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REGIONAL PULSE IMPROVEMENT PROJECT

U. S. Department of Agriculture, Agricultural Research Service

U. S. Agency for International Development

Cooperating

Iran

Plan Organization

Karaj Agricultural College

Ministry of Agriculture

Pahlavi University

Ghazvin Development Project

Khuzestan Pilot Project

India

Indian Council of Agricultural Research

Indian Agricultural Research Institute

Agricultural Universities

State Departments of Agriculture

PERSONNEL and COOPERATORS

IRAN

Administrative

P. H. van Schaik	Regional Project Coordinator
G. M. Horner	Iran Project Leader
B. A. Ryan (Mrs.)	Administrative Officer
J. Afshar	Government Relations Advisor

Breeding

American position vacant since May 1968	
H. Schaybani	Karaj College
M. C. Amirshahi	Karaj College
M. Moaddab	GOI/Plan Organization
M. Khosroshahin	GOI/Plan Organization
J. Jafari	GOI/Plan Organization
A. Ellini	GOI/Plan Organization
M. Taghavi Bayat	GOI/Plan Organization
P. Parvaneh	Ministry of Agriculture
M. Niknejad	Pahlavi University
M. Shishegar	Dez Pilot Project, Khuzestan
M. Chehrenegar	Ghazvin Development Project

Soils-Agronomy

G. M. Horner	RPIP
H. Sarazdaghi	Karaj College
A. Solar-e-dini	Karaj College
M. Mojtehedi	GOI/Plan Organization
B. Bahrani	Pahlavi University

Pathology

W. J. Kaiser	RPIP
F. Eskanderi	Karaj College
M. Okhovat	GOI/Plan Organization
D. Danesh	GOI/Plan Organization
K. Ezadpaneh	Pahlavi University

PERSONNEL and COOPERATORS

IRAN

(Continued)

Entomology	
S. W. Wilson	RPIP
M. Esmaeli	Karaj College
H. Sepasguzarian	Karaj College
M. Omidvar	Pest Control Research Institute
K. Kamali	GOI/Plan Organization
G. R. Rassoulian	GOI/Plan Organization
S. Sherifi	Pahlavi University
A. Ascari	Pahlavi University
Quality	
H. Hedayat	Nutrition Research Institute
N. Sarkissian (Mrs.)	Nutrition Research Institute

PERSONNEL and COOPERATORS

INDIA

Administrative	
P. H. van Schaik	Regional Project Coordinator
W. E. Lansing	Administrative Officer
R. K. Sharma	Administrative Assistant
P. C. Bector	Senior-clerk
R. Gopalan Krishnan	Clerk
A. R. Ramani	Typist
Breeding	
K. H. Evans	RPIP
V. R. Gadwal	RPIP
R. K. J. Narayan	RPIP
D. N. Sajnani	RPIP
K. L. Jagiasi	RPIP
H. L. Chablani	RPIP
V. K. Madan	RPIP
S. R. Dass	RPIP
L. M. Jeswani	GOI/AICPP - IARI
S. P. Singh	GOI/AICPP - IARI
Soils-Agronomy	
R. J. Davis	RPIP
C. S. Saraf	RPIP
S. N. Kapoor	RPIP
A. Narayanan	RPIP
A. Parkash	RPIP
G. Banda (Miss)	RPIP
S. L. Choudhury	GOI/AICPP - IARI
P. C. Bhatia	GOI/AICPP - IARI
B. M. Sharma	GOI/AICPP - IARI
Pathology	
F. J. Williams	RPIP
B. Baldev	RPIP
K. S. Amin	RPIP
J. S. Grewal	GOI/AICPP - IARI

PERSONNEL and COOPERATORS

INDIA

(Continued)

Entomology	
K. E. Gibson	RPIP
A. K. Raina	RPIP
V. Motwani (Miss)	RPIP
H. P. Saxena	GOI/AICPP - IARI (Since July 1968)
Biochemistry	
O. Krober	RPIP

TABLE OF CONTENTS

INDIA

TABLES

IRAN

Varietal Improvement

Soil and Crop Management

Plant Pathology

Plant Pathology

Entomology

Quality

FIGURES

Iran

Plant Pathology

Entomology

Soil and Crop Management

Plant Pathology

SUMMARY

IRAN

A considerable change took place in the operations of the project in Iran during 1968.

The fourth 5-Year Plan went into effect on March 21 and with it the Government of Iran, through the Plan Organization, increased its support to pulse crop research from an average of Rials 2,200,000 ($29,000) per year during the previous four years to Rials 20,000,000 ($270,000) for 1968/69 and projected Rials 12,000,000 ($160,000) per year for the remaining four years of the Plan period. With this Iran assumed the responsibility of the major share of local costs of the Pulse Project. The funds are administered through Karaj Agricultural College which thereby has assumed control over local personnel, procurement and other project operations. Technical control and execution of the research program still rested with the American team but toward the end of the year a committee of Karaj College staff began to participate more actively in project affairs. A re-organization of Iran's universities and colleges with greater stress on the importance of research may well have contributed to this interest as the Pulse Project was the most active research program going on at Karaj College.

Early in 1968 the decision was made that the Regional Pulse Project in Iran would be phased out. Although considerable uncertainty existed regarding the exact timing and procedure, by the end of the year it appeared that at least part of the American team would remain for some time.

Dr. Kenneth Evans, plant breeder, was transferred to take over the breeder's position with RPIP/New Delhi during the summer of 1968, leaving the RPIP team in Iran without a breeder.

A two-day work planning session was held at Karaj in January 1968 to plan and coordinate research activities for the coming season between Karaj College, Ministry of Agriculture and other interested agencies such as Pahlavi University, Dez Irrigation Project and Ghazvin Development Project.

No workshop was held in Iran in 1968 primarily because only one American was present at the most suitable time for the workshop. However, a combined seminar-workshop was planned for January, 1969.

The Agricultural College of the Pahlavi University in Shiraz has actively engaged in pulse crops research. This work was originally supported by funds from the U.S. Regional Project through a Cooperative Agreement. Since the 1968 season Plan Organization funds and those from the University itself became available and very little of the money available from the U.S. program was used. Separate reports have been prepared by the Pahlavi University staff.

Active cooperation was also given by the staff of the Dez Pilot Project in Khuzestan and the Israeli and Iranian staff of the Ghazvin Development Project.

In 1968:

Several varieties of pulse crops were named by the Iran Ministry of Agriculture and seed was grown in seed multiplication blocks on government farms.

Previous data on crop management were confirmed. Maximum yields can be obtained with timely planting, good stands (400-500,000 plants per hectare) and proper irrigation. Nitrogen fertilization has not shown consistent responses indicating adequate nodulation and nitrogen fixation occurs naturally.

Resistance was identified to major diseases in chickpeas, lentils and cowpeas.

Recommendations for pest control schedules were made.

Preliminary screening showed possible resistance to bruchid in cowpeas

INDIA

Project activities in India in 1968 continued to be hampered by a serious lack of facilities. Facilities of land and laboratories at the Indian Agricultural Research Institute in New Delhi are totally inadequate for a U. S. team to do active research. The pressure for the land of the research farm is so great that hardly any of it can ever be taken out for uniform cropping. In addition priority for the good land is invariably given to wheat, maize, sorghum and rice. Out of five crop seasons since 1966, the pulse project has seen four complete or near complete failures. Laboratory space was to be provided by the construction of a Pulses Research Laboratory at IARI as provided in the Memorandum of Understanding between the Government of India and USA. However, this construction is still in the planning stage. In the meantime the laboratories provided are very over-crowded and inadequate.

The All India Coordinated Pulse Project and research on pulse crops in India in general made significant strides forward in 1968. Many positions on the All India Project were filled; in November the Coordinator was appointed. There are now more people working specifically on pulses than ever before. Several of the Agricultural Universities have or are in the process of appointing pulses breeders, pathologists, entomologists and agronomists. Because of the importance of chickpeas in the Punjab, that State has now separate breeders for that crop by itself.

The capability, technical as well as organizational and administrative, to carry on a program is certainly present in India. The presence of the U.S.

team has provided the stimulus to mobilize it. Continued presence of American scientists will help to keep it moving and provide material and other assistance for a strong country program.

During 1968 the question of local rupee funding for the U.S. team was raised and this has brought the matter of its function as a regional research team vs. country support program in focus. This matter is still in the process of being resolved.

The second annual workshop of the AICPP was held in April 1968 while a breeders' meeting took place in August. During the workshop papers were presented and research plans were made by committees of workers in the various disciplines. During the breeders' meeting the All India Coordinated yield trials were planned for the 1968/69 rabi season.

A bibliography of pulse crops is being compiled. When completed and published it should be of considerable value to pulse crop workers all over the world.

The 1968 crop season continued to show that pulse crop production is limited to a large extent by unexpected and unavoidable factors. Factors such as unusual cool and wet winter months which delay flowering and reduce yields in chickpeas; nematode infestations, severe monsoon flooding, new as well as known diseases for which there is no treatment or resistance limit and untimely windstorms which halve the yield of arhar limit the crops.

In spite of these hazards trials showed that:

(1) Proper spacing between and within rows increases yields.

(2) Fertilization with N, P, and K shows responses.

(3) Planting on ridges or beds is advantageous particularly when water-logging is a problem.

(4) With proper plant densities pigeon peas can produce as good yields in 150 days as in 250-300 days thereby releasing the land in time for an additional wheat crop.

(5) Trials with pulses during the dry early summer season between rabi harvest and kharif planting showed that pulses are more sensitive to environment than was previously believed.

Environmental effects appear to be on both vegetative growth and flowering. Chickpea and cowpea varieties, grown in Iran during the hot dry season, failed during the comparable season in India.

(6) Varieties of pigeon peas can be developed which mature in about half the time of presently grown varieties, are smaller in plant size and produce

high yields. Yields between 2,000 and 5,000 kilograms per acre have been produced in 150 days against an average of about 1,000 kg. in 250-300 days. These early varieties would release the land in time for an extra wheat crop. Three such varieties are presently undergoing yield tests.

(7) Resistance to gram blight (Ascochyta rabeii) may be available in varieties brought in from Israel. Thus far no permanent resistance to this very serious chickpea disease had been found.

(8) Resistance to Fusarium wilt in pigeon peas is location dependent, indicating pathogen races. This would explain the susceptibility to wilt of varieties developed with wilt resistance.

(9) Selections can be made which have resistance to several diseases. In mungbean eleven lines showed resistance to four diseases; in urdbean seven lines had resistance to several diseases; 50 cowpea lines were free from bacterial blight and top necrosis. These will be used in crossing programs.

(10) Bruchids, the most serious pests of pulses in storage, can be controlled by good pest control in the field prior to harvest to limit populations coming in with the seed. Good control also appears to be possible by treating seed in storage with a hydrocarbon compound (Bromodan, Hoechst Company of Germany). Availability of this material for this purpose however is doubtful.

(11) Preliminary data indicate that resistance to insects may be available. In 1968 one strain of cowpea (Accession No. 62-069-00576) was particularly free from several insects as well as diseases. A variety of lentil from Iran appears to have resistance to one species of bruchid (Callosobruchus maculatus).

INTRODUCTION

This report contains the details of the research program of the Regional Pulse Improvement Project in Iran and India during 1968.

A summary of results for 1968 was prepared earlier as a separate report.

The Regional Pulse Improvement Project originated in 1963 as the result of a Participating Agency Service Agreement between the U.S. Agency for International Development (USAID) and the U.S. Department of Agriculture, Agricultural Research Service (ARS). The purpose of this PASA was to have ARS personnel do research on the grain legumes (pulse crops) in the Near East, South Asia and Far East regions with the objective to improve production through better varieties and production practices, and to help establish continuing improvement programs on these important human nutrition crops.

The potential of the host countries to participate in this work was considered and after a survey of eight countries, Iran and India were selected as locations for two research teams. They were selected because of the local government interest, the importance of the crops, and the facilities for research and training available.

A Memorandum of Understanding with the Government of Iran was signed in May, 1964, providing for participation in project operations of the Plan Organization, the Ministry of Agriculture, and Karaj Agricultural College of Tehran University. A Cooperative Agreement was signed to provide for U.S. reimbursement to Iranian agencies for personnel provided in addition to the counterpart positions to be filled by the Plan Organization. A similar agreement was formed in 1966 with the Pahlavi University in Shiraz for cooperative research. Project operations started in Iran in August, 1964.

In India, the Memorandum of Understanding was not signed until April, 1965. To counterpart the Pulse Improvement Project, the Council of Agricultural Research of the Indian Government initiated the Project for the Intensification of Coordinated Research for the Improvement of Pulses at the Indian Agricultural Research Institute, New Delhi, and six regional centers and sub-stations throughout India. The first American personnel arrived at post late in 1965. The first full-time counterpart appointments under the Government of India scheme were made in the fall of 1966.

Each U.S. team consists of a plant-breeder, soils scientist-agronomist, plant pathologist, and entomologist. The project's overall activities are coordinated by a research agronomist coordinator and administrative officer. A biochemist was added to the team in India in early 1968.

IRAN

VARIETAL IMPROVEMENT

Karaj (Karaj College)
Dr. Kenneth H. Evans+
Dr. Cyrus Amirshahi
Engineers Jamshid Jaffari,
Mehdi Khosrowshahin, Ali Ellini,
Mohammad Moadab, and Taghavi
Bayat

Seed and Plant Improvement Institute
Ministry of Agriculture
Engineer Parviz Parvaneh

Shiraz (Pahlavi University)
Dr. Mansour Niknejad
Engineer M. Khosh-Khui

Lentils

The lentil germplasm was transferred to Pahlavi University and evaluated there. The more promising lines and selections were grown in Ghazvin in cooperation with the Ghazvin Development Project and at Karaj College.

Yield Trials (Tables 1 - 5)

Preliminary yield trials were planted at Ghazvin and Karaj. Several large seeded types recently obtained from Chile were included. Some large seeded types produced large yields in Ghazvin, but ranked low in Karaj.

Advanced yield trials were planted at nine locations. Yield results are presented for three locations. Isfahan types continue to produce more than large seeded types at Karaj and Varamin. At Ghazvin, both seed types produced nearly equal yields.

Chickpeas (*Cicer arietinum*)

Germplasm

Chickpea germplasm and selections were grown at Shiraz and Karaj. Two strains of chickpea reported to be resistant to blight (*Ascochyta rabeii*) were

---

+ Left Iran, May, 1968 for transfer to RPIP/New Delhi.

obtained from Israel with four other improved varieties.

Yield Trials (Tables 6-24)

Preliminary yield trials of promising selections were conducted at Ghazvin, Shiraz, and Karaj. The data for Karaj and Ghazvin are reported here. Shiraz data is reported in a separate publication by Pahlavi University. Advanced Yield trials were conducted at ten locations. Varamin, Ghazvin, and Karaj results and a summary table of Ministry of Agriculture yield results are presented. Accession Number 12-071-05451 was increased by the Iran Ministry of Agriculture. The yield of Accession Number 12-071-05451 was slightly higher than average.

Beans (Phaseolus vulgaris)

Germplasm

The germplasm and selections were grown in Shiraz and Karaj for seed increase and evaluation.

Yield Trials (Tables 25-34)

Preliminary yield trials were planted at Shiraz and Karaj. At Karaj, several strains produced larger yields than Accession Number 65-071-00446, Pinto 114 or Pinto 111, but were not outstanding for two years.

Advanced yield trials were grown at eight locations. Data are presented for Varamin and Karaj. Data for Shiraz is presented in a separate publication by Pahlavi University. Yields and percentage protein were higher for all tests at Karaj than at Varamin. Accession Number 65-071-00446 is susceptible to disease and yielded poorly in the pinto yield trials at Varamin and Karaj while Accession Number 65-071-00455 produced good yields at both locations as in 1967. Accession Number 65-071-00582 and 65-071-00042 produced about average yields in the advanced yield trials of red and white beans. All of the varieties are susceptible to bean common mosaic virus.

Broadbeans (Vicia faba) (Table 35)

A replicated yield trial of fifty-six strains of broadbeans was planted at the Khuzestan Development Trial Farm. Yield, disease and agronomic characters were noted. Yields ranged from 4400 kilo per hectare to less than 1000 kilo per hectare. Local strains were highest yielding.

Cowpeas (Vigna sinensis)

Germplasm

The germplasm collection was evaluated at Shiraz and more promising selections were also grown at Karaj.

Yield Trials (Tables 36-38)

Yield trials were planted at eight locations. Results from the preliminary yield trial at Karaj and the advanced yield trial at Varamin and Karaj are reported here. The results from Shiraz trials are reported in a separate publication by Pahlavi University. Three cowpea strains were increased by the Iran Ministry of Agriculture. Accession Number 65-071-10003 has some tolerance to cowpea mosaic virus, desirable seed type and good yield potential. Accession Number 65-153-00057 and Early Ramshorn have good seed type and yield potential, but little tolerance or resistance to cowpea mosaic virus.

Mungbeans (Phaseolus aureus)

Germplasm

The mungbean germplasm and selections were evaluated at Shiraz and Karaj.

Yield Trials (Tables 39-41)

Yield trials were grown at six locations. The results from Varamin and Karaj are presented here. A preliminary yield trial of 64 selections was grown in Karaj. Two mungbean strains were increased by the Iran Ministry of Agriculture. The two increased strains ranked second and fourth in yield when Varamin and Karaj results were averaged for 1968. (Accession Numbers 48-157-10307 and 48-069-10075.)

- - -

Additional germplasm was received from various sources. Six improved strains of chickpeas were received from Israel, two of which were reported to have resistance to blight (Ascochyta rabeii). This is being investigated (See Pathology section).

A strain of lentils was obtained with reported bruchid resistance (See Entomology section).

Requests for seed from various other countries were filled. Among them was 215 chickpea lines to the Atomic Energy Research Station in Puerto Rico (Dr. Koo), 70 strains of lentil, beans, and cowpeas to Turkey (Mr. Nibat Canitez) and requests from African countries.

The Plant Breeding and Genetics Department of the Pahlavi University in Shiraz has prepared a detailed report of the work carried on as part of the total pulses program.

Legend For Lentil Agronomic Data Tables - 1 to 5

(1) Numbers assigned to collection maintained by the Regional Pulse Improvement Project.

(2) Source numbers refer to collection numbers assigned by the Iranian Ministry of Agriculture. Six digit numbers are PI numbers from Crops Research Division, ARS, U.S. Department of Agriculture, Beltsville, Maryland, USA.

(3) Source indicates area of origin or area in which the seed was collected.

(4) Plants per meter is an average number of plants per meter of row based on one meter sample per replication.

(5) Rated 1 to 9: 1 = Complete stand 9 = poor stand

(6) Rated 1 to 9: 1 = Vigorous plants 9 = weak plants

(7) Days from planting to first opened flower.

(8) Indicates number of days after planting the first pod in plot reached full maturity, ready for harvest.

(9) Indicates number of days after planting the whole plot was ready for harvest.

(10) Disease rated 1 to 9: 1 = Free from disease symptoms
9 = Severe disease symptoms
For diseases present see pathology section.

(11) Seeds/five pods indicates the average number of seeds in five pods.

(12) Br = Brown; G = Green; R = Red; GR = Green and Red; L = Light

(13) Average weight (grams) of 100 seeds.

(14) Yield in kilogram per hectare based on 5 or 10 square meter plots.

(15) Protein percentage based on total solids. Determined by Kjeldahl method on two samples per strain, duplicate determinations per sample.

(16) Cooking time (in minutes) determined by boiling 50-gram sample in 500 ml. of water, 2 grams Na Cl added and checked regularly for hardness.

(17) Palatability, Maximum rating - 30
Appearance, Maximum 9
Color uniformity - 3 to 0
Size uniformity - 3 to 0
Cooking uniformity - 3 to 0
Smell - 6, 4 or 0
Taste - 15, 10 or 0

Table 1 Agronomic Data, Lentil Preliminary Yield Test, Planted April 7, 1968, RPIP, Ghazvin, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(8)	(10)	(12)	(13)	(14)
Accession Number	Source No.	S O U R C E	Plants /Meter	Stand	Vigor	Pl.to 1st Mat.	Disease Rating	Seed Color	100 Seeds Wt.	Yield Kg/Hec.
33-071-10406		Zanjan	43	3	3	73	2.0	GR	5.4	1536
33-071-10414		Zanjan	38	3	2	70	1.5	GR	4.6	1516
33-071-10419		Ghareh-Aghagh	38	3	2	73	2.0	GR	4.9	1444
33-071-10450	64165	Karaj	36	3	2	66	2.0	G	5.3	1432
33-071-11024	408	Isfahan	41	3	2	66	1.5	GR	3.4	1372
33-032-10199	299,160	Chile	38	3	2	69	2.5	RG	5.3	1368
33-071-11102	2-44-9416	Fars	34	3	3	66	2.0	RG	3.5	1348
33-071-11028	410	Isfahan	37	3	3	69	2.5	RG	3.4	1332
33-071-10423		Moghan	37	3	2	70	2.0	GR	5.1	1312
33-071-10430		Tabriz	37	3	3	69	2.0	GR	5.3	1308
33-071-10581		Iran	40	3	3	67	2.0	RG	4.7	1296
33-071-11023	2-42-4623	Isfahan	37	3	3	69	2.0	R	4.0	1288
33-071-10587	19262	Karaj	38	3	3	70	3.0	RG	5.3	1284
33-071-10417		Ardabil	31	3	2	69	2.0	RG	4.8	1280
33-071-10416		Ardabil	37	3	2	69	2.0	RG	4.4	1256
33-071-11080	2-44-8717	Fars	32	4	5	69	3.0	Br	3.8	1236
33-153-10048	187,971	Turkey	34	3	2	67	2.5	GR	5.5	1232
33-071-11103	2-44-9511	Fars	33	3	2	66	2.0	RG	3.8	1224
33-071-11027	409	Isfahan	33	3	3	68	2.5	RG	3.5	1208
33-071-10407		Ghareh-Aghagh	34	3	3	68	2.0	RG	5.0	1184
33-071-11081	2-44-6819	Fars	41	3	3	70	3.0	GR	3.3	1176
33-071-10420		Ardabil	50	2	3	66	2.0	G	4.9	1172
33-071-10425		Ahar	39	3	2	71	2.5	GR	5.1	1160
33-071-10415		Ardabil	37	3	3	71	2.5	GR	5.4	1160
33-071-10582	19248	Karaj	32	3	3	69	2.0	R	5.6	1152
33-071-11021	2-42-4470	Fars	35	3	3	67	3.5	GBr	3.6	1140
33-071-10418		Ardabil	38	3	3	70	2.5	GR	6.0	1120
33-071-10422		Moghan	42	3	2	71	3.0	RG	4.4	1112
33-071-11020	406	Isfahan	35	3	2	69	2.0	GR	3.1	1108
33-071-11090	2-44-8716	Fars	35	4	3	69	2.5	Br	3.4	1076
33-071-11022	2-42-4479	Fars	39	3	3	67	2.5	RG	3.3	1072
33-071-10427		Zanjan	40	3	2	68	2.0	RG	4.7	1060
33-071-10433		Ardabil	38	3	3	69	2.5	GR	4.3	1048
33-071-11109	2-44-8775	Isfahan	35	3	4	69	3.0	Br	3.4	1044
33-071-11016	2-42-4464	Fars	40	3	4	67	3.0	RG	3.6	1040
33-071-10588	19267	Karaj	30	3	3	73	2.0	GR	4.9	1032
33-071-10718	20135	Ghouchan	28	3	3	72	3.5	RG	3.8	1028
33-071-10412		Moghan	36	4	2	70	2.0	GR	4.5	1024
33-071-10429		Moghan	38	2	1	68	2.0	RG	4.8	1024
33-071-11014	2-42-4467	Fars	31	4	2	67	2.5	GR	4.0	1020
33-071-10713	20180	Ghouchan	32	3	3	68	2.5	R	4.6	1012
33-071-11076	2-44-8713	Fars	35	3	3	68	2.0	Br	3.3	1008
33-071-11078	2-44-8714	Fars	26	4	4	69	3.0	Br	3.2	976
33-071-11070	2-44-8719	Fars	30	3	4	72	2.5	Br	3.1	972
33-071-10436		Tehran	35	3	3	70	3.0	G	5.6	960
33-032-10210	299,174	Chile	38	3	2	68	2.0	RG	5.2	958
33-032-10211	299,175	Chile	33	3	2	68	3.0	RG	5.6	928
33-157-10431		U.S.A.	34	3	3	70	2.5	R	4.4	920
33-071-11111	2-44-8778	Isfahan	36	3	3	70	3.0	Br	3.3	920
33-071-11019	405	Isfahan	36	4	3	69	2.5	GR	3.6	860
33-032-10217	299,182	Chile	34	3	2	73	2.5	RG	419	832
33-032-10202	299,164	Chile	33	3	3	72	3.0	GR	6.7	820
33-032-10208	299,171	Chile	40	3	2	70	2.5	G	5.5	812
33-071-10426		Khoy	34	3	3	67	2.5	GR	4.2	812
33-032-10222	299,187	Chile	38	3	2	77	2.5	RG	5.3	808
33-071-11018	403	Isfahan	34	3	4	69	3.0	GR	3.2	696
33-032-10244	299,215	Chile	35	3	3	72	3.5	GR	5.9	680
33-032-10245	299,216	Chile	35	3	2	75	2.0	GR	4.5	652
33-032-10193	299,145	Chile	31	3	2	70	2.5	R	5.2	640
33-071-10410		Khoy	38	3	2	66	2.0	RG	4.1	604
33-032-10220	299,185	Chile	36	3	3	71	3.0	RG	5.8	596
33-032-10254	299,225	Chile	40	3	2	74	2.5	G	5.4	596
33-032-10216	299,181	Chile	31	3	3	69	3.0	RG	5.2	584
33-032-10258	299,224	Chile	37	3	2	71	2.5	G	4.8	520
CV% =										25
LSD .05 =										216

Table 2 Agronomic Data, Lentil Preliminary Yield Test Planted April 3, 1969, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Accession Number	Source No.	S O U R C E	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seeds per 5 Pods	Seed Color	100 Seeds Wt.	Yield Kg/Hec.
33-071-11076	2-44-8713	Fars	30	2	2	52	83	111	2.3	9	Br	3.0	1176
33-071-11021	2-42-4470	Fars	40	2	2	54	78	112	2.3	9	Gr	2.7	1082
33-071-11080	2-44-8717	Fars	38	3	2	53	76	108	2.3	7	Br	2.5	1080
33-071-11078	2-44-8714	Fars	37	2	2	52	77	112	2.0	8	Br	3.3	1058
33-071-11090	2-44-8716	Fars	34	3	2	53	83	109	2.6	9	Br	3.1	990
33-071-11070	2-44-8719	Fars	29	3	2	53	89	110	2.3	9	Br	3.3	944
33-071-11109	2-44-8776	Isfahan	30	4	2	54	83	114	2.3	9	Br	3.0	918
33-071-11081	2-44-6819	Fars	32	3	3	54	70	108	3.0	8	G	2.9	918
33-071-11020	406	Isfahan	32	2	2	53	79	112	2.6	10	G	2.9	796
33-071-11019	405	Isfahan	40	2	2	52	73	115	3.6	9	G	2.9	786
33-071-11016	2-42-4464	Fars	41	3	2	53	77	107	3.3	10	G	2.8	784
33-071-11014	2-42-4467	Fars	43	2	2	54	81	108	2.6	9	G	2.7	774
33-071-11111	2-44-8778	Isfahan	29	2	2	53	80	106	3.0	8	Br	3.7	690
33-071-11018	403	Isfahan	34	3	2	53	76	105	3.0	9	G	2.6	686
33-071-11022	2-42-4479	Fars	36	2	2	52	75	112	2.3	9	R	2.6	678
33-071-11024	408	Isfahan	35	3	2	54	73	115	2.6	8	LR	2.8	632
33-071-11028	410	Isfahan	34	3	3	54	83	115	2.3	8	LG	2.6	622
33-071-11027	409	Isfahan	43	2	2	52	73	116	3.3	7	G	2.9	520
33-071-10450	6416S	Karaj	37	2	2	55	72	110	3.3	7	G	4.6	458
33-071-11102	2-44-9416	Fars	36	2	2	53	73	107	3.0	9	R	2.8	408
33-071-10718	20135	Ghouchan	31	3	3	57	77	115	3.3	8	R	2.8	408
33-153-10048	178,971	Turkey	35	2	2	53	75	112	3.0	7	G	4.2	406
33-071-10582	19248	Karaj	24	2	2	50	67	104	4.3	8	R	4.1	368
33-071-10419		Ghare-aghagh	36	3	2	51	71	113	3.3	7	GRBr	4.3	348
33-032-10245	299,216	Chile	37	2	2	57	75	114	4.3	7	G	4.2	346
33-071-10417		Ardabil	23	3	3	52	71	111	4.3	7	GRBr	3.4	326
33-071-10588	19297	Karaj	32	3	3	54	73	113	3.3	9	G	4.4	324
33-071-10433		Ardabil	30	3	2	52	68	97	3.0	7	G	3.6	288
33-071-10587	19262	Karaj	33	3	2	54	71	110	3.6	6	GRBr	4.4	284
33-032-10202	299,164	Chile	27	3	2	55	74	116	4.3	5	G	5.4	270
33-032-10199	299,160	Chile	33	2	2	55	77	113	4.0	7	G	4.4	270
33-071-11103	2-44-9511	Fars	33	3	3	54	69	102	3.0	8	GRBr	3.3	262
33-071-11023	2-42-4623	Isfahan	35	3	3	53	69	103	3.3	8	LR	2.8	252
33-071-10581		Iran	33	3	2	50	64	98	3.6	7	RG	3.6	252
33-071-10425		Ahar	39	2	2	52	71	105	3.6	7	GRBr	4.1	248
33-071-10427		Moghan	32	3	3	53	73	103	4.3	6	G	4.3	232
33-071-10407		Ghare-aghagh	39	3	3	53	73	106	3.3	8	GRBr	3.4	224
33-071-10416		Ardabil	28	3	2	52	71	107	3.6	9	G	4.0	214
33-071-10430		Tabriz	34	3	2	52	64	94	3.6	7	G	4.7	204
33-032-10217	299,182	Chile	32	3	2	58	76	106	3.6	6	G	4.1	202
33-071-10436		Tehran	26	3	2	55	70	108	5.0	6	G	5.3	198
33-071-10420		Ardabil	28	2	2	53	68	107	3.6	7	G	3.9	196
33-071-10418		Ardabil	30	3	2	53	70	102	3.6	6	G	4.5	194
33-157-10431		U.S.A.	32	3	3	54	75	103	3.6	7	R	3.8	190
33-071-10414		Zanjan	30	3	3	55	68	99	4.6	6	G	3.6	186
33-071-10713	20136	Ghouchan	37	3	3	54	69	105	3.6	9	GRBr	3.1	184
33-071-10406		Zanjan	30	3	3	53	69	107	4.3	8	GRBr	3.5	180
33-032-10258	299,224	Chile	24	3	3	61	79	110	3.6	7	G	4.7	174
33-032-10254	299,225	Chile	37	2	2	59	82	110	4.3	7	G	4.6	164
33-071-10410		Khoy	32	2	2	55	71	99	4.0	6	G	4.3	160
33-032-10210	299,174	Chile	35	2	2	53	75	112	3.0	7	G	4.2	150
33-032-10211	299,175	Chile	32	2	2	53	73	114	4.3	7	BR	4.5	136
33-071-10427		Zanjan	34	3	3	52	63	98	4.6	6	G	3.3	134
33-071-10423		Moghan	30	3	2	53	69	97	4.3	7	G	4.2	132
33-032-10244	299,215	Chile	29	3	3	59	74	115	5.0	5	G	5.5	128
33-032-10208	299,171	Chile	35	2	2	57	72	101	4.0	6	G	4.7	120
33-032-10216	299,181	Chile	27	2	2	58	70	101	4.0	7	G	4.2	116
33-071-10412		Moghan	38	3	2	54	67	98	4.3	8	GRBr	3.6	104
33-032-10224	299,187	Chile	34	3	3	57	74	111	4.6	8	BR	3.7	100
33-071-10415		Ardabil	23	4	2	52	66	97	4.0	7	G	3.4	96
33-032-10220	299,185	Chile	25	3	2	55	74	113	4.0	5	G	5.2	92
33-071-10422		Moghan	29	2	2	51	61	97	5.0	6	G	3.3	78
33-032-10193	299,145	Chile	34	2	2	60	74	115	4.0	6	GRBr	4.9	70
33-071-10427		Khoy	29	3	3	59	65	102	4.0	8	G	2.8	30
CV% =													37
LSD .05=													178

Table 3 Agronomic Data, Lentil Advance Yield Test Planted April 7, 1968, RPIP, Ghazvin, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(10)	(12)	(13)	(14)
Accession Number	Source No.	S O U R C E	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl.to 1st Mat.	Disease Rating	Seed Color	100 Seeds Wt.	Yield Kg/Hec.
33-071-10409		Ardabil	20	2	3	54	79	2.0	GR	5.3	1470
33-071-10428		Moghan	25	3	3	55	81	2.0	GR	5.8	1344
33-071-10435		Ghazvin	22	3	3	52	80	2.0	RG	4.9	1342
33-071-10421		Ghazvin	19	3	3	46	72	2.5	GR	5.2	1340
33-085-11174	2-42-4925	127 Lebanon	23	3	3	45	69	2.5	GR	4.2	1256
33-071-10408		Ahar	21	3	3	56	81	2.0	GR	5.0	1200
33-071-10437		Ghazvin	25	3	3	48	79	2.0	RG	5.8	1154
33-071-10445	209-91	Isfahan	25	3	3	58	82	2.5	RBr	4.0	1140
33-071-11175	2-42-176-6016	Arasbaran	25	3	3	39	67	2.0	RG	5.5	1138
33-071-11179	2-42-5933	183 Iran Fars	21	3	3	46	71	2.0	GR	5.3	1130
33-071-11178	2-42-6031	176 Azarbaijan	24	3	2	52	77	2.5	GR	4.9	1102
33-071-10424		Moghan	25	3	3	55	73	2.0	GR	4.8	1094
33-071-10432		Ardabil	28	3	3	56	79	2.0	GR	5.0	1086
33-039-11177	2-42-5125	142 Cyprus	25	3	3	54	76	2.0	GR	5.2	1082
33-071-11136	64-217-62	Isfahan	26	4	5	58	81	2.5	LBr	3.6	1070
33-071-10885	209-70	Isfahan	25	4	4	58	85	2.5	Br	3.1	1068
33-071-10903	209-48	Isfahan	30	3	3	58	81	3.0	R	3.6	1066
33-071-10444	209-73	Isfahan	27	3	4	57	81	2.5	Br	3.5	1034
33-071-11139	209-68	Isfahan	23	3	4	57	82	3.0	Br	3.7	1024
33-071-10439	210-41	Jiroft	29	4	4	57	78	2.5	Br	3.4	1008
33-071-10440	209-25	Isfahan	32	3	4	58	77	2.5	DBr	3.5	1008
33-071-10411		Moghan	25	3	4	51	77	2.0	GR	5.5	960
33-071-10436		Ghazvin	25	3	3	55	80	2.0	GR	5.5	946
33-071-10413		Tabriz	19	4	3	55	75	2.0	GR	5.6	914
33-071-10443	209-27	Isfahan	28	4	4	53	75	3.0	Br	3.0	770
33-071-10442	209-53	Isfahan	32	3	4	57	83	2.5	BrR	4.4	734
33-071-11176	2-42-6039	176 Azarbaijan	22	3	3	49	72	2.0	RG	5.5	708
33-071-10438	209-77	Isfahan	21	4	5	58	82	3.0	Br	3.9	696
33-071-11138	2-42-4559	Isfahan	26	4	5	58	83	2.5	GR	3.3	672
33-071-10441	209-75	Isfahan	29	3	4	58	79	2.5	RG	3.6	656
CV% =											35
LSD .05 =											253

Table 4 Agronomic Data, Lentil Advance Yield Test Planted March 12, 1968, RPIP, Varamin, Iran

(1) Accession Number	(2) Source No.	(3) S O U R C E	(5) Stand	(6) Vigor	(7) Planting to 1st Fl.	(10) Disease Rating	(11) Seeds per 5 Pods	(13) 100 Seeds Wt.	(14) Yield Kg/Hec.
33-071-10445		Isfahan	1	1	68	1	5	4.5	1166
33-071-10885		Isfahan	1	2	68	2	10	4.0	994
33-071-10439		Jiroft	2	2	67	2	5	4.4	979
33-071-10440		Isfahan	1	2	67	2	10	5.0	957
33-071-10444		Isfahan	2	2	67	1	10	2.5	952
33-071-11136	217	Isfahan	3	2	69	1	5	4.5	931
33-071-10443		Isfahan	1	1	65	1	10	3.0	912
33-071-10442		Isfahan	2	2	68	2	5	3.0	903
33-071-11139		Isfahan	2	1	68	2	5	5.0	880
33-071-10438		Isfahan	1	2	67	2	5	4.0	824
33-071-10903		Isfahan	2	2	70	2	5	4.5	809
33-071-10441		Isfahan	2	1	67	1	5	3.5	770
33-071-11138		Isfahan	2	3	58	2	5	4.0	617
33-085-11174	127	Lebanon	3	3	61	4	10	5.5	284
33-071-10408		Ahar	3	4	64	3	5	4.5	278
33-071-11179	183	Iran	3	3	61	4	5	5.0	276
33-071-11175	176	Arasbaran	3	3	60	4	5	5.0	231
33-071-10428		Moghan	3	4	62	4	5	5.6	206
33-071-10421		Ghazvin	2	4	60	4	5	5.6	201
33-071-10411		Moghan	3	4	61	4	5	5.5	180
33-071-10413		Tabriz	2	3	63	4	5	5.0	178
33-071-11176	176	Azarbaijan	3	5	61	4	5	6.0	162
33-039-11177	142	Cyprus	3	3	62	4	5	5.0	152
33-071-10437		Ghazvin	3	3	62	4	5	5.0	139
33-071-10436		Ghazvin	3	3	62	4	5	4.4	125
33-071-10424		Moghan	3	3	62	4	5	5.0	124
33-071-10409		Ardabil	3	4	61	3	10	6.5	120
33-071-10435		Ghazvin	3	3	61	4	5	5.0	111
33-071-11178	176	Azarbaijan	3	4	61	4	5	6.5	106
33-071-10432		Ardabil	3	3	62	4	5	5.0	96
CV % =									28
LSD .05 =									186

Table 5 Agronomic Data, Lentil Advance Yield Test Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Accession Number	Source No.	S O U R C E	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seeds per 5 Pods	Seed Color	100 Seeds Wt.	Yield Kg/ Hec.	Protein	Cooking Time	Palatability
33-071-10903	209-48	Isfahan	41	2	2	54	80	108	1.3	9	LR	2.7	1110	28.40	35	22
33-071-10441		Isfahan	31	2	2	54	83	112	1.6	9	LR	3.0	1089	29.49	42	19
33-071-11136	217	Isfahan	33	3	2	54	81	101	2.0	9	Br	3.2	1070	27.59	30	19
33-071-10885	209-70	Isfahan	36	2	2	53	82	117	2.0	8	Br	2.7	1063	27.60	28	20
33-071-11139	209-68	Isfahan	37	2	3	53	83	115	1.6	8	Br	3.2	1055	27.45	37	20
33-071-10439	210-41	Jiroft	38	2	2	55	82	112	2.0	8	Br	3.2	1055	29.16	40	20
33-071-10445	209-97	Isfahan	34	3	2	53	76	116	2.0	8	Br	3.3	1044	28.87	42	17
33-071-10444	209-73	Isfahan	41	2	3	52	77	112	2.0	9	Br	2.7	1008	28.44	37	16
33-071-11138	2-42-4559	Isfahan	36	3	3	55	82	111	1.6	8	G	2.7	1000	28.23	39	22
33-071-10442	209-53	Isfahan	35	2	3	54	81	114	2.0	8	GRBr	3.1	989	28.97	41	19
33-071-10440	209-25	Isfahan	33	3	3	54	84	111	1.6	9	Br	3.1	968	28.08	29	19
33-071-10438	209-77	Isfahan	35	2	3	54	83	115	2.0	7	Br	3.3	917	28.61	39	16
33-071-10443		Isfahan	32	3	3	52	80	114	2.3	7	Br	2.7	700	28.05	39	19
33-071-10408		Ahar	32	2	1	53	75	114	3.3	7	Br	4.4	584	28.87	59	21
33-071-11175	176	Arasbaran	32	3	3	53	75	110	2.6	5	G	4.4	572	29.47	51	21
33-071-10436		Ghazvin	35	3	2	53	72	113	3.3	6	G	4.7	463	29.32	63	13
33-071-11179	183	Unknown	28	2	2	52	73	119	3.0	5	GRBr	4.3	452	29.46	52	19
33-071-10437		Ghazvin	35	3	2	53	74	117	3.0	7	G	4.4	417	29.57	63	18
33-071-10428		Moghan	33	2	2	53	74	109	3.3	6	G	4.3	410	29.40	58	17
33-085-11174	127	Lebanon	36	2	2	52	70	111	3.6	6	LG	4.4	405	28.67	55	16
33-071-10432		Ardabil	31	3	2	53	75	112	3.3	7	G	4.2	390	29.60	63	16
33-071-10413		Tabriz	29	3	3	54	74	106	3.3	8	G	4.3	387	29.10	65	19
33-071-10421		Ghazvin	31	3	3	52	71	99	3.6	6	LG	3.8	372	28.77	57	18
33-071-10409		Ardabil	30	3	3	53	75	113	3.0	7	G	4.2	369	29.38	66	18
33-071-10411		Moghan	33	3	2	53	70	108	4.0	7	G	4.4	269	29.53	69	17
33-071-10435		Ghazvin	30	3	3	52	74	104	3.0	8	GRBr	3.7	354	29.03	58	13
33-039-11177	142	Cyprus	34	2	3	53	72	103	3.0	6	G	4.2	323	29.11	66	18
33-071-11176		Azarbaijan	30	3	2	52	73	107	3.0	7	LG	4.1	319	29.37	62	19
33-071-10424		Moghan	28	3	3	52	73	108	3.0	8	G	3.6	252	29.07	63	17
33-071-11178		Azarbaijan	30	3	2	52	70	101	3.0	8	G	3.8	210	29.39	50	19
CV % =													23			
LSD .05 =													214			

Legend For Chickpea Agronomic Data Tables 6-24

(1) Numbers assigned to collection maintained by the Regional Pulse Improvement Project.

