinities of the Virus -

Mosaic disease of black urd (Sahare and Raychaudhuri, 1963)*, Bean mosaic virus (Yarguntiah and Nariani, 1963) and Mosaic disease of cowpea (Nariani and Kandaswamy, 1961) are sap transmissible to urd, plants. The virus under report resembles Marmor vignae var. catajang (Nariani and Kandaswamy, 1961) in physical properties but differs from it in its inability to cause visible symptoms on V. sinensis and in producing brown necrotic local lesions on Cyamopsis tetragonoloba.

---

* The casual virus of mosaic disease of black urd (Sahare and Raychaudhuri, 1963) is seed borne and resembles the common bean mosaic virus, Marmor phaseoli (Holmes) in its physical properties (58°C, 1:2,000 and 28 hours) and infects Phaseolus aureus, P.mungo, P.aconitifolius and P.vulgaris.

REFERENCES

Anderson, C.W. (1955). Vigna and Crotalaria viruses in Florida. III. Notation concerning identification difficulties, indicator plants, possible vector relationships and virus maintenance. Plant dis. Reptr., 39: 354-357.

Capoor,S.P. and Varma, P.M. (1956). Studies on a mosaic disease of Vigna cylindrica Skeels. Indian J. agric. Sci., 26: 95-103.

Capoor,S.P. Varma, P.M. and Uppal, B.N. (1947). A mosaic disease of Vigna catjang Walp. Curr. Sci., 16: 151

Chant,S.R. (1959). Viruses of Cowpea, Vigna unguiculata (Walp) in Nigeria. Ann. Appl. Biol., 47: 565.

Dale,W.T. (1953). The transmission of plant viruses by biting insects, with particular reference to cowpea mosaic. Ann. Appl. Biol., 40: 384-392.

Kuhn, C.W. (1963). Field occurrence and properties of cowpea strain of sourthern bean mosaic virus. Phytopathology 53 (6): 732.

Kuhn, C.W. (1964). Purification, serology and properties of a new virus of cowpea. Phytopathology 54 (7): 853.

Lister, R.M. and Thresh, J.M. (1955). A mosaic disease of leguminous plants caused by a strain of TMV. Nature 175 (4467): 1047.

McLean, D.M. (1941). Studies on mosaic disease of cowpeas, Vigna sinensis. Phytopathology 31: 420-430.

Nariani,T.K. (1963). Yellow mosaic of Moong (Phaseolus aureus). Ind. Phytopath. 13 (1): 24

Nariani,T.K. and Kandaswamy, T.K. (1961). Mosaic disease of cowpea, Vigna sinensis (Savi.). Indian Phytopath. 14: 77.

Oleveira, M.A. (1947). Contribuice as estudo dos virus causadores de mosaiconos feijoes macassar (Vigna spp.). Biol. Tech. Inst. Agron. Sul. (Pelotas), 1: 1-15.

Sahare, K.C. and Raychaudhuri, S.P. (1963). Mosaic disease of Black Urd. Indian Phytopath. 16: 316.

Samuel,G., Best, R.J. and Bald, J.G. (1935). Further studies in Quantitative methods with two plant viruses. Ann. Appl. Biol., 22: 508-524.

Shepherd,R.J. (1964). Properties of a mosaic virus of cowpea and its relation to bean pod mottle virus. Phytopathology 54: 468.

Shephered, R.J. and Fulton, R.W. (1962). Identity of a seed borne virus of cowpea. Phytopathology 52 (6):491.

Snyder,W.C. (1942). A seed borne mosaic of Asparagus bean, Vigna sesquipedalis, Phytopathology 32: 518-523.

Thomas, K.M. (1937). Adm. Rept. of the Govt. Mycologist Madras for the year 1936-37.

Vasudeva, R.S.(1942). A mosaic disease of cowpea. Indian J. agric. Sci., 12: 281-283.

Warid, W.A. and Plakidas, A.G. (1950). New viruses naturally infectious to cowpea. Phytopathology (Abstr.), 40: 30. - 1952, Thermophilic viruses naturally infectious to cowpea. Plant dis. Reptr., 36: 380-381.

Yarguntiah, R.C. and Nariani, T.K. (1963). Bean Mosaic Virus in India. Indian J. Microbiol. 3: 147.

Yu,J.F. (1946). A mosaic disease of cowpea (V. sinensis Endl.). Ann. appl. Biol. 33: 450-454.

....

SCREENING OF ARHAR VARIETIES FOR RESISTANCE TO WILT AND OF GRAM VARIETIES TO WILT.

J.S. Grewal and Mahendra Pal
Division of Mycology and Plant Pathology
Indian Agricultural Research Institute
New Delhi.

Arhar Wilt:

Seventy two collections (56 selections and 16 varieties) of *Cajanus cajan* were screened for resistance to wilt caused by *Fusarium udum* under artificial conditions of disease infection in pots with two dates of sowings (i.e., 27th July and 13th August, 1968). Final disease incidence, 160 days after sowing, is given in Table - 1.

Sixty five collections (52 selections and 13 varieties) were highly susceptible to wilt; disease incidence ranged from 50 to 100%. Six were susceptible and showed 25-45% wilt. Lowest disease incidence of 5% was recorded in variety NP (WR) 15. Last year also this variety gave similar results.

Variety 75 (Bihar), selections $R_{77}P_1$, $R_{85}P_1$ and 4455 showed, 5,10,15 and 20% wilt respectively in the sowing on 27th July. Incidence of wilt in these collections was 80, 40, 45 and 80% respectively when sown on 13th August indicating disease-escape in early sowing.

Stem Rot of Arhar:

A new disease causing stem rot of *arhar* was recorded on variety T_2 at Delhi and Kanpur in very serious form. The pathogen was isolated, purified and identified as *Pythium* sp. Fifty eight of these namely R_1P_1, R_3P_2, R_4P_1, $R_{10}P_1$, $R_{10}HP_1$, $R_{10}CP_1$, $R_{41}P_1$, $R_{77}P_1$ $R_{85}P_1$, $R_{105}P_2$, S_7P_1, S_7P_3, $S_{17}P_1$, $S_{17}P_2$, $S_{28}P_2$, R_3 , 1289, 2760, 2783, 2793, 2860, P 2908, P 3966, P 3970 P 3986, 4358, 4410, P 4412, P4420, P4422, P4438, 4445, 4455, R 4482, 4522, 4758, 4783, 4999, 5013, 5016, 5047, 5071, B_7 , T_{21}, 75 (Bihar), NP(WR) 15, RG 72, Tur 15-15, NP 69, PT 301, N 290-21, C_{11}, T_7, NP 84, BR 60, Gwalior 3, T_{17}, and Khargaon were found to be susceptible. Fifteen of them namely R_1P_3, R_3 P_3, R_{10} P_2, $R_{20}P_2$, R_{21} ,$R_{21}P_2$, S_3 P_1, S_5 P_1, S_7 P_2, $S_{17}P_3$, $S_{28}P_1$,4466, 4785, 4839, and 2E did not get infected, they need further testing before any of them can be called resistant.