(2) Numbers assigned in 1965 single row nursery

(3) Source numbers are numbers assigned to populations or collections by the Iranian Ministry of Agriculture; 6 digit numbers are PI numbers from Crops Research Division, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(4) Source indicates origin of seed either country or section of Iran.

(5) W = White; P = Purple; LP = Light purple.

(6) Average plant height in centimeters.

(7) Average plant width in centimeters.

(8) Average number of plants per meter based on one meter of row per replication.

(9) Rated 1 to 9: 1 = complete stand 9 = poor stand

(10) Rated 1 to 9: 1 = vigorous plants 9 = weak plants

(11) Days from planting to first opened flower.

(12) Indicates number of days after planting the first pod in plot reached full maturity, ready for harvest.

(13) Indicates number of days after planting the whole plot was ready for harvest.

(14) Disease rated 1 to 9: 1 = free from disease symptoms; 9 = severe disease symptoms including yellowing and wilting

(15) Average number of seeds per 10 pods.

(16) Br = Brown; W = White; Bl = Black; Cr = Cream; Y = Yellow; Gr = Green; L = Light; D = Dark.

(17) Average weight (in grams) of 100 seeds.

(18) Yield in kilograms per hectare based on 5 or 10 square meters per plot.

(19) Protein percentage based on total solids. Determined by Kjeldahl method on two samples per strain, duplicate determination per sample.

(20) Cooking time (in minutes) determined by boiling 50-gram sample in 500 ml. of water, 2 grams Na Cl added and checked regularly for hardness.

(21) Palatability, Maximum rating - 30
- Appearance, Maximum - 9
  - Color uniformity - 3 to 0
  - Size uniformity - 3 to 0
  - Cooking uniformity - 3 to 0
- Smell - 6 to 0
- Taste - 16 to 0

Table 6 Agronomic Data, Chickpea (Black) Preliminary Yield Test No. 2 planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(17)	(18)
Accession Number	Strain Number	Source Number	S O U R C E	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat	Pl.to Com. Mat.	Disease Rating	Seeds per 10 pods	100 Seeds Wt.	Yield per Hectare
12-071-04287	295		Isfahan	P	37	57	19	3	1	55	100	121	1	17	11.0	3108
12-071-04466	2246	221	Isfahan	P	29	56	15	2	1	54	97	126	2	17	12.6	2962
12-071-04282	291	129	Isfahan	P	35	54	14	2	1	53	97	117	1	19	12.3	2916
12-071-04439	2221	221	Isfahan	P	32	55	19	1	1	53	97	121	1	19	12.1	2864
12-071-04433	2216	221	Isfahan	P	34	55	15	3	1	54	99	120	2	16	12.2	2816
12-071-05387	3092	154	Gharyeh-Gole	P	35	48	18	1	1	53	97	117	2	16	12.3	2744
12-071-05378	3084	154	Gharyeh-Gole	P	39	56	16	1	1	53	97	122	2	19	12.2	2742
12-071-05185	2911	174	Ahar	P	23	45	13	4	2	53	97	120	2	15	9.5	2712
12-071-04413	2198	221	Isfahan	P	34	58	15	4	1	54	100	121	2	20	11.2	2710
12-071-04285	293		Isfahan	P	35	52	21	2	1	53	100	120	2	16	12.2	2638
12-071-04265	276	326	Isfahan 221	P	34	55	17	3	1	53	97	117	1	15	11.9	2600
12-071-04440	2222	221	Isfahan	P	36	55	18	1	1	53	97	122	1	18	11.8	2546
12-071-04775	2542	173	Ardabil	P	31	57	19	2	1	53	97	113	2	15	10.2	2534
12-071-04703	2478	172	Ardabil	P	25	47	19	3	2	53	97	114	3	16	10.3	2528
12-071-05131	2863	174	Ahar	P	37	50	19	3	1	53	97	122	2	17	12.2	2524
12-071-04663	2424	172	Ardabil	P	25	44	19	4	3	52	99	121	2	16	9.7	2516
12-071-04445	2226	221	Isfahan	P	37	56	17	2	1	54	97	122	2	16	11.6	2404
12-071-04623	2388	172	Ardabil	P	27	49	20	3	1	52	97	120	2	17	10.0	2376
12-071-04681	2458	172	Ardabil	P	28	49	21	2	1	52	97	114	2	15	10.3	2354
12-071-04799	2564	173	Ardabil	P	26	47	17	1	1	52	97	117	3	19	10.6	2348
12-071-05326	3038	154	Gharyeh-Gole	P	37	57	16	2	1	54	97	119	2	18	11.7	2342
12-071-04629	2396	172	Ardabil	P	30	50	19	1	2	53	97	122	2	18	9.8	2190
12-071-05108	2842	174	Ahar	P	30	53	11	5	2	53	100	123	1	18	11.9	2180
12-071-05055	2794	175	Ahar	P	33	51	17	2	1	54	97	114	2	17	11.5	2098
12-071-05403	3121	164	Moghan sel.	P	31	51	16	3	2	56	97	118	3	16	10.6	2032
CV % =																20

Yield differences not significant at .05.

Table 7 Agronomic Data, Chickpea (White) Preliminary Yield Test No. 2 planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	Strain Number	Source Number	S O U R C E	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds Wt.	Yield per Hectare
12-071-10041	226	170	Ardabil	LP	40	63	15	1	1	55	101	130	1	13	LCr	27.5	4792
12-071-02842	1005	170	Ardabil	LP	43	63	15	1	1	58	102	132	1	12	LCr	26.1	4750
12-071-02946	1102	169	Ardabil	LP	45	66	12	1	1	59	106	127	1	13	LCr	26.3	4582
12-071-06359	797	230	Nishabour	LP	30	52	13	2	1	55	100	119	2	19	LCr	17.0	4493
12-071-02193	387	241	Ghochan	W	33	62	12	2	2	53	101	134	2	16	Cr	28.5	4475
12-071-03578	1707	153	Karaj	LP	46	64	11	1	1	57	104	129	2	12	LCr	23.0	4385
12-071-02479	646	106	Fars	LP	43	65	13	1	1	54	101	122	2	13	DCr	26.7	4354
12-071-03240	1385	111	Varamin	LP	49	61	14	1	1	55	102	123	1	15	DCr	25.9	4289
12-071-03081	1225	169	Ardabil	LP	38	61	14	1	1	56	103	131	1	12	LCr	23.9	4283
12-071-02841	1004	170	Ardabil	LP	46	65	13	1	1	67	103	130	1	12	LCr	26.6	4283
12-071-02729	898	182	Shiraz	W	43	59	17	1	1	62	103	128	3	13	W	18.9	4215
12-071-03230	1373	41	Varamin	LP	38	63	12	1	1	55	104	137	1	14	LCr	22.6	4204
12-071-02759	924	182	Shiraz	LP	40	57	16	1	1	54	101	131	1	14	LCr	16.1	4187
12-071-10042	134	230	Tehran 251025	LP	38	58	14	1	1	54	103	131	1	14	LCr	16.6	4145
12-071-02290	474	220	Isfahan	W	45	60	10	2	1	75	108	135	1	13	W	23.0	4119
12-071-02613	776	230	Nishabour	W	38	66	12	2	1	53	101	124	2	17	W	20.2	4094
12-071-03236	1381	111	Varamin	LP	40	61	12	1	1	52	100	119	1	15	DCr	29.3	4087
12-071-03413	1550	161	Mamaghan	LP	40	68	15	1	1	64	101	124	1	17	LCr	18.2	3997
12-071-03249	1393	111	Varamin	LP	38	65	13	1	1	53	101	119	1	13	DCr	29.5	3982
12-071-03430	1565	161	Mamaghan	LP	42	70	15	1	1	58	103	129	1	15	Cr	17.4	3972
12-071-02845	1008	170	Ardabil	LP	44	65	14	1	1	57	101	124	1	13	Cr	30.7	3932
12-071-03421	1557	161	Mamaghan	LP	47	63	16	1	1	63	102	120	1	12	DCr	19.4	3906
12-071-02302	485	220	Isfahan	W	33	54	11	1	1	54	101	128	2	16	W	18.3	3893
12-071-10043	71(1)	170	Ardabil	LP	48	68	12	1	1	62	102	131	1	12	Cr	27.2	3873
12-071-03393	1532	168	Mamaghan	W	36	58	15	1	1	53	100	134	1	13	W	22.0	3872
12-071-02302	458	220	Isfahan	W	46	65	11	1	1	72	109	136	1	15	W	20.7	3850
12-071-02448	618	106	Fars	W	53	55	14	2	1	54	100	126	2	13	W	19.4	3822
12-071-06342	2013	217	Torbat-Haidari	LP	38	59	14	1	1	66	104	130	1	18	Cr	14.0	3786
12-071-02270	935	182	Shiraz	W	39	57	13	1	1	55	101	132	2	15	W	18.1	3754
12-071-03523	1657	152	Karaj	LP	37	60	15	1	1	53	100	120	1	16	LCr	19.7	3732
12-071-05471	310	241	Ghochan	W	29	54	14	2	1	51	100	125	2	16	W	20.9	3730
12-071-02733	902	182	Shiraz	W	36	54	14	1	1	56	101	127	1	17	W	17.7	3682
12-071-02765	931	182	Shiraz	W	35	48	14	2	1	54	101	130	1	16	W	18.4	3638
12-071-10044	71(2)	170	Ardabil	LP	43	67	12	1	1	62	102	118	1	12	LCr	27.0	3603
12-071-02631	800	230	Nishabour	W	39	61	15	1	1	54	100	122	1	18	W	16.8	3599
12-071-03226	1370	111	Varamin	LP	42	69	13	1	1	54	100	121	2	13	DCr	27.6	2596
12-071-02095	267	460	Karaj sel.	LP	38	60	12	1	1	54	100	126	2	11	Cr	29.5	3555
12-071-02744	912	182	Shiraz	W	41	56	13	1	1	60	103	135	1	13	W	18.9	3550
12-071-02898	1055	170	Ardabil	W	36	55	16	1	1	54	104	138	1	14	W	17.6	3520
12-071-02639	809	230	Nishabour	W	34	57	12	1	1	54	101	123	2	18	W	19.3	3482
12-071-02214	406	241	Ghochan	W	26	46	10	1	1	49	101	127	2	15	W	21.0	3468
12-071-02270	935	182	Shiraz	W	37	55	14	1	1	55	103	128	1	14	W	27.9	3453
12-071-02565	731	230	Nishabour	W	36	55	14	1	1	54	100	124	1	14	W	18.1	3445
12-071-06364	794	230	Nishabour	LP	57	58	17	1	1	54	101	123	2	17	DCr	15.8	3431
12-071-02892	1050	170	Ardabil	LP	46	64	13	1	1	54	101	120	2	10	LCr	29.1	3427
12-071-02655	828	230	Nishabour	W	39	60	15	1	1	55	100	124	2	22	W	17.8	3413
12-071-03253	1398	111	Varamin	W	38	57	14	1	1	53	100	128	2	12	W	23.1	3407
12-071-01916	84		P.S.K.P.	W	34	57	11	1	1	52	100	127	2	15	W	24.1	3399
12-071-03240	1385	111	Varamin	LP	41	64	11	1	1	53	101	122	2	14	Cr	28.8	3386
12-071-02791	954	230	Nishabour	W	36	55	12	1	1	57	103	128	1	14	W	16.9	3385
12-071-03259	1406	111	Varamin	LP	37	60	11	1	1	54	100	117	2	13	DCr	27.7	3347
12-071-03629	1760	153	Karaj	LP	43	62	11	1	1	57	101	126	1	11	LCr	25.1	3341
12-071-02478	645	106	Fars	W	42	55	13	1	1	55	100	121	1	15	W	18.0	3328
12-071-03069	1213	169	Ardabil	W	36	53	15	2	1	56	101	123	1	15	W	19.1	3326
12-071-02195	389	241	Ghochan	W	31	60	11	2	1	52	101	123	2	17	W	20.0	3316
12-071-02442	613	106	Fars	W	30	47	13	1	1	55	100	120	1	14	W	18.2	3314
12-071-03886	2014	217	Torbat-Haidari	W	36	62	15	1	1	53	100	127	1	20	W	17.4	3308
12-071-02732	901	182	Shiraz	W	37	54	16	1	1	55	101	133	1	16	W	18.3	3305
12-071-02023	201	2	Torbat	W	38	59	14	1	1	55	100	122	2	13	W	30.2	3301
12-071-02653	825	230	Nishabour	W	34	56	14	1	1	54	100	128	2	23	W	16.3	3298
12-071-02443	614	106	Fars	W	32	53	15	1	1	53	100	127	1	16	W	18.6	3293
12-071-02479	646	106	Fars	W	32	52	20	1	1	54	100	134	1	15	W	17.1	3278
12-071-02270	456	220	Isfahan	W	41	66	10	2	1	70	109	132	2	13	W	22.0	3233
12-071-02651	823	230	Nishabour	W	37	61	14	1	1	53	100	123	1	16	W	21.0	3219
12-071-02244	433	241	Ghochan	W	28	60	13	2	1	52	100	126	1	17	W	17.0	3191
12-071-04044	2167	220	Isfahan	W	48	65	11	2	1	72	106	128	3	12	W	35.8	3170
12-071-02814	975	230	Nishabour	W	33	55	13	1	1	53	100	118	2	16	W	20.5	3165
12-071-02695	868	182	Shiraz	W	36	56	14	2	1	56	100	126	1	13	W	16.5	3152

contd..

Table Agronomic Data, Chickpea (White) Preliminary Yield Test No. 2, Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	Strain Number	Source Number	S O U R C E	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds W Wt.	Yield per Hectare
12-071-02244	433	241	Ghochan	W	30	60	13	1	1	53	100	122	1	18	W	18.1	3150
12-071-03249	1393	111	Varamin	LP	42	60	12	1	1	55	100	115	1	14	DCr	26.9	3142
12-071-02249	437	241	Ghochan	W	34	59	12	1	1	52	100	122	2	16	W	20.9	3116
12-071-01919	86	84	Karaj sel.	W	38	59	11	1	1	54	101	128	1	16	W	31.1	3084
12-071-02738	906	182	Shiraz	W	35	51	13	1	1	55	104	120	1	16	W	19.1	3038
12-071-03233	1376	111	Varamin	W	34	54	18	2	1	55	100	121	2	16	W	17.7	3036
12-071-02643	813	230	Nishabour	W	28	57	12	1	1	52	100	125	2	16	W	19.0	3031
12-071-02053	229	424	Karaj sel.	W	34	53	12	1	2	54	100	134	2	12	W	26.8	3005
12-071-02629	795	230	Nishabour	W	27	52	11	2	1	51	100	125	2	16	W	17.9	3002
12-071-02815	976	230	Nishabour	W	32	62	14	1	1	52	100	118	2	13	W	19.0	2997
12-071-03355	1497	168	Mamaghan	W	44	60	13	1	1	53	100	121	2	11	W	27.3	2975
12-071-03232	1375	41	Varamin	W	39	64	11	2	2	56	101	126	2	16	W	29.3	2972
12-071-03073	1217	169	Ardabil	W	35	58	15	1	1	55	101	135	1	12	W	17.6	2858
12-071-01915	83	71	Karaj sel.	W	38	64	13	2	1	52	100	122	2	13	W	33.6	2813
12-071-10045	5174		Ghazvin local	W	35	55	10	2	1	54	100	127	2	13	W	25.0	2801
12-071-02684	856	230	Nishabour	W	27	52	12	2	1	50	100	114	2	19	W	17.2	2797
12-071-03459	1591	161	Mamaghan	LP	34	63	12	1	1	55	101	121	3	12	Cr	20.4	2751
12-071-02460	629	106	Fars	W	34	59	20	1	1	53	100	124	2	13	W	15.7	2738
12-071-10046	345	194	Kermanshah	W	39	61	13	2	1	55	102	120	2	11	W	33.1	2728
12-071-02441	612	106	Fars	W	33	52	13	2	1	53	100	126	2	15	W	13.6	2725
12-071-05470	332	217	Torbat Haidari	W	34	56	13	2	1	52	100	128	2	13	W	20.9	2674
12-071-02443	614	106	Fars	W	29	55	13	2	2	54	100	119	2	15	W	18.9	2656
12-071-02243	432	241	Ghochan	W	33	58	10	2	1	49	100	125	2	14	W	20.4	2631
12-071-10047	36	111	Varamin	LP	41	62	12	2	1	62	100	114	2	15	DCr	23.8	2607
12-071-02110	1364	194	Kermanshah	W	27	51	10	1	1	53	100	116	3	13	Cr	27.0	2543
12-071-02246	435	241	Ghochan	W	29	59	12	1	1	53	100	115	1	16	W	19.6	2541
12-071-10048	154	207	Mazandaran	W	34	62	10	2	1	54	101	129	4	13	W	26.0	2498
12-071-10049	85	249982	Iran	W	31	58	11	2	1	56	100	121	3	17	W	26.0	2394
12-071-03028	1176	169	Ardabil	W	40	54	13	2	1	53	100	119	2	16	LCr	19.7	2196
12-071-03376	1516	168	Mamaghan	W	31	60	11	2	1	52	100	126	2	13	W	24.9	2110
12-071-02516	681	232	Dareh-gaz	W	38	60	10	2	1	60	101	131	2	15	W	37.2	2087
12-071-03260	1407	111	Varamin	W	37	58	11	2	1	53	100	125	2	14	W	20.4	2018
CV % =																	13
LSD .05 =																	519

Table 8. Agronomic Data, Chickpea (Black) Preliminary Yield Test No. 1, Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	Strain Number	Source Number	S O U R C E	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seeds per 10 Pods	Seed Color	100 Seeds Wt.	Yield per Hectare
12-071-04509	2285	193	Kermanshah	P	35	51	19	2	1	53	96	120	2	17	Bl	11.3	3050
12-071-04432	2215	221	Isfahan	P	34	53	18	3	1	53	96	124	2	18	Bl	11.5	2848
12-071-05331	3043	154	Gharyeh-Gole	P	35	49	19	2	1	54	96	121	1	19	Bl	12.1	2832
12-071-04279	287		Karaj 315-1	P	38	60	17	2	1	54	96	118	1	18	Bl	12.0	2804
12-071-05126	2858	174	Ahar	P	29	53	14	3	2	56	100	121	3	18	Bl	12.3	2754
12-071-04244	305		Ardabil	P	30	50	21	3	1	54	96	120	2	18	Bl	11.8	2726
12-071-04481	2260	221	Isfahan	P	31	50	18	2	2	54	96	123	2	17	Bl	11.8	2720
12-071-05300	3015	154	Gharyeh-Gole	P	32	49	14	3	1	53	96	124	3	19	Bl	12.0	2684
12-071-05487	2433	172	Ardabil	P	25	47	13	4	2	54	96	116	4	17	Bl	9.7	2676
				P	39	53	17	2	1	54	96	125	2	18	Bl	12.0	2660
12-071-04475	2254	221	Isfahan	P	35	55	15	3	2	55	99	119	2	16	Bl	11.9	2646
12-071-04536	2309	193	Kermanshah	P	32	50	19	2	1	53	96	124	2	17	Bl	11.3	2642
12-071-04428	2211	221	Isfahan	P	34	55	19	1	1	53	96	122	2	18	Bl	11.5	2628
12-071-05080	2817	174	Ahar	P	34	55	15	4	2	54	96	118	2	17	Bl	12.0	2602
12-071-04458	2239	221	Isfahan	P	34	56	18	2	1	54	96	121	2	18	Bl	12.7	2588
12-071-04618	2383	172	Ardabil	P	22	40	12	4	2	53	96	122	3	16	Bl	10.3	2574
12-071-05093	2829	174	Ahar	P	32	68	14	4	2	54	96	124	2	16	Bl	12.2	2558
12-071-04661	2422	172	Ardabil	P	29	47	18	1	1	52	96	117	3	18	Bl	10.0	2534
12-071-04491	2269	221	Isfahan	P	32	51	12	5	2	57	96	126	3	15	Bl	11.7	2516
12-071-04705	2482	173	Ardabil	P	25	47	13	3	3	54	100	126	2	18	Bl	11.2	2510
12-071-04691	2467	172	Ardabil	P	27	50	19	3	1	52	96	120	2	17	Bl	10.8	2496
12-071-04409	2194	221	Isfahan	P	31	48	15	2	2	55	96	120	2	17	Bl	11.9	2490
12-071-04467	2247	221	Isfahan	P	35	60	15	3	1	54	96	123	1	17	Bl	12.1	2466
12-071-04748	2518	173	Ardabil	P	24	48	12	4	3	51	96	121	3	17	Bl	10.5	2444
12-071-04276	284		Ghazvin 327-1	P	34	56	13	3	1	57	96	125	2	18	Bl	11.1	2424
12-071-04270	278	49	Ardabil	P	24	51	12	4	3	51	100	123	4	18	Bl	10.6	2420
12-071-04407	2192	221	Isfahan	P	33	53	19	2	2	54	96	120	2	17	Bl	12.0	2412
12-071-04795	2560	173	Ardabil	P	27	48	17	3	2	53	96	117	3	17	Bl	10.4	2376
12-071-04462	2243	221	Isfahan	P	31	52	8	4	2	56	100	120	2	18	Bl	12.8	2366
12-071-04833	2595	173	Ardabil	P	28	50	15	4	2	53	96	124	3	18	Bl	10.0	2318
12-071-05437	438	154	Karaj	P	34	53	21	1	1	54	96	123	2	17	Bl	12.7	2312
12-071-04475	2254	221	Isfahan	P	31	51	9	5	2	60	100	124	2	16	Bl	12.6	2284
12-071-04479	2258	221	Isfahan	P	31	49	10	5	2	55	96	124	3	17	Bl	12.8	2260
12-071-04937	2688	175	Gharyeh-Gole	P	33	57	16	3	1	54	96	120	1	17	Bl	13.4	2260
12-071-04653	2415	172	Ardabil	P	25	51	16	2	2	53	96	118	3	16	Bl	12.0	2240
12-071-05089	2825	174	Ahar	P	31	55	18	2	1	54	98	126	1	19	Bl	11.7	2230
12-071-04689	2465	172	Ardabil	P	22	48	13	4	2	54	96	121	3	18	Bl	16.1	2222
12-071-04450	2231	221	Isfahan	P	32	55	19	2	1	54	96	117	2	16	Bl	12.8	2203
12-071-04261	269	222	Iran 222772	P	26	51	16	2	2	52	96	115	3	18	Bl	11.4	2152
12-071-04789	2555	173	Ardabil	P	26	48	15	2	2	53	96	114	4	16	Bl	11.2	2136
12-071-04787	2553	173	Ardabil	P	29	49	20	2	2	52	96	113	4	17	Bl	10.3	2134
12-071-05399	3117	173	Ardabil	P	25	44	16	2	3	55	96	119	3	18	Bl	10.4	2110
12-071-04693	2469	172	Ardabil	P	25	48	17	2	1	52	96	118	4	18	Bl	9.9	2100
12-071-04573	2343	193	Kermanshah	P	25	46	18	2	2	52	96	116	2	17	Bl	10.7	2012
12-071-04461	2242	221	Isfahan	P	35	52	18	3	1	53	96	118	3	17	Bl	12.5	2002
12-071-04619	2384	172	Ardabil	P	23	44	15	1	2	53	96	112	4	17	Bl	10.3	1950
12-071-05486	2432	172	Ardabil	P	26	49	17	2	1	53	96	118	3	18	Bl	10.6	1912
12-071-04620	2385	172	Ardabil	P	23	45	23	1	1	51	96	115	3	15	Bl	10.1	1866
12-113-05406	3134		Pakistan C-727	P	36	58	12	2	1	56	96	119	2	16	LBr	19.3	1854

Table 9 Agronomic Data, Chickpea (White) Preliminary Yield Test No. 1, Planted April 7, 1968, RPIP, Ghazvin, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(16)	(17)	(18)
Accession Number	Strain Number	Source Number	S O U R C E	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seed Color	100 Seeds Wt.	Yield per Hectare
12-071-02818	979	230	Nishabour	W	32	54	19	2	1	50	89	102	1	W	23.4	1892
12-071-03306	1451	111	Varamin	LP	43	60	21	1	1	55	93	102	1	Cr	30.1	1882
12-071-03423	1596	161	Mamaghan	LP	37	60	21	1	1	54	93	102	1	W	29.5	1872
12-071-03696	1829	162	Shahpour	W	43	59	19	1	1	56	94	105	1	W	28.4	1866
12-071-03455	1588	161	Mamaghan	LP	41	65	21	2	1	52	93	102	1	W	29.4	1862
12-071-02469	637	106	Fars	W	41	49	20	2	1	58	94	105	1	W	21.5	1858
12-071-02855	1017	170	Ardabil	W	42	64	21	1	1	53	92	103	1	LCr	24.6	1846
12-071-02840	1003	170	Ardabil	LP	44	63	20	1	1	59	96	105	1	Cr	29.3	1840
12-071-02185	380	241	Ghochan	W	30	68	20	1	1	51	90	106	1	W	22.3	1836
12-071-02345	524	241	Ghochan	W	36	62	20	1	2	50	89	104	1	W	23.4	1820
12-071-03645	1779	153	Karaj	LP	43	65	19	1	1	60	96	106	1	W	26.4	1792
12-071-03378	1517	168	Mamaghan	W	32	54	21	2	1	50	88	102	1	W	30.4	1770
12-071-03062	1207	169	Ardabil	LP	42	58	22	1	1	53	94	105	1	LCr	20.3	1764
12-071-03289	1435	111	Varamin	W	30	48	20	2	1	52	91	105	1	W	33.5	1742
12-071-03250	1395	111	Varamin	LP	37	54	20	2	1	59	95	102	1	LCr	26.5	1720
12-071-02968	1122	169	Ardabil	W	28	58	22	1	1	49	89	105	1	LCr	30.7	1720
12-071-02655	828	230	Nishabour	W	32	56	22	1	1	50	91	105	1	W	23.4	1658
12-071-03471	1602	161	Mamaghan	LP	38	62	21	1	1	57	93	102	1	Cr	23.6	2492
12-071-02333	1376	111	Varamin	LP	41	68	22	1	1	55	91	102	1	W	32.3	2488
12-071-03244	1389	111	Varamin	LP	34	64	22	1	1	57	94	105	1	W	27.4	2434
12-071-02569	734	230	Nishabour	W	29	54	21	1	1	50	90	102	1	W	22.1	2414
12-071-03468	1599	161	Mamaghan	LP	39	70	21	1	1	56	93	103	1	Cr	26.2	2336
12-071-03455	1588	161	Mamaghan	LP	37	57	19	2	1	54	93	102	1	W	26.9	2306
12-071-03235	1380	111	Varamin	LP	40	62	21	1	1	55	91	102	1	W	29.4	2302
12-071-05406	301	111	Isfahan	LP	38	63	20	1	1	54	92	106	1	LCr	27.1	2258
12-071-02650	822	230	Nishabour	W	34	57	22	1	1	51	90	102	1	Cr	19.6	2214
12-071-03295	1441	111	Varamin	LP	36	66	21	1	1	54	92	102	1	Cr	30.3	2108
12-071-03456	1589	161	Mamaghan	LP	39	60	19	2	1	58	94	105	1	LCr	30.3	2102
12-071-03298	1443	111	Varamin	LP	37	56	20	1	1	55	92	102	1	Cr	30.1	2028
12-071-03718	1848	162	Shahpour	W	41	54	20	1	1	55	94	102	1	W	25.9	2016
12-071-05471	310	241	Ghochan	W	35	57	20	1	1	50	91	106	1	W	21.5	1968
12-071-05470	332	217	Torbat-Haidari	W	34	57	21	2	1	53	92	105	1	W	19.8	1962
12-071-03351	1493	168	Mamaghan	W	33	57	21	2	1	56	91	102	1	W	22.0	1928
12-071-03300	1445	111	Varamin	LP	35	50	20	2	1	57	91	105	1	W	28.0	1894
12-071-02346	525	241	Ghochan	W	36	55	19	2	1	50	89	105	1	Cr	24.7	1604
12-071-02173	374	241	Ghochan	W	35	67	19	1	1	50	88	105	1	W	23.3	1580
12-071-02596	759	230	Nishabour	W	33	55	20	2	1	56	94	105	1	W	22.6	1504
12-071-03251	1396	111	Varamin	W	31	55	16	3	2	54	94	106	1	W	32.2	1442
12-071-01921	88	86	Karaj	W	37	51	18	2	1	51	90	105	1	W	34.0	1440
12-071-01919	86		Karaj sel.	W	34	58	16	2	1	51	89	102	1	W	33.1	1414
12-071-02896	1034	170	Ardabil	W	38	63	18	2	2	59	96	109	1	W	33.9	1364
12-071-02295	479	220	Isfahan	W	48	65	19	1	2	56	100	111	1	W	18.1	1312
12-071-02734	903	182	Shiraz	W	33	55	19	2	1	57	92	105	1	W	20.4	1304
12-071-03005	1156	169	Ardabil	W	35	40	19	2	1	51	89	106	1	W	31.4	1294
12-071-02188	382	241	Ghochan	W	40	58	16	3	2	55	97	111	1	W	18.4	792
12-071-02298	481	220	Isfahan	W	44	64	18	2	2	54	100	112	1	W	19.8	710
12-071-02300	483	220	Isfahan	W	43	65	17	2	2	54	100	112	1	W	19.4	624
12-071-02306	489	220	Isfahan	W	42	58	17	2	1	62	98	111	1	W	18.1	606
12-071-02339	518	220	Isfahan	W	43	68	15	2	2	58	100	111	1	W	20.4	424
CV % =																28
LSD .05 =																351

Table 10 Agronomic Data, Chickpea (White) Preliminary Yield Test No. 1, Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	Strain Number	Source Number	S O U R C E	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds Wt.	Yield per Hectare
12-071-02298	481	220	Isfahan	W	55	66	11	2	2	72	110	130	1	14	W	23.3	4780
12-071-02295	479	220	Isfahan	W	54	64	12	2	2	70	109	129	1	14	W	22.2	4614
12-071-02855	1017	170	Ardabil	W	54	69	15	1	1	65	105	130	2	12	LCr	21.7	4516
12-071-03718	1848	162	Shahpour	W	54	64	12	1	1	57	105	133	1	12	Cr	21.1	4484
12-071-02333	1376	111	Varamin	LP	53	71	13	1	1	54	100	124	2	14	DCr	28.8	4464
12-071-02339	518	220	Isfahan	W	56	71	10	1	1	64	109	137	2	12	W	18.7	4412
12-071-02469	637	106	Fars	W	47	62	14	1	1	56	105	133	1	13	W	21.5	4330
12-071-03645	1779	153	Karaj	LP	56	68	13	1	1	62	105	129	1	11	LCr	23.3	4300
12-071-05470	332	217	Torbat-Haidari	W	53	67	12	1	1	46	100	131	1	15	W	19.7	4152
12-071-03298	1443	111	Varamin	LP	51	66	12	1	1	53	100	121	1	14	DCr	28.9	4140
12-071-03351	1493	168	Mamaghan	W	45	66	14	2	1	56	107	132	1	14	W	17.7	4108
12-071-02346	525	241	Ghochan	W	46	70	11	1	1	52	100	129	2	17	W	20.1	4054
12-071-03456	1589	161	Mamaghan	LP	57	67	12	1	1	55	105	128	1	13	LCr	26.8	4042
12-071-01919	86		Karaj sel.	LP	46	59	9	1	1	56	100	128	1	14	W	29.0	4040
12-071-03468	1589	161	Mamaghan	LP	47	65	12	1	2	54	100	127	2	13	DCr	22.5	4030
12-071-02569	734	230	Nishabour	W	47	61	14	1	1	53	95	127	2	16	W	17.2	4026
12-071-03289	1435	111	Varamin	W	43	66	11	2	2	53	95	132	3	13	Cr	29.1	4004
12-071-02188	382	241	Ghochan	W	53	62	12	2	2	62	105	135	2	14	W	24.2	3968
12-071-03423	1596	161	Mamaghan	LP	52	64	12	1	1	54	105	128	2	12	LCr	25.5	3860
12-071-02968	1122	169	Ardabil	W	46	63	12	1	1	52	105	134	2	12	LCr	23.4	3852
12-071-03471	1602	161	Mamaghan	LP	52	71	12	2	1	54	105	121	2	16	DCr	19.9	3848
12-071-05471	310	241	Ghochan	W	45	64	13	1	1	46	100	128	2	14	W	18.5	3816
12-071-05406	301	111	Isfahan	LP	50	66	12	1	1	55	105	126	2	13	Cr	25.7	3798
12-071-03455	1588	161	Mamaghan	LP	46	63	11	2	1	55	100	127	1	17	LCr	26.3	3776
12-071-03250	1395	111	Varamin	LP	54	60	12	1	2	57	105	126	2	13	Cr	23.7	3720
12-071-03696	1829	162	Shahpour	LP	51	68	13	1	1	56	100	124	1	11	Cr	21.9	3710
12-071-02655	828	230	Nishabour	W	47	69	12	1	1	54	100	129	1	17	W	18.6	3706
12-071-03455	1588	161	Mamaghan	LP	53	68	13	1	1	54	100	130	2	11	LCr	26.4	3690
12-071-03062	1207	169	Ardabil	LP	47	67	12	1	1	56	107	123	1	15	Cr	18.5	3680
12-071-03244	1389	111	Varamin	LP	48	58	13	1	1	54	100	126	2	12	LCr	24.8	3670
12-071-02840	1003	170	Ardabil	LP	54	65	11	2	1	65	105	127	2	13	Cr	27.1	3602
12-071-02306	489	220	Isfahan	W	54	66	10	2	2	62	109	131	2	15	W	22.1	3600
12-071-02818	979	230	Nishabour	W	43	67	12	2	1	52	95	123	2	16	W	20.2	3554
12-071-03306	1451	111	Varamin	LP	52	64	12	1	1	54	100	118	2	15	DCr	27.0	3546
12-071-03295	1441	111	Varamin	LP	51	67	13	2	1	53	105	120	2	15	DCr	27.5	3512
12-071-03300	1445	111	Varamin	LP	52	63	12	1	1	54	95	118	2	13	DCr	28.9	3416
12-071-02596	759	230	Nishabour	W	45	69	14	2	2	55	105	129	2	14	W	19.1	3396
12-071-02179	374	241	Ghochan	W	45	63	12	1	2	51	89	127	2	17	W	20.3	3362
12-071-02185	380	241	Ghochan	W	41	64	13	2	2	50	95	127	2	15	W	19.3	3348
12-071-02650	822	230	Nishabour	W	40	58	12	1	1	54	95	122	2	13	W	18.1	3342
12-071-01921	88	86	Karaj	W	49	66	12	2	1	53	95	129	3	11	W	28.9	3336
12-071-02300	483	220	Isfahan	W	55	63	10	2	2	73	112	131	2	16	W	23.4	3312
12-071-02734	903	182	Shiraz	W	48	64	14	2	2	55	95	125	2	14	W	21.3	3304
12-071-02345	524	241	Ghochan	W	42	64	13	1	1	50	89	118	2	16	W	20.5	3252
12-071-03005	1156	169	Ardabil	W	52	72	12	2	1	53	105	126	2	12	W	26.7	3226
12-071-03378	1517	168	Mamaghan	W	49	68	12	2	1	52	100	130	2	13	W	27.4	3212
12-071-02896	1054	170	Ardabil	W	47	68	13	1	1	55	105	127	2	12	W	29.3	3184
12-071-03251	1396	111	Varamin	W	45	68	11	2	1	55	100	123	2	17	W	27.1	2648
12-071-03235	1380	111	Varamin	LP	48	64	12	2	1	54	100	117	2	16	Cr	28.1	2632

Table 11 Agronomic Data, Chickpea (Black) Uniform Advanced Yield Test, Planted April 7, 1968, RPIP, Ghazvin, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl. to 1st Mat.	Pl. to Com.Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds Weight	Yield per Hectare	Protein	Cooking Time	Palata-bility
12-071-05428	417M	175	Gharyeh-Gole	P	34	63	18	2	1	42	86	101	1	12	DCr	16.4	2349	25.32	60	24
12-071-05436	416M	175	Gharyeh-Gole	P	35	54	19	2	1	41	89	101	1	13	DCr	16.7	2315	25.45	75	26
12-071-05452	419M	175	Gharyeh-Gole	P	34	60	18	3	1	41	87	100	1	12	DCr	16.5	2282	26.61	75	22
12-071-05438	401M	175	Gharyeh-Gole	P	34	54	19	2	1	44	86	100	1	12	DCr	15.1	2169	29.45	60	24
12-071-05451	410M	175	Gharyeh-Gole	P	34	61	19	2	1	42	87	101	1	13	DCr	16.6	2067	27.58	45	28
12-071-05435	404M	175	Gharyeh-Gole	P	34	58	20	2	1	42	85	100	1	11	DCr	14.8	1985	26.51	45	26
12-071-04570	2340	139	Kermanshah	P	42	56	19	2	1	40	86	101	1	10	Bl	12.6	1979	28.17	45	23
12-071-05433	439M	154	Karaj	P	37	62	19	1	1	40	87	104	1	12	Bl	13.7	1970	26.23	45	27
12-071-10054	4111M	171	Ardabil	P	29	46	19	1	1	40	84	103	1	12	Bl	14.0	1949	28.55	30	25
12-071-05441	303		Azarshahr	P	34	56	17	2	1	41	88	102	1	11	DCr	13.9	1925	28.92	50	23
12-071-05429	427M	154	Karaj	P	30	54	20	2	1	40	85	103	1	13	Bl	12.7	1802	28.93	45	26
12-071-05446	440M	154	Karaj	P	37	53	18	2	1	41	88	103	1	12	Bl	13.1	1771	28.75	60	27
12-071-05130	2862	174	Ahar	P	32	47	20	2	1	40	85	104	1	13	Bl	12.6	1744	30.30	45	26
12-071-05132	2864	174	Ahar	P	41	56	17	1	1	43	88	105	1	12	Bl	13.4	1736	27.23	75	27
12-071-10052	4197M	174	Ardabil	P	36	49	18	1	1	43	86	102	1	13	Bl	12.8	1626	26.60	50	27
12-071-05432	428M	154	Karaj	P	37	57	17	1	1	41	87	105	1	11	Bl	13.7	1621	29.88	45	27
12-071-10051	387M	164	Moghan	P	37	52	18	1	1	41	86	102	1	12	Bl	13.9	1571	28.20	45	27
12-071-04255	307		Ghazvin	P	36	58	17	2	1	43	89	103	1	13	Bl	14.7	1555	28.07	60	25
12-071-05442	231	251514	Iran	P	38	57	17	2	1	42	89	103	1	12	Bl	13.1	1522	27.75	75	26
12-071-04244	305		Ardabil	P	35	48	19	2	1	42	87	103	1	12	Bl	15.0	1512	29.41	45	24
12-071-10053	2147	221	Isfahan	P	33	53	18	2	1	41	87	103	1	12	Bl	17.3	1508	29.94	45	24
12-071-05093	2829	174	Ahar	P	38	53	17	2	1	43	89	104	1	12	Bl	13.3	1479	27.64	75	26
12-071-05301	3016	154	Gharyeh-Gole	P	37	52	17	2	1	44	87	103	1	13	Bl	14.9	1472	30.57	45	27
12-071-10050	4171M	174	Ardabil	P	36	51	17	2	1	41	86	102	1	12	Bl	13.8	1400	27.82	45	27
12-071-04283	292		Isfahan	P	36	48	18	2	1	41	88	104	1	12	Bl	13.7	1280	28.91	45	24
CV % =																	16			
LSD .05 =																	392			

Table 12 Agronomic Data, Chickpea (Black) Uniform Advanced Yield Test, Planted March 12, 1968, RPIP, Varamin, Iran

(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(14)	(15)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	S O U R C E	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Disease Rating	Seeds per 10 pods	100 Seeds Wt.	Yield per Hectare	Protein	Cook-ing Time	Palata-bility
12-071-10053	2147M	221	Isfahan	44	69	8	1	2	61	105	1	20	11.0	2885	27.25	80	24
12-071-05132	2864	174	Ahar	50	70	7	1	1	61	104	1	20	10.0	2785	25.73	98	23
12-071-05451	410M	175	Gharyeh-Gole	44	57	7	2	2	61	103	2	10	12.0	2730	24.83	85	24
12-071-05301	3016	154	Gharyeh-Gole	52	67	6	1	1	60	102	1	20	11.0	2708	25.62	78	26
12-071-04244	305		Ardabil	48	64	7	1	1	60	102	1	20	11.0	2628	25.97	78	25
12-071-10054	4111M	171	Ardabil	40	66	6	1	1	60	100	2	20	11.0	2444	26.10	65	27
12-071-05093	2829	174	Ahar	48	73	7	1	1	60	102	1	20	11.0	2389	26.86	98	23
12-071-05432	428M	154	Karaj	47	64	7	1	1	60	103	1	20	10.0	2258	26.65	80	22
12-071-10050	4171M	174	Ardabil	41	54	7	1	1	61	101	1	20	11.0	2226	25.83	70	22
12-071-04255	307		Ghazvin	41	60	7	1	2	62	100	2	20	10.0	2141	26.36	80	27
12-071-05433	439M	154	Karaj	43	64	7	1	1	60	102	2	20	9.0	2134	26.35	80	23
12-071-05441	303		Azarshahre	45	68	6	1	1	61	100	2	20	10.0	2129	26.84	98	23
12-071-10051	387M	164	Moghan	42	59	7	1	1	60	100	1	20	12.0	2010	26.49	78	25
12-071-05436	416M	175	Gharyeh-Gole	37	62	7	1	2	60	101	2	10	14.0	1975	22.57	105	22
12-071-05452	419M	175	Gharyeh-Gole	37	61	7	2	1	60	98	2	10	14.0	1956	24.06	90	22
12-071-05442	231	251514	Iran	48	62	6	1	1	61	102	2	20	10.0	1940	26.09	103	25
12-071-05446	440M	154	Karaj	44	66	7	2	2	61	104	2	20	10.0	1906	24.97	70	25
12-071-10052	4197M	174	Ardabil	45	57	7	2	1	60	99	1	20	10.0	1889	24.52	70	25
12-071-05438	401	175	Gharyeh-Gole	37	55	7	2	2	63	99	2	20	12.0	1880	24.35	90	24
12-071-05429	427M	154	Karaj	40	59	7	1	2	60	100	1	20	9.0	1843	25.44	65	26
12-071-04570	2340	193	Kermanshah	41	64	7	2	2	62	101	2	20	10.0	1798	25.27	60	24
12-071-04283	292		Isfahan	47	55	7	1	1	60	99	1	20	11.0	1785	26.97	68	25
12-071-05428	417M	175	Gharyeh-Gole	36	59	8	2	1	61	100	2	10	11.0	1762	23.73	90	23
12-071-05435	404M	175	Gharyeh-Gole	37	59	7	1	2	63	101	2	20	10.0	1678	24.66	80	21
12-071-05130	2862	174	Ahar	38	64	7	1	1	61	100	1	20	9.0	1584	25.96	60	25
CV % =														25			
LSD .05 =														750			

Table 13 Agronomic Data, Chickpea (Black) Uniform Advanced Yield Test, Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl. to 1st Mat.	Pl. to Com. Mat	Disease Rating	Seeds per pod	Seed Color	100 Seeds wt.	Yield per Hectare	Protein	Cooking Time	Palatability
12-071-05432	428M	154	Karaj	P	33	57	19	1	1	53	96	126	1	18	Bl	12.0	3172	25.67	51	25
12-071-05301	3016	154	Gharyeh-Gole	P	35	59	16	2	1	54	96	129	2	16	Bl	12.6	3002	25.86	70	27
12-071-05446	440	154	Karaj	P	36	54	17	1	1	52	96	125	1	16	Bl	12.0	2944	25.71	55	27
12-071-10050	4177M	174	Ardabil	P	36	54	16	2	2	53	96	131	2	18	Bl	12.5	2943	25.64	54	25
12-071-05451	410M	175	Gharyeh-Gole	P	30	54	14	1	2	53	96	128	2	15	LBr	14.7	2909	24.03	68	26
12-071-05132	2864	174	Ahar	P	37	60	20	2	1	54	96	134	1	17	Bl	12.1	2868	26.30	53	25
12-071-05442	231	251514	Iran	P	33	55	21	2	1	53	96	124	2	18	Bl	12.4	2851	24.79	63	22
12-071-10051	387M	164	Moghan	P	36	58	20	1	2	53	96	128	1	18	Bl	12.1	2841	25.66	60	24
12-071-05093	2829	174	Ahar	P	35	51	18	2	1	54	96	127	1	18	Bl	12.8	2840	26.88	58	27
12-071-10052	4197M	174	Ardabil	P	37	63	21	3	2	53	96	120	1	20	Bl	11.3	2753	25.42	58	27
12-071-04255	307		Ghazvin	P	36	56	16	2	1	54	96	127	2	17	Bl	12.3	2745	25.95	58	27
12-071-04283	292		Isfahan	P	39	60	17	2	1	53	96	123	2	16	Bl	12.7	2673	26.77	73	26
12-071-10053	2147	221	Isfahan	P	34	54	16	2	2	53	96	125	2	16	Bl	14.4	2651	27.43	53	26
12-071-04570	2340	193	Kermanshah	P	33	55	18	2	2	53	96	125	1	16	Bl	11.1	2567	26.23	73	23
12-071-04244	305		Ardabil	P	36	51	20	2	2	53	96	118	2	18	Bl	12.5	2559	26.34	53	25
12-071-05441	303		Azarshahre	P	33	52	26	2	2	52	96	128	3	18	Bl	11.5	2446	25.19	68	26
12-071-05438	401	175	Gharyeh-Gole	P	29	56	17	2	2	52	96	121	2	15	LBr	13.4	2436	24.53	68	21
12-071-05433	439	154	Karaj	P	33	51	18	2	2	52	96	127	2	17	Bl	10.2	2398	25.79	55	23
12-071-05429	427	154	Karaj	P	31	54	17	1	2	51	96	122	2	18	Bl	11.2	2327	24.97	45	28
12-071-05428	417	175	Gharyeh-Gole	P	31	54	18	2	2	53	96	122	2	13	LBr	13.3	2178	24.42	52	23
12-071-05130	2862	174	Ahar	P	28	56	20	2	2	52	96	117	2	17	Bl	10.6	2077	25.65	68	27
12-071-05452	419	175	Gharyeh-Gole	P	27	56	14	2	2	52	96	117	2	15	LBr	13.5	2056	23.98	65	22
12-071-05436	416	175	Gharyeh-Gole	P	30	51	19	3	3	52	96	124	2	14	LBr	14.7	1985	24.30	73	25
12-071-05435	404	175	Gharyeh-Gole	P	31	53	18	2	2	53	96	118	2	14	LBr	12.4	1962	25.41	50	27
12-071-10054	4111M	171	Ardabil	P	26	48	18	2	2	49	96	117	2	18	Bl	11.9	1912	25.15	35	22
CV % =																	17			
LSD .05 =																	604			

Table 14. Black Chickpea Uniform Advanced Yield Test, RPIP 1968

Accession Number	Source and Source Number	Yield Kg. Per Hectare						
		Varamin	Isfahan	Shiraz	Meshed	Rezaieh	Hamadan	Zabol
12-071-05132	Ahar 174	2785	2062	470	2605	534	1006	156
12-071-05093	Ahar 174	2380	2300	746	2640	309	952	157
12-071-05436	Gharyeh-gole 175	1975	2512	500	2505	495	965	150
12-071-05441	Azarshahr	2128	1637	626	2420	360	920	149
12-071-05452	Gharyeh-gole 175	1955	1200	580	2680	612	1078	159
12-071-05438	Gharyeh-gole 175	1880	975	445	3556	362	1021	183
12-071-05442	Iran 251514	1938	2212	1570	2982	293	912	154
12-071-05446	Karaj 154	1913	2037	260	2562	508	811	157
12-071-05433	Karaj 154	2134	1912	894	2307	425	758	193
12-071-05428	Gharyeh-gole 175	1761	1875	725	2457	370	908	180
12-071-04255	Ghazvin	2141	1900	683	2780	662	915	166
12-071-05435	Gharyeh-gole 175	1678	1350	767	2722	466	1128	191
12-071-05432	Karaj 154	2257	1950	853	2907	722	958	149
12-071-05451	Gharyeh-gole 175	2730	2212	723	2845	325	978	200
12-071-05429	Karaj 154	1843	1800	687	3001	300	902	183
12-071-10050	Ardabil 174	2225	1712	533	2792	637	903	172
12-071-10051	Moghan 164	2010	1400	443	2687	319	935	170
12-071-10052	Ardabil 174	1889	2050	736	2856	485	920	169
12-071-10054	Ardabil 171	2439	1875	793	2972	712	1052	182
12-071-04244	Ardabil	2628	2275	485	2950	912	1012	152
12-071-10053	Isfahan 221	2885	2412	644				
12-071-05301	Gharyeh-gole 154	2707	2075	733				
12-071-05130	Ahar 174	1584	1537	544				
12-071-04283	Isfahan	1785	2387	628				
12-071-04570	Kermanshah 193	1798	2550					

Table 15 Agronomic Data, Chickpea (White) Advanced Yield Test II, Planted April 7, 1968, RPIP, Ghazvin, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds Weight	Yield per Hectare	Protein	Cooking Time	Palatability
12-071-10019	2604M	106	Fars	W	32	56	20	2	1	44	92	105	1	12	W	17.6	2147	21.97	255	22
12-071-10023	2566M	106	Fars	W	33	57	19	3	1	43	92	105	1	13	W	19.4	2127	22.04	220	24
12-071-05470	332	217	Torbat-Haidari	W	40	53	22	2	1	45	93	105	1	12	W	24.6	2101	23.61	220	26
12-071-10026	3063M	162	Shahpour	W	34	53	21	2	1	43	91	106	1	13	W	29.3	2039	22.12	240	26
12-071-10033	2433M	111	Isfahan	W	34	56	21	2	1	44	90	106	1	13	W	32.9	2036	20.32	240	27
12-071-10028	2618	106	Fars	W	32	56	19	3	1	44	91	105	1	13	W	19.9	1995	22.11	220	26
12-071-10024	2609M	106	Fars	W	34	57	21	3	1	40	91	105	1	13	W	17.3	1966	21.73	240	27
12-071-10029	2702M	152	Karaj	W	36	56	19	3	1	41	91	105	1	12	W	34.2	1959	22.68	285	26
12-071-10036			Ghazvin, Mashal-dar	W	39	56	20	3	1	42	92	105	1	13	W	26.6	1911	23.06	220	25
12-071-10020	3463M	169	Ardabil	W	41	66	20	2	1	44	95	110	1	12	W	33.4	1904	25.01	210	26
12-071-10025	2407M	111	Isfahan	W	36	56	22	3	1	43	93	105	1	12	W	31.9	1902	21.15	240	27
12-071-10035	2818M	153	Karaj	W	41	60	21	2	1	45	93	104	1	12	W	36.3	1882	20.24	240	26
12-071-05471	310	241	Ghochan	W	37	64	20	3	1	43	86	107	1	12	W	23.3	1879	24.06	225	27
12-071-10022	2603M	106	Fars	W	36	52	21	2	1	42	90	102	1	12	W	17.7	1871	21.77	240	26
12-071-10031	3389M	169	Ardabil	W	35	56	21	2	1	43	91	106	1	12	W	31.1	1864	22.76	255	27
12-071-10034	2753M	153	Karaj	W	29	60	23	2	1	44	92	102	1	12	W	37.6	1862	20.33	240	25
12-071-10037			Ghazvin,Mohammadabad	W	46	62	20	2	1	43	92	105	1	12	W	37.5	1805	22.48	250	26
12-071-10038			Ghazvin,Nosratabad	W	39	64	19	2	1	43	93	104	1	12	W	38.1	1785	23.06	220	26
12-071-10030	2587M	106	Fars	W	30	51	19	2	1	42	90	102	1	13	W	18.8	1781	23.93	270	26
12-071-10039			Ghazvin,Haji-Tappeh	W	41	61	19	2	1	41	91	103	1	12	W	38.2	1762	22.95	220	26
12-071-10021	2610M	106	Fars	W	31	56	20	3	1	42	89	102	1	12	W	17.2	1732	22.32	240	27
12-071-10032	2763M	152	Karaj	W	34	51	19	3	1	44	90	104	1	12	W	36.2	1722	20.88	255	24
12-071-10040			Ghazvin, Bidestan	W	36	61	20	2	1	41	92	103	1	12	W	37.6	1678	22.02	225	27
12-071-10018	2647M	106	Fars	W	31	53	19	3	1	43	92	104	1	12	W	18.7	1620	21.70	240	25
12-071-10027	2606M	106	Fars	W	37	57	19	3	1	44	91	105	1	12	W	19.7	1612	23.93	240	25
CV % =																	18			
LSD .05 =																	474			

Table 16 Agronomic Data, Chickpea (White) Advanced Yield Test II, Planted March 12, 1968, RPIP, Varamin, Iran

(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	S O U R C E	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	100 Seeds Wt.	Yield per Hectare	Protein	Cook-ing Time	Palata-bility
12-071-03468	1599	161	Mamaghan	51	67	8	1	1	68	110	135	1	21.0	4437	20.66	285	23
12-071-05470	332	217	Torbat-Haidari	54	69	7	2	1	64	110	135	2	22.0	4039	20.79	260	25
12-071-10025	2407	111	Isfahan	50	73	6	1	1	58	110	135	1	28.0	3969	20.25	170	27
12-071-10031	3389	169	Ardabil	56	73	7	1	1	64	109	134	1	27.0	3670	22.64	275	26
12-071-03116	1265	169	Ardabil	53	73	7	1	1		108	133	1	23.0	3595	21.32	285	22
12-071-10026	3063	162	Shahpour	46	61	7	1	1	62	107	132	1	25.0	3587	21.87	260	24
12-071-10032	2763	152	Karaj	42	65	7	1	1	63	107	131	2	30.0	3530	20.68	240	27
12-071-10019	2604	106	Fars	42	61	7	1	1	66	107	133	2	10.0	3486	21.48	255	23
12-071-10018	2647	106	Fars	36	55	6	1	1	65	105	133	2	16.0	3461	21.69	310	25
12-071-10028	2618	106	Fars	43	61	7	1	1	66	108	133	2	17.0	3453	22.50	240	25
12-071-10035	2818	153	Karaj	46	53	6	1	1	65	107	133	2	29.0	3413	21.56	260	26
12-071-10027	2606	106	Fars	42	64	8	1	1	64	107	133	2	18.0	3392	23.32	275	25
12-071-10034	2753	153	Karaj	45	70	6	1	1	63	106	132	2	34.0	3388	20.94	260	25
12-071-02274	460	220	Isfahan	51	73	8	1	1		109	131	1	20.0	3379	22.27	285	25
12-071-10033	2433	111	Isfahan	41	63	7	1	1	63	106	132	2	35.0	3361	20.24	200	26
12-071-01980	161	302	Ghazvin	49	62	7	1	1		107	130	2	27.0	3255	20.95	270	
12-071-10020	3463	169	Ardabil	48	64	7	1	1	65	108	136	2	26.0	3246	21.74	215	27
12-071-10030	2587	106	Fars	39	64	8	1	2	66	106	130	2	16.0	3122	23.69	225	26
12-071-10021	2610	106	Fars	38	64	8	1	1	64	107	131	2	15.0	3113	22.18	360	24
12-071-10023	2566	106	Fars	40	60	7	1	1	65	102	131	2	19.0	3101	21.84	255	22
12-071-02275	461	220	Isfahan	45	66	7	1	1		111	130	1	24.0	3069	21.21	270	26
12-071-05471	310	241	Ghochan	39	69	6	1	1	60	107	130	1	18.0	3043	21.81	260	27
12-071-10024	2609	106	Fars	41	61	7	1	1	65	106	133	2	16.0	3003	21.77	255	24
12-071-10022	2608	106	Fars	38	55	6	1	1	65	107	133	2	16.0	3001	21.46	255	24
12-071-10029	2702	152	Karaj	41	61	7	1	1	61	105	132	2	28.0	2967	20.88	225	21
CV % =														18			
LSD .05 =														880			

Table 17 Agronomic Data, Chickpea (White) Advanced Yield Test II, Planted April 3, 1969, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Fl. to 1st Fl.	Fl. to 1st. Mat.	Fl. to Com. Mat.	Disease Rating	Seeds per 10 pods	Seed Color	Yield per Hectare	Protein	Cooking time	Palatability
12-071-03468	1599	161	Managhan	W	46	58	11	1	1	57	104	130	1	13	W	3925	21.84	115	19
12-071-03116	1265	169	Ardabil	W	46	54	12	1	1	57	108	136	1	11	W	3664	21.49	85	20
12-071-10018	2647M	106	Fars	W	42	59	14	1	1	53	105	134	2	16	W	3397	21.35	115	24
12-071-10019	2604M	106	Fars	W	40	61	13	1	1	54	105	131	2	17	W	3351	22.98	133	21
12-071-02275	461	220	Isfahan	W	54	60	11	2	2	75	108	132	2	13	W	3343	23.55	85	23
12-071-05470	332	217	Torbat-Haidari	W	45	58	13	2	2	55	102	135	2	13	W	3270	23.58	110	23
12-071-02274	460	220	Isfahan	W	50	63	12	1	1	69	110	133	1	14	W	3250	23.56	85	23
12-071-10020	3463M	169	Ardabil	W	52	60	11	1	1	53	105	141	2	11	W	3247	26.10	110	23
12-071-10021	2610M	106	Fars	W	41	61	14	1	2	52	104	126	2	15	W	3142	23.42	115	26
12-071-01980	161	302	Ghazvin	W	46	59	12	1	1	54	97	126	2	13	W	3019	22.31	85	23
12-071-10022	2608	106	Fars	W	43	59	15	1	1	53	104	125	2	16	W	3016	22.40	138	23
12-071-10023	2566M	106	Fars	W	37	54	13	2	1	53	103	124	1	15	W	2975	22.11	140	21
12-071-10024	2609M	106	Fars	W	38	57	14	1	1	52	100	124	2	16	W	2969	22.07	138	22
12-071-05471	310	241	Ghochan	W	39	58	12	1	1	50	102	125	2	17	W	2872	23.10	113	26
12-071-10025	2407M	111	Isfahan	W	50	64	12	2	1	55	103	129	2	16	W	2725	21.85	115	23
12-071-10026	3063M	162	Shahpour	W	49	62	12	2	1	54	103	125	3	12	W	2715	21.25	110	22
12-071-10027	2606M	106	Fars	W	40	56	12	1	2	54	100	132	2	14	W	2696	23.12	138	34
12-071-10028	2618M	106	Fars	W	49	51	16	1	2	54	107	130	1	18	W	2663	22.14	115	26
12-071-10029	2702M	152	Karaj	W	52	58	13	1	1	53	97	120	2	15	W	2639	22.98	128	26
12-071-10030	2587	106	Fars	W	38	56	12	2	2	55	103	124	2	17	W	2629	23.74	138	24
12-071-10031	3389M	169	Ardabil	W	51	59	11	2	1	54	103	125	2	12	W	2405	22.89	110	23
12-071-10032	2763M	152	Karaj	W	47	58	11	2	1	53	103	120	2	13	W	2234	22.88	103	22
12-071-10033	2433M	111	Isfahan	W	42	57	11	1	1	54	100	117	2	13	W	2198	23.56	103	23
12-071-10034	2753M	153	Karaj	W	42	58	11	2	2	56	103	121	3	15	W	2081	22.89	90	22
12-071-10035	2818M	153	Karaj	W	46	61	11	2	1	54	103	125	3	13	W	2052	22.82	95	26
CV % =																21			
LSD .05 =																901			

Table 18 White Chickpea Advanced Yield Test II, 1969

Yield Kg. Per Hectare

Accession Number	Source and Source Number	Varamin	Isfahan	Shiraz	Meshed	Rezaieh	Hamadam	Zabol
12-071-10029	Karaj 152	2966	1175	1980	3262	625	705	483
12-071-10030	Fars 106	3121	1700	1932	3510	1512	507	478
12-071-10023	Fars 106	3101	1600	1922	3880	1400	623	876
12-071-10019	Fars 106	3486	1325	1807	3777	1350	486	633
12-071-10024	Fars 106	3002	1575	2172	3652	1325	537	474
12-071-10022	Fars 106	3001	1612	1962	3793	1612	530	349
12-071-10027	Fars 106	3391	812	2322	3652	1587	481	704
12-071-10028	Fars 106	3453	1512	1971	3947	1662	462	629
12-071-10018	Fars 106	3461	1725	1822	3757	1450	398	556
12-071-10021	Fars 106	3112	1375	1812	3325	1512	473	884
12-071-10020	Ardabil 169	3145		1940	3282	1387	326	598
12-071-10031	Ardabil 169	3669		1230	3652	1003	692	592
12-071-10032	Karaj 152	3529		2200	3747	1125	632	518
12-071-10025	Isfahan 111	3968		2117	4017	1162	531	602
12-071-10026	Shahpour 162	3587		2135	3555	745	611	363
12-071-10034	Karaj 153	3388		1758	3475	1450	530	862
12-071-10033	Isfahan 111	3360		1698	3422	1237	541	634
12-071-10035	Karaj 153	3413		2021	3480	1212	512	723
12-071-05470	Torbat-Haidari 217	4038		2017	2680	1725	461	880
12-071-05471	Ghochan 241	3043		1545	3117	1712	522	941

Table 19 Agronomic Data, Chickpea (White) Uniform Advanced Yield Test, Planted April 7, 1968, RPIP, Ghazvin, I

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl. to 1st Mat.	Pl. to Com. Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds Weight	Yield per Hectare	Protein	Cooking Time	Palata-bility
12-071-02446	617	106	Fars	W	36	60	25	2	1	50	93	105	1	12	W	20.9	2980	23.67	150	28
12-071-03243	1388	111	Varamin	LP	41	54	23	2	1	41	90	105	1	11	LCr	28.8	2887	21.75	210	27
12-071-10014	3163M	162	Shahpour	W	34	61	22	3	1	46	92	106	1	13	W	36.3	2487	22.90	180	26
12-071-03662	1796	162	Shahpour	LP	35	59	21	2	1	42	91	102	1	12	LCr	23.1	2417	20.86	215	24
12-071-05457	340M	170	Ardabil	LP	35	57	21	3	1	44	93	105	1	13	LCr	27.6	2415	23.02	250	22
12-071-03515	1649	152	Karaj	LP	34	59	23	2	1	43	88	104	1	13	LCr	21.2	2342	19.85	220	20
12-071-05476	312M	153	Karaj	W	37	65	23	2	1	43	88	103	1	11	W	21.7	2340	22.01	250	23
12-071-05453	328M	170	Ardabil	LP	37	62	21	4	1	42	91	109	1	12	Cr	22.5	2338	23.19	190	26
12-071-05468	3		Karaj selection	W	33	62	21	3	1	41	91	109	1	13	W	28.4	2296	22.07	210	25
12-071-05460	302M	129	Moghan	LP	35	58	20	3	1	41	88	103	1	12	Cr	30.8	2291	20.69	250	24
12-071-10013	2517M	129	Moghan	W	32	56	20	3	1	44	90	105	1	12	W	36.1	2257	22.24	180	25
12-071-10015	2504M	129	Moghan	W	34	65	19	3	1	43	92	104	1	11	W	36.7	2240	21.54	210	25
12-071-05456	34		Karaj selection	W	38	66	22	4	1	41	89	105	1	13	W	27.4	2142	21.30	210	25
12-071-05475	313M	161	Moghan	LP	35	59	21	4	1	42	93	107	1	12	LCr	23.1	2126	21.56	250	26
12-039-05462	331	32	Cyprus	LP	32	52	21	3	1	42	88	103	1	13	Cr	30.0	2066	19.95	250	22
12-071-10017	2407M	111	Isfahan	W	40	61	22	4	1	45	93	105	1	12	W	50.5	1964	22.97	180	27
12-071-05473	225	249982	Iran	W	32	58	22	3	1	47	91	105	1	12	W	33.3	1937	20.52	210	26
12-071-05469	322M	169	Ardabil	LP	37	62	22	3	1	49	89	102	1	12	LCr	21.1	1931	21.08	250	23
12-071-02518	682	232	Darehgaz	W	34	67	24	2	1	46	89	102	1	13	W	39.1	1927	21.22	180	27
12-071-05466	18		Karaj selection	W	36	65	21	2	1	44	90	105	1	13	W	24.5	1924	24.16	210	27
12-071-05472	347M		Karaj	LP	34	61	22	3	1	42	91	103	1	12	W	24.1	1905	21.62	250	23
12-071-10016	2524M	129	Moghan	W	32	58	21	4	1	42	92	105	1	13	W	37.6	1896	22.38	190	28
12-071-02089	261	454	Karaj selection	W	38	64	21	3	1	42	92	110	1	12	W	40.0	1824			
12-071-02276	462	220	Isfahan	W	40	69	21	3	1	60	96	111	1	13	W	19.6	1762	28.24	180	25
12-071-05471	310	241	Ghochan	W	33	59	18	4	1	44	86	103	1	13	W	19.7	1521	22.06	210	24
CV % =																	17			
LSD .05 =																	515			

Table 20 Agronomic Data, Chickpea (White) Uniform Advanced Yield Test, Planted March 12, 1968, RPIP, Varamin, Iran

(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	S O U R C E	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	100 Seeds Wt.	Yield per Hectare	Protein	Cook-ing Time	Palata-bility
12-071-05453	328M	170	Ardabil	42	65	8	1	1	60	108	130	2	27.0	3875	20.32	235	20
12-071-05457	340M	170	Ardabil	50	67	10	1	1	65	108	128	1	25.0	3741	20.07	240	20
12-071-05471	310	241	Ghochan	38	58	8	1	1	60	107	132	1	19.0	3421	22.18	180	23
12-071-05460	302M	129	Moghan	43	61	8	1	1	65	106	125	2	25.0	3404	19.26	225	20
12-071-03515	1649	152	Karaj	40	52	9	1	1	61	106	128	2	20.0	3298	19.89	180	21
12-071-10013	2517M	129	Moghan	42	66	7	2	1	60	106	129	3	35.0	3234	20.64	220	25
12-039-05462	331	32	Cyprus	38	65	8	1	1	61	105	126	2	28.0	3203	19.78	235	18
12-071-03662	1796	162	Shahpour	41	60	10	1	1	65	107	131	2	22.0	3169	20.63	170	19
12-071-05475	313M	161	Moghan	36	60	9	1	1	63	105	129	2	21.0	3139	20.49	225	20
12-071-05469	322M	169	Ardabil	42	69	8	1	1	66	103	127	2	19.0	3123	20.00	225	16
12-071-05476	312M	153	Karaj	38	65	8	1	1	60	106	132	2	19.0	3080	20.21	195	22
12-071-05472	347M		Karaj	42	61	9	1	1	61	106	128	2	25.0	3058	20.86	225	19
12-071-05468	3		Karaj selection	40	62	7	2	1	60	108	132	2	25.0	3016	21.00	195	22
12-071-10016	2524M	129	Moghan	46	62	8	1	1	60	106	131	2	35.0	3014	20.61	220	23
12-071-02276	462	220	Isfahan	48	69	7	1	1	57	111	134	2	20.0	2989	22.39	170	23
12-071-10015	2504M	129	Moghan	47	64	7	2	1	60	108	129	2	34.0	2989	20.36	220	24
12-071-05466	18		Karaj selection	33	60	7	2	1	60	105	129	2	29.0	2936	22.03	165	26
12-071-03243	1388	111	Varamin	43	58	8	1	1	61	106	131	1	26.0	2826	20.39	220	18
12-071-10014	3163M	162	Shahpour	40	56	8	1	1	63	105	129	2	34.0	2798	20.76	220	24
12-071-02446	617	106	Fars	43	57	8	1	1	64	108	129	2	20.0	2751	21.45	205	25
12-071-05456	34		Karaj selection	39	54	8	2	2	60	103	123	3	27.0	2616	20.78	220	24
12-071-05473	225	249982	Iran	38	57	7	2	2	61	108	130	2	30.0	2612	19.79	250	26
12-071-02518	682	232	Darehgaz	40	60	7	2	2	66	105	129	2	38.0	2593	20.45	185	27
12-071-10017	2407M	129	Isfahan	47	63	7	2	1	60	107	128	2	45.0	2521	20.73	130	28
12-071-02089	261	454	Karaj selection	47	64	8	1	1	62	106	130	2	35.0	2493	22.24	205	23
CV % =														16			
LSD .05 =														664			

Table 21 Agronomic Data, Chickpea (White) Uniform Advanced Yield Test, Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Fl. to 1st Fl.	Fl. to 1st Mat.	Fl. to Com. Mat.	Disease Rating	Seeds per 10 pods	100 Seeds Weight	Yield per Hectare	Protein	Cooking Time	Palata-bility
12-071-05475	313M	161	Moghan	LP	52	59	14	1	1	55	106	136	1	11	22.3	4500	22.32	94	23
12-071-05453	328M	170	Ardabil	LP	57	59	14	1	1	53	102	139	1	11	28.3	4297	22.80	114	19
12-071-05460	302M	129	Moghan	LP	55	65	13	1	1	52	102	122	1	12	27.5	4243	20.29	143	17
12-071-05457	340M	170	Ardabil	LP	60	60	18	2	1	60	106	134	1	12	28.9	4198	21.49	156	22
12-039-05462	331	32	Cyprus	LP	54	57	13	2	1	55	105	123	1	13	28.3	4046	20.40	113	20
12-071-03662	1796	162	Shahpour	LP	50	62	19	2	1	57	102	131	2	11	24.1	3945	23.31	94	23
12-071-03515	1649	152	Karaj	LP	50	61	18	2	1	50	102	125	1	15	20.1	3907	21.67	86	19
12-071-05469	322M	169	Ardabil	LP	55	56	20	1	1	58	105	126	1	12	22.6	3901	22.92	116	18
12-071-05476	312M	153	Karaj	W	48	63	13	1	1	51	99	129	1	17	18.7	3777	22.49	123	26
12-071-02446	617	106	Fars	LP	45	56	20	1	1	54	102	131	2	15	19.5	3769	23.12	95	24
12-071-05472	347M		Karaj	LP	50	66	16	1	1	54	105	132	1	12	27.6	3763	22.25	86	21
12-071-05471	310	241	Ghochan	W	45	58	16	1	1	48	102	122	1	17	19.7	3514	23.09	90	22
12-071-02276	462	220	Isfahan	W	57	64	15	1	1	63	110	143	1	15	21.1	3416	24.60	95	23
12-071-05468	3		Karaj selection	W	47	61	16	1	1	50	102	134	2	13	29.1	3276	22.01	105	23
12-071-03243	1388M	111	Varamin	LP	52	65	16	1	1	52	102	118	2	12	26.4	3193	22.13	93	18
12-071-10013	2517M	129	Moghan	W	48	70	12	2	2	49	102	126	2	11	34.3	3119	22.77	98	23
12-071-05466	18		Karaj selection	W	48	62	13	2	1	51	102	132	2	11	33.3	3006	22.98	127	25
12-071-10014	3163M	162	Shahpour	W	51	60	11	2	1	53	99	120	3	12	32.3	2959	23.44	93	23
12-071-10015	2504M	129	Moghan	W	52	56	13	1	1	51	102	121	3	10	33.4	2820	22.80	100	25
12-071-05456	34		Karaj selection	W	47	59	13	2	2	49	97	125	3	13	27.5	2813	22.50	83	23
12-071-05473	225	249988	Iran	W	51	68	11	2	2	52	105	127	1	14	35.4	2609	22.55	83	23
12-071-10016	2524M	129	Moghan	W	47	59	11	2	2	49	100	124	2	11	33.6	2470	23.94	100	24
12-071-02089	261	254	Karaj selection	W	56	66	15	2	2	52	99	127	3	11	36.3	2142	22.53	90	23
12-071-02518	682	232	Darehgaz	W	46	55	12	2	1	54	96	122	2	14	32.7	2009	24.02	75	23
12-071-10017	2407M	111	Isfahan	W	56	59	10	2	1	54	102	126	3	11	45.3	1881	22.94	83	22
CV % =																20			
LSD .05 =																483			