Gram Wilt:

Six thousand, six hundred and twenty lines of germ plasm of *Cicer arietinum* grown at Indian Agricultural Research Institute, New Delhi as well as at Punjab Agricultural University, Hissar, Campus, were screened for resistance to wilt under natural conditions of disease incidence. On the basis of preliminary screening 225 lines were selected and have been sown both at Delhi and Hissar this year for further evaluation. Out of above, plantings No. 516, 589, 654, 664, 1079, 1636, 2464, 2692, 3703, 4422, 4441, 4492, 4519, 4534, 4537 and 4853 were also promising from yield point of view during 1967-68.

Gram Blight:

Temperatures prevailing in the months of February and March are favourable for the appearance and spread of the disease. One hundred sixty nine varieties have been sown and will be tested during this and the next month with 10 morphologically different isolates of *Ascochyta rabiei* isolated last year from different varieties and locations.

Table 1. Showing reaction of *Arhar* selections and varieties to wilt.

Selection	% Wilt in sowings conducted on 27.7.1968	13.8.1968
$R_1 P_1$	100	*
$R_1 P_3$	70	*
$R_3 P_2$	35	*
$R_4 P_1$	100	*
$R_{10} P_1$	100	*
$R_{10} CP_1$	95	*
$R_{10} P_2$	100	100
$R_{20} P_2$	85	60
R_{21}	100	80
$R_{21} P_2$	100	80
$R_{41} P_1$	45	70
$R_{77} P_1$	10	40
$R_{85} P_1$	15	45
$R_{105} P_2$	75	60
$S_3 P_2$	100	90
$S_5 P_1$	100	100
$S_7 P_1$	100	100
$S_7 P_2$	95	100
$S_7 P_3$	80	100
$S_{17} P_1$	95	100
$S_{17} P_2$	100	90
$S_{17} P_3$	100	100
$S_{28} P_1$	100	100
$S_{28} P_2$	90	100
$S_{29} P_1$	100	90
R^3 (Bulk)	95	95
1289	100	*
2760	60	35
2783	65	100
2793	90	100
2860	55	*
P-2906	100	100
P-2966	95	95
P-3970	65	90
P-3986	30	10
4358	80	100
4410	30	70
P-4412	50	70
4420	55	95
P-4422	70	95
4438	75	75
4445	30	95
4447	100	95
4455	20	80
4466	85	100
R-4482	60	90
4522	70	100
4758	50	*
4783	85	90
4785	75	45
4839	70	60
4999	100	*
5013	100	*
5016	60	60
5047	80	100
5071	65	100
B_7	80	90

Selection/variety	27.7.68	13.8.1968
75 (Bihar)	5	80
NFWR 15	5	5
RG 72	70	95
Tur 15-15	50	95
NP 69	70	65
PT 301	50	95
2 E	30	50
N 290-21	70	90
C11	35	25
T7	60	75
NP 84	85	*
BR 60	80	*
Gwalior 3	65	*
T17	35	*
Khargaon	50	*

* Not tested.

Report on the coordinated fungicidal trial (1968)

F.J. Williams
R.P.I.P./U.S.A.I.D., New Delhi

It was agreed at the last Workshop that coordinated fungicidal trials (seed treatment, protective spraying and soil treatment), would be accomplished at several locations and that the data would be sent to Delhi for analysis, comparison and presentation.

Seed of Phaseolus aureus variety T-51, P. mungo variety T-27 and Vigna sinensis variety Mashad was treated with Ceresan M, Thiram, Captan, Brassicol, copper carbonate, Demosan, Panogen-15, Busan 72 and Vitavax. Treated seed was sent to Hyderabad, Jabalpur, Pant Nagar, Coimbatore, Ludhiana and Hissar. There were to be four replications in a randomized block design. Data have been received from Ludhiana, Pant Nagar and Delhi.

Treating P. aureus (T-51) seed did not affect germination at any of the three locations in comparison to the untreated control, according to the F test and the Duncan multiple range test.

Treating P. mungo (T-27) seed with Busan 72 or Captan reduced germination at Ludhiana in comparison to the control. The differences are barely significant at the 5% level and I do not consider them important.

Treating Vigna sinensis (Mashad) seed with any of the materials used expect Brassicol or Busan 72 increased germination in comparison to the untreated control at both Ludhiana and Pant Nagar. (Table 1) Captan ranked first at Ludhiana and Pant Nagar and second at Delhi. Vitavax ranked third at Ludhiana and Pant Nagar.

Spraying P. aureus (T-2) (in a randomized block with 4 replications), with Captan, Zineb, Manzate D, Fytolan or Aureofungin did not increase yield in comparison to the unsprayed control at Delhi or Pant Nagar. At Ludhiana, leaf fungal diseases were not important.

A randomized block with 4 replications is being used at Pant Nagar and New Delhi to test the efficacy of soil fungicides in controlling soil-borne diseases of Cicer. The test is not complete, but at New Delhi the Methyl bromide treated plots are growing most rapidly.

If germination of Vigna sinensis has been a problem, treating seed with Captan or Thiram may improve stands.

Table 1. Effect of seed treatment with fungicides on germination of Vigna sinensis var. Mashad at 3 locations, 1968.

Location	Material (Percent Germination)									
Ludhiana	Captan 93	Copper Carbonate 93	Vitavax 92	Thiram 90	Ceresan M 87	Demosan 86	Panogen 15 83	Brassicol 70	Control 66	Busan 72 59
Pant Nagar	Captan 85	Thiram 85	Vitavax 84	Ceresan M 83	Demosan 82	Copper Carbonate 81	Panogen 15 78	Control 74	Brassicol 71	Busan 72 65
New Delhi	Demosan 96	Captan 92	Brassicol 92	Copper Carbonate 91	Control 89	Busan 72 89	Vitavax 89	Thiram 89	Ceresan M 87	Panogen 15 79

POSSIBILITY OF DETECTING SEED-BORNE VIRUSES BY SEROLOGICAL TECHNIQUES

S.P. Raychaudhuri
Division of Mycology & Plant Pathology
Indian Agricultural Research Institute
New Delhi.

More than 50 plant virus diseases are known to be seed-borne, out of these a majority of diseases are of leguminous plants including several pulse crops. All plant virus diseases are damaging but seed-borne virus diseases are doubly damaging because they, not only produce infected plants but also provide a source of virus infection for neighbouring plants. It is, therefore essential to device some methods for checking of seed-borne viruses.