Table 22 White Chickpea Uniform Advanced Yield Test, RPIP, 1968

Yield Kg. Per Hectare

Accession Number	Source and Source Number	Varamin	Isfahan	Shiraz	Meshed	Rezaieh	Hamadam	Zabol
12-071-03662	Shahpour 162	3168	1462	1548	3662	837	801	182
12-071-03515	Karaj 152	3298	1912	1909	2856	1337	1042	159
12-071-05472	Karaj	3058	2262	1915	3293	1037	726	226
12-071-05475	Moghan 161	3139	2037	1531	2576	1187	696	163
12-071-05469	Ardabil 169	3123	2062	1981	2773	1237	547	203
12-071-05476	Karaj 153	3080	2012	1309	2760	325	965	193
12-071-05460	Moghan 129	3421	2612	1913	3105	725	958	192
12-071-05457	Ardabil 170	3741	1925	1632	3028	725	715	171
12-039-05462	Cyprus 32	3203	2200	2049	2717	1025	903	208
12-071-05471	Ghochan 241	3421	1337	1467	3107	687	586	220
12-071-05456	Karaj selection	2616	1400	1606	2715	172	606	175
12-071-05468	Karaj selection	3015	2025	1617	2707	487	837	180
12-071-05453	Ardabil 170	3875	2025	2144	3220	1262	945	195
12-071-05466	Karaj selection	2935	1350	1427	2427	562	666	196
12-071-05473	Iran 249982	2611	2000	1384	2473	400	877	175
12-071-10016	Moghan 129	3014	1387	1547	3125		790	209
12-071-10013	Moghan 129	3233	1487	1660	2162		776	183
12-071-10015	Moghan 129	2989	1725	1912	2425		796	222
12-071-10017	Isfahan 111	2520	1450	1943	3187		727	180

Table 23 Agronomic Data, Chickpea (White) International Yield Test, Planted April 7, 1968, RPIP, Ghazvin, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Fl. to 1st Fl.	Fl. to 1st Mat.	Fl. to Com. Mat.	Disease Rating	Seeds per 10 Pods	Seed Color	100 Seeds Weight	Yield per Hectare	Protein	Cooking Time	Palatability
12-071-05475	313		Moghan, Iran	LP	43	60	22	1	1	57	94	105	1	12	LCr	22.3	4270	24.34	225	27
12-071-05465	335		Ardabil, Iran	LP	45	61	21	1	1	56	93	107	1	12	W	27.3	4148	23.64	195	24
12-074-10008		319	Israel	W	39	58	22	1	1	42	90	104	1	12	W	24.9	3910	23.31	215	26
12-071-05472	347		Karaj, Iran	W	43	54	23	1	1	57	93	105	1	13	W	26.5	3754	22.32	225	23
12-074-10011		CP	Israel	W	47	64	19	3	1	53	94	110	1	12	W	48.8	3432	23.21	210	24
12-113-10006		C 727	Pakistan	P	35	55	26	1	1	56	89	102	1	11	Br	18.4	3252	22.64	225	24
12-074-10009		CP 42	Israel	W	49	64	17	3	1	54	93	107	1	12	W	52.7	3170	24.26	215	26
12-079-10004			Jordan	W	40	59	19	3	1	49	90	107	2	13	W	47.1	3132	23.57	225	25
12-074-10012		CP 43	Israel	W	46	61	20	2	1	51	92	107	1	12	W	48.3	3128	23.57	220	24
12-155-10001		F1	U.A.R.	W	38	49	23	1	1	39	87	107	1	13	W	13.1	3116	21.02	195	25
12-155-10002		Giza	U.A.R.	W	40	52	22	1	1	41	87	103	1	13	W	34.7	3034	23.19	190	29
12-113-10007		C 612	Pakistan	LP	29	42	26	1	1	45	85	102	1	12	Cr	14.5	3002	24.02	225	25
12-074-10010		I 13	Israel	LP	44	53	21	2	1	66	93	107	1	13	Bl	26.2	2804	23.89	215	27
12-113-10005		Punjab	Pakistan	W	33	48	20	2	1	50	90	103	1	12	W	22.8	2802	23.38	225	25
12-155-10003		F 13	U.A.R.	W	37	55	19	1	1	40	88	105	2	12	W	21.5	2660	23.13	190	29
CV % =																	22			
LSD .05 =																	536			

Table 24 Agronomic Data, Chickpea International Yield Test, Planted April 3, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Fl. to 1st Fl.	Fl. to 1st. Mat.	Fl. to Com. Mat.	Disease Rating	Seeds per 10 pods	Seed Color	100 Seeds Weight	Yield per Hectare	Protein	Cooking time	Palatability
12-071-05464	335	170	Ardabil, Iran	LP	54	56	22	1	1	53	102	127	2	12	W	22.5	4233	23.22	135	10
12-071-05472	347		Karaj, Iran	LP	49	55	22	1	1	55	102	123	2	11	LCr	27.4	3873	22.83	110	11
12-071-05474	313	161	Moghan, Iran	W	52	49	22	1	1	55	102	129	2	11	LCr	21.3	3658	23.12	110	12
12-074-10008		319	Israel	W	48	53	18	1	1	47	97	126	2	13	W	23.7	3078	22.84	60	15
12-155-10002		Giza 1	U.A.R.	W	48	60	19	2	1	49	102	110	2	15	W	29.7	2952	20.99	108	20
12-155-10003		F 13	U.A.R.	W	49	58	17	2	1	49	97	120	2	14	W	26.8	2921	22.31	92	17
12-113-10005		Punjab	Pakistan	W	52	57	20	2	2	52	97	122	2	17	W	24.6	2676	21.18	93	17
12-079-10004			Jordan	W	49	55	15	2	1	50	102	140	2	12	W	45.1	2661	20.38	90	17
12-113-10007		C-612	Pakistan	LP	35	40	26	1	1	51	102	119	2	17	Br	13.8	2626	21.64	115	17
12-113-10006		C-727	Pakistan	LP	40	42	30	2	1	58	100	117	1	18	Br	18.6	2521	23.65	115	18
12-074-10009		CP 42	Israel	W	57	58	12	2	1	54	100	134	2	12	W	48.8	2411	22.64	88	19
12-155-10001		F1	U.A.R.	W	52	63	28	1	1	41	100	125	2	15	W	13.9	2379	23.58	148	21
12-074-10010		I.13	Israel	LP	52	51	16	2	1	64	100	118	1	16	Bl	25.3	2315	23.33	90	16
12-074-10011		CP	Israel	W	64	61	18	2	1	55	105	142	2	12	W	45.9	2189	22.98	180	12
12-074-10012		CP 43	Israel	W	49	61	12	3	1	51	102	129	2	14	W	45.5	1572	22.53	90	18
CV % =																	24			
LSD .05 =																	800			

Legend for Beans Agronomic Data Table 25-34

(1) Numbers assigned to collection maintained by the Regional Pulse Improvement Project.

(2) Indicates variety name or area of origin. Numbers are numbers assigned to populations or collection by the Iranian Ministry of Agriculture; 6-digit numbers are PI numbers from Crops Research Division, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) W = White; P = Purple; LP = Light Purple

(4) V = Viney; B = Bushy

(5) Average number of plants per meter based on one meter of row per replication.

(6) Rated 1 to 9: 1 = complete stand; 9 = poor stand

(7) Rated 1 to 9: 1 = vigorous plants; 9 = weak plants

(8) Days from planting to first opened flower.

(9) Indicates number of days after planting the first pod in plot reached full maturity, ready for harvest.

(10) Indicates number of days after planting the whole plot was ready for harvest.

(11) Disease rated 1 to 9: 1 = free from disease; 9 = severe disease symptoms.

(12) First column: C = Curved; S = Straight
Second column: C - Cylindrical; F = Flat

(13) S = Short; M = Medium; L = Long; VL = Very Long

(14) Average of 10 pods per replication.

(15) W = White; Cr = Cream; R = Red; P = Purple; Br = Brown; Pi - Pink; Y = Yellow; Bl = Black; M = Mottled; S = Spotted; L = Light; D = Dark.

(16) C = Cylindrical; F = Flat; P = Plump

(17) Average weight (grams) of 100 seeds.

(18) Yield in kilograms per hectare based on 5 or 10 square meter plots.

(19) Protein percentage based on total solids. Determined by Kjeldahl method on two samples per strain, duplicate determinations per sample.

(20) Cooking time (in minutes) determined by boiling 50 gram sample in 500 ml. of water, 2 grams Na Cl added and checked regularly for hardness.

(21) Palatability, Maximum rating - 30.
- Appearance, maximum 9
  - Color uniformity, 3, 2, 1, 0
  - Size uniformity, 3, 2, 1, 0
  - Cooking uniformity, 3, 2, 1, 0
- Smell, maximum 6
- Taste, maximum 15

Table 25. Agronomic Data Beans (Pinto) Preliminary Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(15)	(16)	(17)	(18)
Accession Number	S O U R C E	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seed Color	Seed Shape	100 Seeds Weight	Yield per Hectare
65-071-00619	Ghouchan	P	V	20	1	1	44	80	107	3	CF	M	DPiM	F	30.9	3374
65-071-00206	Iran 142,900	LP	V	20	1	1	46	86	116	1	CF	M	CrM	C	30.0	3356
65-153-01275	Turkey	P	V	20	1	1	45	79	107	3	CF	M	LP	C	26.5	3210
65-153-02125	Turkey	W	V	19	1	1	42	75	106	3	CF	M	CrM	C	28.5	3164
65-153-01470	Turkey	P	V	15	1	1	44	82	112	2	CC	M	CrM	C	28.4	3128
65-071-00615	Ghouchan	P	V	21	1	1	42	83	111	3	CC	M	DPiM	C	24.0	3046
65-071-00036	Hamadan	PLP	V	20	1	1	44	80	113	3	CF	M	CrM	F	28.6	3012
65-153-01228	Turkey	W	V	17	2	1	39	70	95	3	CF	M	CrM	C	34.3	2992
65-071-00614	Ghouchan	LP	V	21	1	1	44	80	106	3	CC	M	PiM	C	23.5	2976
65-071-00445	Kermanshah	P	V	17	1	1	46	80	101	2	CF	M	CrM	C	30.2	2958
65-034-01122	Colombia 207,441	PLP	B	15	2	1	40	77	105	2	CC	L	BlM	C	35.7	2954
65-071-00609	Ghouchan	P	V	21	1	1	43	81	111	3	CC	S	DPiM	C	22.7	2926
65-000-00932	Unknown	P	V	18	1	1	51	86	117	2	CF	L	GYM	F	25.7	2840
65-071-00612	Ghouchan	P	V	20	2	1	43	81	106	3	CC	M	DPiM	F	27.4	2850
65-153-01225	Turkey	W	V	14	1	1	44	80	109	2	CF	M	CrM	F	24.0	2718
65-046-01915	Ethiopia 194,329	PLP	V	16	1	1	45	82	118	2	CF	L	CrM	F	24.3	2718
65-153-02317	Turkey	LP	V	12	1	1	43	87	117	2	SC	L	RM	C	46.6	2688
65-071-00616	Ghouchan	P	V	19	1	1	43	80	111	4	CF	M	DPiM	C	21.6	2666
65-071-00611	Ghouchan	P	V	22	1	2	44	83	114	3	CC	M	DPiM	C	21.4	2618
65-157-00294	U.S.A. 149,484	LP	B	16	1	1	39	81	102	2	CC	L	PM	C	32.2	2506
65-071-00446	Isfahan	LP	V	14	1	1	41	83	107	2	CC	L	PiM	C	47.6	2500
65-007-00293	Argentina	LPW	V	16	1	1	44	79	104	3	CC	M	DPiM	C	28.6	2256
65-071-00599	Isfahan	LP	V	15	2	1	43	88	113	2	CC	L	PiM	C	46.6	2170
65-157-00068	Pinto 114	W	V	19	2	2	39	69	91	3	CF	M	CrM	C	37.0	2170
65-153-00930	Turkey	LP	V	13	2	1	48	86	118	2	CF	L	PiM	C	47.2	2166
65-157-00072	Pinto 111	W	V	13	2	1	38	72	97	4	CF	M	CrM	C	36.3	2144
65-071-00600	Dashtsar Amol	LP	B	15	2	2	40	83	112	3	CC	M	PiM	C	36.6	2022
65-071-00605	Isfahan	LP	V	18	2	1	41	83	112	2	CC	M	PiM	C	42.0	2020
65-071-00603	Isfahan	LP	V	19	1	1	40	84	115	2	CC	L	PiM	C	41.2	2012
65-071-00601	Isfahan	LP	V	16	2	1	40	83	115	2	CC	M	PiM	C	39.7	1980
65-069-00241	India 164,778	LP	B	19	1	2	41	82	104	3	CF	L	CrM	P	29.1	1978
65-071-00593	Isfahan	LP	V	14	2	1	39	81	113	2	CC	M	PiM	C	42.7	1972
65-071-00594	Isfahan	LP	V	18	2	1	40	83	115	2	CC	M	PiM	C	43.1	1832
65-071-00604	Isfahan	LP	V	16	2	1	40	81	112	2	CC	M	PiM	C	43.8	1806
65-071-00457	Isfahan	W	V	18	2	1	46	88	117	1	CF	L	PiM	C	33.9	1628
65-165-00296	Africa 146,787	LP	V	17	2	1	41	84	112	2	CC	L	PiM	C	40.2	1388
CV % =																16
LSD .05 =																284

Table 26. Agronomic Data, Beans (Red) Preliminary Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	S O U R C E	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seeds per Pod	Seed Color	Seed Shape	100 Seed Weight	Yield per Hectare
65-071-00477	Isfahan	W	V	16	1	1	42	79	108	2	CC	M	5	Br	C	27.9	4144
65-034-01152	Colombia 207,175	LP	B	15	1	2	57	93	119	1	SC	L	5	Bl	C	23.2	3820
65-071-00720	Darehgaz	W	V	18	1	2	53	86	117	2	CF	M	5	DR	C	21.4	3704
65-117-00262	Paraguay 155,213	P	B	17	1	2	47	86	115	1	SC	M	6	Bl	C	18.1	3632
65-071-00733	Nishabour	W	V	17	2	1	54	87	118	2	CF	M	5	P	F	27.3	3608
65-071-00721	Ghouchan	W	V	18	1	1	51	90	119	2	CF	L	6	R	C	25.9	3580
65-071-00701	Torbat Heidarie	W	V	19	1	2	42	79	108	2	CC-CF	M	5	DR	C	25.5	3570
65-165-01860	So.Africa 172,033	W	V	18	1	1	44	85	112	2	CF	L	5	Br	F	28.5	3434
65-071-00743	Torbat Heidarie	W	V	16	1	1	43	74	104	-	CC-CF	M	6	P	C	28.0	3434
65-153-00925	Turkey	W	V	17	1	1	43	83	112	2	CC	L	6	Br	F	27.3	3378
65-071-00577	Ghouchan	W	V	18	1	1	54	90	120	2	CF	L	5	R	C	26.2	3310
65-153-02151	Turkey	W	V	15	1	1	53	85	119	2	CF	L	6	Br	C	25.9	3280
65-071-00729	Unknown	W	V	17	1	1	41	75	103	2	CF	M	5	DR	C	24.2	3278
65-096-00989	Mexico 201,495	P	B	15	1	1	44	84	113	1	SC	M	7	Bl	C	21.9	3262
65-071-00739	Unknown	W	V	16	1	1	41	73	104	3	CF	M	5	P	F	29.2	3238
65-032-00971	Chile 151,027	P	V	18	1	1	46	83	112	2	SC	M	6	Bl	C	21.5	3194
65-071-00704	Unknown	W	V	19	1	1	42	79	106	2	CF	M	6	DR	F	23.3	3188
65-071-00397	Sabzevar	W	V	17	1	1	43	77	109	2	CF	M	5	P	C	26.1	3150
65-153-01421	Turkey	W	V	19	1	2	51	87	117	2	CF	M	5	DBr	F	22.9	3144
65-071-00711	Ghouchan	W	V	19	1	1	42	77	107	2	CF	M	6	Br	F	27.0	3136
65-071-00730	Nishabour	W	V	18	1	1	57	90	119	2	CF	L	6	R	C	24.8	3118
65-085-00746	Lebanon	W	B	20	1	2	42	75	103	2	CF	M	6	Cr	C	29.1	3056
65-117-00262	Paraguay 155,212	P	V	15	1	2	50	83	114	1	SF	M	6	Bl	C	18.5	3052
65-071-00742	Unknown	W	V	19	1	1	44	83	112	2	CF	M	6	R	F	26.2	3046
65-071-00734	Nishabour	W	V	18	1	1	52	88	119	2	CF	L	6	LR	C	24.4	3028
65-071-00703	Unknown	W	V	16	1	2	45	83	114	2	CC-CF	M	6	R	C	31.5	3006
65-071-00361	Rasht	W	V	18	1	1	43	80	111	2	CF	S	5	DR	C	24.8	2994
65-071-00536	Torbat Heidarie	W	B	18	1	2	44	81	111	3	CF	M	5	Bl	C	16.5	2992
65-096-00124	Mexico 165,419	P	V	21	1	2	43	83	112	2	CC	S	5	Bl	C	19.2	2990
65-153-01415	Turkey	W	V	14	1	1	49	87	118	2	CC	VL	6	Br	F	34.5	2978
65-071-00306	Darehgaz	W	V	18	1	1	50	87	118	2	CF	L	6	LR	C	23.1	2976
65-165-00924	Africa 186,505	P	V	17	1	2	47	84	113	2	SC	L	6	Bl	C	19.3	2974
65-071-00732	Nishabour	W	V	18	1	1	41	76	104	2	CF	M	5	DR	C	27.9	2964
65-071-01031	Iran 222,821	W	V	17	1	2	53	87	116	2	CF	M	6	R	F	18.1	2962
65-071-00560	Darehgaz	W	V	18	1	1	53	89	119	2	CF	L	6	R	C	18.5	2952
65-032-00269	Chile 151,017	P	V	16	1	1	38	76	102	3	CF	L	6	LCr	C	44.3	2944
65-032-00929	Chile 300,665	P	B	15	1	3	53	99	126	1	SC	L	7	Bl	C	24.4	2900
65-071-00713	Darehgaz	W	V	17	1	1	54	90	119	2	CF	L	6	R	C	23.3	2886
65-071-00726	Torbat Heidarie	W	V	18	1	2	42	77	110	2	CF	M	5	P	C	26.0	2874
65-071-00748	Nishabour	W	V	19	1	1	54	92	119	2	CF	L	6	R	C	22.8	2866
65-071-00717	Ghouchan	W	V	20	1	2	46	87	117	2	CC	L	4	Br	C	19.0	2854
65-146-01561	Syria 181,793	P	V	18	1	1	51	88	117	3	CC	M	5	LCr	C	19.9	2848
65-034-00912	Colombia 207,193	W	V	22	1	2	45	86	117	2	CF	M	5	Pi	F	18.9	2836
65-071-00750	Nishabour	W	V	19	1	2	45	82	111	2	CF	M	5	DR	C	21.8	2336
65-071-00725	Torbat Heidarie	W	V	17	2	1	42	81	110	2	CF	M	5	P	F	26.6	2822
65-071-00754	Kermanshah	W	B	13	1	1	46	83	111	2	SC	M	5	Pi	C	24.8	2818
65-071-00709	Darchgaz	W	V	17	1	1	41	72	101	3	CF	S	6	LR	C	29.9	2804
65-071-01831	Iran 228,358	W	V	18	1	2	48	82	116	2	CF	M	5	LR	F	25.7	2802
65-007-00292	Argentina 162,565	W	V	18	1	2	54	90	119	2	CF	L	6	LR	C	24.7	2798
65-071-00724	Torbat Heidarie	W	V	18	2	1	43	82	110	2	CF	M	5	DR	F	27.5	2794
65-071-00476	Ghouchan	P	V	17	1	1	43	84	113	2	CF	M	5	LCr	F	27.1	2780
65-096-00125	Mexico 165,433	P	V	18	1	2	48	82	112	2	SC	M	6	Bl	C	14.8	2776
65-071-00062	Bojnurd	LP	V	17	1	1	51	85	113	2	CF	L	6	LCr	F	33.2	2768
65-071-00727	Iran	W	V	17	1	1	41	74	103	3	CF	M	5	LR	C	32.9	2758
65-071-00719	Darehgaz	W	V	19	1	1	47	86	116	2	CF	L	6	R	F	20.4	2758
65-071-00745	Iran	W	V	18	1	2	45	83	113	2	CF	M	5	P	F	24.3	2748
65-071-00395	Nishabour	W	V	18	1	2	47	90	121	2	CF	M	6	R	F	22.2	2744
65-071-00723	Darehgaz	W	V	19	1	1	44	84	113	3	CF	M	6	Pi	C	21.9	2742
65-071-00708	Kermanshah	W	V	17	1	2	44	85	118	2	CF	L	5	LR	C	24.4	2740
65-071-00534	Torbat Haidarie	W	V	17	1	1	43	76	105	2	CF	L	6	R	F	29.2	2722
65-071-00727	Iran	W	V	18	1	2	44	77	106	2	CF	M	5	LR	C	30.8	2716
65-071-00392	Meshed	W	V	18	1	1	50	90	120	2	CF	L	6	R	C	27.3	2710
65-071-00537	Nishabour	W	V	18	1	1	54	91	119	2	CF	L	5	LR	C	25.0	2690
65-071-00740	Dashtsar Amol	P	V	18	1	1	48	86	116	2	CF	M	6	Bl	C	29.1	2666
65-071-00103	Fars Min. 104	W	V	15	1	2	44	83	113	2	CF	L	5	P	F	28.7	2646
65-027-00071	Mexico 36	W	V	19	1	1	41	72	101	2	CF	M	5	R	C	25.2	2638
65-071-00736	Kermanshah	W	V	18	1	1	51	86	112	2	CF	L	6	Pi	F	20.7	2638

contd.....

Table 26. Agronomic Data, Beans (Red) Preliminary Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	S O U R C E	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seeds per Pod	Seed Color	Seed Shape	100 Seed Weight	Yield per Hectare
65-071-00475	Kermanshah	W	V	17	1	2	42	78	104	3	CF	M	6	Y	C	28.2	2634
65-071-01031	Iran 222,821	W	V	16	1	2	55	91	121	2	CF	L	6	R	F	24.7	2618
65-071-00582	Isfahan 50	W	V	19	1	2	44	82	112	2	CF	M	5	P	F	25.3	2600
65-071-00710	Kermanshah	W	V	18	1	1	41	72	104	3	CF	M	5	LR	C	32.5	2590
65-071-00723	Darehgaz	W	V	18	1	1	48	86	117	2	CF	M	6	R	C	16.3	2586
65-071-00753	Darehgaz	W	V	19	1	3	49	87	117	2	CF	L	5	P	C	20.9	2574
65-071-00712	Darehgaz	W	V	16	1	2	49	88	119	2	CF	L	6	R	C	20.4	2560
65-085-00100	Lebanon M. 139	W	V	17	1	1	41	74	101	3	CF	M	6	LR	C	29.5	2548
65-071-00399	Fars	W	V	16	1	2	43	76	105	2	CF	M	5	LR	C	30.8	2546
65-071-00483	Ghouchan	W	V	17	1	1	41	78	107	2	CF	M	5	LY	F	29.8	2544
65-062-00928	Guatemala 195,364	LP	V	13	2	1	40	83	111	1	CF	L	6	DP	C	32.2	2526
65-071-00394	Nishabour	W	V	19	1	1	48	88	120	2	CF	L	6	R	C	23.6	2520
65-071-00504	Kermanshah	W	V	18	1	1	42	74	102	3	CF	M	5	R	C	34.3	2504
65-071-00472	Dashtsar Amol	P	V	18	1	2	42	81	111	3	CF	S	5	LCr	C	27.0	2472
65-071-00702	Torbat Heidarie	W	V	18	1	2	45	82	107	3	CF	M	5	R	C	30.6	2454
65-153-01371	Turkey	W	V	14	2	1	46	86	115	2	CF	L	5	Br	F	29.4	2428
65-071-00741	Ghouchan	W	V	17	1	2	48	83	116	3	CF-CC	M	5	R	C	22.4	2348
65-153-02122	Turkey	W	V	17	1	1	54	88	119	2	CF	L	5	R	F	25.2	2332
65-062-01734	Guatemala 194,578	P	V	17	1	3	48	87	120	2	SC	M	6	Bl	C	19.8	2322
65-085-00440	Lebanon	W	V	16	1	2	48	85	117	2	CF	M	5	R	F	26.3	2316
65-153-01390	Turkey	W	V	17	1	2	46	84	117	3	CF	M	5	R	C	29.8	2306
65-071-00700	Darehgaz	W	V	17	1	2	56	92	119	2	CF	L	6	R	F	19.9	2276
65-096-00967	Mexico 196,936	W	B	16	1	2	52	87	119	2	SC	M	6	Y	C	19.5	2272
65-071-00751	Darehgaz	W	V	20	1	2	50	87	117	2	CF	M	6	LR	C	17.7	2272
65-157-00076	California	W	V	17	1	1	48	85	117	2	CF	M	6	DR	C	25.2	2270
65-118-00923	Peru 217,624	P	B	18	1	3	52	89	119	2	CC	L	6	LCr	F	14.8	2268
65-071-00750	Nishabour	W	V	18	1	2	44	84	117	2	CF	L	6	Pi	C	19.2	2242
65-153-02201	Turkey	W	V	16	1	2	54	93	114	2	CF	L	7	Br	F	31.7	2196
65-146-01571	Syria 181,953	W	B	16	1	2	46	84	109	1	SC	M	5	LCr	C	23.4	2150
65-071-00382	Chalous	W	V	18	1	1	50	92	125	1	CF	M	6	R	C	19.2	2144
65-065-00887	Honduras 206,222	W	B	17	2	3	42	89	119	3	CF	L	6	R	C	17.8	1941
65-146-02385	Syria 181,920	W	B	10	2	2	51	92	119	2	CF	L	5	Y	C	27.2	1846
65-157-00589	U.S.A. Red Kidney	W	B	9	2	1	43	79	110	3	CF	L	6	R	P	42.0	1604
CV % =																	20
LSD .05 =																	387

Table 27. Agronomic Data, Beans (White) Preliminary Yield Test, Planted May 21, 1968, RWIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	SOURCE	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seeds per Pod	Seed Color	Seed Shape	100 Seeds Wt.	Yield per Hectare
65-071-00512	Iran	W	V	17	2	2	43	77	109	1	CF	L	5	W	F	22.9	4014
65-071-00695	Isfahan	W	V	19	2	2	41	76	107	2	CC	M	5	W	C	29.7	3784
65-071-00677	Kermanshah	W	V	16	2	2	40	73	102	2	CC-CF	M	4	W	F	28.7	3780
65-071-00314	Varamin	W	V	16	1	1	41	73	102	2	CC-CF	L	5	W	F	25.5	3738
65-071-00621	Karaj	W	V	17	2	1	41	78	108	2	CF	M	5	W	F	28.5	3560
65-153-01286	Turkey	W	V	16	2	1	40	77	111	2	CF	L	6	W	F	42.5	3474
65-071-00335	Varamin Min. 382	W	V	19	2	2	41	73	106	2	CC	M	5	W	C	28.0	3466
65-071-00652	Isfahan	W	V	16	2	2	42	74	102	2	CC	M	6	W	C	27.2	3442
65-071-00675	Karaj	W	V	17	2	2	41	77	104	2	CF	M	5	W	C	30.2	3428
65-071-00628	Karaj	W	V	16	2	1	41	73	100	2	CC	M	5	W	C	27.8	3412
65-071-00666	Darehgaz	W	V	16	2	1	43	75	105	2	CF	M	5	W	C	28.1	3404
65-085-00688	Lebanon	W	V	17	2	2	41	73	99	2	CC	M	5	W	F	27.4	3398
65-085-00645	Lebanon	W	V	17	1	1	42	73	101	2	CC	M	5	W	F	27.7	3398
65-071-00640	Shiraz	W	V	16	2	2	41	78	104	2	CC	M	5	W	C	23.1	3384
65-153-01368	Turkey	W	V	18	1	2	43	81	112	2	CC-CF	L	6	W	C	29.7	3366
65-071-00623	Karaj	W	V	16	2	1	44	74	107	2	CC	M	6	W	C	28.5	3366
65-071-00650	Iran	W	V	16	2	1	42	75	102	2	CC	M	5	W	C	26.0	3362
65-071-00643	Shiraz	W	V	15	2	1	42	75	102	2	CC	M	5	W	C	31.1	3316
65-071-00649	Iran	W	V	17	2	1	42	73	100	2	CC	M	6	W	C	26.7	3314
65-071-00696	Isfahan	W	V	18	2	1	41	76	108	2	CC	M	5	W	C	26.2	3290
65-071-00683	Shiraz	W	V	18	2	2	41	73	101	2	CC	M	5	W	F	26.9	3274
65-085-00690	Lebanon	W	V	17	2	1	41	72	99	2	CC	M	5	W	C	28.3	3270
65-153-01344	Turkey	W	V	18	1	1	41	80	112	1	CF	M	5	W	C	25.7	3270
65-071-00642	Shiraz	W	V	18	1	1	43	74	104	2	CC	M	6	W	F	25.1	3260
65-157-02023	U.S.A. 278,681	W	V	17	2	2	45	82	113	1	CF	L	6	W	C	17.7	3248
65-071-00692	Karaj	W	V	17	2	1	42	77	112	2	CC	M	6	W	F	21.0	3242
65-071-00699	Iran	W	V	18	1	2	42	75	104	2	CC	M	5	W	C	29.7	3242
65-071-00098	Fars	W	V	17	2	1	40	76	107	2	CC	M	5	W	C	28.9	3226
65-071-00676	Karaj	W	V	16	2	1	41	74	100	2	CC	M	5	W	C	28.8	3222
65-071-00626	Karaj	W	V	16	2	1	42	80	112	2	CF	L	5	W	F	21.1	3214
65-027-01584	Canada 136,680 Sel.	W	V	19	2	2	42	80	110	3	SC	M	6	W	C	20.3	3208
65-153-02129	Turkey	W	V	16	2	1	43	82	115	1	CF	L	6	W	F	31.6	3208
65-071-00674	Karaj	W	V	15	2	2	41	73	100	2	CC	M	5	W	F	28.3	3180
65-071-00637	Shiraz	W	V	17	2	1	44	76	106	2	CF	M	5	W	C	30.4	3172
65-153-02186	Turkey	W	V	17	1	1	42	81	112	2	CF	M	6	W	C	30.1	3156
65-153-02213	Turkey	W	V	16	1	2	44	82	116	2	CF	L	5	W	C	22.4	3152
65-085-00646	Lebanon	W	V	16	2	1	41	74	102	2	CC	M	5	W	C	30.4	3152
65-071-00655	Isfahan	W	V	16	2	2	44	83	112	2	CF	L	6	W	C	21.2	3138
65-071-00672	Karaj	W	V	16	2	2	41	74	100	2	CC	M	5	W	C	28.2	3130
65-153-01416	Turkey	W	V	17	1	1	46	85	117	2	CF	M	5	W	C	23.6	3122
65-071-00625	Karaj	W	V	15	2	1	41	76	108	2	CC	L	6	W	F	27.2	3112
65-085-00689	Lebanon	W	V	15	2	2	42	75	105	2	CC	M	5	W	F	27.8	3098
65-157-00081	U.S.A.	W	V	16	2	2	41	79	107	3	SC	M	5	W	C	37.7	3090
65-071-00671	Karaj	W	V	15	2	1	44	78	111	2	CC	M	5	W	C	30.7	3088
65-071-00662	Ghouchan	W	V	18	2	2	42	80	112	2	CF	M	6	W	C	27.5	3086
65-071-00636	Kermanshah	W	V	17	2	1	45	79	108	2	CC	L	6	W	F	22.3	3080
65-071-00654	Isfahan	W	V	15	2	2	42	73	99	2	CC	M	5	W	C	29.0	3074
65-153-02030	Turkey	W	V	15	2	2	41	89	110	1	CC	M	5	W	C	26.4	3072
65-071-00684	Shiraz	W	V	17	1	1	42	73	100	2	CC-CF	L	6	W	F	27.0	3062
65-071-00661	Ghouchan	W	V	20	1	2	44	79	112	3	CF	M	5	W	C	27.5	3032
65-071-00104	Sarab Min. 158	W	V	15	2	2	42	75	105	2	CC	M	6	W	C	24.9	3022
65-071-00638	Shiraz	W	V	18	2	1	42	74	105	2	CF	M	6	W	C	29.6	3012
65-085-00686	Lebanon	W	V	16	2	2	42	79	105	2	CC-CF	M	6	W	C	22.7	3010
65-071-00042	Shiraz	W	V	17	2	1	41	76	104	2	CF	M	5	W	F	26.8	2996
65-153-00190	Turkey 165,008	W	V	15	2	1	44	81	114	1	CF	L	6	W	F	30.2	2996
65-071-00660	Ghouchan	W	V	18	2	2	41	78	111	2	CF	M	5	W	F	24.8	2994
65-071-00069	U.S.A.C.N. 123	W	V	16	2	2	39	71	99	2	CC-CF	M	5	W	C	23.7	2974
65-085-00648	Lebanon	W	V	17	2	2	41	74	102	2	CC-CF	M	5	W	C	27.0	2960
65-071-00679	Kermanshah	W	V	17	2	1	41	74	105	2	CF	M	5	W	C	26.4	2950
65-071-00685	Shiraz	W	V	14	3	1	42	76	108	2	CC	M	5	W	F	37.9	2938
65-153-02435	Turkey	W	B	13	2	2	45	83	113	1	CC	L	6	W	C	31.2	2936
65-071-00651	Isfahan	W	V	17	2	2	40	73	99	2	CC	M	6	W	C	27.3	2932
65-085-00687	Lebanon	W	V	19	2	1	41	74	99	2	CC	M	6	W	F	24.2	2926
65-071-00620	Karaj	W	V	17	2	1	43	74	101	2	CC-CF	M	5	W	F	31.9	2916
65-071-00681	Shiraz	W	V	15	2	1	39	73	101	2	CC	M	5	W	C	30.7	2916
65-157-01188	U.S.A. 278,685	W	V	16	2	1	44	86	120	1	CF	L	6	W	C	24.3	2884
65-153-02087	Turkey	W	V	15	2	2	42	83	114	2	CF	L	6	W	C	20.1	2874
65-153-01368	Turkey	W	V	17	1	2	45	83	115	2	CC-CF	L	5	W	C	24.4	2866