The best method of detecting any virus infection is by transmission to test plants by insects or by sap inoculations. Fortunately all the seed-borne virus diseases are also transmitted by sap which makes detection easy. As for other viruses, seed-borne viruses can also be detected by serological methods; these tests, however, have the dis-advantage that only the known viruses can be detected. The first requisite, of course, is the production of antiserum for a particular virus and once the antiserum is prepared the virus can be detected in infected tissue by gel-diffusion, tube precipitin, slide agglutination or other tests.

Seed-borne viruses can be detected by serology either in seeds or seedlings or fully grown plants. Most advantageous will be to detect them at seed stage, but the concentration of a particular seed-borne virus in seeds is a limiting factor. When the concentration of the virus is high in seeds, it can be effectively detected by serological tests. An interesting example is that of barley stripe mosaic virus which was detected in seeds by serology (Hamilton, 1965), using gel-diffusion test, as effectively as at seedling stage. This, however, may not work for all the seed-borne viruses; in some cases the viruses will have to be detected in young seedlings or fully grown plants.

The use of serological technique, despite limitations, is useful because often seeds take a long time to germinate and develope visible symptoms. If, however, this time is shortened by some method-say embryo culture (Mishra, Raychaudhuri and Chandra, 1967), then visual observation can also be useful in detecting seed-borne viruses. Mishra *et al* could get indication of the presence of virus within 1-2 weeks in plants obtained by culturing embryos from seeds obtained from runner bean (*Phaseolus multiflorus*) infected with a mosaic disease.

...

BACTERIAL BLIGHT OF COWPEA

P.N.Patel and J.K. Jindal
Division of Mycology & Plant Pathology
Indian Agricultural Research Institute
New Delhi

Table 1: Summary of observations on bacterial blight severity in 1085 Cowpea germplasm lines under natural infection in field during July-October, 1968.

Country	Total No. of lines	No. of lines in disease severity class				
		Severe	Moderate	Slight	Trace	Free
ASIA						
India	601	223	212	89	54	23
Turkey	19	0	3	5	8	3
Iran	19	9	4	2	3	1
Afghanistan	12	4	3	0	3	2
others	17	8	5	2	1	1
AMERICA						
U.S.A.	218	64	52	35	51	16
Maxico	13	3	6	1	3	0
Brazil	10	4	4	1	1	0
Gauteemala	10	8	1	0	0	1
Others	17	4	5	4	2	2
AFRICA						
Nigeria	61	25	20	5	10	1
S.or S.W Africa	15	2	2	3	3	5
Senegal	10	2	1	1	6	0
S. Rhodesia	10	9	1	0	0	0
Others	13	4	3	3	0	3
EUROPE	10	6	3	0	1	0
Australia	30	8	11	7	3	1
	1085	383	336	158	149	59

Table 2: Comparison of reactions of cowpea germplasm lines to bacterial blight under artificial inoculations and natural infection in field.

Reaction in artificial inoculations	No. of lines in disease intensity class					
	Severe	Moderate	Slight	Trace	Free	Total
Susceptible(S)	109	105	37	20	7	278
Tolerant (T)	0	0	3	7	8	18
Resistant (R)	0	0	0	2	25	27
R:T	0	0	3	10	4	17
R:T:S:	0	0	6	8	4	18
T:S	0	4	4	7	4	19
R:S	1	12	12	15	4	44
Total:	110	122	65	69	56	421

PRELIMINARY STUDIES ON A NEW DISEASE OF ARHAR CAUSED BY CHOANEPHORA CUCURBITARUM

D.P. Mishra and R.C.S.Mehra
Botanical Sub-station
I.A.R.I., Pusa (Bihar)

Arhar is an important pulse crop in North Bihar and usually grows luxuriently under the available agro-climatic conditions. With the inception of the Coordinated Pulse Project, concerted studies were undertaken on this crop at Botanical Sub-station, I.A.R.I., Pusa. While taking observations on the trials and genetic stocks, the young leaves and tender shoots of arhar were found to be killed during the month of September, 1968. Critical observations revealed that a fungus is involved in the cause and spread of the disease. The infected portions were found to loose the green colour in the beginning and showed tendency of wet rot. This was followed in a few days by the growth of shining silvery conidiophores on the infected parts. The conodial heads appear as minute greyish-black dots on the top of the conidiophores. The conidiophores are erect and project vertically. At the top of conidiophore a capitate vasicle originates which becomes vasicular later on. From the vesicle secondary brownish-black conidia appear in clustures. Conidia are elliptical to oval in shape and light-brown in colour. Mature sporangia have big round columella. The disease continued to spread on the crop and involved older parts as well, till end of October, 1968. However, the spread declined during the month of November, 1968. The average ranges of temperatures were 33-35°C (maximum) and 17-24°C (minimum) during September-October and during November, 1968, the respective temperatures were 26-30°C and 10-13°C. The relative humidity from September to November was almost identical and ranged from 85 to 100 percent.

Natural incidence of the disease was recorded on the genetic stocks of arhar and the varieties or cultures found infected were:- B.7, BR.183, C.11, 2E, 15E, No.84, No.290-21, Gwalior-3, Khargaon-2, N.P.(WR)15, N.P.24, N.P. 51, N.P.69, P285, P.T.301, R.G.72, S.103, T.7, T.21, E.3(R3/P1), E.9(R5A/P3). E.172(S28/P2), E.91(R5A/P6), E150(S7/P1), E112(R85/P1), E.116(R87/P2), E.148(R5/P1), E.150(S7/P2), E.170(S27/P3) E.173(S29/P1), E.191(R76/P1), E.3(R3/P1), E.6(R4/P1), E.21(R10D/P1), .29(R20/P2), E.106(R78/P1) S3/P1 and E.157(S17/P1).

However, the varieties and cultures that were found to be free included: E.1(R1/P1), E.12(R/10/P2), E.25(R10H/P2), E.41(R21/P2), E.171(S28/P1), BR.60, R.3, and E.130(R105/P2).

The fungus was collected and cultured on sterilized artificial medium for pathological studies. Conidia developed on the medium in 4 to 6 days at the temperature range 23 to 35°C. Water suspension of the fungus material including conidia was used as inoculum for testing the arhar varieties in seedlings and adult stages. Seedlings in 4-5 leaf stage were sprayed with the inoculum and kept in humid chamber for 2-3 days and later transferred on thelaboratory benches. The disease symptoms appeared after 7-8 days at temperature range 26 to 35°C. Similarly young shoots of adult plants in field were sprayed with inoculum and covered by alkathene for four days. High humidity was maintained by intermittent water sprayings. The shoots were covered later by butter-paper envelopes. The disease appeared in the usual way.

The pathogenic nature of fungus was thus, established and it was identified as Choanephora cucurbitarum (Berk. and Rav.) Thaxt. The identification was confirmed at the Division of Mycology and Plant Pathology, I.A.R.I., New Delhi.