Table 27. Agronomic Data, Beans (White) Preliminary Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
Accession Number	S O U R C E	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Pl.to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seeds per Pod	Seed Color	Seed Shape	100 Seeds Wt.	Yield per Hectare
65-071-00021	Ghouchan	W	V	17	2	2	44	75	111	2	CF	L	7	W	F	25.6	2864
65-071-00657	Dashtsar Amol	W	V	16	2	2	41	74	105	2	CF	M	5	W	F	27.0	2858
65-071-00212	Iran 140,302	W	V	15	3	1	42	81	110	2	CF	L	6	W	F	27.6	2822
65-071-00639	Shiraz	W	V	16	2	1	43	73	101	2	CF	M	6	W	F	26.6	2812
65-071-00495	Iran	W	V	16	2	2	46	83	113	2	CF	M	5	W	C	19.3	2812
65-071-00663	Ghouchan	W	V	15	2	2	44	73	113	2	CC-CF	L	5	W	C	24.3	2770
65-071-00633	Kermanshah	W	V	16	2	2	41	75	104	2	CC	M	5	W	C	26.3	2770
65-046-01906	Ethiopia	W	V	17	2	2	44	81	112	3	CC	M	5	W	F	27.1	2752
65-071-00664	Darehgaz	W	V	17	2	2	41	74	105	3	CF	M	5	W	C	23.9	2750
65-071-00682	Shiraz	W	V	15	2	1	41	73	100	3	CF	M	5	W	C	31.0	2734
65-071-00676	Karaj	W	V	15	2	2	40	83	116	2	CF	L	5	W	C	19.8	2728
65-069-02370	India 175,278	W	V	15	2	2	41	84	119	2	CF	L	6	W	C	26.2	2708
65-071-00641	Shiraz	W	V	17	2	1	42	73	103	2	CF	M	5	W	F	28.0	2706
65-071-00653	Isfahan	W	V	17	2	1	42	77	106	2	CF	M	6	W	F	29.9	2702
65-032-00814	Chile 282,025	W	V	13	2	3	46	82	112	4	CF	M	5	W	C	22.4	2680
65-071-00693	Darehgaz	W	V	17	2	2	49	82	113	2	CF	L	6	W	F	20.2	2638
65-071-01014	Iran 223,005	W	V	13	2	1	40	84	118	2	CF	L	5	W	F	21.1	2566
65-071-00272	Dashtsar Amol	W	V	16	2	2	40	74	103	2	CC	M	5	W	C	27.2	2544
65-062-01742	Guatemala 182,006	W	V	15	2	2	41	84	116	2	CF	L	6	W	C	28.5	2496
65-153-01471	Turkey Sel.	W	V	14	2	1	41	79	112	2	CF	L	5	W	F	35.8	2484
65-071-00698	Iran	W	V	14	2	2	43	84	115	2	CF	M	6	W	F	36.2	2466
65-071-00670	Karaj	W	V	15	2	2	42	75	105	2	CF	M	5	W	C	26.4	2448
65-071-00371	Hasan Kiadeh	W	V	13	2	2	41	84	116	2	CF	L	5	W	C	27.0	2422
65-069-02331	India 183,704	W	V	14	2	2	42	79	113	2	CF	M	5	W	F	30.2	2420
65-153-02030	Turkey	W	V	16	1	1	41	81	118	2	CF	L	6	W	F	27.1	2410
65-157-00010	Blue Lake	W	V	15	2	2	42	77	108	2	CC-CF	L	6	W	F	32.0	2216
65-153-02283	Turkey	W	V	12	2	1	46	82	119	2	CF	L	6	W	C	33.2	2196
65-118-01046	Peru 372 Sel.	W	B	13	2	1	54	84	112	1	SC	L	6	W	C	19.4	2138
65-153-01330	Turkey Sel.	W	V	16	2	2	44	83	116	3	SF	M	5	W	C	23.0	2122
65-071-01830	Iran 229,536	W	V	16	2	1	46	88	124	2	CF	L	6	W	F	24.2	1994
	Iran	W	V	16	1	1	48	92	124	2	CF	L	6	W	F	21.7	1726
65-069-01509	India 215,717	W	B	14	2	1	52	85	111	1	SF	L	6	W	C	22.2	1708
CV % =																	16
LSD .05 =																	336

Table 28. Agronomic Data, Beans (Pinto) Advanced Yield Test, Planted April 13, 1968, RPIP, Varamin, Iran

(1) Accession Number	(2) SOURCE	(3) Flower Color	(5) Plants /Meter	(6) Stand	(7) Vigor	(11) Disease Rating	(14) Seeds per Pod	(17) 100 Seeds Wt.	(18) Yield per Hectare	(19) Protein	(20) Cooking Time	(21) Palatability
63-071-00455	Torbat Heidarie	P	9	1	2	2	5	29.4	1834	20.43	180	28
65-071-00063	Bojnurd	P	10	2	3	4	4	21.9	1718	20.57	160	26
65-071-00023	Malayer	W	9	2	2	3	4	26.5	1694	21.95	160	26
65-157-00005	US Resistant Tender Green	P	7	2	1	2	6	30.0	1610	21.75	180	27
65-071-00618	Ghochan	W	8	2	2	4	5	25.6	1550	22.23	210	27
65-157-00068	USA Pinto 114	W	7	2	2	2	5	31.0	1531	23.10	210	25
65-071-00096	Ardekan 179	P	8	2	2	3	4	22.5	1436	22.43	180	28
65-071-00446	Isfahan	W	9	2	2	2	5	30.0	1401	19.92	85	27
65-071-00449	Ghochan	P	8	2	2	4	5	23.4	1388	21.11	210	25
65-157-00072	USA Pinto 111	W	8	4	3	4	6	26.1	1308	21.68	210	29
65-071-00445	Kermanshah	P	9	3	3	3	5	25.6	1284	20.14	180	27
65-071-00606	Isfahan	W	8	3	2	2	4	23.7	1270	21.62	170	27
65-071-00617	Kermanshah	P	9	2	1	3	5	24.4	1203	19.83	210	26
65-071-00607	Dashtsar Amol	P	9	2	3	3	6	20.5	1176	20.54	60	29
65-071-00755	Ghochan	P	11	2	2	3	5	23.1	1171	21.15	195	27
65-071-00452	Ghochan	P	9	2	2	3	5	20.1	1140	20.59	210	27

Table 29. Agronomic Data, Beans (Pinto) Uniform Advanced Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1) Accession Number	(2) SOURCE	(3) Flower Color	(4) Plant Type	(5) Plants /Meter	(6) Stand	(7) Vigor	(8) Fl. to 1st Fl.	(9) Fl. to 1st Mat.	(10) Fl. to Com.Mat.	(11) Disease Rating	(12) Pod Shape	(13) Pod Size	(14) Seeds per pod	(15) Seed Color	(16) Seed Shape	(17) 100 Seeds Weight	(18) Yield per Hectare	(19) Protein	(20) Cooking Time	(21) Palatability
65-071-00618	Ghochan	W	V	16	2	1	48	85	116	3	CP	M	4	RM	F	25.3	3385	23.94	195	25
65-071-00755	Ghochan	P	V	16	2	1	47	82	109	3	CP	M	5	RM	F	25.0	3358	24.57	190	24
65-071-00455	Torbat Heidarie	P	V	15	2	1	47	79	109	2	CP	M	5	RM	F	29.0	3178	22.97	180	24
65-071-00063	Bojnourd	LP	V	17	1	1	47	83	114	2	CP	S	5	RM	F	25.1	3178	23.51	190	26
65-071-00023	Malayer	W	V	17	2	1	47	81	109	2	CP	M	5	CrM	F	28.4	3162	23.92	175	25
65-157-00068	Pinto 114	W	V	15	3	2	47	71	94	3	CP	L	6	CrM	F	38.3	3087	22.58	180	28
65-071-00096	Ardekan 179	P	V	16	2	1	48	83	116	2	CP	M	5	CrM	F	31.7	3016	24.40	175	25
65-071-00606	Isfahan	W	V	17	2	1	47	81	109	2	CP	M	5	CrM	F	30.5	3005	22.86	165	28
65-071-00607	Dashtsar Amol	P	V	19	1	1	47	83	114	3	CC	M	5	RM	F	25.9	2988	23.66	190	27
65-071-00449	Ghochan	P	V	17	2	1	47	82	109	3	CP	M	5	RM	F	31.8	2985	25.66	185	22
65-071-00452	Ghochan	P	V	15	2	1	48	82	110	2	CP	M	5	RM	F	24.1	2938	24.52	180	22
65-071-00617	Kermanshah	P	V	16	2	1	47	78	108	3	CP	M	5	CrM	F	29.5	2919	21.13	180	25
65-157-00005	Resistant Tender Green	LP	B	10	3	1	47	79	115	1	CC	L	6	CrM	C	36.3	2818	24.00	160	24
65-071-00445	Kermanshah	P	V	17	1	1	47	81	110	2	CP	ML	6	CrM	F	27.8	2764	22.79	180	25
65-157-00072	Pinto 111	W	V	16	2	2	47	72	92	3	CP	L	6	CrM	F	36.2	2321	22.90	185	25
65-071-00446	Isfahan	W	V	13	3	1	47	84	115	2	CC	L	5	CrM	F	45.3	2147	23.69	105	24
CV = %																	12			
LSD .05 =																	481			

Table 30. Agronomic Data, Beans (Red) Advanced Yield Test, Planted April 13, 1968, RPIP, Varamin, Iran

(1)	(2)	(3)	(5)	(6)	(7)	(14)	(17)	(18)	(19)	(20)	(21)
Accession Number	S O U R C E	Flower Color	Plants /Meter	Stand	Vigor	Seeds per Pod	100 Seeds Wt.	Yield per Hectare	Protein	Cooking Time	Palatability
65-071-00569	Nishabour	W	8	1	1	6	20	2471	21.20	220	26
65-071-00744	Torbat Heidarie	W	8	2	2	6	23	2256	21.14	220	25
65-071-00565	Dashtsar Amol	W	10	1	1	6	20	2116	22.13	210	27
65-071-02071	Fars 104	W	10	2	3	5	20	2070	23.77	180	28
65-071-00735	Nishabour	W	9	1	1	6	19	2067	21.76	180	26
65-071-00389	Ghochan	W	9	1	1	6	18	1969	22.56	195	24
65-071-00749	Nishabour	W	11	2	3	5	16	1906	25.12	180	28
65-071-00431	Iran	W	9	2	2	5	22	1843	20.17	195	26
65-071-00540	Dashtsar	W	10	1	1	5	19	1813	22.72	195	25
65-071-00707	Darehgaz	W	11	1	1	6	11	1812	21.74	195	29
65-071-00731	Nishabour	W	10	2	2	5	23	1795	21.74	220	26
65-071-00538	Darehgaz	W	10	3	2	5	16	1773	21.99	220	25
65-071-00582	Isfahan	W	10	3	2	6	20	1763	20.41	135	25
65-071-00551	Isfahan	W	10	2	3	6	22	1730	19.51	195	25
65-071-01997	Torbat Heidarie	W	10	3	3	5	20	1729	22.34	220	26
65-071-00535	Torbat Heidarie	W	9	2	1	5	20	1695	22.58	195	27
65-085-00440	Lebanon	W	10	3	3	5	20	1674	20.38	195	26
65-085-01999	Lebanon 132	W	8	4	3	5	26	1656	21.62	180	27
65-071-02074	Iran 119	W	9	3	3	6	25	1641	20.07	190	28
65-085-02051	Lebanon 132	W	10	3	3	5	24	1632	20.47	195	26
65-071-00534	Torbat Heidarie	W	9	3	3	5	24	1623	20.98	185	26
65-071-00430	Iran	W	9	3	3	6	20	1597	21.60	210	27
65-071-00566	Isfahan	W	9	4	3	5	22	1589	21.88	210	25
65-071-00539	Nishabour	W	10	1	1	6	15	1570	24.85	195	26
65-071-00580	Darehgaz	W	13	1	1	5	19	1523	22.18	195	23
65-071-00481	Ghochan	W	9	3	3	6	17	1511	21.99	180	26
65-085-02075	Lebanon	W	9	3	2	6	21	1465	21.50	180	27
65-071-00536	Torbat Heidarie	W	8	2	2	5	18	1439	21.43	210	22
65-071-00563	Nishabour	W	9	1	1	6	15	1174	25.29	195	24
65-071-02076	Iran	W	8	4	3	5	26	1146	20.35	195	27
CV. % =								27			
LSD .05 =								654			

Table 31. Agronomic Data, Beans (Red) Uniform Advanced Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	S O U R C E	Flow Col	Plan Type	Plan /Mel	Stan	Vig	Pl. 1st	Pl. 1st	Pl. 1st Com.	Disea Ratir	Pod Shap	Pod Size	Seed per	Seed Colo	Seed Shap	100 Seed Wt.	Yiel per Heat	Prot	Cook Time	Pala bili
65-071-00538	Dareghaz	W	V	15	1	1	54	91	120	2	CF	L	6	R	C	26.5	4188	23.32	150	24
65-071-00735	Nishabour	W	V	15	1	1	55	85	117	2	CF	L	6	P	C	29.5	4124	23.10	180	24
65-071-00535	Torbat Heidarie	W	V	17	1	1	57	89	118	2	CF	L	6	R	C	27.7	4056	22.13	135	24
65-071-00707	Darehgaz	W	V	13	1	1	54	90	119	2	CF	M	5	R	C	25.1	3970	23.47	180	22
65-071-00569	Nishabour	W	V	15	2	1	54	91	119	2	CF	L	5	R	C	27.2	3959	23.30	120	24
65-071-00580	Darehgaz	W	V	15	2	1	50	89	117	3	CF	M	5	R	C	26.8	3876	22.98	150	25
65-071-00539	Nishabour	W	V	17	1	1	55	89	118	2	CF	L	6	R	C	25.5	3781	27.38	135	23
65-071-00551	Isfahan	W	V	18	1	2	44	79	104	3	CF	M	5	P	C	29.2	3631	23.34	135	23
65-071-00565	Dashtsar Amol	W	V	18	1	1	56	89	118	3	CF	M	5	R	C	27.9	3572	22.57	135	21
65-071-00540	Dashtsar	W	V	15	1	1	56	92	119	3	CF	L	6	R	C	29.1	3562	23.43	135	22
65-071-00536	Torbat Heidarie	W	V	16	1	1	46	80	109	3	CF	M	5	P	C	25.5	3558	23.85	120	22
65-071-00731	Nishabour	W	V	16	2	1	52	90	119	2	CF	M	6	R	C	27.6	3507	24.96	150	24
65-071-00431	Iran	W	V	15	1	1	43	76	100	2	CF	L	6	DPi	C	31.3	3466	22.22	135	23
65-071-00481	Ghouchan	W	V	18	1	1	50	83	113	3	CC	S	5	Br	C	20.3	3427	23.40	150	24
65-071-00563	Nishabour	W	V	15	1	1	54	88	117	2	CF	M	6	P	F	33.5	3426	25.77	135	23
65-071-00389	Ghouchan	W	V	15	1	1	51	87	118	3	CF	M	6	R	C	25.2	3408	26.12	150	24
65-085-00440	Lebanon	W	V	16	2	1	47	83	115	3	CF	M	5	LR	C	29.4	3267	22.53	150	26
65-085-02051	Lebanon	W	V	16	1	1	45	79	100	3	CF	M	5	DBr	C	27.7	3254	21.80	180	23
65-071-02071	Fars 104	W	V	16	1	1	44	78	102	3	CF	M	6	P	C	27.6	3201	24.65	180	23
65-071-00566	Isfahan	W	V	16	2	1	46	80	106	2	CF	M	5	R	C	28.1	3069	24.40	135	23
65-071-00749	Nishabour	W	V	18	1	1	54	85	111	3	CF	M	6	Pi	C	23.6	3016	26.28	180	22
65-071-00582	Isfahan	W	V	17	1	1	43	79	97	3	CF	M	5	P	C	26.6	2900	22.82	150	23
65-071-00744	Torbat Heidarie	W	V	17	2	1	46	78	103	2	CF	M	5	PBr	C	35.0	2895	22.25	150	24
65-071-02076	Iran	W	V	14	1	2	46	78	100	3	CF	M	5	P	C	28.9	2810	22.37	180	23
65-071-00430	Iran	W	V	15	2	1	45	78	105	3	CF	M	5	P	C	27.8	2759	22.06	135	21
65-085-02075	Lebanon 132	W	V	16	1	2	42	74	91	2	CF,CC	M	5	R	C	31.8	2641	22.68	180	25
65-071-01997	Torbat Heidarie	W	V	16	2	1	41	73	95	3	CF	M	5	R	C	23.7	2591	27.82	180	23
65-085-01999	Lebanon 132	W	V	17	2	1	43	76	92	3	CF	M	5	LR	C	30.5	2553	23.11	180	23
65-071-00534	Torbat Heidarie	W	V	14	1	1	48	80	105	3	CF	M	5	P	C	29.6	2552	21.84	150	23
65-071-02074	Iran	W	V	16	2	2	43	74	94	3	CF	M	5	LR	C	29.0	2267	21.37	180	23
CV % =																	12			
LSD .05 =																	---			

Table 32. Agronomic Data, Beans (White) Uniform Advanced Yield Test, Planted April 13, 1968, RPIP, Varamin, Iran

(1) Accession Number	(2) S O U R C E	(3) Flower Color	(5) Plants /Meter	(6) Stand	(7) Vigor	(14) Seeds per Pod	(17) 100 Seeds Wt.	(18) Yield per Hectare	(19) Protein	(20) Cooking Time	(21) Palatabilit
65-071-01948	Shiraz 178	W	9	2	2	5	25	2605	21.04	150	27
65-071-01969	Isfahan 110	W	8	2	2	6	25	2376	21.34	145	25
65-071-00525	Isfahan	W	9	2	3	5	26	2293	20.58	210	23
65-071-01966	Sarab 185	W	9	3	2	5	26	2275	21.34	145	21
65-071-00697	Isfahan	W	9	2	2	6	24	2273	21.11	160	27
65-071-00678	Kermanshah	W	9	2	2	5	26	2218	21.55	170	27
65-071-00517	Ghouchan	W	10	2	2	6	21	2211	21.02	195	27
65-071-00513	Iran	W	10	2	2	6	19	2185	20.79	210	22
65-071-00515	Ghouchan	W	9	2	2	5	20	2159	24.16	185	27
65-071-01947	Isfahan	W	9	3	3	5	25	2134	20.88	150	27
65-071-00644	Shiraz	W	9	2	2	5	22	2056	21.08	135	23
65-071-00622	Karaj	W	9	3	3	5	24	2053	21.91	170	26
65-157-00014	USA Haubers St.Andres	W	9	3	2	6	23	1965	21.04	180	26
65-071-00042	Shiraz	W	9	3	3	6	26	1924	21.57	150	23
65-071-01950	Karaj 149	W	10	3	3	5	23	1922	21.95	150	27
65-071-00680	Kermanshah	W	10	3	3	6	23	1922	20.87	135	25
65-071-00658	Dashtsar Amol	W	8	2	1	5	40	1884	18.44	185	26
65-071-00470	Kermanshah	W	10	3	3	5	27	1876	18.86	200	22
65-071-00054	Isfahan	W	9	2	2	5	23	1850	21.76	180	24
65-071-00515	Ghouchan	W	9	2	2	6	18	1824	25.06	170	27
65-071-00694	Ghouchan	W	10	2	2	6	17	1815	22.67	200	27
65-071-00490	Iran	W	8	2	2	6	25	1798	19.05	185	25
65-071-00503	Karaj	W	9	2	2	5	25	1795	20.67	195	24
65-071-00506	Isfahan	W	10	3	3	6	23	1711	20.05	170	24
65-071-00376	Shiraz	W	9	3	3	5	26	1685	20.02	135	24
65-071-00051	Iran Min. 1365	W	8	2	3	6	22	1664	20.32	145	22
65-085-00583	Lebanon 3	W	10	3	3	5	25	1666	21.18	180	26
65-085-00494	Lebanon	W	10	2	2	5	19	1849	21.88	225	23
65-071-00040	Kermanshah	W	10	3	3	5	23	1643	21.20	150	25
65-071-00505	Shiráz	W	9	3	3	6	28	1549	21.86	180	24
CV % =								23			
LSD .05 =								646			

Table 33. Agronomic Data, Beans (White) Uniform Advanced Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	SOURCE	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl. to 1st. Mat.	Pl. to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seeds per pod	Seed Color	Seed Shape	100 Seeds Wt.	Yield per Hectare	Protein	Cooking Time	Palatability
65-071-00515	Ghouchan	W	V	14	2	1	45	81	107	3	CP	L	6	W	P	23.2	3506	25.21	120	25
65-071-00490	Iran	W	V	15	2	1	47	83	110	3	CP	ML	5	W	C	27.0	3346	22.85	125	23
65-071-00505	Shiraz	W	V	16	2	1	42	78	102	3	CP	ML	5	W	C	28.4	3205	23.32	105	23
65-071-00517	Ghouchan	W	V	15	1	1	45	76	95	1	CC	M	5	W	C	24.7	3195	22.38	140	23
65-071-00506	Isfahan	W	V	16	1	1	42	77	99	3	CC	M	5	W	C	28.1	3182	21.71	115	26
65-085-00494	Lebanon	W	V	17	2	1	46	77	102	2	CP	M	5	W	C	20.2	3113	24.74	150	24
65-071-00054	Isfahan	W	V	15	1	1	43	76	100	2	CC	ML	6	W	C	25.1	3096	23.05	120	23
65-071-00470	Kermanshah	W	V	16	2	1	43	75	99	2	CC	ML	5	LY	P	30.5	3059	22.71	140	25
65-071-00697	Isfahan	W	V	14	2	1	45	78	103	3	CC	L	5	W	C	25.7	3058	23.36	140	22
65-071-00513	Iran	W	V	15	1	1	47	81	105	3	CC	M	5	W	C	22.6	3056	24.26	135	25
65-071-00678	Kermanshah	W	V	17	2	1	42	74	98	2	CC	M	5	W	C	26.9	3023	23.45	105	24
65-071-00040	Kermanshah	W	V	13	2	1	42	74	98	2	CC-CP	L	5	W	C	23.4	3022	23.37	120	24
65-157-00014	USA Haubers St.Andres	W	V	17	1	2	42	74	98	2	CC	M	5	W	C	23.1	3021	23.22	135	24
65-071-00694	Ghouchan	W	V	14	2	1	46	77	104	2	CC	M	5	W	C	23.0	3008	22.86	140	25
65-071-00515	Ghouchan	W	V	16	2	1	44	77	103	2	CP	L	5	W	C	22.8	3001	25.21	120	25
65-071-01947	Isfahan 110	W	V	15	3	1	43	75	97	2	CC	M	5	W	C	26.0	2980	22.74	140	24
65-085-00583	Lebanon 3	W	V	16	2	1	41	73	99	2	CC-CP	L	5	W	C	26.1	2923	22.00	120	24
65-071-01950	Karaj 149	W	V	16	2	1	42	75	93	3	CC	M	5	W	C	27.0	2884	22.92	125	23
65-071-00622	Karaj	W	V	17	2	1	42	76	95	2	CC	M	4	W	C	28.2	2881	22.90	100	24
65-071-00525	Isfahan	W	V	14	3	1	43	76	100	3	CC-CP	M	5	W	C	26.2	2879	22.36	145	25
65-071-01948	Shiraz 178	W	V	15	1	1	42	75	92	2	CC	L	5	W	C	26.4	2817	22.67	140	24
65-071-00658	Dashtsar Amol	W	V	11	3	1	40	80	112	2	CC-CP	M	5	W	P	44.7	2808	22.45	135	23
65-071-01966	Sarab 185	W	V	13	2	1	43	74	95	2	CC	M	5	W	C	28.8	2806	22.86	140	23
65-071-00503	Karaj	W	V	14	1	2	45	75	100	3	CC-CP	M	5	W	C	29.1	2798	22.53	90	24
65-071-00644	Karaj	W	V	16	2	1	44	77	99	2	CC	M	5	W	C	27.1	2723	22.44	90	24
65-071-00042	Shiraz	W	V	16	2	1	42	76	99	2	CC-CP	M	5	W	C	28.3	2609	23.24	120	24
65-071-00051	Iran Min. 1365	W	V	14	2	2	43	75	103	2	CC	M	5	W	C	26.4	2607	22.89	125	25
65-071-01969	Isfahan 110	W	V	16	2	2	42	73	89	2	CC-CP	ML	5	W	C	27.0	2582	22.47	120	25
65-071-00376	Shiraz 1085	W	V	14	2	1	45	75	95	2	CC	ML	5	W	C	28.1	2570	22.36	150	23
65-071-00680	Karaj	W	V	13	2	2	43	74	94	2	CC	M	5	W	C	26.4	2518	22.00	135	23
CV % =																	13			
LSD .05 =																	515			

Table 34. Agronomic Data, Beans International Yield Test, Planted May 21, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Accession Number	SOURCE	Flower Color	Plant Type	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl. to 1st Mat.	Pl. to Com. Mat.	Disease Rating	Pod Shape	Pod Size	Seeds per pod	Seed Color	Seed Shape	100 Seeds Wt.	Yield per Hectare	Protein	Cooking Time	Palatability
65-085-00440	Lebanon	W	V	21	1	1	44	81	106	2	CP	M	5	R	C	29.8	3256	22.25	120	23
65-071-00042	Shiraz	W	V	19	1	1	44	75	93	2	CP	M	4	W	C	26.6	3200	23.24	90	23
65-071-00582	Isfahan	W	V	20	1	1	42	75	95	2	CP	M	5	R	C	28.0	3190	23.90	120	22
65-153-00757	Oturak, Turkey	W	B	18	1	1	41	79	99	1	CC	L	5	W	[illegible]	46.6	3101	25.29	70	23
65-153-00756	Bodur, Turkey	W	B	17	1	1	42	80	106	2	CP	M	5	W	P	32.6	2902	23.86	70	24
65-157-00072	USA Pinto 111	W	V	20	1	1	35	68	90	3	CC	M	4	CrM	C	33.8	2278	23.82	105	23
65-157-00069	Great Northern 123	W	V	21	1	1	39	66	89	2	CC	M	4	W	C	29.3	2254	23.62	85	21
65-157-00589	Red Kidney	LP	B	17	2	2	44	80	107	3	CC	L	5	DPi	P	41.8	2183	25.08	70	25
65-157-00004	Wade	LP	V	16	1	2	39	78	109	1	CC	L	5	DP	C	37.2	2072	24.92	70	23
65-157-00005	Resistant Tender Green	LP	B	19	1	1	36	73	108	1	CC	L	6	BlM	C	32.1	2061	26.24	115	23
CV % =																	7			
LSD .05 =																	84			

Legend For Broadbean Data Table 35

(1) Strain Number: Assigned in 1966 field trials.

(2) Source: Indicates origin of seed, either country or section of Iran.

(3) Plant height: Average plant height in centimeters.

(4) Stand: Rated 1 to 9 — 1 = complete stand 9 = poor stand.

(5) Vigor: Rated 1 to 9 — 1 = vigorous plants 9 = weak plants

(6) Disease rated 1 to 9 — 1 = free from disease symptoms

9 = all plants in plot diseased with one or combination of diseases caused by bean yellow mosaic virus, pea leaf roll virus, chocolate spot caused by Botrytis Fabae.

(7) Pod length (in centimeters) average of ten pods.

(8) Average weight (in grams) of 100 seeds.

(9) Yield in kilogram per hectare based on 10 square meters per plot.

Table 35 Agronomic Data Broadbean Yield Test, Planted 1968, RPIP, Dezful, Iran

(1) Strain No.	(2) SOURCE	(3) Plant Height	(4) Stand	(5) Vigor	(6) Disease Rating	(7) Pod Size	(8) 100 Seeds Weight	(9) Yield per Hectare
152	Dezful	185	2	1	7	16	94.6	4419
32	Algerian Iran	179	2	1	7	17	122.2	4241
151	Sarazir, Iran	172	2	1	6	20	145.4	3984
17	Italy FAO	174	2	2	7	36	134.3	3955
120	Anauan Piere	175	2	3	7	23	125.2	3802
113	Semaisee Aieree	171	3	2	6	21	126.0	3745
18	Italy 13.792	163	2	2	6	24	119.7	3700
150	Algerian Iran	174	3	2	7	20	125.2	3572
25	Morocco 13.838	166	2	2	6	20	126.8	3563
101	Semousee Lizuee	179	2	2	6	23	137.0	3546
123	Emuchamel	173	2	1	7	20	125.1	3515
8	England 13.729	166	2	2	6	40	129.4	3507
107	Velma	176	1	1	6	20	122.3	3471
26	Morocco 13.839	165	3	2	7	24	119.5	3335
103	Pafos, Cyprus	165	2	2	7	16	177.4	3295
111	Shoahter	194	2	2	7	18	122.1	3169
24	Morocco	163	1	1	8	16	100.7	3164
16	Italy 13-790	171	3	3	7	24	153.6	3096
19	Spain 13-793	174	2	2	7	28	132.8	3079
33	Shami, Iran	173	2	2	6	20	117.3	3044
15	Italy 13-789	169	2	1	6	38	141.0	3037
102	Tenguchene	175	2	2	7	19	130.9	3007
112	Varamin	168	2	2	7	21	87.4	2982
22	France	165	2	2	7	19	110.6	2959
38	Turkey 13-681	171	2	2	7	29	132.7	2952
110	Shahi, Iran	176	2	2	7	20	131.8	2914
121	Guelenun CaVesses	173	2	2	7	21	112.5	2874
14	West Germany	165	3	2	7	39	145.7	2848
19	England	168	3	3	8	29	148.1	2759
119	Varamin	179	2	2	7	19	91.7	2688
30	Japan FAO No.13	175	3	2	6	20	111.0	2650
23	Morocco	163	2	2	7	18	106.6	2649
27	Morocco 13.840	185	2	2	7	16	66.7	2575
28	Morocco 13.841	173	2	2	6	18	113.9	2193
36	Turkey 644	170	2	2	6	16	135.8	2148
263	Giant Butter Burpee 263	174	4	3	6	25	137.6	2141
1	Poland 13.905	170	2	2	7	22	143.8	2109
209	Shoahtar, Iran	208	2	1	6	15	66.2	2081
116	Bam, Iran	173	2	2	6	15	71.5	2062
211	Shoahtar, Iran	179	2	1	7	19	103.9	2043
118	Rafsandjan, Iran	181	2	2	8	19	96.5	2031
108	Iran 121 C Dr. Bollard	175	3	2	7	14	100.1	1988
212	Mazandaran	198	2	1	7	15	98.3	1949
253	Egypt, Gaza	168	3	1	6	15	74.5	1899
124	Ankara, Turkey	170	2	3	7	20	134.6	1884
215	Mazandaran, Iran	186	2	3	7	15	93.6	1854
254	Egypt, Gaza	160	2	1	6	16	71.1	1829
100	Mazandaran, Iran	190	3	2	7	15	140.0	1797
124	Ankara, Turkey	164	3	3	8	19	135.7	1796
37	Turkey	173	3	2	6	18	117.4	1796
259	Jordan	150	3	3	6	14	51.2	1567
213	Mazandaran, Iran	188	4	3	9	15	100.6	1366
203	Mazandaran, Iran	190	3	3	8	16	99.6	1275
205	Mazandaran, Iran	179	2	2	7	16	94.1	1233
252	Egypt, Rebia 40	160	3	2	6	13	63.8	1003
202	Mazandaran, Iran	189	3	3	8	15	113.2	970
CV % =								20
LSD .05 =								733

Legend for Cowpea Agronomic Data Tables 36-38A

(1) Numbers assigned to collection maintained by the Regional Pulse Improvement Project.

(2) Strain numbers refer to entry numbers assigned in 1964 introduction nursery.

(3) Source numbers refer to PI numbers from New Crops Research Branch, CRD, ARS, USDA, Beltsville, Maryland. "C" numbers are strains obtained from Oklahoma State University. Other three or four digit numbers are numbers assigned by the Iranian Ministry of Agriculture.

(4) Source indicates variety name or area of origin.

(5) Flower color: P = Purple; W = White; WP = mixed White and Purple flowers.

(6) Plant type: E = Erect; SE = Semi-erect; B = Bushy; P = Prostrate; BP = Bushy Prostrate.

(7) Plant height (in centimeters) at near full plant growth.

(8) Plant width (in centimeters) at near full plant growth.

(9) Plants per meter is an average number of plants per meter of row based on one meter sample per replication.

(10) Rated 1 to 9: 1 = complete stand; 9 = poor stand

(11) Rated 1 to 9: 1 = vigorous plants; 9 = weak plants.

(12) Days from planting to first opened flower.

(13) Days from planting to first mature pod ready for harvest.

(14) Rated 1 to 9: 1 = free from disease symptoms; 9 = severe disease symptoms, major disease mosaic virus. See pathology section for diseases present.

(15) Pod shape: S = Straight; C = Curved.

(16) Pod color: Br = Brown; Pu = Purple; P = Pink; Cr = Cream; W = White; Y = Yellow; G = Green; L = Light; D = Dark.

(17) Pod size: VL = Very Large; L = Large; M = Medium; S = Small.

(18) Seeds per pod is average based on five random pods per replication.

(19) Seed Color: Cr = Cream; P = Pink; M = Milky; Bk = Black; Br = Brown, G = Green; Bl = Blue; W = White; Y = Yellow; R = Red; Pu = Purple; Sp = Spotted; D = Dark; L = Light.

(20) Eye color: Cr = Cream; P = Pink; M = Milky; Bk = Black; Br = Brown, G = Green; Bl = Blue; W = White; Y = Yellow; R = Red; Pu = Purple; D = Dark; L = Light.

(21) Seed size: L = Large, approximately 24 grams per 100 seeds; M = Medium, approximately 15 grams per 100 seeds; S = Small, approximately 8 grams per 100 seeds.

(22) Shattering rated 1 to 9: 1 = no loss of seed from shattering; 9 = considerable loss of seed from shattering.

(23) 100 seeds weight - average weight (in grams) of 100 seeds.

(24) Yield in kilogram per hectare based on 10 M^2 plots.

(25) Protein percentage based on total solids. Determined by Kjeldahl method on two samples per strain, duplicate determinations per sample.

(26) Cooking time (in minutes) determined by boiling 50 gram sample in 500 ml. of water, 2 grams Na Cl added and checked regularly for hardness.

(27) Palatability, Maximum rating - 30.

Appearance, maximum 9
- Color uniformity, 3, 2, 1, 0
- Size uniformity, 3, 2, 1, 0
- Cooking uniformity, 3, 2, 1, 0

Smell, maximum 6
Taste, maximum 15

Table 36 Agronomic Data, Cowpea Preliminary Yield Test, Planted June 8, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Pl.Type	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Fl. to 1st Mat.	Disease Rating	Pod Color	Pod Size	Seeds per pod	Seed Color	Eye Color	Seed Size	Shatter	100 Seeds Wt.	Yield per Hectare
62-155-00068	57	182350	Egypt	W	B	37	67	10	4	4	60	82	3	YCr	L	9	LCr	Bk	L	3	25	3426
62-071-01444	720	177	R.A.Nishabour	W	SE	66	69	8	2	4	62	89	5	YBr	M	12	LCr	GY	S	5	13	3411
62-155-00223	146	250587	Egypt	W	E	61	63	10	5	4	61	87	5	YCr	M	10	LCr	Bk	VL	4	27	3378
62-000-01437	333		Unknown	W	SE	58	61	14	2	4	69	87	5	YPu	M	11	LCr	G	S	4	11	3326
62-071-01439	692	177	R.A.Nishabour	P	SE	63	61	12	2	4	68	97	5	YPu	M	12	Cr	GBr	MS	5	13	3291
62-157-01431			Miss.Silver	P	SE	59	59	10	3	4	61	88	3	YCr	L	10	P	YBr	ML	2	20	3243
62-157-00441	304	293574	Texas Cream	W	SE	63	53	11	4	4	62	85	5	YW	ML	11	M	GBr	M	4	17	3242
62-110-00113	79	189378	Nigeria	W	B	55	66	15	3	4	71	99	4	YCr	ML	11	LCr	Bk	MS	4	11	3238
62-157-00466		C-620	Top Set	W	SE	62	60	11	3	4	62	86	5	YW	M	11	LCr	GBr	M	4	14	3219
62-157-00316	213	293477	Calif.Black Eye	W	SE	61	52	11	3	4	59	78	4	YCr	ML	9	LCr	Bk	L	4	22	3190
62-071-00197	128	223420	Iran	P	E	66	62	17	2	4	62	90	4	YBr	M	12	Cr	G	ML	4	11	3177
62-071-00296	214	293479	Black Eye No.7	W	E	62	52	9	4	4	57	81	5	YBr	M	11	LCr	Bk	L	4	20	3005
62-071-01443	718	177	R.A.Nishabour	W	SE	60	61	14	3	4	68	90	5	YPu	M	12	LCr	Bk	M	4	14	3005
62-071-01441	696	177	R.A.Nishabour	W	SE	56	62	14	2	4	62	89	5	YBr	M	11	LCr	YG	M	4	14	2948
62-157-00383		293535	Miss.Crowder	P	E	64	62	10	3	3	67	97	3	YBr	L	14	P	YBr	M	3	16	2888
62-157-00355	246	293516	Hib-Canel	P	SE	54	63	13	3	4	62	85	3	PW	L	13	PG	GBr	M	3	19	2736
62-069-00070	58	183363	India	W	SE	56	57	9	3	4	59	72	4	YW	ML	8	LCr	DGr	ML	4	20	2687
62-157-00288	187	293450	Ala. Crowder	W	SE	73	62	10	4	4	66	93	5	YPu	M	11	LCr	Bk	M	4	16	2664
62-153-00067	55	182317	Turkey	W	E	64	55	12	3	4	58	87	5	YBr	M	11	LCr	Bk	M	4	17	2641
62-071-10002			Karaj	W	SE	61	61	10	4	4	63	80	5	YW	M	9	LCr	Bk	L	3	23	2634
62-110-00242	157	255781	Nigeria	P	E	76	69	14	3	3	76	99	4	YPu	ML	15	PCr	GBr	S	4	11	2630
62-157-00293	193	293456	Black Crowder	P	SE	65	56	11	3	4	71	91	3	PPu	ML	14	Bk	GBr	L	4	26	2608
62-136-00201	151	225921	Africa	W	W	32	71	16	3	3	62	85	4	YBr	ML	12	BkCr	DBr	ML	4	15	2590
62-071-01442	715	177	R.A.Nishabour	W	SE	73	62	12	3	4	63	88	5	YCr	L	10	LCr	YG	M	3	14	2521
62-157-00342	223	293500	Dixilee	P	SE	66	63	15	2	3	68	97	3	PY	L	12	Cr	YG	M	3	17	2499
62-071-01435	387	185	Darahgaz	W	SE	62	58	14	2	4	67	92	6	YW	M	10	LCr	Bk	ML	4	15	2497
62-071-01447	604	180	Shahi	P	E	31	48	17	1	2	65	86	2	YW	M	11	P	YG	MS	5	10	2462
62-071-01448	19675		M.Aneh,Iran	W	SE	59	67	12	5	4	66	100	6	YBr	M	11	LCr	Bk	ML	4	19	2418
62-071-10008	814	179	Isfahan	W	E	60	63	11	3	5	69	100	7	YPu	ML	10	LCr	Bk	M	4	18	2396
62-157-00287	186	293449	Dunch	W	SE	64	58	10	3	4	65	99	5	YPu	ML	12	LCr	DBr	ML	4	18	2366
62-157-00295	10195	293458	Black Eye No.5	W	SE	60	46	11	4	4	56	79	5	YPu	ML	8	LCr	Bk	L	4	22	2362
62-002-00160	110	211754	Afghanistan	W	SE	51	60	12	3	4	52	85	4	YPu	M	11	LCr	Bk	M	4	16	2319
62-110-00249	160	255784	Nigeria	P	E	79	68	18	2	3	75	99	3	PY	ML	13	P	YG	S	4	12	2307
62-071-01440	696	177	R.A.Nishabour	W	SE	60	65	15	3	4	63	92	6	YW	ML	11	LCr	LG	M	4	13	2304
62-071-01432	810	178	Isfahan	W	E	66	60	12	3	4	67	80	5	YBr	M	8	LCr	Bk	ML	4	20	2285
62-071-01445	781	173	Mamaghan	P	SE	66	60	16	3	4	65	90	5	DY	M	11	Cr	G	MS	5	11	2284
62-038-00155	105	208771	Cuba	P	SE	62	72	14	3	5	74	100	4	YW	ML	13	Bl	DBr	ML	3	14	2272
62-071-01446	811	179	Isfahan	W	SE	63	58	9	3	6	69	100	6	YPu	M	10	LCr	Bk	ML	4	18	2249
62-008-00078	63	186360	Australia	P	SE	60	67	12	2	4	67	78	4	PBr	M	13	P	YG	S	4	9	2247
62-157-00468	10325	C-621	Climax	W	SE	63	56	12	2	4	61	89	5	YPu	ML	10	M	GBr	MS		14	2237
62-157-00345	236	293503	Early Black Eye	P	E	58	72	13	2	4	74	100	3	YPu	L	10	R	Bk	MS	4	14	2174
62-071-01434	376	185	Darahgaz	P	SE	65	60	16	2	4	76	91	5	YBr	S	11	Cr	G	MS	4	13	2110
62-071-01438	415	170	Shoushtar	W	E	67	56	10	2	4	69	100	5	YBr	ML	11	Cr	Bk	ML	4	9	2058
62-071-01436	850		Darahgaz	W	E	69	58	16	3	4	73	93	6	YPu	ML	10	Cr	Bk	M	4	20	2039
62-110-00067	62	185647	Africa	P	E	64	66	13	3	3	59	99	4	YP	L	15	Cr	Y	M	3	18	1981
62-110-00102	72	186467	Nigeria	P	E	67	59	16	2	3	79	100	4	P	ML	13	CrG	G	S	4	11	1949
62-157-00286	185	293448	Ala. Brown Eye	P	E	68	60	17	3	4	73	99	4	YP	ML	15	DPu	YBr	M	3	11	1496
62-157-00413	283	293553	Purple Pod	W	SE	58	60	12	3	4	74	92	4	DPu	L	13	LCr	GBr	M	4	13	1383
62-157-00447	310	293582	Victor K-798	W	B	60	36	14	3	4	81	101	4	YW	M	12	LCr	Bk	M	4	16	1262
CV % =																						19
LSD .05 =																						1176

Table 37 Agronomic Data Cowpea Uniform Yield Test, Planted April 12, 1968, RPIP, Varamin, Iran

(1) Accession Number	(2) Strain Number	(3) Source Number	(4) SOURCE	(5) Flower Color	(6) Plant Type	(7) Plant Height	(8) Plant Width	(9) Plants /Meter	(10) Stand	(11) Vigor	(12) Fl. 1st Fl.	(13) Pl. to 1st Mat.	(14) Disease Rating	(15) Pod Shape	(16) Pod Color	(17) Pod Size	(18) Seeds per pod	(19) Seed Color	(20) Eye Color	(21) Seed Size	(22) Shatter	(24) Yield per Hectare
62-023-00141	97	200867	Burma	P	B	37	31	5	2	2	72	103	2	S	YW	L	16	Bl	DBl	S	3	3762
62-071-10003	4002		Meshed	W	B	35	35	5	3	3	63	101	2	S	LY	ML	8	CrW	Bk	L	2	3703
	244	293513	Giant Ramshorn	W	E	48	33	5	3	2	64	108	2	C	LY	L	10	W	Bk	L	1	3367
62-043-00012	12	151562	Dominican Republic	W	BP	30	30	5	2	3	75	103	4	S	LCr	S	12	MW	LG	S	1	3183
62-071-10004	713	177	R.A. Nishabour	P	B	47	35	5	3	2	70	111	2	S	LY	M	12	MW	LG	M	1	3008
62-069-00276	175	271257	India	P	BP	28	27	5	4	4	67	107	3	S	YBr	ML	12	PBr	GBl	M	3	2981
62-157-00341	232	293499	Davis Pea	P	SE	40	34	6	3	3	68	104	3	S	Pu	ML	11	Cr	GBl	S	3	2945
62-110-00234	151	255765	Nigeria	P	BP	28	25	7	3	3	62	103	3	C	YCr	ML	10	W	Bk	M	1	2887
62-157-00436	300	293570	Speckled Purple Hull	P	SE	44	36	5	3	2	70	101	3	S	Pu	L	12	SpBrCr	YG	M	2	2858
62-157-00347	238	293505	Early Ramshorn	W	E	45	34	5	3	3	64	101	3	S	YBr	MS	8	MW	Bk	L	1	2853
62-157-00470	325	C-642	Princess Ann	P	SE	50	49	6	3	2	64	102	2	S	YBr	M	9	CrW	Bk	M	1	2848
62-157-00296	195	293459	Black Eye No. 7	P	B	41	29	5	4	4	63	103	3	S	YBr	MS	8	CrW	Bk	L	1	2767
62-153-00057	50	179555	Turkey	W	PB	39	31	5	2	3	68	106	2	C	LY	L	9	CrW	LBr	ML	2	2756
62-071-01451		2-42-1203	Isfahan 109	WP	B	49	33	5	3	3	67	107	8	S	LY	S	12	LCr	YG	S	1	2658
62-000-10001	327		Unknown	P	B	35	28	5	4	4	67	101	3	S	LY	S	10	Cr	LG	S	4	2618
62-071-01453		2-42-1375	Karaj 150	W	BP	29	27	5	4	3	66	103	3	S	LY	L	10	W	Bk	L	2	2552
62-157-00356	247	293517	Holstein	WP	E	44	30	5	4	3	69	102	3	S	YBr	ML	13	SpWBk	DG	M	2	2505
62-071-01449		2-42-1139	Fars 102	W	B	38	29	5	5	4	65	104	4	S	YCr	M	10	CrW	LG	S	1	2480
62-071-01450		2-42-1444	Moghan 157	P	SE	51	32	5	3	2	73	103	8	S	YBr	M	12	CrG	LG	S	1	2426
62-071-10006	795	184	Chamchal	P	B	51	34	4	2	2	74	106	3	S	LY	MS	12	PCr	LG	M	1	2345
62-085-00065	53	181833	Lebanon	P	BP	22	29	5	4	6	67	104	3	C	YBr	L	10	W		ML	1	2288
62-071-01452		2-42-1369	Karaj 150	W	SE	43	29	5	3	3	64	111	7	S	YBr	M	11	CrW	LG	S	1	2278
62-157-00442	215	293480	Calara	PW	B	28	26	7	4	4	64	100	3	S	YW	M	10	W	Bk	M	2	2265
62-157-00358	290	293560	Red Speckled Crowder	P	BP	48	37	4	2	1	70	112	2	S	LP	L	15	P	DBr	M	6	2132
62-157-00290	249	0154	Institute	P	B	31	29	5	4	3	68	107	2	S	YW	MS	9		DBr	M	2	1998
CV % =																						20
LSD .05 =																						793

Table 37A. Agronomic Data, Cowpea Uniform Yield Test, Planted April 12, 1968, RPIP, Varamin, Iran

(1) Accession Number	(2) Strain Number	(3) Source Number	(4) SOURCE	(25) Protein	(26) Cooking Time	(27) Palatability
62-023-00141	97	200867	Burma	22.78	45	27
62-071-10003	4002		Meshed	24.22	45	28
	244	293513	Giant Ramshorn	24.02	45	26
62-043-00012	12	151562	Dominican Republic	23.20	45	28
62-071-10004	713	177	R. A. Nishabour	26.32	45	24
62-069-00276	175	271257	India	24.88	45	27
62-157-00341	232	293499	Davis Pea	25.09	45	29
62-110-00234	151	255765	Nigeria	25.31	50	27
62-157-00436	300	293570	Speckled Purple Hull	24.22	55	29
62-157-00347	238	293505	Early Ramshorn	23.82	55	27
62-157-00470	325	C-642	Princess Ann	26.63	50	27
62-157-00296	195	293459	Black Eye No. 7	24.27	45	27
62-153-00057	50	179555	Turkey	26.27	50	25
62-071-01451		2-42-1203	Isfahan 109	25.62	55	24
62-000-10001	327		Unknown	24.27	45	26
62-071-01453		2-42-1375	Karaj 150	23.11	45	26
62-157-00356	247	293517	Holstein	24.51	45	26
62-071-01449		2-42-1139	Fars 102	23.36	45	26
62-071-01450		2-42-1444	Moghan 157	26.07	45	28
62-071-10006	795	184	Chamchal	25.59	45	28
62-085-00065	53	181833	Lebanon	23.66	50	22
62-071-01452		2-42-1369	Karaj 150	25.29	45	25
62-157-00442	215	293480	Calara	25.62	50	26
62-157-00358	290	293560	Red Speckled Crowder	24.28	45	26
62-157-00290	249	0154	Institute	26.46	50	21

Table 38 Agronomic Data, Cowpea Uniform Yield Test, Planted June 8, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Accession Number	Strain Number	Source Number	SOURCE	Flower Color	Pl.Type	Plant Height	Plant Width	Plants /Meter	Stand	Vigor	Pl. to 1st Fl.	Pl. to 1st Mat.	Disease Rating	Pod Shape	Pod Color	Pod Size	Seeds per pod	Seed Color	Eye Color	Seed Size	Shatter	100 Seeds Wt.	Yield per Hectare
62-110-00234	151	255765	Nigeria	PW	B	42	57	12	4	4	59	81	5	S	YCr	M	10	LCr	Bk	M	3	16	3565
62-069-00274	175	271257	India	P	B	43	64	13	3	3	61	83	4	C	YBr	ML	11	P	OBl	M	3	13	3407
62-071-01453		2-42-1375	Karaj 150	W	SE	52	58	15	3	4	64	86	4	S	LY	L	8	LCr	Bk	L	2	20	3091
62-157-00296	195	293459	Black Eye No. 7	W	E	68	61	12	4	4	60	81	4	S	YBr	ML	8	LCr	Bk	L	3	22	2983
62-085-00065	53	181833	Lebanon	PW	BP	47	55	13	4	4	62	83	3	C	YBr	M	11	LP	G	M	3	14	2912
62-071-10003	4002		Meshed	W	SE	55	60	14	4	4	61	85	4	S	LY	ML	8	LCr	Bk	L	4	21	2893
62-023-00141	97	200867	Burma	P	SE	53	64	12	3	5	64	83	4	S	YW	L	16	Bl	DBl	S	2	12	2892
62-157-00347	238	293505	Early Ramshorn	W	E	67	55	12	4	4	75	84	5	S	YBr	ML	8	LCr	Bk	L	2	24	2844
62-157-00358	249	0154	Institute	P	B	46	66	16	3	4	62	85	4	S	YW	L	12	Bl	DBr	M	2	12	2784
62-157-00442	215	293480	Calara	PW	B	43	58	14	4	4	65	81	4	S	YW	ML	9	LCr	Bk	M	3	16	2716
62-157-00341	232	293499	Davis Pea	P	SE	44	59	14	4	4	62	82	4	S	Pu	L	11	P	GBr	S	3	15	2678
62-153-00057	50	179555	Turkey	PW	SE	53	58	12	3	5	62	87	5	C	LY	ML	10	LCr	LBr	ML	3	20	2613
62-071-01449		2-42-11-39	Fars 102	WP	SE	53	48	13	4	4	61	80	5	S	YCr	M	12	LCr	LG	S	3	12	2604
62-157-00470	325	C-642	Princess Ann	PW	E	59	50	14	4	4	58	80	4	S	YBr	M	10	LCr	Bk	M	2	20	2485
62-157-00356	247	293517	Holstein	W	SE	47	58	13	4	4	65	85	4	S	YBr	ML	13	Bk	DG	M	3	10	2255
62-157-00436	300	293570	Speckled Purple Hull	P	SE	52	56	14	4	4	66	80	3	S	Pu	L	12	PPu	YG	M	3	17	2191
62-071-10006	795	184	Chamchal	P	SE	62	52	14	3	4	66	96	5	S	LY	S	11	LP	LG	S	4	10	2157
62-043-00012	12	151562	Dominican Republic	W	B	44	60	12	3	4	67	97	4	S	LP	S	12	LCr	LG	S	5	9	2089
62-071-10004	713	177	Nishabour	PW	B	57	59	13	4	5	63	87	4	S	LY	M	11	LCr	LG	M	4	15	2032
62-157-00353	244	293513	Giant Ramshorn	W	SE	68	53	11	4	5	61	91	4	S	LY	ML	10	LCr	Bk	ML	4	20	1967
62-000-10001	327		Unknown	P	SE	52	58	15	4	5	62	82	3	S	LY	S	12	LCr	LG	S	3	9	1893
62-157-00290	290	293560	Red Speckled Crowder	P	SE	54	61	12	4	5	68	101	4	S	LP	ML	11	R	DBl	M	4	14	1598
62-071-01452		2-42-1369	Karaj 150	W	E	61	55	14	4	4	63	97	8	S	YBr	S	11	LCr	LG	S	4	10	1590
62-071-01451		2-42-1203	Isfahan 109	W	SE	57	54	13	4	5	63	99	8	S	LY	S	10	LCr	YG	S	4	14	1439
62-071-01450		2-42-1444	Moghan 157	P	E	102	5[illegible]	14	4	4	68	99	7	S	YBr	S	14	Cr	LG	[illegible]	4	12	1283
CV % =																							17
LSD .05 =																							610

Table 38A, Agronomic Data, Cowpea Uniform Yield Test, Planted June 8, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(25)	(26)	(27)
Accession Number	Strain Number	Source Number	SOURCE	Protein	Cooking Time	Palatability
62-110-00234	151	255765	Nigeria	25.70	35	22
62-069-00274	175	271257	India	24.88	50	24
62-071-01453		2-42-1375	Karaj 150	22.07	50	25
62-157-00296	195	293459	Black Eye No. 7	23.37	60	28
62-085-00065	53	181833	Lebanon	24.95	35	27
62-071-10003	4002		Meshed	23.82	60	26
62-023-00141	97	200867	Burma	24.15	50	27
62-157-00347	238	293505	Early Ramshorn	24.43	60	28
62-157-00358	249	0154	Institute	24.82	35	21
62-157-00442	215	293480	Calara	24.48	35	20
62-157-00341	232	293499	Davis Pea	23.58	45	27
62-153-00057	50	179555	Turkey	25.50	35	24
62-071-01449		2-42-11-39	Fars 102	25.45	55	23
62-157-00470	325	C-642	Princess Ann	21.95	35	24
62-157-00356	247	293517	Holstein	22.36	50	27
62-157-00436	300	293570	Speckled Purple Hull	24.54	35	27
62-071-10006	795	184	Chamchal	25.09	50	25
62-043-00012	12	151562	Dominican Republic	21.64	50	26
62-071-10004	713	177	Nishabour	22.67	50	23
62-157-00353	244	293513	Giant Ramshorn	24.55	50	23
62-000-10001	327		Unknown	21.45	55	25
62-157-00290	290	293560	Red Speckled Crowder	23.40	50	26
62-071-01452		2-42-1369	Karaj 150	25.66	50	25
62-071-01451		2-42-1203	Isfahan 109	24.58	50	27
62-071-01450		2-42-1444	Moghan 157	25.34	50	24

Legend for Mungbeans Agronomic Data Tables 39 - 41

(1) Numbers assigned to collection maintained by the Regional Pulse Improvement Project.

(2) Three digit numbers are Iranian Ministry of Agriculture numbers, six digit numbers refer to PI numbers from New Crops Research Branch, CRD, ARS, USDA, Beltsville, Maryland, U. S. A.

(3) Indicates variety name or area of origin.

(4) E = Erect; B = Bushy; P = Prostrate; SP = Semi-prostrate; SE = Semi-erect

(5) Plant height measured in centimeters at full plant growth.

(6) Number of plants per meter of row, based on one meter sample per replication.

(7) Rated 1 to 9: 1 = complete stand; 9 = poor stand

(8) Rated 1 to 9: 1 = vigorous plants; 9 = weak plants

(9) Days from planting to first open flower.

(10) Days from planting to first mature pod, ready to harvest.

(11) Rated 1 to 9: 1 = free from disease symptoms; 9 = severe disease symptoms

(12) S = Straight; M = Moderately curved; C = Curved

(13) L = Light; M = Medium; D = Dark

(14) Average number of seeds per pod based on ten pods/replication.

(15) L = Light; M = Medium; D = Dark

(16) Average weight of 100 seeds.

(17) Yield in kilogram based on $4m^2$ plots in Karaj, Varamin $5m^2$ plots.

Table 39 Agronomic Data Mungbeans Preliminary Yield Test, Planted May 23, 1968, RPIP; Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Accession Number	Source Number	S O U R C E	Plant Type	Plant Height	Plants /Meter	Stand	Vigor	Pl.to 1st Fl.	Pl.to 1st Mat.	Disease Rating	Pod Shape	Pod Color	Seeds per Pod	Leaf Color	100 Seeds Wt.	Yield per Hectare
48-071-10326	217	Kermanshah	SE	22	12	1	1	64	86	2.0	M	M	11	L	3.0	1771
48-071-10288	215	Karaj	SE	24	12	1	1	64	86	2.6	S	D	11	L	3.3	1641
48-071-10301	215	Karaj	SE	24	11	1	1	60	85	2.6	S	D	11	L	2.9	1637
48-071-10659	223	Isfahan	SE	24	13	2	1	66	87	2.3	M	M	12	I	2.9	1612
48-071-10382	216	Jiroft	SE	23	15	1	1	60	87	1.6	S	M	10		3.1	1612
48-071-10926	215	Karaj	E	24	13	1	1	60	79	1.6	C	D	11	D	5.8	1600
48-071-10285	215	Karaj	SE	23	14	2	2	62	89	2.6	S	M	11	L	3.0	1575
48-071-10303	224	Daregaz	SE	21	13	2	1	63	89	2.6	S	M	12	L	3.1	1566
48-071-10690	222	Sari	SE	24	16	1	2	59	81	2.6	S	M	11	L	3.1	1562
48-071-10406	216	Jiroft	SE		13	2	1	64	84	2.3	M	M	11	L	2.9	1558
48-071-10396	216	Jiroft	SE	28	11	3	1	61	86	2.0	S	M	10	L	3.0	1553
48-157-11085	M-1	Kiloga	B	28	12	1	1	58	73	1.6	S	D	11	D	4.1	1553
48-071-10326	217	Kermanshah	SE	25	10	2	1	59	84	2.0	S	M	12	L	3.6	1537
48-071-10698	222	Sari	SE	24	11	2	1	60	87	2.0	S	D	11	L	3.2	1521
48-071-10393	216	Jiroft	SE	24	12	1	1	62	87	2.3	S	M	11	M	2.9	1500
48-071-10810	224	Daregaz	B	24	13	1	1	59	83	1.3	S	M	13	L	4.9	1500
48-071-10864	218	Zahidan	SE	26	12	2	1	60	86	1.3	S	M	12	L	5.4	1491
48-071-10411	216	Jiroft	SE	27	12	1	1	63	82	2.3	S	M	10	L	3.1	1487
48-071-10668	223	Isfahan	E	28	73	1	1	62	82	1.3	M	D	12	L	3.9	1478
48-071-10386	216	Jiroft	E	26	13	2	1	62	88	2.6	S	M	11	L	2.9	1471
48-071-10314	213	Mamaghan	E	22	18	1	1	61	92	2.6	S	D	10	L	3.0	1466
48-071-10414	216	Jiroft	SE	26	13	1	1	62	83	3.0	S	M	11	M	2.9	1450
48-071-10935	215	Karaj	SE	24	14	2	1	60	88	2.3	M	M	11	L	3.3	1425
48-071-10328	226	Karaj	SE	26	11	2	1	64	86	2.6	S	M	11	L	3.1	1416
48-071-10391	216	Jiroft	SE	24	11	1	1	64	83	2.3	M	M	11	L	3.0	1416
48-071-10965	116	Dezful	E	26	14	3	1	60	82	2.0	M	D	13	M	3.4	1403
48-071-10298	222	Sari	SE	23	12	2	1	69	90	2.6	S	M	11	M	3.0	1400
48-071-10566	221	Neyshabour	SE	26	17	2	1	63	86	2.6	S	M	10	L	2.8	1391
48-071-10289	215	Karaj	E	23	11	2	1	59	79	2.0	S	D	13	D	4.3	1375
48-071-10383	216	Jiroft	SE	26	11	2	1	57	85	2.3	S	M	11	L	2.9	1371
48-071-10962	184	Shiraz	SE	22	12	2	1	58	79	1.6	C	D	13	D	4.0	1362
48-071-10865	218	Zahidan	SE	21	11	2	1	60	82	1.3	S	M	11	L	4.4	1358
48-071-10783	226	Karaj	SE	23	12	2	1	61	82	1.3	M	M	12	L	4.0	1353
48-069-10308	164644	India	SE	24	12	1	2	60	86	3.0	C	M	10		3.1	1341
48-071-10286	215	Karaj	SE	22	11	2	2	60	85	2.3	M	M	11	L	2.6	1333
48-071-10870	215	Karaj	E	22	14	2	1	61	86	2.3	S	M	12	L	4.0	1333
48-071-10681	223	Isfahan	E	28	12	1	1	62	80	2.0	S	D	13	D	4.1	1328
48-071-10318	214	Isfahan	SE	21	12	2	2	62	85	3.0	S	M	12	L	3.0	1312
48-071-10955	203	Jiroft	E	26	12	2	1	57	79	1.6	C	D	12	D	4.0	1303
48-157-11087		Berken	E	18	15	2	1	62	84	1.3	M	D	13	D	4.9	1303
48-071-10408	216	Jiroft	SE	37	13	2	2	62	88	2.3	M	M	10	L	2.8	1303
48-071-10294	427	Jiroft	E	25	13	2	1	62	86	2.3	M	M	12	L	5.6	1300
48-071-10855	218	Zahidan	SE	21	12	2	1	62	85	1.3	S	M	11	L	5.2	1291
48-071-10282	215	Karaj	E	20	15	2	1	60	80	1.6	S	M	12	L	4.8	1291
48-071-00757	226	Karaj	SE	25	12	2	1	62	84	1.6	S	M	13	L	5.5	1284
48-071-10381	216	Jiroft	SE	21	13	2	2	58	80	3.0	M	M	10	D	2.7	1284
48-157-11086	12	Oklahoma M-3	E	25	13	1	1	58	79	2.3	C	D	14	M	4.4	1278
48-071-10293	218	Zahidan	B	21	15	2	1	63	81	1.3	S	M	13	L	5.2	1258
48-071-10925	215	Karaj	E	21	12	3	1	59	81	1.6	C	D	12	D	4.0	1237
48-071-10377	216	Jiroft	SE	25	12	2	1	57	83	2.6	S	M	10	L	3.0	1232
48-071-10667	223	Isfahan	E	28	13	1	1	61	85	2.0	C	D	12	L	3.9	1225
48-071-10678	223	Isfahan	E	29	11	2	1	59	77	1.6	S	M	12	D	4.4	1221
48-071-10733	222	Sari	SE	25	12	2	1	62	87	2.0	M	M	11	L	3.1	1212
48-071-10809	224	Daregaz	SE	18	10	2	1	66	82	1.3	S	M	12	L	3.8	1196
48-071-10954	399	Dashtesar	E	20	17	2	1	60	83	2.0	C	D	12	D	4.3	1175
48-071-11089	15279	Kerman	E	28	11	3	1	61	84	1.6	S	D	13	M	4.8	1221
48-071-10811	224	Daregaz	SE	23	10	2	1	58	84	2.0	S	M	10	D	3.4	1108
48-071-10923	215	Karaj	E	24	14	1	1	60	81	1.6	C		12	D	4.3	1078
48-071-10292	215	Karaj	E	24	14	1	1	62	80	2.0	S	D	12	D	5.1	1050
48-069-11020		Dezful (1965) (8)	E	27	12	2	1	65	87	1.3	C	L	11	L	6.0	966
48-069-11035		Dezful (1965) (8)	E	28	14	1	1	67	88	2.0	C	L	11	M	5.5	933
48-071-10283	215	Karaj	E	23	10	2	1	64	82	2.3	S	D	13	D	4.9	916
48-069-11019		Dezful (1965) (8)	E	29	14	2	1	66	82	2.0	C	L	12	D	5.3	553
48-069-10991		Dezful (1965) (8)	E	20	13	4	1	64	85	2.3	C	L	11	M	4.8	725
CV % =																15
LSD .05 =																282

Table 40 Agronomic Data Mungbeans Advanced Yield Test, Planted June 5, 1968, RPIP, Varamin, Iran

(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(10)	(11)	(12)	(14)	(17)
Accession No.	Source No.	S O U R C E	Plant Type	Plant Height	Stand	Vigor	Fl. to 1st Fl.	Fl. to 1st Mat.	Disease Rating	Pod Shape	Seeds per pod	Yield per Hectare
48-069-10105	271492	India	E	70	1	1	53	69	2.0	S	12	1504
48-069-10075	183136	India	B	55	2	2	52	71	2.0	S	11	1306
48-157-11152	901V	U.S.A.	B	41	1	2	47	71	2.5	S	12	1303
48-157-11156	921V	U.S.A.	P	45	3	2	51	71	2.0	S	12	1299
48-071-10293	218	Zahidan	BP	55	2	1	55	76	2.5	S	14	1285
48-071-10282	215	Karaj	B	56	3	2	54	74	2.0	S	12	1279
48-071-10107	167(2)	Moghan	B	55	2	2	50	70	1.5	S	13	1252
48-069-10323	271490	India	E	68	1	1	55	72	3.0	S	13	1211
48-157-10004	31080	Beltsville, USA	B	42	3	3	46	66	2.5	S	13	1186
48-157-11154	905V	U.S.A.	BP	57	2	2	55	72	2.0	S	11	1169
48-157-10022	31710	Beltsville, USA	E	60	2	3	52	70	2.0	S	13	1155
48-071-10963	167(1)	Moghan	B	49	2	2	48	70	3.0	S	11	1153
48-157-11155	906V	U.S.A.	B	62	2	1	53	73	3.0	S	12	1121
48-157-10307	31287	Beltsville, USA	B	42	2	2	50	70	2.0	S	11	1093
48-157-11153	903V	U.S.A.	P	50	2	2	50	72	2.0	S	13	1042
48-071-10087	201869	Iran	SE	62	3	2	51	72	2.0	S	13	1034
48-157-10023	31728	Beltsville, USA	B	50	3	3	48	72	3.0	S	13	996
48-033-10045	171435	China	B	59	2	2	49	70	2.5	S	14	990
48-157-10019	31569	Beltsville, USA	E	46	3	4	42	68	2.0	S	10	990
48-157-11157	909V	U.S.A.	P	53	2	2	52	74	2.0	S	12	920
48-069-10104	21298	India	B	59	2	1	50	74	2.0	S	12	787
48-076-10290	286298	Ivory Coast	B	59	2	3	56	80	3.5	S	13	380
48-062-10296	227754	Guatemala	E	64	3	2	56	79	4.0	S	12	374
48-071-10284	217	Nosratabad	E	58	2	9	56	80	5.0	S	10	353
48-069-10066	180311	India	B	57	2	2	44	70	3.0	S	13	330
CV % =												24
LSD .05 =												341

Table 41 Agronomic Data Mungbeans Advanced Yield Test, Planted May 23, 1968, RPIP, Karaj, Iran

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
Accession Number	Source Number	S O U R C E	Plant Type	Plant Height	Plants /Meter	Stand	Vigor	Fl. to 1st Fl.	Fl. to 1st Mat.	Disease Rating	Pod Shape	Pod Color	Seeds per Pod	Leaf Color	100 Seeds Wt.	Yield per Hectare
48-157-10307	31287	Beltsville, USA	E	31	15	2	1	56	80	2,3	M	M	12	L	4.0	1703
48-071-10087	201869	Iran	E	33	12	2	1	54	75	2.3	C	D	11	M	4.2	1669
48-033-10045	171435	China	SE	29	15	3	1	54	73	2.3	S	D	11	L	4.0	1644
48-157-10023	31728	Beltsville, USA	SE	30	11	2	1	55	76	2.6	S	M	12	L	4.0	1638
48-069-10066	180311	India	SE	34	11	2	1	55	76	2.0	M	D	12	M	4.5	1621
48-076-10290	286298	Ivory Coast	SE	28	15	1	1	59	84	2.3	M	M	11	L	3.3	1619
48-071-10284	217	Nosratabad, Iran	SE	32	12	2	1	56	81	2.0	S	M	11	L	2.7	1571
48-069-10105	271492	India	SE	31	14	1	1	58	78	2.0	C	D	13	M	4.8	1563
48-062-10296	227754	Guatemala	E	32	17	2	1	63	84	1.6	M	M	12	L	3.0	1563
48-069-10323	271490	India	SE	33	11	2	1	59	79	2.0	S	D	12	M	4.5	1531
48-157-10019	31569	Beltsville, USA	SE	33	15	3	1	53	69	1.6	S	D	11	D	3.2	1528
48-071-10963	167(1)	Moghan, Iran	SE	32	14	2	1	56	74	2.0	S	D	11	L	4.2	1509
48-069-10104	212908	India	SE	30	16	2	1	57	82	1.3	M	D	11	L	4.0	1506
48-157-10022	31710	Beltsville, USA	E	36	17	1	1	56	79	2.3	S	D	11	L	4.0	1463
48-157-11157	909V	U.S.A.	SE	29	12	2	1	61	79	1.6	M	M	12	L	3.8	1420
48-069-10075	183136	India	SE	28	14	2	1	58	83	2.0	M	D	13	M	4.7	1409
48-157-10004	31080	Beltsville, USA	SE	29	17	1	1	54	73	2.0	S	D	12	D	3.7	1379
48-157-11156	921V	U.S.A.	P	27	10	2	2	54	69	2.0	S	D	13	D	6.2	1378
48-071-10293	218	Zahidan, Iran	SE	28	14	2	1	59	78	1.6	S	D	11	L	5.1	1359
48-157-11153	903V	U.S.A.	B	30	11	2	2	53	75	2.0	S	D	12	D	4.3	1353
48-157-11154	905V	U.S.A.	SE	30	16	2	2	56	78	2.0	S	D	11	L	4.1	1325
48-071-10282	215	Karaj, Iran	B	31	13	1	1	57	80	1.3	S	M	12	L	4.5	1290
48-071-10107	167(2)	Moghan, Iran	SE	29	15	1	1	58	77	2.3	M	D	13	D	4.1	1281
48-157-11155	906V	U.S.A.	B	27	11	2	1	58	79	1.6	S	L	11	L	4.5	1090
48-157-11152	901V	U.S.A.	B	19	12	2	2	58	75	2.3	S	D	11	D	4.7	1056
CV % =																
LSD .05 =																23

SOIL AND CROP MANAGEMENT

Glenn M. Horner
Massoud Mojtehedi
Mohammad Moadab

Summary

Based on results for 1966 to 1968, the optimum planting dates for pulse crops in the Karaj area are as follows: before mid-March (or as soon as possible thereafter) for lentils, the first two weeks of April for chickpeas, first two weeks of May for dry beans and cowpeas, and the first three weeks of May for mungbeans. Planting dry beans, cowpeas, or mungbeans as early as mid-April usually resulted in poor stands.

Maximum yields were obtained with a plant population of 500,000 plants per hectare (50 cm row spacing) for chickpeas and dry beans and with 400,000 plants for cowpeas.

Highest yields of chickpeas, dry beans, and cowpeas were obtained by maintaining soil moisture at a level not less than two-thirds of field capacity. To maintain this level, it was necessary to irrigate every 6 or 7 days, except early in the crop season.

Considering total crop production, however, the high moisture treatment will not utilize irrigation water efficiently where the quantity of water is insufficient to irrigate all the land available for cropping. With dry beans, for example, irrigating every 14 days (half as often) reduced the yield only 25% below that for the high moisture level. Using the same amount of water on a larger area (with fewer irrigations) would result in greater total production. Therefore, the relationship between the amount of water and the amount of land available should be considered in determining irrigation practices.

Considerable research on irrigation and fertilization of pulses has been conducted by the Irrigation and Soils Departments of Pahlavi University in Shiraz. The University has prepared a separate report of the results of this work.

Date of Planting

Tests were continued with fall, winter and spring plantings of lentils and chickpeas and spring plantings of dry beans, cowpeas and mungbeans. However, the lentil and chickpea tests are not reported here because damage from rabbits and crows made the results unreliable.

Yields of dry beans, cowpeas and mungbeans for 1968 followed the same general patterns set in 1966 and 1967 (Table 42). As in previous years, plantings made the middle of April were damaged by seed corn maggot (*Hylemya ciliorura*).

This resulted in thin stands and greatly reduced yields. Approximately maximum yields occurred when planting was delayed so as to avoid the seed corn maggot infestation. Planting after May 1 is generally satisfactory in this respect. Planting dry beans and cowpeas after the middle of May and mungbeans after early June resulted in lower yields.

The length of time from planting to maturity decreased as the planting date was delayed. This effect was most pronounced with mungbeans.

Plant Population Density

Treatments in 1968 comprised plant densities ranging from 200,000 to 600,000 plants per hectare for chickpeas and from 200,000 to 500,000 for dry beans and cowpeas. Row spacing was 50 cm. This represented a change from 1966 and 1967, when treatments included three and four row spacings and plant densities ranging from 100,000 to 400,000 plants/ha.

Table 42. Relation of date of planting to yield of pulse crops, RPIP, Karaj, Iran.

Planting date 1/	Days to: (1968)		Grain yield, tons/hec.	
	First Bloom	Full Maturity	1968	Mean: 1966-68
		Dry beans		
April 16	57	93	0.85 c 2/	1.07 b
May 2	52	89	1.36 a	1.42 a
May 17	45	87	1.08 b	1.38 a
June 1	39	85	1.17 ab	1.31 ab
June 17	37	82	1.19 ab	1.27 ab
		Cowpeas		
April 16	80	116	2.37 bc	1.84 b
May 2	71	109	3.09 a	2.74 a
May 17	63	104	2.87 ab	2.58 a
June 1	57	98	2.31 bc	1.98 b
June 17	52	91	2.05 c	1.82 b
		Mungbeans		
April 16	76	114	0.72 b	0.73 c
May 2	66	108	1.33 a	1.33 a
May 17	58	101	1.35 a	1.42 a
June 1	51	92	1.37 a	1.37 a
June 17	47	84	1.27 a	1.02 a

1/ Dates given are means of 3 years.

2/ Figures within a column for each crop followed by the same letter are not significantly different at the 5% level.

Grain yields, pods per plant and seed weight of chickpeas, dry beans, and cowpeas are summarized in Tables 43, 44, and 45 for 1966, 1967, and 1968.

Chickpea yields in 1968 increased until the 500,000 plants/ha density was reached, although yields tended to level off at the 300,000 level in 1966 and 1967. Similarly for dry beans, small but statistically insignificant yield increases were obtained with increases in density to 500,000. For cowpeas, there was no indication of higher yields for plant densitites greater than 400,000.

The number of pods per plant decreased with increasing plant density, while seed weight increased (except for cowpeas).

Herbicides

Seven herbicides were used in this test. Each herbicide was applied at three rates: none, the recommended rate, and twice the recommended rate. Four of the herbicides were used on chickpeas and lentils and six on dry beans, cowpeas, and mungbeans. Planting and application dates were April 10, 1968, for the first group and June 9, 1968 for the second group. Four replications were used.

Data concerning weed control and crop yields are given in Table 46. The number of broad-leaf weeds in the untreated areas was much greater in the first test (lentils and chickpeas) than in the second (dry beans, cowpeas, and mungbeans). This was probably the result of cultivating later in the season for seedbed preparation for the second test. Grassy weeds, however, were more numerous in the second test than in the first.

Lorox, Dacthal, and Vegadex at the low rate reduced the number of broad-leaf weeds by approximately 30% and grassy weeds by 75% in the first test. The effectiveness of Lorox and Dacthal increased at the high rate. Dowpon had no appreciable effect on broad-leaf weeds.

Control of broad-leaf weeds was ineffective in the second test, although Lorox, Dacthal, Eptam, and Treflan reduced the number of grassy weeds.

Crop yields were largely unaffected by the herbicides, except for lentils. The four herbicides used on lentils were toxic and reduced yields. Dowpon also damaged chickpeas. Where toxicity did not occur, the reduction in weed growth due to a herbicide treatment probably had no appreciable effect on yields, as all plots were kept free of weeds following the weed count. Weeds had not attained sufficient size by that date to have had much influence on the crops.

Table 43. Relation of plant population density to growth of chickpeas, RPIP, Karaj, Iran

Plants per hectare [1]	1966	1967	1968	Mean
	Grain yield, tons per hectare			
100,000	1.92 c [2]	0.72 c	------	------
200,000	2.69 b	0.99 b	0.80 c	1.49 b
300,000	2.94 a	1.27 a	1.05 b	1.75 a
400,000	3.07 a	1.28 a	1.21 b	1.85 a
500,000	------	------	1.44 a	------
600,000	------	------	1.47 a	------
	Pods per plant			
100,000	105 a	41 a	----	----
200,000	84 b	32 b	10 a	42 a
300,000	56 c	28 bc	9 a	31 b
400,000	54 c	24 c	8 a	29 b
500,000	-----	-----	8 a	----
600,000	-----	-----	9 a	----
	Seed weight, gm. per seed			
100,000	0.312 b	0.168 c	-------	-------
200,000	0.332 a	0.178 b	0.167 a	0.226 a
300,000	0.346 a	0.182 b	0.172 a	0.233 a
400,000	0.348 a	0.192 a	0.167 a	0.236 a
500,000	-------	-------	0.182 a	-------
600,000	-------	-------	0.186 a	-------

1/ Row spacings: 50, 60, and 75 cm. in 1966; 40, 50, 60, and 70 cm. in 1967; and 50 cm. only in 1968. Data are averages of all row spacings for each year.