Choanephora cucurbitarum has been reported to be pathogenion Capsicum by Dastur (1920) from Pusa. Several other hosts have also been reported to get infected with this fungus in other parts of the country. However, this appears to be the first record of the fungus on arhar. It will be seen that the disease appears during September-October and the infection declines on the approach of cooler weather. In case the disease appears in epidemic form, losses can be apprehended on the early-maturing varieties of arhar particularly. Further studies in relation to its perpetuation, mode of infection, and control measures are in progress.

Dastur J.F. (1920) Choanephora cucurbitarum (Berk and Rav). Thaxter on chillies (Capsicum Spp.) Ann. Bot.; 34:399-403.

...

A NOTE ON THE IDENTITY OF THE COMMON PULSE GALERUCID BEETLES AT DELHI.

M.G.Ramdas Menon and H.P.Saxena
Division of Entomology
I.A.R.I.,N.Delhi.

The common pulse galerucid-beetle found at Delhi has been earlier identified as Monolepta nigrobilineata (Motschulsky) from the Division of Entomology at the Indian Agricultural Research Institute, New Delhi. Recently, material referred to the United States Department of Agriculture Washington D.C., has been tentatively identified as Madurasia obscurella Jacoby. This has led to some confusion.

In going through the literature it is observed that M.nigrobilineata is a very widely distributed species recorded from various parts of India, China and Japan, while M.obscurella seems to have been recorded only from Madura and Nilgiri Hills in Tamil Nadu. Maulik (1936) has recorded variations in colour markings in the former. It is also remarkable that on account of these variations Motschulsky himself (1858) had described specimens under a distinct species M.suturalis (Motschulsky) and Weise (1922) described two varieties, vittatus and abbreviatus. Maulik (1936) placed Madurasia under the section in which all claws are simple, and Monolepta in quite another section in which the claws are all appendiculate. In going through the description of the two species in question, it is noticed that the two may be easily mistaken. Both are small, linear insects possessing the same colouration. However, M.obscurella is indicated as only 2.5 mm. long and 1.25 mm. broad, whereas M. nigrobilineata is shown as 3.75 mm. long and 2 mm. broad. The morphological characters in general including the body and elytral punctures of the two species also seem to tally to a great extent. Nevertheless, besides the claw difference pointed out above, there is also a difference noticeable between the two in the relative lengths of the hind tarsus. In M.nigrolineata it is said to be nearly three-quarters the length of hind tibia; in M.obscurella it seems to be only half as long as the hind tibia. (from Maulik's figure).

Now turning to a careful study of the material collected at Delhi the following points have been observed. (1) There is a great deal of variation in the development of pigment particularly on the elytra; (2) There is a good deal of size variation, (3) The claws vary even in the same specimen, from apparently simple to those with a distinct basal lobe; and (4) the hind tarsi attain three fourth the length of hind tibia.

The National Pusa Collection has some specimens standing under M. nigrobilineata. One of these has been collected on mung at Delhi and determined as luperodes (= Monolapta) species by G.E. Bryant. The others, a good series, are from Mandalay, Burma. The Delhi specimen is not at all different from the material now in hand. But the Mandalay material shows a darker colouration on the elytra, and more prominent basal lobes on the claws. Unfortunately, there is no South Indian material for comparison.

In view of the foregoing, it is felt that careful comparison with the types of the two species should be made before the correct identity of the species is finally established. The types of Monolepta nigrobilineata and M.suturalis of Motschulsky are said to be located in the Moscow University Museum and that of Madurasia obscurella in the British Museum (Natural History).

References: MAULIK,S., 1936, Fauna Br. India, Col., Chrysomelidae (Galerucinae), p.p. 74, 396-397.

MOTSCHULSKY, V., 1958, Etud.Ent., Helsingfors, p.100

WEISE, J., 1922, TIJDSCHR. Ent., 65:80,81.

...

FIELD KEY FOR THE QUICK IDENTIFICATION OF GRASSHOPPERS DAMAGING PULSES AT DELHI.

H.D. Vasu
Division of Entomology
Indian Agricultural Research Institute
New Delhi-12.

There are 329 species of Acridids occurring in India (Kisby) 1914), out of which some are destructive to pulse crops. Sirivastava (1964) from Rajasthan reported extensive damage to pulse crop (Lentil, *Lens esculenta*) by grasshoppers but has not mentioned any specific species. When there is any out break of grasshoppers, usually a list of the species seen in the field is prepared and all these grasshoppers are given the credit of damaging the crop but it has been found that many species, though numerous at the time of outbreaks of grasshoppers, do not feed at all on cultivated plants.

Since studies are now being vigorously pursued for working out pest control schedules for various pulse crop grown under different climatic regions, it is necessary to make a clear, judicious, critical analysis of the insect that is responsible for the damage to crops and to pindown the responsibility of any particular grasshopper species. For this purpose, the present author recorded observations on the pulse crops in I.A.R.I., of the grasshoppers which were actually damaging the pulse crops and has drawn up a key for their quick identification in the fields. This key has been found to work well in the fields when trials were made. In case the adult grasshoppers are not available then the faecal pellets may be collected and the identification may be made through faecal pellets (Vasu, 1965).

A field key for the identification of grashoppers damaging pulse cropsat Delhi.

1. Adult insect greenish in general colouration.....2
- Adult insect not greenish in general colouration.....5
2. Insect adults large sized measuring 40 mm or over 3
- Insect adults not large sized but medium sized measuring 29-31 mm.....4
3. Head slopping unward.....*Acrida exaltata*
- Head not sloping upward colourless greenish inclining to light brownish.....*Aswatthamnus cylindricus*
4. Head sloping upward.....Acrida exaltata
- Head not sloping upward.....*Atractomorpha crenulata*
5. Adults measuring over 6 mm in length and pronotum not extending over the abdomen.....6
- Adults measuring 6 mm. and pronotum extending over abdomen.....*Tetrigids*
6. Adults measure 15 mm in length and 6 mm in greatest thickness. Head small and narrow towards the front, body short and stout.....*Chrotogonus sp.*
- Adults measure 18 mm. and 3 mm in greatest thickness Head broad towards front.....*Aeolopus affini*

REFERENCES:

Kirby, W.F., 1944, Fauna British India, Orthoptera (Acrididae).9

Sirivastava, B.K., 1964, *Indian, J. Ent.*, Silver Jubilee number: 87 pp.

VASU, H.D., 1965, Indian J.Ento. 27(II):150-152.

SCREENING OF GERM PLASM OF PULSE CROPS FOR INSECT RESISTANCE

H.P.Saxena, Sunil Kumar and S.K. Prasad
All India Coordinated Pulse Project
Delhi Centre, Division of Entomology,
I.A.R.I.,New Delhi-12

The reaction of germ plasm of cowpea (Vigna sinensis), Mung (Phaseolus aureus) and Urid (Phaseolus mungo) to insect pests were studied during 1968. This work was started during Kharif 1967, when 1020 lines of cowpea were screened. Out of these, 32 lines were selected for further investigations during the next year.