2/ Figures within a column followed by the same letter are not significantly different at the 5% level.

Table 44. Relation of plant population density to growth of dry-beans, RPIP, Karaj, Iran

Plants per hectare 1/	1966	1967	1968	Mean
		Grain yield, tons per hectare		
100,000	1.08 c 2/	1.67 c	------	------
200,000	1.31 b	2.26 b	1.64 b	1.74 b
300,000	1.47 a	2.44 ab	1.84 a	1.92 a
400,000	1.58 a	2.58 a	1.97 a	2.04 a
500,000	------	------	2.06 a	------
		Pods per plant		
100,000	10.7 a	13.1 a	------	------
200,000	7.3 b	10.5 b	15.2 a	11.0 a
300,000	5.2 c	11.5 b	12.3 b	9.7 b
400,000	4.9 c	9.8 c	11.5 bc	8.7 b
500,000	------	------	10.2 c	------
		Seed weight, gm. per seed		
100,000	0.331 b	0.310 c	-------	-------
200,000	0.339 a	0.324 b	0.345 b	0.336 b
300,000	0.341 a	0.322 b	0.377 a	0.347 a
400,000	0.339 a	0.331 a	0.382 a	0.351 a
500,000	-------	-------	0.385 a	-------

1/ Row spacings: 50, 60, 75 cm. in 1966; 40, 50, 60, and 70 cm. in 1967; and 50 cm. only in 1968. Data are averages of all row spacings for each year.

2/ Figures within a column followed by the same letter are not significantly different at the 5% level.

Table 45. Relation of plant population density to growth of cowpeas, RPIP, Karaj, Iran

Plants per hectare [1]	1966	1967	1968	Mean
		Grain yield, tons per hectare		
100,000	3.34 c [2]	1.96 c	------	------
200,000	3.62 b	2.19 b	1.20 c	2.34 c
300,000	3.73 ab	2.28 ab	1.40 b	2.47 b
400,000	3.79 a	2.36 a	1.76 a	2.64 a
500,000	------	------	1.74 a	------
		Pods per plant		
100,000	23.1 a	13.5 a	------	------
200,000	13.2 b	8.1 b	10.8 a	10.7 a
300,000	9.5 c	6.5 c	8.0 b	8.0 b
400,000	7.7 c	6.1 c	6.7 b	6.8 c
500,000	------	------	7.5 b	------
		Seed weight, gm. per seed		
100,000	0.244 a	0.238 b	-------	-------
200,000	0.239 ab	0.248 ab	0.232 a	0.240 a
300,000	0.237 b	0.251 a	0.223 b	0.237 a
400,000	0.230 b	0.255 a	0.226 b	0.237 a
500,000	-------	-------	0.222 b	-------

1/ Row spacings: 50, 60, and 75 cm. in 1966; 40, 50, 60, and 70 cm. in 1967; and 50 cm. only in 1968. Data are averages of all row spacings for each year.

2/ Figures within a column followed by the same letter are not significantly different at the 5% level.

Table 46. Effect of herbicides on weed control and yield of pulse crops, RPIP, Karaj, Iran, 1968.

Herbicide		Weeds 1/				Seed yield, tons/ha.				
		Test No. 1		Test No. 2						
Kind	Rate kg/ha	Broad-leaf	Grass	Broad-leaf	Grass	Lentils	Chick-peas	Dry beans	Cow-peas	Mung-beans
Lorox	0	407	20	56	78	0.25	0.57	1.47	0.58	1.16
	1	258	4	46	76	0.03	2.76	1.85	0.50	1.26
	2	189	6	65	36	0.01	0.62	1.57	0.44	1.25
Dacthal	0	407	20	56	78	0.25	0.57	1.47	0.58	1.16
	8	305	4	41	65	0.14	0.79	1.62	0.43	1.28
	16	213	2	50	29	0.02	0.92	1.82	0.59	1.13
Dowpon	0	407	20	56	78	0.25	0.57	1.47	0.58	1.16
	1	371	15	66	85	0.00	0.26	1.48	0.45	1.27
	2	425	10	62	63	0.05	0.25	1.29	0.59	1.04
Vegadex	0	407	20			0.25	0.57			
	10	285	4			0.06	0.91			
	20	266	6			0.02	0.78			
Eptam	0			56	78			1.47	0.58	1.16
	3			87	36			1.52	0.47	1.25
	6			82	20			1.62	0.48	1.16
Treflan	0			56	78			1.47	0.58	1.16
	1.5			85	23			1.22	----	1.15
	3			87	17			1.36	0.66	1.20
Herbam	0			56	78			1.47	0.58	1.16
	5			65	87			1.48	0.94	1.35
	10			69	90			1.54	0.53	1.01

1/ Number of weeds per 10 square meters 32 days after treatment. Test No. 1 treated April 10, 1968, (lentils and chickpeas) and Test No. 2 treated June 9, 1968 (dry beans, Cowpeas and mungbeans).

Irrigation - Fertilization

Combination irrigation and fertilizer treatments started in 1967 were continued in 1968. The experimental design was a split plot with four replications of irrigation treatments as main plots and fertilizer treatments as subplots. Details of the treatments and a summary of crop yields are given in Tables 47, 48, and 49 for chickpeas, dry beans, and cowpeas.

The influence of soil moisture on yields was more pronounced at low than at high soil moisture levels. Subjecting plants to moisture stress (dry treatment) caused a marked reduction in yields below those for the medium and wet treatments. There was no appreciable advantage, however, in maintaining soil moisture above the medium level. The differential in yields between the wet or medium and the dry treatments in 1968 was greater for chickpeas than for dry beans or cowpeas.

Yield depression due to soil moisture stress was influenced by the stage of plant growth. Generally, this effect was greater during bloom and early maturity than during earlier stages of growth.

Nitrogen fertilizer had no appreciable effect on yields, indicating that the nitrogen requirements of the crops were supplied by symbiotic fixation.

Significant responses to phosphorus were obtained in 1968 for chickpeas and dry beans but not for cowpeas. This difference in response among crops is probably caused by variations in the amount of available phosphorus in the soil on the different field sites, and is not associated with the kind of crop.

An interaction between irrigation and phosphorus fertilization was evident with chickpeas but not with dry beans and cowpeas.

Table 47. Influence of irrigation and fertilization on yield of chickpeas, RPIP, Karaj, Iran 1968.

Soil moisture 1/ when irrigated		Number of irrigations	Grain yield, tons per hectare					
			Fertilization 2/				Mean	
To Full Bloom	After Full Bloom		None	N	P	NP	1968	1967-68
High	High	12	3.63	3.30	3.98	3.75	3.67 ab 3/	3.16 ab
High	Medium	10	3.03	3.01	4.11	3.73	3.47 ab	2.89 b
Medium	High	10	3.73	3.36	3.69	4.06	3.71 ab	3.25 a
Medium	Medium	8	3.56	3.43	4.11	4.15	3.81 a	3.02 ab
Low	Medium	6	3.06	3.14	3.64	3.57	3.35 ab	2.54 c
Medium	Low	6	3.27	3.00	3.18	3.54	3.25 b	2.53 c
Low	Low	4	2.65	2.52	2.93	2.97	2.77 c	2.23 d
Mean: 1968			3.27b	3.11b	3.66a	3.68a		
Mean: 1967-68			2.47b	2.47b	3.10a	3.17a		

1/ Soil moisture levels: high, when two-thirds of available soil moisture at field capacity remained; medium, when one-third of available soil moisture remained; and low, when plants began to wilt.

2/ Fertilizer rates: 100 kg. N (ammonium nitrate) and 150 kg. P (concentrated phosphate) per hectare.

3/ Figures within a column or line followed by the same letter are not significantly different at the 5% level.

Table 48. Influence of irrigation and fertilization on yield of dry beans, RPIP, Karaj, Iran, 1968.

Soil moisture 1/ when irrigated		Number of irrigations	Grain yield, tons per hectare					
			Fertilization 2/				Mean	
To Full Bloom	After Full Bloom		None	N	P	NP	1968	1967-68
High	High	12	2.44	2.26	2.43	2.65	2.44 a	2.81 a 3/
High	Medium	9	2.27	2.36	2.30	2.48	2.35 a	2.70 a
Medium	High	10	2.17	2.21	2.27	2.49	2.28 ab	2.64 ab
Medium	Medium	8	2.29	2.15	2.33	2.34	2.28 ab	2.57 ab
Low	Medium	7	2.10	2.04	2.20	2.25	2.15 b	2.36 bc
Medium	Low	6	1.93	1.99	2.22	2.19	2.08 b	2.14 c
Low	Low	5	2.0[illegible]	2.10	2.19	2.03	2.08 b	2.08 c
Mean: 1968			2.17b	2.16b	2.27ab	2.34a		
Mean: 1967-68			2.29b	2.35b	2.60a	2.65a		

1/ Soil moisture levels: high, when two-thirds of available soil moisture at field capacity remained; medium, when one-third of available soil moisture remained; and low, when plants began to wilt.

2/ Fertilizer rates: 100 kg. N (ammonium nitrate) and 150 kg. P (concentrated phosphate) per hectare.

3/ Figures within a column or line followed by the same letter are not significantly different at the 5% level.

Table 49. Influence of irrigation and fertilization on yield of cowpeas, RPIP, Karaj, Iran, 1968.

Soil moisture when irrigated [1]			Number of irrigations	Fertilization [2]				Mean	
Pre-Bloom	Bloom	Post-Bloom		None	N	P	NP	1968	1966-68
High	High	High	13	2.44	2.38	2.31	2.64	2.44 ab	2.29 ab [3]
High	Medium	Medium	11	2.37	2.17	2.30	2.25	2.27 abc	2.26 abc
Medium	High	Medium	10	2.42	2.57	2.33	2.59	2.48 ab	2.34 ab
Medium	Medium	High	11	2.30	2.46	2.65	2.38	2.45 ab	2.37 a
Medium	Medium	Medium	10	2.37	2.62	2.45	2.48	2.48 ab	2.40 a
Low	Medium	Medium	8	2.51	2.50	2.63	2.67	2.58 a	2.34 ab
Medium	Low	Medium	8	2.40	2.19	2.22	2.03	2.21 bc	2.18 bc
Medium	Medium	Low	8	2.06	2.31	2.05	2.24	2.16 bc	2.10 cd
Low	Low	Low	6	2.21	2.21	1.77	1.98	2.04 c	1.98 d
Mean: 1968				2.35a	2.39a	2.31a	2.37a		
Mean: 1967-68				2.02b	2.08b	2.16ab	2.20a		

1/ Soil moisture levels: high, when two-thirds of available soil moisture at field capacity remained; medium, when one-third of available soil moisture remained; and low, when plants began to wilt.

2/ Fertilizer rates: 100 kg. N (ammonium nitrate) and 150 kg. P (concentrated phosphate) per hectare.

3/ Figures within a column or line followed by the same letter are not significantly different at the 5% level.

PLANT PATHOLOGY

Walter J. Kaiser - Pathologist
Counterparts: Dariush Danesh
Mahmoud Okhovat

Summary

Virus diseases were widely distributed and of primary importance in the cultivation of several pulse crops grown in Iran during 1968. Foliar diseases caused by fungi were of minor importance, except for blight of chickpea.

Beans (Phaseolus vulgaris) are cultivated in several regions of the country, and under natural field conditions are infected by four viruses - bean common mosaic (BCMV), bean yellow mosaic (BYMV), cucumber mosaic (CMV), and pea leaf roll (PLRV). All bean viruses are aphid transmitted, but only BCMV is transmitted through the seed. Inoculation studies were conducted in the field with several isolates of BCMV, BYMV, CMV, and PLRV, and three bean varieties at different stages of plant growth. Seed yields were reduced 23-99% with BCMV, 11-87% with BYMV, 79-98% with CMV, and 96-99% with PLRV. Yields were generally less in plants infected before flowering. Bean common mosaic virus, the most important and widespread virus disease of beans in Iran, is introduced into a field at the time of planting in seed previously harvested from virus-infected plants. The virus was seed-borne in up to 20% of bean seed present in bazars from various bean growing areas of the country, and caused subsequent yield reductions of 0-81% in virus-infected plants. Two bean lines in a replicated variety trial in Khuzestan were highly resistant to BCMV under field conditions of high disease incidence. Pea leaf roll virus infected 21% of 1292 bean lines grown in yield and observation trials at Karaj and 98% of 78 bean lines in Khuzestan.

Broadbean (Vicia faba) yields may be drastically reduced by foliar diseases caused by fungi (rust and chocolate spot) or by virus diseases, the most important being caused by BYMV and PLRV. Virus diseases occur yearly regardless of the weather, but rust and chocolate spot are of little consequence in the absence of frequent rainfall. In field and greenhouse tests no resistance to BYMV and PLRV was found in 106 broadbean lines. The effect of BYMV and PLRV on growth and yield of broadbeans was studied in greenhouse and field inoculation tests. Depending on the stage of growth at the time of virus infection, seed yields were reduced 3-40% with BYMV and 65-94% with PLRV. Bean yellow mosaic virus was seed-borne in 1.5, 0.25, and 0% of the seed from broadbean plants infected at the pre-bloom, full bloom, and post bloom stages of growth, respectively. Pea leaf roll virus was not found to be seed-borne in broadbeans.

Chickpeas (Cicer arietinum) are naturally infected by four viruses - AMV, BYMV, CMV, and PLRV. Weeds and other leguminous plants are important reservoirs

of these viruses. Ninety-four per cent of the plants of a biennial weed (Melilotus sp.) which were indexed for virus in early spring as plants were resuming growth were infected with BYMV. All viruses infecting chickpeas are aphid-transmitted, but apparently not seed-borne. In field inoculation studies, the four chickpea viruses reduced seed yields from 79-99% and mortality of inoculated plants ranged from 0-79% depending on the virus isolate and stage of growth at the time of infection. Chickpea blight which infects all above ground portions of the plant is caused by the fungus Ascochyta rabiei. The disease occurs sporadically in Iran, but can cause substantial losses, as it did in 1968, when environmental conditions were favorable for spread and disease development (late spring rains). Preliminary studies in the field biology of A. rabiei have shown that the fungus can survive in diseased plant tissue for an extended period of time under adverse environmental conditions. In greenhouse inoculation tests, a few chickpea selections, especially black-seeded types, have shown resistance to several isolates of the fungus. A culture medium utilizing extracts of chickpea seed has been developed which results in abundant sporulation of the fungus, and spores produced on this medium have been used successfully in the inoculation tests. Studies are also being conducted on the effect of environmental conditions on growth, sporulation and survival of Ascochyta.

Lentils (Lens esculenta) were severely damaged at several locations by virus diseases. The viruses isolated from diseased lentils include AMV, BYMV, CMV, and PLRV. Bean yellow mosaic virus was found in several lentil-growing areas of Iran. Although CMV is more restricted in its distribution, it is capable of reducing lentil yields as much or more than BYMV. At Varamin BYMV and CMV were transmitted by aphids throughout a lentil variety trial and drastically reduced yields in most large-seeded lentil types, but several small-seeded lines (characteristic of types from Isfahan) showed a high level of field resistance to virus infection. Many of these small-seeded lentil types are also resistant to root rot under field conditions.

Determinations were made of the protein content of seed from virus-infected and healthy pulses. The protein content was invariably higher in seed from virus-infected plants, although seed yields were almost always much greater from healthy plants.

Papers and Publications

W.J. Kaiser, Dariush Danesh, Mahmoud Okhovat, and Hossein Mossahebi. 1968. Diseases of Pulses (edible legumes) in Iran. Plant Disease Reporter 52(9) 687-691.

Walter J. Kaiser and Louise V. Kaiser. 1968. The challenge of overseas work. Phytopathology News. Vol. 2, No. 7 and 8.

W.J. Kaiser, Dar[illegible] Danesh, Mahmoud Okhovat, and Hossein Mossahebi. 1968. Regional Pulse Im[illegible]ment Project. Diseases of pulse crops (edible legumes) occurring in Iran. Iranian Journal of Plant Pathology 4(3):2-6.

1968 Work

Beans (Phaseolus vulgaris)

Beans are one of the most important pulses grown in Iran. In the major pulse growing regions of the country, beans are infected by one or more viruses, including bean common mosaic (BCMV), bean yellow mosaic (BYMV), cucumber mosaic (CMV), and pea leaf roll (PLRV). Under natural field conditions these viruses are transmitted by aphids, and all, except PLRV, are mechanically transmissible. Bean common mosaic virus is the only bean virus so far identified in Iran which is seed-borne.

The effect of virus infection on yield of three bean varieties was studied under field conditions at Karaj (Table 50). Bean plants were inoculated at the pre-bloom and full bloom stages of growth with one of the following four viruses: BCMV, BYMV, CMV, and PLRV.

Depending on the bean variety, size of the plant at the time of virus infection, and the virus isolate, plant growth was adversely affected resulting in yield losses up to 99.9%. Yields were generally reduced more when plants were infected while small, although yield of Wade bean infected with certain isolates of BYMV was less in plants infected at the time of flowering (Table 50). The percentage of protein in bean seed from Bountiful and Red Kidney bean plants infected at pre-bloom and full bloom with BCMV and BYMV was higher by 0.9-14.5% than in seed from healthy plants (Table 50).

Bean common mosaic virus appears to be the most widely distributed and economically important virus disease of beans in Iran. The virus, which is restricted in its host range to beans and closely related plants, is introduced into a bean field at planting time in seed which was harvested one or more years previously from virus-infected plants. Insects (aphids) are responsible for subsequent spread of the virus within and between bean plantings. Depending on various factors, including environmental conditions, BCMV may be spread rapidly by different aphid species from a few virus-infected plants (originating from seed-borne infection) (Figure 1) to most or all plants in a planting.

Bean common mosaic virus may be introduced into a new bean planting in virus-infected seed which the Iranian farmers obtain from their previous year's harvest or from the local bazar. A study was initiated to determine the incidence of BCMV in bean seed from bazars in various bean growing areas of Iran. Sixty-one collections of white, red and pinto bean types were made from bazars throughout the country. The seed was planted at Karaj and observations were made on seed transmission and yield differences between healthy and virus-infected plants (Table 51). Seed collections from some areas were found to be heavily infected with BCMV (up to 19%), and seed yields reduced by 81% in virus-infected plants (Table 51). The results of this study indicate the importance of virus-free seed in preventing the initial introduction and subsequent spread of virus into a new bean planting and reducing yield losses resulting from virus infection.

Table 50. Effect of four viruses on yield and per cent protein in seed from three bean varieties in field inoculation tests at RPIP. Karaj, Iran, 1968.

Virus	Isolate	Bountiful Bean						Red Kidney Bean						Wade Bean			
		Pre-Bloom [a]			Full Bloom			Pre-Bloom			Full Bloom			Pre-Bloom		Full Bloom	
		Seed Yield (g) [b]	% Decrease	% Protein	Seed Yield (g)	% Decrease	% Protein	Seed Yield (g)	% Decrease	% Protein	Seed Yield (g)	% Decrease	% Protein	Seed Yield (g)	% Decrease	Seed Yield (g)	% Decrease
Healthy Check		959	----	23.82	---	----	-----	1952	----	22.58	---	----	-----	1902	-----	---	----
BCMV [c]	1	300	68.7	24.80	410	57.2	24.65	687	64.8	26.92	727	62.7	25.79	----	----	---	----
BCMV	2	6	99.3	-----	422	55.9	-----	67	96.6	-----	593	69.6	-----	----	----	---	----
BCMV	3	9	99.0	-----	736	23.2	-----	---	----	-----	---	----	-----	----	----	---	----
BYMV	1	840	12.4	-----	1057	+10.2 [d]	-----	---	----	-----	---	----	-----	1408	22.2	1300	31.6
BYMV	2	568	40.7	-----	843	11.8	-----	---	----	-----	---	----	-----	783	58.8	941	55.2
CMV	1	17	98.2	-----	202	78.9	-----	---	----	-----	---	----	-----	----	----	---	----
PLRV	1	34	96.4	-----	---	----	-----	1	99.9	-----	---	----	-----	1	99.9	---	----
Unknown	1	124	87.0	25.78	434	54.7	24.15	119	93.9	27.26	739	62.1	24.04	1349	29.1	922	51.1

[a] Plants inoculated in pre-bloom and full bloom stages of growth.

[b] Seed yield (in grams) from 100 plants.

[c] BCMV = bean common mosaic virus; BYMV = bean yellow mosaic virus; CMV = cucumber mosaic virus; PLRV = pea leaf roll virus; Unknown = unknown virus from Wade Bean.

[d] Seed yield from plants inoculated at full bloom with BYMV, Isolate 1, was greater by 10.2% than the healthy check.

Figure 1. Bean plants infected from seed (left) with bean common mosaic virus are stunted and lighter green in color than healthy plants (right).

Table 51. Observations on seed transmission of bean common mosaic virus and effect of virus infection on yield in sixty-one collections of bean seed from bazars located in various areas of Iran.

Bean Type [a]	Number of Collections	Range in: % Seed Transmission	Range in: % Decrease in Yield
White	32	0 - 9.8	0 - 81.2
Red	20	0 - 19.8	0 - 65.9
Pinto	9	0 - 0.6	0 - 61.4

[a] Bean types were differentiated on color of seed.

From preliminary observations and studies there appears to be one or more strains of BCMV in Iran. It is extremely important to identify new strains of BCMV and their distribution because a bean variety which is resistant in one area may subsequently become susceptible in another due to the presence of a different strain of the virus. Studies are underway to screen isolates of BCMV from various regions of Iran on a series of bean varieties in order to differentiate strains of the virus.

The host range of PLRV which appears to be restricted to legumes includes several pulses. Beans infected with this virus have been observed in the provinces of Western Azarbaijan, Fars, Khorasan, Khuzestan and Tehran. Infected plants which are severely stunted with shortened internodes have a bushy appearance. There is a pronounced twisting, thickening and downward curling of newly formed leaves and often a proliferation of the axillary buds (Figures 2, 3, and 4). Pods generally fail to form on plants infected before flowering. Beans infected by PLRV (aphid vector) could easily be confused with those infected by curly top virus (leafhopper vector) (Figures 2, 3, and 4). Curly top virus (CTV) was recently found infecting sugar beets in Fars Province and is now spreading to other sugar beet growing areas of Iran. Although it is not known whether beans are susceptible to CTV in Iran, studies have been initiated to determine the reaction of beans and other pulses to CTV in the greenhouse and field.

Table 52. Transmission of pea leaf roll virus to healthy broadbeans (*Vicia faba*) by three species of aphid which infest pulses in Iran.

Aphid Species	Aphids per Plant [a]	Number of Test Plants	Number of Diseased Plants	% Transmission
Aphis craccivora	5	10	10	100
Acyrthosiphon sesbaniae	2	5	2	40
Myzus persicae	5	29	0	0

[a] Aphids which had fed for at least five days on virus-infected broadbeans were transferred with a camel's hair brush to healthy broadbeans in leaf cages for a 72-hour inoculation feeding period.

Figure 2. Stunted bean plant (variety Wade) (center of photo) is infected with pea leaf roll virus -- a circulative (persistent), aphid-borne virus.

Figure 3. Bean plant (local Iranian line) infected with pea leaf roll virus is severely stunted with twisted, thickened leaves which curl downward.

Figure 4. The dwarfed bean plant (variety Wade) with proliferation of the axillary buds is infected with pea leaf roll virus.

Pea leaf roll virus is transmitted in a circulative (persistent) manner by several aphids which feed on pulses. Two aphid species, Aphis craccivora and Acyrthosiphon sesbaniae, were found to be vectors of the virus, but another, Myzus persicae, failed to transmit PLRV after repeated tests (Table 52).

The vector-virus relationships of PLRV with its aphid vector was studied in more detail with A. craccivora. Aphids require between 3-6 hours to acquire PLRV from virus-infected broadbeans. The possibility of acquiring virus increases the longer a vector feeds on a diseased plant (Table 53). The length of the latent period (the period of time which passes between acquisition and first transmission of the virus by the vector) in A. craccivora has yet to be determined. Once aphids have acquired PLRV, they can transmit the virus to healthy plants within minutes. The percentage of transmission increases with the time viruliferous aphids are allowed to feed on a healthy plant. Aphids at different stages of growth transmit PLRV, although it appears that the youngest immature aphids (nymphs) are less efficient vectors. The most efficient vectors were the apterae (wingless) adults (Table 54). Viruliferous aphids continue to transmit PLRV after shedding their skin (molting). It does not appear that PLRV is transmitted to the parthenogenetically produced progeny of viruliferous apterae or alatae (winged) adults of A. craccivora. Viruliferous adult aphids were placed on moist filter paper and the nymphs were transferred soon after being born to healthy broadbeans, but no virus transmission resulted in 259 transfers.

Table 53. The length of time required for aphids (Aphis craccivora) to acquire pea leaf roll virus from diseased broadbeans

Acquisition Period [a/]	Number of Test Plants	Number of Diseased Plants	% Transmission
10 minutes	33	0	0
1 hour	99	0	0
3 hours	73	0	0
6 hours	104	3	2.9
18 hours	30	8	26.7
48 hours	32	15	46.9

a/ At the end of each acquisition feeding period, aphids were transferred to healthy broadbeans (1 aphid/plant) in leaf cages for 72 hours.

In order to determine the host range of PLRV, viruliferous aphids (A. craccivora) were fed on test plants for periods up to 5 days. Plants found to be susceptible in the greenhouse inoculation trials were: Beans (Phaseolus vulgaris, varieties Bountiful, Blue Lake, Contender, Great Northern U.I. 123, Michelite, Pearl Green, Saginaw, Sanilac, Stringless Green Refugee, Tendercrop, Tenderpod and Wade); peas (Pisum sativum, varieties Alaska, Asgrow No. 40, Big Ben, Dark Skin Perfection, Freezer 69, Gregory Surprise, Honey, Kelvedon Wonder, Laxton Progress No. 9, Little Marvel, Progress, Rondo); chickpea (Cicer arietinum); soybean (Glycine max); Galacta sp.; sweet pea (Lathyrus odoratus); lentil (Lens

Table 54. Transmission of pea leaf roll virus by aphids (Aphis craccivora) in different stages of development to healthy broadbeans.

Stage of Development	Number of Test Plants [a]	Number of Diseased Plants	% Transmission
Alatae (winged) Adults	91 [b]	48	52.8
Apterae (wingless) Adults	91	65	71.4
3rd-4th Instar Nymphs	102	61	59.8
1st-2nd Instar Nymphs	111	33	39.7

a/ After an acquisition feeding period of at least three days on virus-infected broadbeans, aphids were transferred to healthy test plants (1 aphid/plant) and allowed to feed for 72 hours.

b/ Combined results of four experiments.

esculenta); crimson clover (Trifolium incarnatum); red clover (T. pratense); Persian clover (T. resupinatum); subterranean clover (T. subterraneum); and broadbean (Vicia faba).

In a variety trial located in Khuzestan (Southwestern Iran) two bean lines, one a white-seeded type (Accession Number 65-071-00517) and the other a Pinto type (Accession Number 65-157-00005), were highly resistant to BCMV and CMV under field conditions of high disease incidence. Plants in the Khuzestan bean trial were also infected with BYMV (Figures 5 and 6) and PLRV. Bean yellow mosaic virus infects many legumes in Iran, including several pulses. Weeds are an important reservoir of different strains of the virus in various parts of Iran. Breeding activities designed to incorporate resistance to BYMV in pulses should not be neglected because this virus could become a limiting factor in the cultivation of beans and other pulses grown in Iran. At Karaj PLRV infected plants in 21% of 1292 bean lines included in yield and observation trials. In the Khuzestan bean trial PLRV infected plants in 98% of 78 bean lines.

Broadbeans (Vicia faba)

In Khuzestan broadbean yields may be adversely affected by foliar diseases caused by rust (Uromyces fabae) and chocolate spot (Botrytis fabae) and virus diseases, the most important being BYMV and PLRV. The occurrence and spread of foliar diseases is dependent upon frequent rainfall in the spring. Foliar diseases were widespread on broadbeans in Khuzestan in the spring of 1966 when rains were abundant; foliar diseases were nonexistent in 1968 when rainfall was sparse. Virus diseases which are less dependent upon the weather for development and spread were widespread in broadbean plantings in Khuzestan in 1967 and 1968.

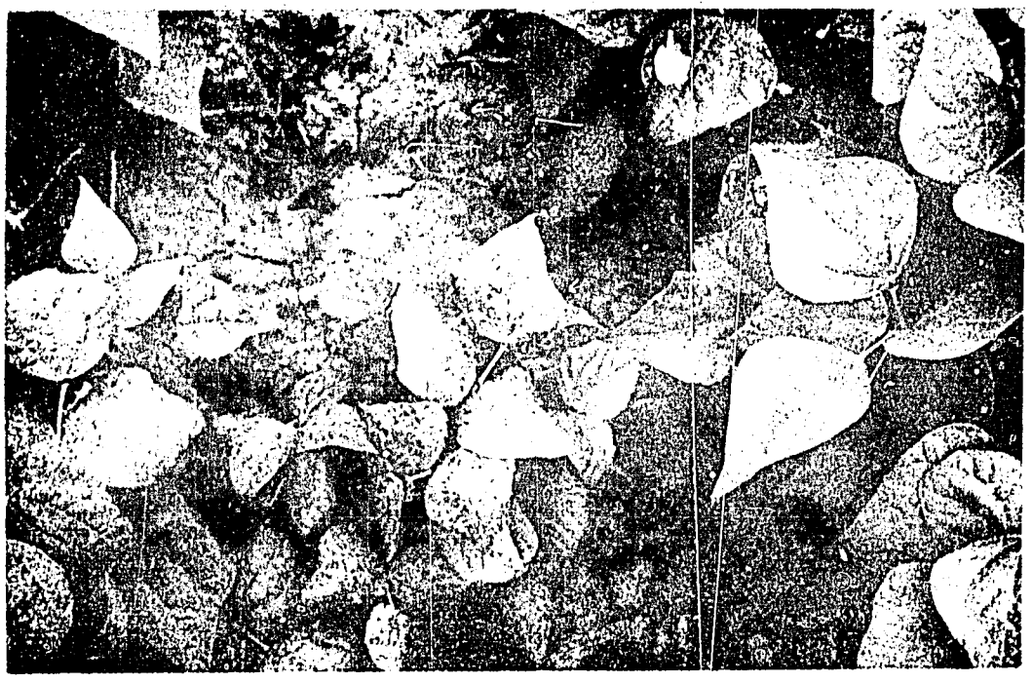


Figure 5. Bean plant (variety Wade) with conspicuous mosaic symptoms on the foliage (center) is infected with bean yellow mosaic virus.

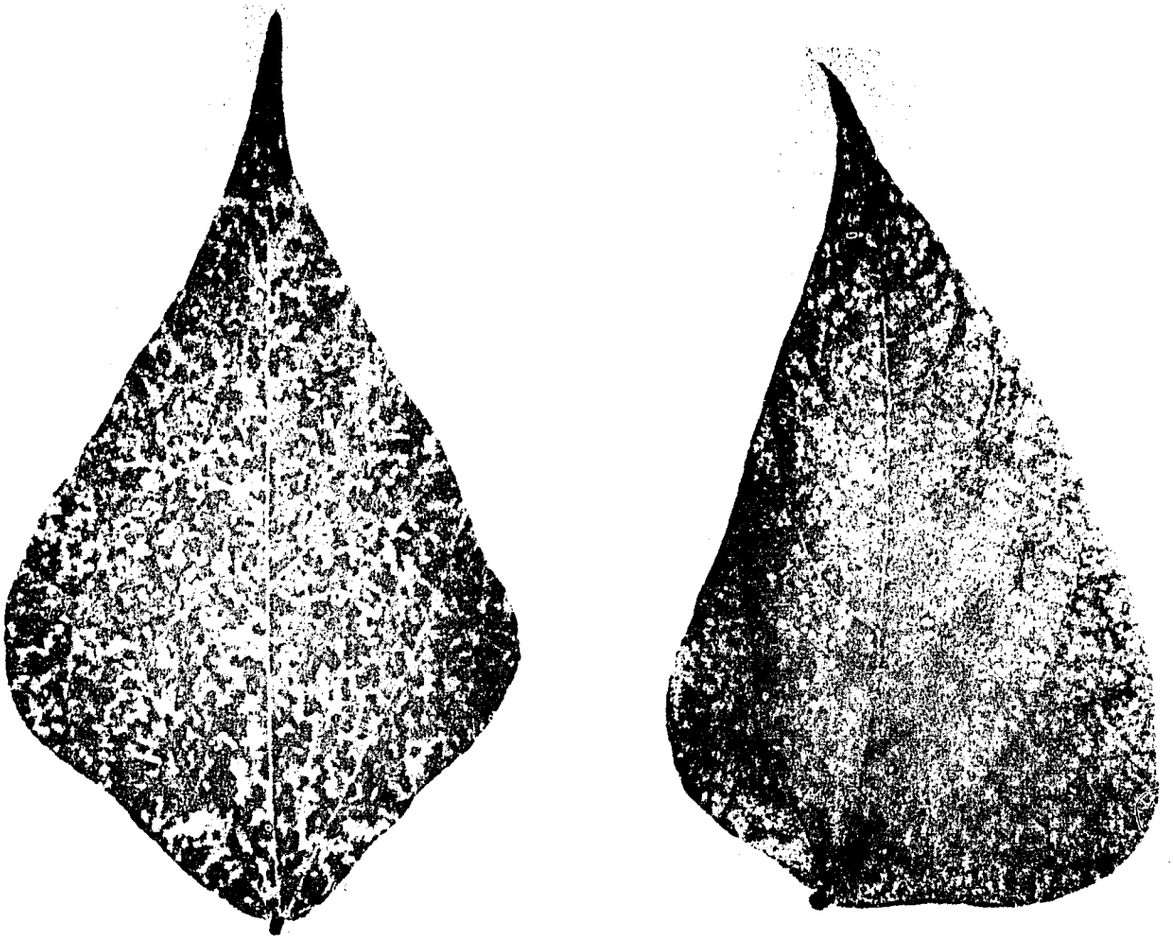


Figure 6. Mosaic symptoms which develop in bean leaves (variety Bountiful) infected with bean yellow mosaic virus may vary with different strains of the virus (left, isolate from broadbean; right, isolate from chickpea).

Bean yellow mosaic virus is the most important and widely distributed virus infecting broadbeans in Khuzestan, but PLRV (Figures 7 and 8) is at times widespread and damaging to broadbeans in Khuzestan and Fars (Shiraz area). In broadbeans BYMV is seed-borne in a small percentage of the seed. Aphids subsequently transmit the virus within and between broadbean plantings. Observation were made in consecutive years on the percentage of plants which arose from virus-infected seed in a large broadbean planting in Khuzestan and the rate that subsequent spread of BYMV occurred in the planting (Table 55). Seed infection was less than 0.25% each year, but increased to more than 98% within four months of planting (Table 55).

Table 55. Observation of initial seed-borne infection in broadbean plantings (variety Algerian) by bean yellow mosaic virus (BYMV) in tests at Dezful, Iran for two consecutive years. Fields were planted in mid-October of each year and harvested the following May.

Year	Number of Plants	% Plants Infected with BYMV — Date			
		November [a]	January	February	March
1967	20,000	0.20	15.5	51.0	99.4
1968	15,000	0.16	---- [b]	----	98.0

a/ The initial survey was made when plants had two to four leaves. Plants had to have mosaic symptoms on the first formed leaves to be tallied as seed-borne infection.

b/ Surveys were not made due to adverse weather conditions and floods.

The effect of virus infection with BYMV and PLRV on yield of broadbean was studied in greenhouse and field trials at Karaj (Table 56). Yields were always reduced more in plants inoculated before pods had formed. Bean yellow mosaic virus was seed-borne in 1.5, 0.25, and 0% of the seed from plants inoculated at pre-bloom, full bloom, and post bloom, respectively. In these trials PLRV was not seed-borne. In field and greenhouse inoculation tests no resistance was found in 106 broadbean lines to BYMV or PLRV.

In the absence of abundant rainfall, yields of a few local broadbean varieties in Khuzestan, like Algerian, can be high even though 100% of the plants may be infected with BYMV, if virus infection occurs late in the growing season (after pod set). When rainfall is high and foliar diseases are widespread, yields of all broadbean lines are low. No field resistance to the most devastating foliar disease, chocolate spot, has been found in over 56 lines included in field trials in Khuzestan.