During the last Kharif screening was done in 132 lines of cowpea, including 101 new and 31 from the last years selection, 104 lines of Mung and 100 lines of Urid.

Material and Methods

The material was supplied by the Genetics Division of the I.A.R.I. from world germplasm collection. During 1967, screening was done on visual basis and the attack was categorised as slight, moderate and heavy. Three screenings were done at 4 weekly intervals. Mainly the screening was directed against galerucid beetle. The attack of jassid, Empoasca kerri Pruthi and aphid, Aphis craccivora K. was very mild.

During kharif 1968, the method of screening was modified. In each line of 6.5 metre length, leaving border of 0.75 metre on both sides, 5 plants falling at 1st, 2nd, 3rd, 4th and 5th metre were observed.

Screening was done for the following pests:

1. Galerucid beetle
2. Jassid, E. kerri Pruthi.
3. Aphid, A. craccivora K.
4. Semiloopers, Plusia spp.
5. Leaf miner, Acrocercops sp.

Two screenings at 4 weekly intervals, were done.

For galerucid beetle total number of damaged and healthy leaves per plant were counted. On the basis of the damage to the 3rd leaf the attack was graded as slight, moderate and heavy.

For jassids, Empoasca kerri Pruthi, leaf miner, Acrocercops sp. and semiloopers, Plusig spp., total pest population on the selected plant was recorded. The attack of aphid, Aphis craccivora K. was confined only to few lines.

Results and Discussion - The position of different pests was as under:

Galerucid beetle: From 32 lines of cowpea selected during 1967, 5 lines namely P417-67, P1077-67, P647-67 and P1128-67 were graded in slight category during both the screenings. From the new 101 introduction the lines included in the slight grade were P1129, P122, P118, P576, P523, P520, P209-68. During the second screening the varieties coming under this grade were P237, P245, P249, P220, P211,P150, P118,P108, P91,P579, P549, P548, P546, P547, P543, P519,P517, P467,P363, P364, P374, P361, P267, P261, P246, P250, P204, P783, P1126. Out of these P783 and P1126 were the most promising since these had the least percentage of damaged leaves as well. Two lines i.e. P118 and P576 came in slight grade in both the screenings.

In the first screening of mung varieties 34 lines and in the second screening 26 lines came under slight grade. Out of these 14 namely P22, P25, P55, P27, P344, P271, P217, P326, P332, P332, P333, P336, P335 and P338 were common during both the observations.

In urid during the first screening only two lines, i.e. P530 and P145 could be graded as slight. In the 2nd screening, 23 lines namely P1-68, P23, P13, P20, P274, P205, P190, P274, P198, P161, P192, P160, P154,P153, P141, P147, P148,P238, P241,P234, P240 and P239 were put in slight grade. None of the lines were common in these screenings.

Jassid (Empoasca kerri Pruthi): Since the attack was mild counts were taken on plant basis. Populations of adults and nymphs were added in final grading. The five categories for each crop were (Table No.1): 1.

1. Lines with nil population....
2. Lines with population below 5.
3. Lines with population between 5-10
4. Lines with population between 11-15.
5. Lines with population more than 15.

From 1967 selections none of the cowpea lines, would come under the first and second categories, i.e, none had population below 5. In the new introductions, although no line could come in the first grade i.e., nil population, seven lines namely P237, P245, P242, P204, P107, P576, P359 could be graded under second category. These lines are considered promising for further studies.

Both mung and urd appear to be less susceptible to the attack of jassids. This is clear from the fact that in mung, 27 lines and in urid 45 lines came in the first grade i.e., had no jassid attack. In the second grade, mung had 26 and urid had 42 lines. In the 4th and 5th grade mung had 13 and 8 lines respectively. In case of urid only one line could be graded in the 4th category and none came in the 5th category. Moreover the population range in mung was from 0 to 25 and in urid it was from 0 to 14. Out of these two crops urid was less preferred.

Leaf minder (Acerocercops sp.): As is clear from Table - 2, except in two lines of cowpea none had severe attack. The cowpea was more preferred than mung and urid.

Aphid (Aphis craccivora K.): The attack was confined to only few lines in all the crops.

Table - 1

Screening for Jassid, Empoasca Kerri Pruthi

Crop	Jassid Population per plant					No. of lines screened.	Population Range.	Promising line
	Nil	Below 5	Between 5-11	Between 11-15	Above 15			
Cowpea (Old)	Nil	Nil	3	5	23	31	5-68	Nil
Cowpea (New Introduction),	Nil	7	24	14	56	101	1-85	P237, P245, P242, P304, P107, P576, P359.
Moong	27	30	26	13	8	104	0-25	Nil
Urid	45	42	12	1	Nil	100	0-13	Nil

Table - 2

Screening of leaf miner, Acerocercops sp.

Crop	Leaf miner-Population/plant					No. of lines screened.	Population Range (mines)	Promising lines
	Nil	Below 5	Between 5-10	Between 11-15	Above 15			
Cowpea (Old)	1	12	15	3	Nil	31	0-13	Nil
Cowpea(New Introduction)	15	50	26	8	2	101	0-16	Nil
Moong	76	27	Nil	Nil	Nil	104	0-4	Nil
Urid	74	26	Nil	Nil	Nil	100	0-3	Nil

Table - 3

Cowpea

Line No.	Variety	Origin	Line No.	Variety	Origin
P1129	P772-66	-	P517	10364-4	Senegal
P122	10088	U.S.A.	P467	10324-2	U.S.A.
P118	10084	U.S.A.	P363	10252-2	U.S.A.
P576	PLL 59	India	P374	10257	U.S.A.
P523	PLL 6	India	P361	10251-3	U.S.A.
P520	PLL 2	India	P267	10169	Nigeria
P209-68	10137-1	Guatemala	P261	10167-2	Nigeria
P417-67	10288	U.S.A.	P246	10160-3	Nigeria
P1077-67	EL 826411	Mexico	P250	10162-1	Nigeria
P1101-67	IC 3338	India	P1177-67	Bulk Sample	Andhra(India)
P647-67	IC 2441	India	P701-67	I.C 2913	India
P1128-67	15251	Iran	P273-67	10175-1	India
P237	10155-1	Nigeria	P321-67	10119	U.S.A
P245	10160-2	Nigeria	P22-67	10022	Pargua
P249	10161	Nigeria	P647-67	I.C.2441	India
P220	10144	Madagascar	P237	10155-1	Nigeria
P211	10138-1	Guatemala	P107	10075-1	Nigeria
P150	10142-3	Turkey	P359	10251-1	U.S.A
P118	10084	U.S.A	P242	10158	Nigeria
P204	10134-2	Iran	P121	PLA 34	India
P108	10075-2	Nigeria	P355	10247	U.S.A
P91	10067-1	Nigeria	P502	10354	Senegal
P579	PLL62	India	P498	10350-2	Iran
P549	P1131	India	P545	PLL-27	India
P548	PLL 30	India	P427	10298-1	U.S.A
P546	PLL 29	India	P267	10169	Nigeria
P547	PLL 29	India	P256	10168-2	Nigeria
P543	PLL 25	India	P250	10162-1	Nigeria
P519	PLL 1	India			

Moong

Line No.	Variety	Origin	Line No.	Variety	Origin
P22	NP 16-2	India	P332	Perambalu	India
P25	NP 17-2	India	P333	M.S 9720/2	India
P55	Moong-9	Pakistan	P336	1535/1	India
P27	NP 16	India	P335	M.S. 9381	India
P344	M.S.9719	India	P338	1788/9	India
P271	152016	India	P103	15005	U.S.A.
P217	15148	Afganistan	P164	15068	India
P326	M.S.9385	India	P42	N.P. 33	India
P331	N.A.5	India	P353	1788-3	India

Urid

Line No.	Variety	Origin	Line No.	Variety	Origin
P145	T26	(Punjab) India	P160	38	(U.P.)India
P1-68	N.P.22	India	P154	41	(U.P.)India
P23	N.P.22	India	P153	39	(U.P.)India
P13	N.P.12	India	P141	19	(U.P.)India
P20	N.P.19	India	P147	29	(U.P.)India
P30	EC 16571	India	P148	30	(U.P.)India
P274	T70	(U.P.)India	P238	6301	(Bihar)India
P205	Bhadola 109	(U.P.)India	P241	6304	(Bihar)India
P190	T95	(U.P.)India	P234	6213-1	(U.P.)India
P274	6402	(U.P.)India	P240	6303	(Bihar)India
P161	51	(U.P.)India	P239	6302	(Bihar)India
P198	67-1	(U.P.)India	P32	Kasarkoda	India
P192	97	(Bihar)India	P219	5909	(U.P.)India
P195	100	(Bihar)India			

From the selections of 1967 of cowpea, only six lines namely P1177-67 P701-67, P273-67, P321-67, P22-67, P647-67 (Black) were found to be infested. From 1968 introduction, 9 lines found to be infested were P121, P355, P502, P498, P454, P427, P267, P256, P250. In mung four infested lines were P103, P164, P42 and P353. In urd only two lines namely P32 and P279 were attacked.

Semiloopers, Plusia spp: The attack was very mild at the time of observation, so no grading was carried out.

Note: The details of P numbers referred above under each pest are given in Table No. 3.

FUTURE LINE OF WORK:

1. All the lines exhibiting resistance under different crops should be further screened in larger plots.

2. The most promising ones, should be further tested by artificial infestation in screen house.

3. Factors responsible for the resistance in the promising varieties may be determined.

4. The entire germplasm should be screened for Jassids, Empoasca kerri Pruthi; Aphid, Aphis craccivora K., semiloopers Plusia sp. and leaf miner, Acerocercops sp. The rescreening is more important for mung and Urid because only 104 and 100 lines respectively were available for the studies last year.

ACKNOWLEDGEMENTS

Thanks are due to Dr. S. Pradhan, Head of Division of Entomology, IARI and to Dr. Peter H.van Schaik, Coordinator, USAID (Pulse Project) for their keen interest in these studies. Without the assistance from Prof. K.E. Gibson of USAID and Dr. L.M. Jeswani, Pulse Breeder, IARI, it would have been quite difficult to carry out this work and their help is gratefully acknowledged.

-oOo-

Control of Pea stem borer, Melanagromyza phaseoli Coq.(Diptera:Agromyzidae) in peas, Pisum sativum by the use of systemic insecticides.

J.P.Singh (C)* and R.C. Chhibber*

INTRODUCTION

Under the agro-climatic conditions of Tarai, the main problem in pea cultivation faced by the cultivators, is attack of pea stem borer, Melanagromyza phaseoli Coq. when the plants are young. The fly is 2.07 mm. long and dark metallic green in colour. A female lays 16-46 elongate, oval, white eggs singly in the tissue of the leaf. The tiny, whitish maggot hatches out after 2 to 4 days and soon after starts winding through leaf towards the petiole and in one or two days it reaches the stem or the side branches (Lall, 1959). The larval period varies from 9-12 days in November - December and 6-7 in June-July. The pupal period is 7 to 19 days (Agarwal and Pandey, 1961). The symptoms of its attack are wilting and yellowing of the leaves (Singh, 1968). The intensity of the pest infestation is observed as high as 90 per cent. It has been observed that an early sown peas crop is heavily infested as compared with that of late sown crop. In agronomic experimental trials being conducted at Experiment Station, U.P.A.U., Pantnagar difficulty was faced due to the attack of pea stem borer. Keeping this in view a field trial was conducted to find out a suitable chemical control of this pest.

Material and Methods

A randomised block design with 4 replications and 5 treatments including a check was adopted. Three insecticides, Dimethoate (Roger) 5G (T_1), Di-syston 5G (T_2) and Phorate (Thimet) 10G (T_3) at the rate of 1 kg., 1 kg. and 2 kg. active ingredient per hectare respectively were applied in granular form before sowing. Fourth treatment consisted of 2 sprays of 0.1 per cent Metasystox 35 E.C. when the plants were about 2- inch tall and 15 days later. In check plot (T_5) no chemical was used. In 2.1 x 5.1 sq. m. plots there were 7 rows 30 cms. apart and plant to plant spacing was 6 cms. New Line Perfection was sown on 15th October, 1968 and fertilized with Nitrogen at the rate of 20 kg./ha. and 60 kg/ha. each of K_2O and P_2O_5.

First observation was taken after a month of sowing. A total of 100 plants from 5 inner rows per plot were selected, taking 20 plants at random from each row. In case of doubt the plants were dissected out to confirm the presence of pea stem borer. Second observation was taken after 60 days of sowing.

Results and Discussion

The data on percentage infestation observed at 30 and 60 days after planting are given in Table 1. It is evident that there was severe infestation in check plots.

---

* Department of Entomology, College of Agriculture, U.P. Agricultural University, Pantnagar, Distt. NAINITAL.

Table-1. Mean of original percentage and transformed data alongwith C.P. Value

Treatments	30 days		60 days	
	Mean of original percentage	Mean of transformed data	Mean of original percentage	Mean of transformed data
Rogor 5G	31.00	33.48	24.00	29.13
Di-syston 5G	11.25	19.46	7.50	15.74
Thimet 10G	6.00	13.70	3.75	10.95
Metasystox 35 E.C.	53.75	47.36	47.00	43.21
Check	66.25	53.35	56.75	49.51
C.D. 5%		8.07		7.61

After 30 days :

Thimet	Di-syston	Rogor	Metasystox	Check
13.70	19.46	33.48	47.36	53.35

After 60 days :

Thimet	Di-syston	Rogor	Metasystox	Check
10.95	15.75	29.13	43.21	49.51

There were significant differences among the treatments tested. Thimet 10G proved to be consistantly most affective against the attack of Pea stem borer. Second in order was Di-syston 5G, which, of course, was statistically not different from Thimat in its effect. Rogor 5G was third in the order of its effectiveness and was significantly different on the one hand from Thimet and Di-syston and on the other hand from Metasystox and check.

It has already been reported (Getzin and Chapman, 1960) that after one hour from the time Thimet has been applied, a little or no volatilization occurs. Thimet when applied to soil, is partially oxidized and bound to the soil. When it is absorbed by the plants, it is initially and rapidly oxidized to its sulfoxide and sulfone of the phorate oxygen analog. While it is a weak anticholinesterase agent, its oxidation products show increasing potency as inhibitors of cholinesterase (Bowman and Casida, 1957). Due to this property of thimet it is more potent than other systemic insecticides used in the experiment. Di-syston is oxidized and its metabolites vary greatly in their ability to inhibit cholinesterase (Zweig, 1964). While Rogor is predominently an indirect inhibitor of cholinesterase and due to this property it appears that it is not very effective. Metasystox was sprayed when the plants were about 2 inch tall and it may be conceived that infestation might have taken place earlier than the actual spraying was done. Metasystox, therefore, was not effective.

Summary

Pea stem borer, Melanagromyza phaseoli is a serious insect pest in young plants of early sown peas i.e. sown in September-October instead of November-December. Its maggots enter into the stem and feed inside it. The symptoms of its attack are wilting and yellowing of leaves, and in severe cases the plants may die. Phorate (Thimet), Di-syston and Dimethoate (Rogor) were used at the rate of 2 kg., 1 kg. and 1 kg. active ingredient per hectare as soil insecticides before sowing add 0.1 per cent metasystox 35 E.C. was sprayed twice in first spraying when the plants were 2 inch tall and second spraying after 15 days. Thimet was consistantly most effective against the pea stem borer amongst all the insecticides used.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. N.K. Anant Rao, Dean College of Agriculture and Dr. R.L. Paliwal, Director (Research), Experiment Station, U.P.A.U., Pantnagar for providing facilities for these investigations and their interest in this work. Thanks are also due to Dr. A.P. Kapur, Director, Zoological Survey of India, Calcutta-12 for kindly identifying the insect pest.

LITERATURE CITED

Agarwal, N.S. & Pandey, N.P. 1961. Bionomics of Melanagromyze phaseoli Coq. (Diptera: Agromyzidae). Indian J. Ent., 23(4): 293-298.

Bowman, J.S. and Casida, J.E. 1957. Metabolism of the systemic insecticide O, O-diethyl S-ethylthiomethyl phosphorodithioate (Thimet) in plants. J. Agric. & Food Chem. 5(3): 192-197.

Getzin, L.W. and Chapman, R.K. 1960. The fate of phorate in Soils. J. Econ. Ent. 53(1) : 47-51.

Lall, B.S. 1959. On the biology and control of the bean fly, Melanagromyza phaseoli. Sci. & Cult. 24: 531-532.

Singh, (C) J.P. 1968. Insect pests of Soybean in Tarai the foothills of the Himalayas and Kumaon Hills. Proc. of Conference on Soybean Production and Marketing. JNKVV, Jabalpur (M.P.) 8 pp.

Zweig, G. 1964. Analytical Methods for Pesticides, Plant Growth and Food Additives. Academic Press, New York: Vol.II:187-198.

...

CHEMICAL CONTROL OF GALERUCID BEETLE ON PULSES VIZ., MUNG, URID AND COWPEA

H.P. Saxena, Sunil Kumar and S.K. Prasad
Division of Entomology, IARI, Delhi.

Galerucid beetle which was earlier identified as Monoleptа nigrobilineata (and about which some confusion has arisen in its identification on account of its tremendous resemblance with Madurasia obscurella Jacoby) is an important pest of kharif pulses such as cowpea (Vigna sinensis), mung (Phaseolus aureus), urid (Phaseolus mungo), arhar (Cajanus cajan), and soyabean (Glycine max). The adults feed on the leaf lamina and make holes. Although the infestation continues throughout the entire duration of the crop, the newly germinated plants are more prone to its attack.

During kharif 1967, granular systemic insecticides were tried. This experiment was repeated at a larger scale during the last kharif (1968). The results are reported in the paper.

Material and Methods

Granular forms of carbamate insecticides viz., Temik and Phorate (Thimet 10G) and disulfoton in the form of Solverx and Disyston were tried. Each product was applied in 4 doses, i.e., 2 kg. per hectare, 1.5 kg. per hectare, 1 kg. per hectare and 0.5 kg. per hectare, The application was done before the showing on ridges. First, the insecticide was applied in soil and later the seeds were sown with corn planter. The plan of of the experiment was simple randomised block. Each treatment had four replication and each plot had four 5.6 metre long rows. The sowing was done during the first week of July. These treatments were tried in cowpea, mung and urid; however, in case of cowpea the dose 2 kg. Solvrex was not applied because the shortage of the insecticide and this insecticide was not taken into consideration in the results. The variety of cowpea was Rashmi, of mung improved T2 and of Urid T65.

Observations were recorded six weeks after sowing. Two plants, selected with the help of random table, were observed from each row. Thus from each plot 8 plants were observed. Total and damaged leaves of the observed plants were counted.

From the top, holes made by the insect on 3rd, 4th and 5th leaves of each plant were counted in case of mung and urid. In case of cowpea, holes of 3rd, 4th and 5th leaves were counted from the lower side. In cowpea the position of leaves was reversed because of the profuse branching in the upper portion of the plants at the time of observations Yield data was not taken into consideration because of severe nematode attack in patches in various plots.

Results and Discussion

The dose of 2 kg. per hectare of all the insecticides proved better in all the three crops (Table 1). The results in urid and mung were quite significant,. In case of cowpea the results were not clear.

In cowpea, Phorate (Thimet) @ 2 kg. per hectare had significantly less percentage of damaged leaves than in the control but the differences in the average number of holes was not significant although the number of holes was the lowest in this treatment. In case of mung, Phorate (Thimet) @ 2 kg. per hectare recorded 38.4 per cent damaged leaves as against 84.7 per cent in the control. The average number of holes, i.e., 52.7 was also significantly lower than the average number of holes i.e. 204.2 in the control. In urid also the dose of Phorate @ 2 kg/ha. proved best as the percentage of damaged leaves was 36.6 as compared to 68.6 in the control. The average number of holes in this treatment were 36.2 as against 201.0 in the control. On the whole Dicyston proved better in mung and urid. All its four doses resulted in significant control. Temik did not give significant control in these crops.

Control of galerucid beetle on kharif pulses by the application of granular insecticides

Insecticide	Dose kg/ha.	Percentage of damaged leaves			Average No. of holes		
		Cowpea	Moong	Urid	Cowpea	Moong	Urid
Disulfoton (Dicyston)	2.0	69.2	52.5	35.7	69.2	48.5	38.2
-do-	1.5	74.2	58.4	25.2	74.2	53.7	40.0
-do-	1.0	66.9	54.4	29.2	68.4	67.0	53.0
-do-	0.5	73.6	70.0	29.3	73.6	146.0	62.5
Temik	2.0	65.9	64.4	47.8	65.4	72.5	73.5
-do-	1.5	78.9	71.3	38.3	78.9	97.0	80.0
-do-	1.0	68.5	66.6	36.4	68.5	109.0	102.2
-do-	0.5	84.6	78.1	58.9	84.6	133.7	102.5
Phorate (Thimet 10 g)	2.0	54.7	38.4	26.6	57.2	52.7	36.2
-do-	1.5	72.4	80.6	33.2	72.3	114.7	35.7
-do-	1.0	72.7	63.3	41.6	72.7	107.0	45.7
-do-	0.5	89.8	76.5	45.7	89.8	108.2	85.5
Control	-	76.4	84.7	69.6	76.3	204.2	221.0
C.D. at 1%		6.9	25.3	4.5	113.9	102.4	48.5
C.D. at 5%		4.0	21.7	2.5	25.1	76.5	36.2

LINES FOR FUTURE INVESTIGATIONS:

1. It is further proposed to have comparison between one and two insecticidal applications. Each treatment should have two sets. In one set the insecticidal application should be done once at the time of sowing. In the second set, in addition to the basal application done at the sowing time another basal application should be done six weeks after the sowing.

2. After working out a particular recommendable dose, its toxicity hazards should be worked out.

ACKNOWLEDGEMENTS

Thanks are due to Dr. S. Pradhan, Head of the Entomology Division, Indian Agricultural Research Institute, New Delhi and Dr. Peter H.van Schaik, Coordinator, USAID/RPIP for their keen interest in these studies. Help rendered by Prof. K.E. Gibson, of USAID/RPIP in laying out the trial and Dr. L.M. Jeswani, Pulse Breeder, IARI, in getting the cultural operations carried out from time to time, is also gratefully acknowledged. Shri J.S. Balan, Senior Research Assistant in the scheme also helped in noting observations in some plots, during his short stay in the section and his help is also acknowledged.

-oOo-

"INDUCED VARIABILITY FOR NEUROTOXIN CONTENT IN LATHYRUS SATIVUS"

Y.R.Nerkar
N.R. .,I.A.R.I., New Delhi

B-N oxalyl B-diamino propionic acid found in the seeds of Lathyrus sativus has been reported to cause neurolathyrism. With the object of developing a variety free of the lathrogen or with low content of the lathyrogen four commercial varieties of Lathyrus were treated with the chemical mutagen Ethyl Nethane Sulphonate (EMS). Seed samples of individual plants in the M_2 generation were screened for the lathyrogen. The results of the variability induced by the mutagen are summerized in the following table.

Variety	% Neurotoxin in seeds (at 10% moisture basis)					
	Control		EMS treatment			
	Mean		Mean			Range
Rewa-1	0.34 ±	0.030	0.37 ±	0.148		0.15 - 0.73
Rewa-2	0.60 ±	0.023	0.48 ±	0.109		0.24 - 0.72
LrC-76	0.45 ±	0.025	0.47 ±	0.137		0.24 - 0.72
T-2-12	0.68 +	0.041	0.55 +	0.149		0.15 - 0.80

The results indicate the possibility of realizing wide range of variability for nuerotoxin content in the mutagen treated material, this offering an immense scope for selecting lines with the toxin content at desired level. Being a quantitative trait, as evidenced from the results, recurrent mutagenic treatments of selected lines (with low levels of toxin) would help to a greater extent, in furthering our pursuit to isolate lines practically free of the toxin.

.....

PROTEIN QUALITY OF PULSES

BY

Y.P. Gupta
Division of Agril. Biochemistry
Indian Agricultural Research Institute
New Delhi-12.

During the recent years, protein malnutrition has assumed one of the most outstanding dietary problem in India as well as in the other developing countries, and attempts are being made these days to increase production and use of edible protein in all forms conventional and non-conventional in order to meet the protein deficiency. In India, people are mostly vegetarian and pulses constitute an important source of proteins in the Indian diet but the proteins from these sources is known to be inferior in quality. Proteins from plant sources are generally deficient in one or the other essential amino acid. Lysine and methionine are the major limiting amino acids among the cereals and pulses respectively when compared to a FAO reference protein or to that from the animal source.

The supplementation of pulses with methionine has resulted in improving their protein quality. The PER of different pulses increases significantly with supplementation of methionine alone or in combination with other amino acids. For improving the quality of protein from cereals and pulses, it is, therefore, necessary to alter the pattern of these amino acids as to compare well to that of FAO reference. In case of cereals, it has already been made possible at the Purdue University, Indiana, to alter the pattern of amino acids genetically and maize of improved protein quality has already been developed.

For this purpose, it was initially thought to screen a number of varieties of different pulses for their limiting amino acids so that information regarding promising material could be made available to the breeder for future breeding work.

Protein was calculated by multiplying the nitrogen value obtained by the usual procedure by the factor 6.25 while methionine and tryptophan were estimated by the chemical procedures.

The analysis of different varieties of urid (high yielding ones), mung are reported here. The protein content, methionine and tryptophan contents expressed on protein basis of different varieties of urid are found to range from 23.8 to 27.3%, 1.28 to 1.81% and 0.73 to 0.91% respectively whereas the corresponding values for the different mung varieties are from 23.4 to 29.1%, 1.21 to 1.66% and 0.56 to 0.73% respectively. The protein quality of a new variety of gram - Annigeri-1 found to be high yielding and possessing better agronomic characteristics developed by the University of Agricultural Sciences, Bangalore, is also compared to that of Chafa one. Chafa variety is found to contain slightly higher protein content as 25.4% as compared to Annigeri one which contains 23.9% protein but the latter contained higher methionine and tryptophan content as 1.38% and 0.92% in the grain protein as compared to Chafa for which the corresponding values are 1.26% and 0.71%. Therefore Annigeri variety appears to be somewhat better in its protein quality as compared to Chafa one. Annigeri variety is found to show higher values for yield, total protein and methionine as compared to Chafa one when calculated on acre basis.

The above work on the analysis of these pulses indicate that there is a great scope for improving the quantity and quality of proteins through genetic manipulation.

-oo0-