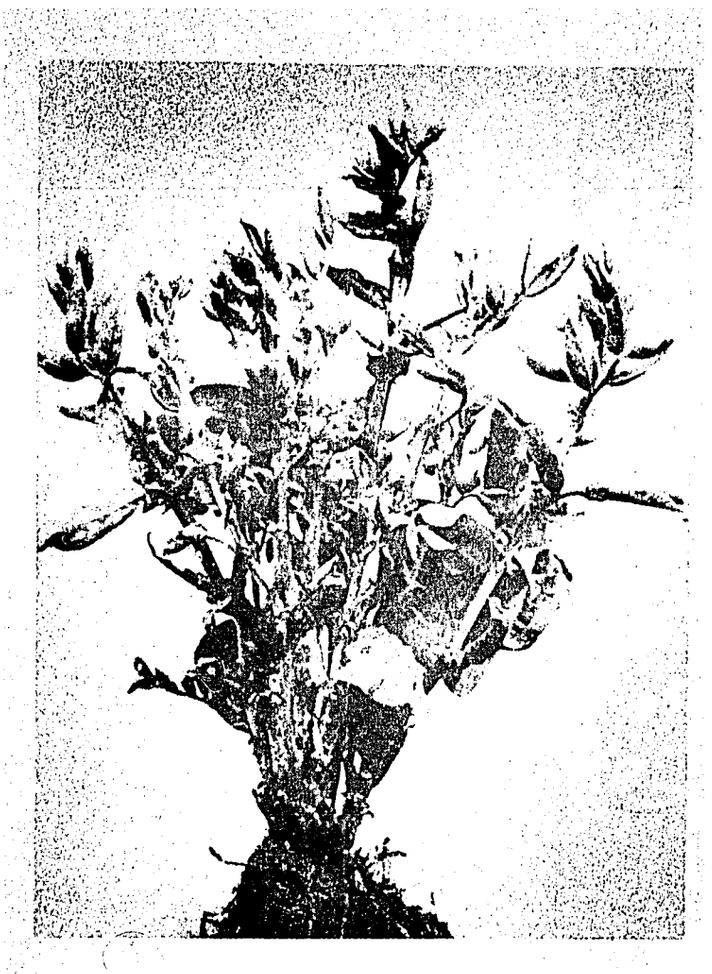


Figure 7. The stunted, chlorotic broadbean plant is infected with pea leaf roll virus. The dwarfed leaves of infected plants curl inward.

Figure 8. Broadbean plant (variety Algerian) with dwarfed, chlorotic leaves which curl inward (center of photo) is infected with pea leaf roll virus. Flowering and pod formation are sparse or lacking in virus-infected plants.

Table 56. Effect of bean yellow mosaic virus and pea leaf roll virus on yield of broadbean (variety Algerian) in field and greenhouse inoculation trials at Karaj.

Stage of Plant Development When Infected	Bean Yellow Mosaic Virus				Pea Leaf Roll Virus			
	Field		Greenhouse		Field		Greenhouse	
	Seed Yield (g) a/	% Decrease	Seed Yield (g) b/	% Decrease	Seed Yield (g) c/	% Decrease	Seed Yield (g) b/	% Decrease
Healthy Check	6776	----	283	----	2259	----	283	-----
Pre-Bloom	4084	40.2	181	36.1	31	94.2	0	100
Full Bloom	5171	23.7	24	91.5	793	64.9	0	100
Post Bloom d/	6546	3.4	283	+ 1.0 e/	610	72.9	83	70.7

a/ Seed yield (in grams) from 75 plants.

b/ Seed yield (in grams) from 15 plants.

c/ Seed yield (in grams) from 25 plants.

d/ Plants had started forming pods.

e/ Seed yield was greater by 1.0% than the healthy check

Several leguminous weeds growing in and around broadbean plantings in Khuzestan are hosts and potential reservoirs of broadbean viruses. Both BYMV and PLRV have been isolated from the following weeds: yellow-flowered alfalfa (Medicago falcata), sweet clover (Melilotus sp.) and wild vetch (Vicia narbonensis).

Chickpeas (Cicer arietinum)

In addition to AMV, BYMV and CMV, chickpeas were also found to be a host of PLRV under natural field conditions (Figures 9 and 10). To determine the effect of virus infection on yield, mortality and protein content of chickpeas, the four viruses were included in a field inoculation trial at Karaj using a local chickpea variety. Yields were reduced from 79-100% by all viruses when infection occurred at both the pre-bloom and full bloom stages of plant development (Table 57). Mortality was highest when plants were infected before flowering. Protein content of seed from diseased plants varied with regard to that of healthy seed, and appeared to depend on the virus isolate and the stage of plant development at the time of infection (Table 57).

Weeds, vegetables and forage crops are hosts and important reservoirs of chickpea viruses. In the Karaj area sweet clover (Melilotus sp.), a biennial legume, is a major reservoir and overwintering host of BYMV (Figure 11). Sweet clover plants growing in irrigation ditches surrounding pulse plantings in Karaj were indexed for virus in early spring as plants were resuming growth. Over 94% of these plants were infected with BYMV. Other legumes which are hosts of BYMV, in addition to sweet clover, include red clover (Trifolium pratense), wild vetch (Vicia peregrina) (Figure 12), and yellow trefoil (Medicago lupulina) (Figure 13).

Alfalfa (Medicago sativus) is the most important forage crop grown in Iran and is the main reservoir and overwintering host of AMV. Pulses, including chickpeas, which are grown near alfalfa plantings are often heavily infected by AMV which is transmitted by aphids from virus-infected alfalfa plants to adjacent pulse plantings. Another host of AMV is Trifolium rytidosemium.

Cucumber mosaic virus is probably one of the most important and widely distributed viruses infecting vegetable and field crops in Iran. Cucumbers (Cucumis sativus), squash and pumpkins (Cucurbita spp.), tomatoes (Lycopersicon esculentum), Persian clover (Trifolium resupinatum), and weeds, like Jimsonweed (Datura stramonium) (Figure 14) are hosts of CMV. Several strains of the virus occur in Iran, but not all strains infect pulses.

Chickpea blight, caused by the fungus Ascochyta rabiei, is a disease which attacks the foliar portions of the plant. Blight occurs sporadically in Iran and is restricted to areas which have late spring rains. Moisture is required for infection, disease development, and spread of the pathogen in a chickpea planting.

Figure 9. Chickpea plants (left) infected with pea leaf roll virus are severely stunted and chlorotic when compared to healthy plants (right) of the same age.

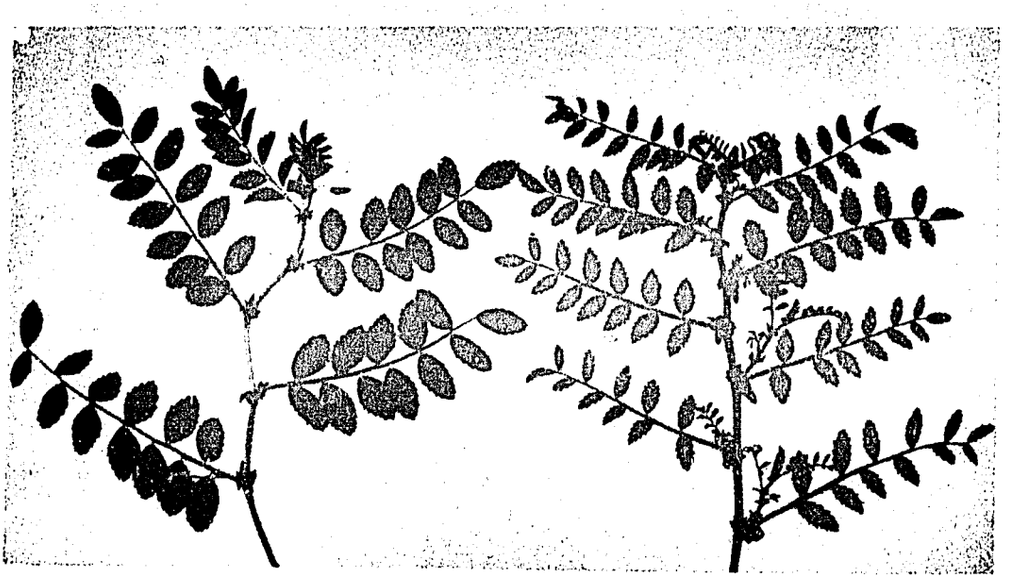


Figure 10. Chickpea plant infected with pea leaf roll virus (right) is stunted and chlorotic. The apical portion of infected plants stops growing and there is a proliferation of the axillary buds; healthy plant, left.

Table 57. Effect of four viruses on yield, mortality and protein content (seed) of chickpea (variety Ghazvin) in field inoculation tests at Karaj.

Virus [b]	Isolate	Pre-Bloom [a] Seed Yield (g) [c]	Pre-Bloom % Decrease	Pre-Bloom % Mortality	Pre-Bloom % Protein	Full Bloom Seed Yield (g)	Full Bloom % Decrease	Full Bloom % Mortality	Full Bloom % Protein
Healthy check		2015	----	----	20.20	---	----	----	-----
AMV	1	13	99.4	65.3	19.14	272	86.5	0	20.78
AMV	2	18	99.1	64.0	19.59	344	82.9	1.3	22.32
BYMV	1	90	95.5	40.0	25.50	268	86.7	0	19.56
BYMV	2	211	89.5	4.2	23.19	419	79.3	8.7	20.09
BYMV	3	8	99.6	45.0	-----	302	85.0	19.7	21.73
BYMV	4	0	100.0	78.7	-----	298	85.2	9.2	21.23
CMV	1	7	99.7	59.8	-----	257	87.2	2.9	20.51
CMV	2	45	97.8	36.8	19.47	273	86.5	16.5	25.00
PLRV	1	1	99.9	99.0	-----	117	94.2	----	24.76

a/ Plants inoculated at the pre-bloom and full bloom stages of growth.

b/ AMV = alfalfa mosaic virus; BYMV = bean yellow mosaic virus; CMV = cucumber mosaic virus; PLRV = pea leaf roll virus.

c/ Seed yield (in grams) from 100 plants.

Figure 11. Mosaic symptoms in Melilotus leaf (right) are characteristic of those produced by bean yellow mosaic virus; healthy leaf left. Melilotus is an important reservoir and overwintering host of this virus.

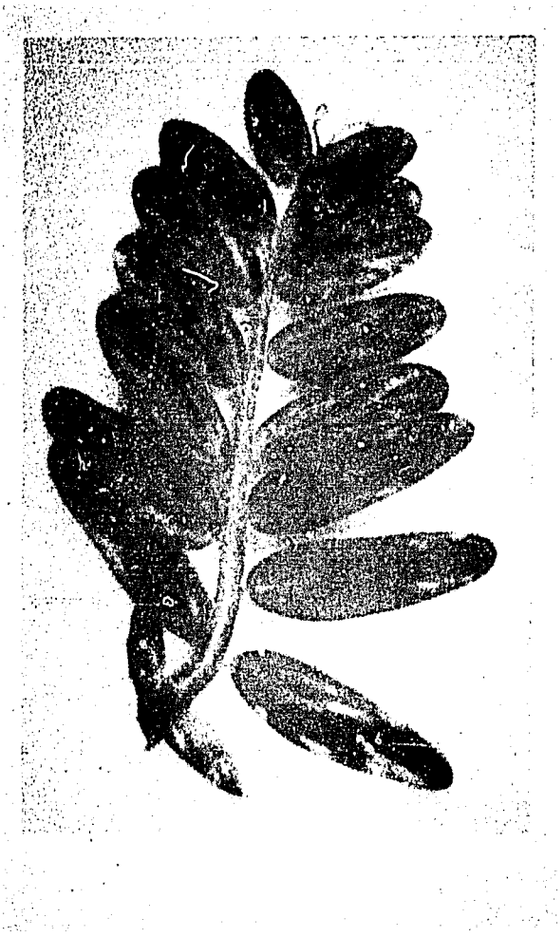


Figure 12. Mosaic symptoms in leaflet of wild vetch, Vicia peregrina, infected with bean yellow mosaic virus.

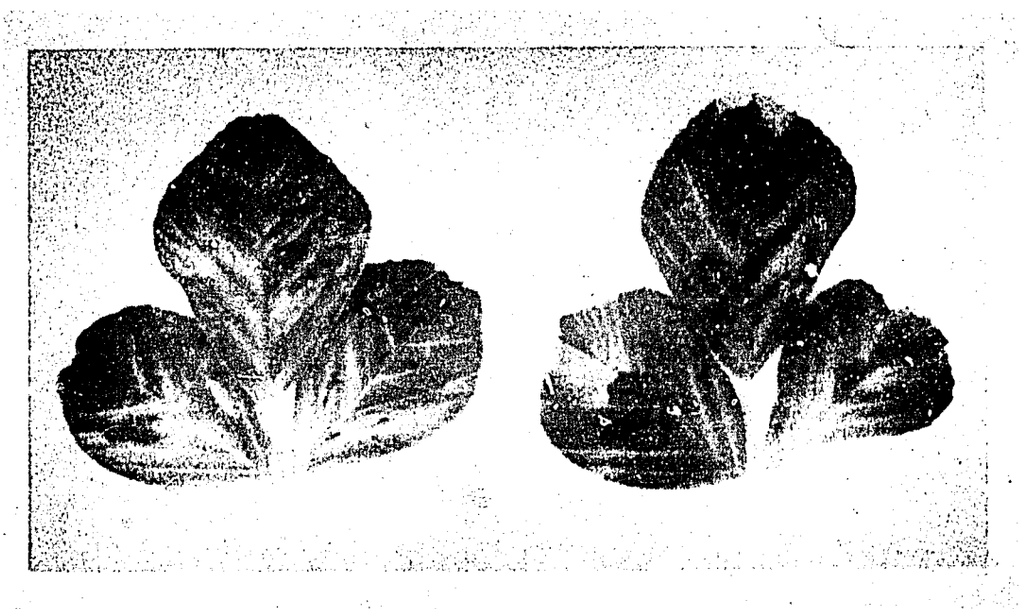


Figure 13. Mosaic symptoms in leaves of yellow trefoil, Medicago lupulina, infected with bean yellow mosaic virus.

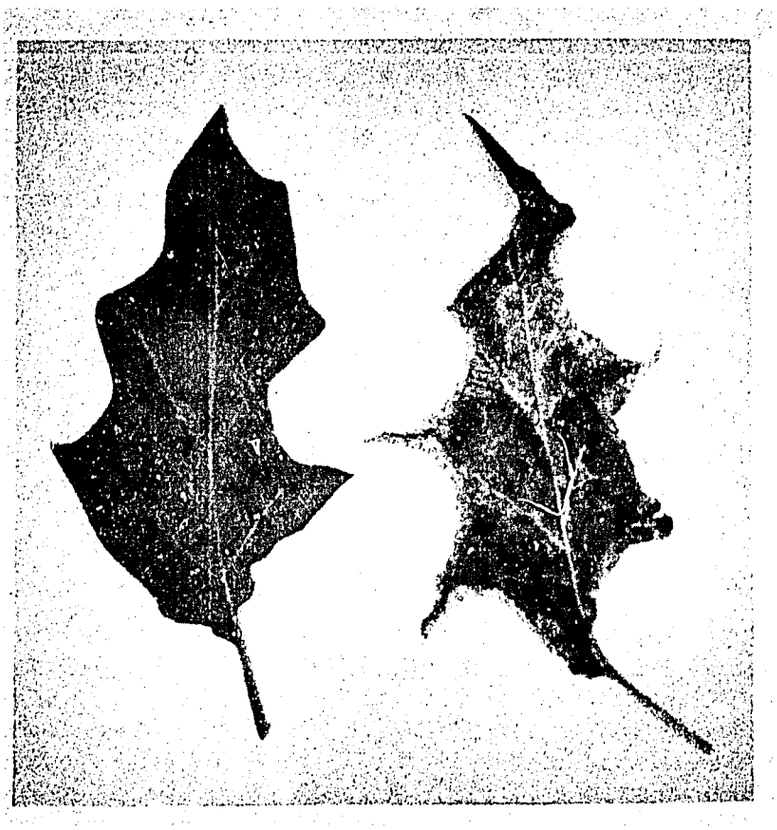


Figure 14. Leaf of Jimson-weed (Datura stramonium) infected with cucumber mosaic virus (right) is mottled and deformed; healthy leaf (left).

Isolates of A. rabiei have been collected from diseased chickpeas from various areas of Iran. Among isolates there is a great deal of variation in growth rate, sporulation, sectoring and pycnidial formation (Figure 15). In nature Ascochyta seems to survive for extended periods of time under adverse environmental conditions on plant debris or in seed (Figure 16). In preliminary field experiments the fungus has survived a severe winter with temperatures below -10°C in naturally infected chickpea tissue maintained outdoors in a weather station shelter or on the soil surface.

Large quantities of spores were needed before inoculation studies could be carried out in the greenhouse and field. The fungus was grown on different culture media and sporulated most abundantly on a medium made from the extracts of white chickpea seed (Table 58; Figure 17).

Several chickpea lines were screened in greenhouse inoculation trials to find sources of resistance to Ascochyta. Many of the large-seeded, white chickpea types were very susceptible, although a few black-seeded types showed some resistance to A. rabiei. Additional testing in the field and greenhouse with more isolates of Ascochyta will be required before resistant lines can be turned over to the plant breeder.

Lentils (Lens esculenta)

Lentils are infected by several viruses under natural field conditions in various regions of Iran. Viruses isolated from diseased lentils are AMV, BYMV, CMV, and PLRV. Although BYMV appears to be the most widely distributed and potentially damaging lentil virus, CMV could become a limiting factor in lentil production in some areas, like Varamin, where large reservoirs of the virus exist in weed and vegetable plants. A lentil yield trial at Varamin (located 40 km south of Tehran) was heavily infected and severely damaged by BYMV and CMV (Figures 18 and 19). Most plants in many of the large-seeded lentil lines were diseased and yields from these virus-infected plots were drastically reduced, whereas many of the small-seeded lentil lines (characteristic of Isfahan lentil types) produced good yields and exhibited high levels of field resistance to virus infection (Table 59). All lentil lines included in the Varamin field trial were inoculated in the greenhouse with lentil isolates of BYMV and CMV in two separate tests. Several of the small-seeded lentil lines showed a high degree of resistance to one or both of the viruses, even when reinoculated on several occasions in each inoculation test (Table 59). Although the small-seeded types are not as desirable as the large-seeded lines in the market place, they should be included in the lentil breeding program in Iran to incorporate virus and root rot resistance into the highly susceptible, but desirable, large-seeded lentil types.

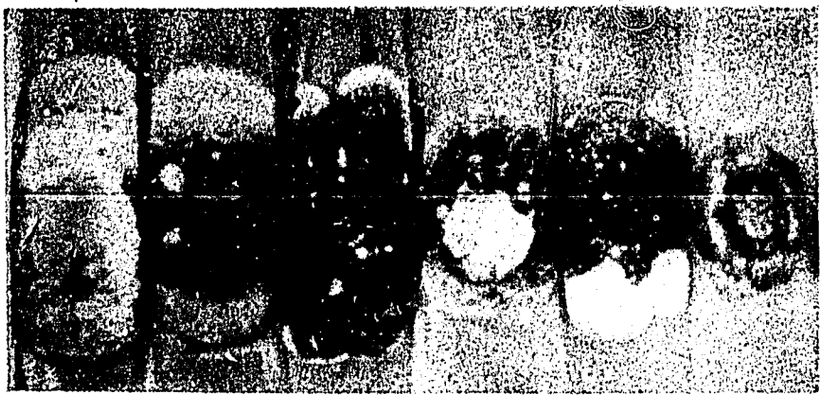


Figure 15. Isolates of chickpea blight, Ascochyta rabiei, after 15 days growth at room temperature on potato dextrose agar.

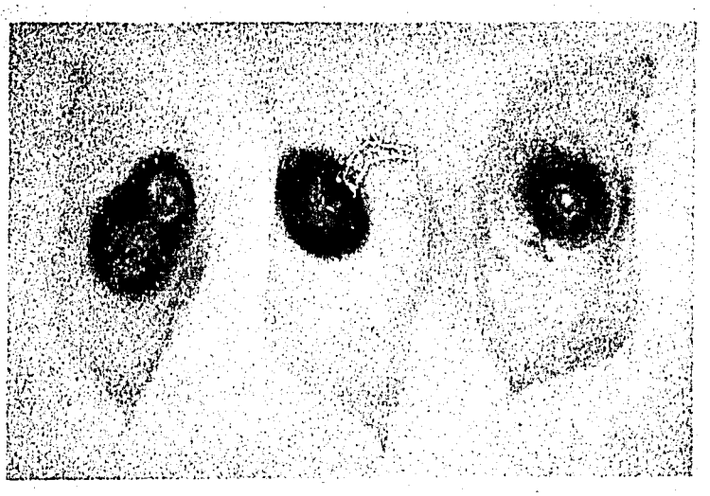


Figure 16. Chickpea pods infected under natural field conditions with Ascochyta rabiei, blight of chickpea.

Table 58. Growth and sporulation of one isolate of Ascochyta rabiei in petri plates containing different culture media for 13 days in the dark

Culture Medium	Mycelial growth [a] (mm)	Number of Spores per Colony x 10^6
Nutrient Agar	13	0
Yeast Extract Agar	13	0.6
Potato Dextrose Agar (Acidified) [b]	23	1.8
Potato Dextrose Agar (Difco Powder) [c]	13	2.6
Peptone Agar	8	2.8
Malt Agar	23	3.4
Potato Dextrose Agar [b]	25	5.4
Mycological Agar	30	68.8
Chickpea Seed Extract Agar (100 g) [d]	24	60.8
Chickpea Seed Extract Agar (300 g)	35	126.3
Chickpea Seed Extract Agar (500 g)	40	139.5

a/ The average diameter (in mm) from 6 to 10 colonies.

b/ Potato dextrose agar (PDA) was made in the laboratory from potatoes purchased locally; in making acidified PDA latic acid (25%) was added to PDA after autoclaving to lower the pH to 4.0 - 4.5.

c/ Potato dextrose agar (Difco Powder) manufactured by the Difco Company, Detroit, Michigan.

d/ Chickpea seed extract agar is made by adding 100, 300 or 500 g of crushed, white chickpea seed to 1 liter of distilled water, cooking for two hours, straining contents through cheese cloth and adding 2% agar to the liquid extract before autoclaving.

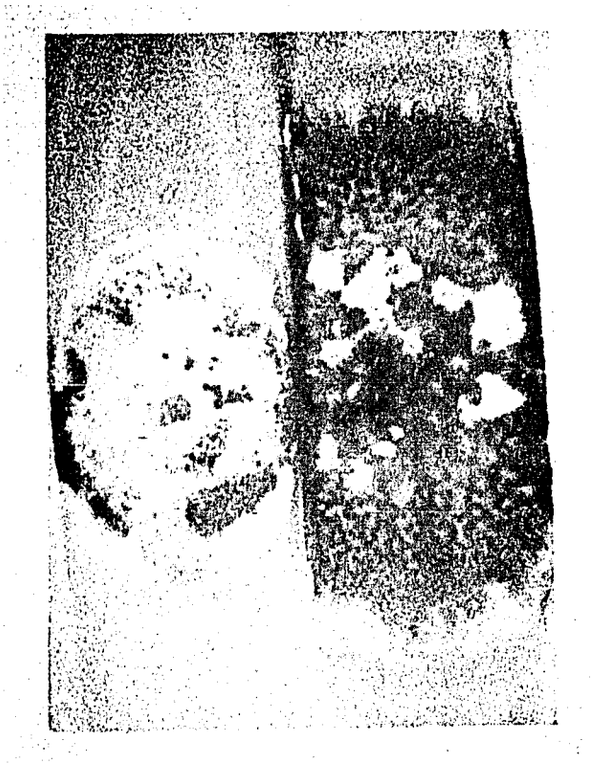


Figure 17. Effect of culture medium (potato dextrose agar, left; chickpea seed extract agar, right) on growth and sporulation of one isolate of Ascochyta rabiei after 15 days growth in the dark at room temperature.

Table 59. Effect of bean yellow mosaic virus (BYMV) and cucumber mosaic viru (CMV) on disease severity and seed yields in 30 lentil lines inclu in an advanced yield test at Varamin in 1968, and subsequent react of these lines to lentil isolates of each virus in greenhouse inoc tion tests.

Lentil Plot No. Varamin 1968	Accession No.	Source	Disease Rating: Field [a] Virus Symptoms	Disease Rating: Greenhouse [b] BYMV	Disease Rating: Greenhouse [b] CMV	Yield kg/ha
7019	33-071-10445	Isfahan	1	1/14 [c]	2/12	1166
7022	33-071-10885	Isfahan	2	3/14	0/14	994
7013	33-071-10439	Jiroft	2	6/15	1/14	979
7014	33-071-10040	Isfahan	2	5/13	5/14	957
7018	33-071-10444	Isfahan	2	7/14	2/16	952
7023	33-071-11136	Isfahan	2	3/14	5/15	931
7017	33-071-10443	Isfahan	2	11/16	4/15	912
7016	33-071-10442	Isfahan	2	4/13	2/13	903
7021	33-071-11139	Isfahan	2	4/15	4/15	880
7012	33-071-10438	Isfahan	2	1/15	3/15	824
7020	33-071-10903	Isfahan	2	4/15	3/15	809
7015	33-071-10441	Isfahan	2	2/14	6/15	770
7024	33-071-11138	Isfahan	3	9/15	6/16	617
7025	33-085-11174	Lebanon	6	12/15	9/14	284
7001	33-071-10408	Ahar	4	4/16	5/15	278
7030	33-071-11179	Iran	8	12/15	13/15	276
7026	33-071-11175	Arasbaran	7	12/15	12/15	231
7007	33-071-10428	Moghan	5	11/15	14/16	206
7005	33-071-10421	Ghazvin	5	10/15	10/14	201
7003	33-071-10411	Moghan	6	12/13	12/15	180
7004	33-071-10413	Tabriz	5	2/15	10/14	178
7027	33-071-11176	Azarbaijan	6	12/15	13/15	162
7028	33-039-11177	Cyprus	8	10/14	11/15	152
7011	33-071-10437	Ghazvin	8	13/14	12/14	139
7010	33-071-10436	Ghazvin	6	9/14	13/14	125
7006	33-071-10424	Moghan	7	10/14	9/15	124
7002	33-071-10409	Ardabil	5	12/15	10/15	120
7009	33-071-10435	Ghazvin	7	11/15	11/14	111
7029	33-071-11178	Azarbaijan	7	12/14	11/14	106
7008	33-071-10432	Ardabil	7	14/15	14/15	96

a/ Lentil plots in the field were graded for disease (virus symptoms) on a scale of 1-9: 1 = no disease; 9 = 100% disease.

b/ Seeds of each lentil line were planted in clay pots containing pasteurized soil in the greenhouse and were inoculated with lentil isolates of BYMV and CMV. In each inoculation test, plants not showing symptoms were reinoculated 2-3 times and at the termination of the test, plants not exhibiting virus symptoms were back inoculated to susceptible indicator test plants.

c/ Combined results of two inoculation experiments. Numerator = number of plants infected, and denominator = total number of plants inoculated (No. infected/No. inoculated).

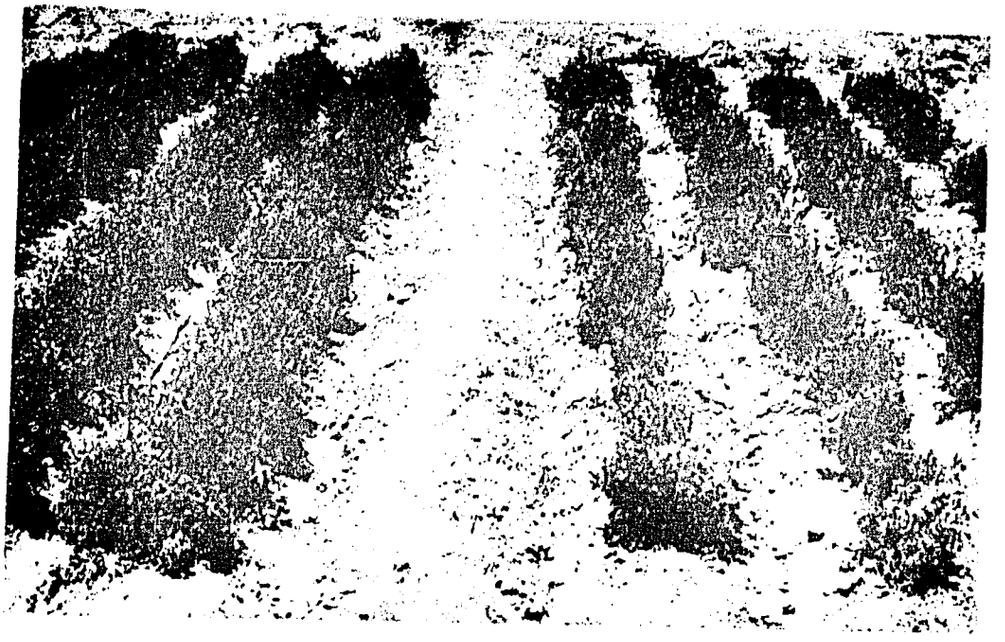


Figure 18. Effect of virus infection in two lentil plots included in an advanced yield test at Varamin in 1968. Plot 7012 (left) was almost free of disease and yielded 824 kg/ha, whereas in plot 7011 (right), over 80% of the plants were infected with virus and the yield was 139 kg/ha.

Figure 19. Lentils grown in Iran are infected by several viruses, some of which severely reduce plant growth and seed yields. The effect of virus infection with lentil isolates of bean yellow mosaic virus (center) and cucumber mosaic virus (right) can be observed when compared to a healthy lentil plant (left) of the same age.

ENTOMOLOGY

Karaj College
S. W. Wilson
Dr. Esmaeli
Karim Kamali
G. Rassoullian

Plant Pest Control Research Institute (Tehran)
Dr. Omidvar - Nematologist

Summary

During 1968 the RPIP/USDA Jr. Scientists were transferred to Plan Organization funding and Karaj College control. While they are still assigned to the RPIP/USDA they are under the supervision of Dr. Esmaeli of the Plant Protection Department. The College has taken additional steps to support the Entomology activities by providing the part time services of Dr. Morad-Saghi who is head of the toxicology branch of the Pest Control Department and the advisory services of Dr. Sepasguzarian, Vice Dean of Agriculture. Mr. Morad-Saghi will make arrangements for pesticide residue studies on the pulse crops and is now setting up laboratory facilities for this work at Karaj. Dr. Sepasguzarian has been very active in pulse work on storage insect control and mite trials.

Initial recommendations have been made for the pulse crops on mites, seed corn maggot, old world bollworm, aphids, thrips, and leafhoppers.

Varietal resistance trials have been conducted on cowpeas for bruchid resistance. This preliminary screening has shown promise. The reported resistance to bruchids of a lentil variety from Hamadan (Western Iran) is being investigated.

Nematology trials in the greenhouse and field have indicated partial resistance in a few varieties of all the pulse crops. They have also determined that all pulse crops are susceptible to nematode attack, and conducted nematocid trials on all the pulse crops grown in Iran. Nematocide trials indicate that several nematocides will give acceptable control of pulse nematodes.

Pesticide Recommendations

Recommendations are based on results of field trials from 1965 through 1968 The pesticides listed have been selected on the basis of effectiveness, availability and safety. While the pesticides listed are considered to be the most effective to date, they are interim and not final recommendations.

The problem of pesticide residues has caused a great deal of concern to both the Iranian research entomologists and the RPIP entomologist. Since in many parts of Iran the custom is to feed all crop thrashings to sheep and goats, it has been stressed that these animals, when used for dairy or meat purposes must not be fed the pulse trash when treated with certain insecticides.

Crop	Pest	Pesticide	Rate	Remarks
Dry beans	mites	Ethion	250 g/ha	Control may be marginal during heavy infestations.
		Dicofol or Kelthane	600 g/ha	Do not feed treated plant to livestock.
		Tetradifon or Tedion	1 kg/ha	Do not feed treated plant to livestock.
Dry beans	seed corn maggot			Plant when soil is warm enough for quick plant growth or soil temperature reaches 22°C.
		Dieldrin	0.33 g/kg seed	Seed treatment is considered to be only partially effective, later planting is preferable. Seed should be dried thoroughly after mixing with insecticide and used within 30 days of planting.
Dry beans	leafhoppers	Diazinon	½ kg/ha	
		Carbophenothion	1 kg/ha	
		Malithion	1 kg/ha	
		Ethion	½ kg/ha	
		Dimethoate	½ kg/ha	Do not feed treated plants to livestock.
		Carbaryl or Sevin & Tedion	1+2 kg/ha	Do not feed treated plants to livestock.
Mungbean	mite	Dicofol or Kelthane	1 kg/ha	Do not feed treated plants to dairy or meat animals.
		Ethion	600 g/ha	
		Tetradifon or Tedion	½ kg/ha	Do not feed treated plants to livestock.

Crop	Pest	Pesticide	Rate	Remarks
Lentils	aphids	Dimethoate or Cygon or Rogor	250 g/ha	Do not feed treated plants to livestock.
		Malithion	1 kg/ha	
Lentils	thrips	Dimethoate or Cygon or Rogor	250 g/ha	Do not feed treated plants to livestock.
		D.D.T.	500 g/ha	Do not feed treated plants to livestock.
		Malithion	1 kg/ha	
		Diazinon	600 g/ha	
Chickpeas	old world bollworm	D.D.T. + Lindane	1500 gr + 450 g/ha	Do not feed treated plants to livestock.
		Toxaphene	2.5 kg/ha	Do not feed treated plants to livestock.
		Carbaryl or Sevin	1½ kg/ha	
		Supracide	600 g/ha	Control may not be adequate under heavy infestations.
Cowpeas	aphids	Dimethoate or Cygon or Rogor	½ kg/ha	Do not feed treated plants to livestock.
		Diazinon	600 g/ha	
		Malithion	1 kg/ha	

Insect Occurrence, 1968

During 1968 a number of pulse pests infestations were recorded. In most locations the infestations were not of economic importance, but in scattered areas moderate damage was reported. In order of their appearance the following pests occurred in 1968.

Seed corn maggot Hylemya cilicrura adults were observed on the Entomology dry bean plots and chickpea plots on April 28. By April 29 damage ranged from 33 to 44% in the dry bean plantings. By May 15 warm weather had reduced the damage to 2% or less.

Thrips Caliothrips impurus were observed on lentils as early as May 2 in Karaj and Gazvin, but populations did not become significant until June 3. Even at the peak of the infestation no apparent damage occurred.

Leaf miner Liriomyza congesta appeared on all chickpea plots in Karaj on Ma 5. Defoliation ranged from 9 to 20% by May 9th. In the Azarbaijan area scatter field suffered over 90% defoliation. Light damage was also reported in the Isfahan area.

Bollworm Heliothis armigera was observed for the first time on Karaj chickpeas on June 10 and in Varamin on the 12th of June. In the entomology chickpeas in Meshed they were reported as early as May 18. Damage was the most severe in the Meshed area with losses up to 19% recorded.

Beet army worm Spodoptera exigua was reported by July 1 in Karaj, but numbe were extremely low. No serious infestation developed in the areas of pulse production.

Bruchids Bruchus lentis were observed in Karaj and Gazvin on lentils on July 7th and 8th. Numbers were low and large populations did not develop.

Leafhoppers Empoasca fabae were recorded in trace numbers in Karaj in early May, however, only light populations occurred at the peak of infestation on July 17.

Aphids Acyrthosyphon sesbaniae were observed during every month of the year in the Karaj area. On winter seeded lentils they were actually present on lentils standing in snow. Populations never reached economic numbers at any tim during the growing season.

Two spotted mites Tetranychus bimaculatus were recorded in the Karaj dry bean plots, and mungbean plots on July 31. By August 6 populations were heavy, but the infestation occurred too late to cause any apparent loss to either the dry beans or mungbeans.

Bruchids Callosobruchus maculatus appeared August 2 in the pulse project cowpeas in Karaj. Four bruchids/100 sweeps were counted at the peak of the infestation. Bruchids damage by harvest time was less than 1%.

Bean butterfly Lycana baeticae was recorded in late August, but never was present in more than trace numbers.

Pesticide Trials of Significance

Table 60. Effect of four insecticides on aphids Acyrthosiphon sesbaniae population on cowpeas, RPIP, Karaj, Iran, 1968.

	No. of Aphids per Treatment (1)							
Pesticide	9 days Before Spray	3 days After Spray	12 days After Spray	21 days After Spray	28 days After Spray	Total	% Reduction	Seed Wt. Gr.
Dimethoate 1/2 kg/ha	415	2^{+}	1^{++}	0^{++}	4^{++}	22^{++}	94.0	18040
Diazinon 600 gr/ha	447	4^{+}	1^{++}	5^{++}	44^{++}	60^{+}	83.6	17440
Malathion 1 gr/ha	310	4^{+}	0^{++}	6^{++}	91^{++}	108^{++}	70.5	18360
Supracid 600 gr/ha	466	13^{+}	3^{++}	20^{++}	100^{++}	148^{++}	59.6	20520
Check	468	104	9	49	144	367	----	15840

(1) Aphids were counted on 100 cowpea leaves per treatment.

\+ Significant at 5% level.

\++ Significant at 1% level.

Although the reduction in aphid populations was highly significant, the over all population level was too low to cause significant reduction in the seed weight.

Aphids have not been a serious problem in project plots since the project work began. However, the exception to this has been disease transmission on dry beans, broadbeans, and cowpeas. In addition, scattered reports of high populations have been recorded in areas of pulse production in Khuzestan and Azarbaijan.

Adequate plant protection has been provided RPIP plots using dimethoate, diazinon, or malathion.

Table 61. Effect of five insecticides against aphids Acyrthosiphon sesbaniae on lentils, RPIP, Karaj, Iran, 1968.

	No. of aphids per treatment (1)		
Pesticide	3 days Before Spray	2 days After Spray	4 days After Spray
Dimethoate 250 gr/ha	176	19+	16
Malathion 1 kg/ha	175	27+	42
Diazinon 600 gr/ha	207	40+	60
D.D.T. 500 gr/ha	258	40+	61
Check	235	137	97

Pesticide	7 days After Spray	Total	% Reduction	Seed Wt. Gr.
Dimethoate 250 gr/ha	33	68+	78.6	5210
Malathion 1 kg/ha	80	149+	53.2	4730
Diazinon 600 gr/ha	58	158+	50.4	5320
D.D.T. 500 gr/ha	85	186+	41.6	6130
Check	58	319	----	4760

(1) Number of aphids were counted on 10 single plants per plot x four replications.

\+ Significant at 5% level.

Although populations were not high enough to cause a reduction in yield on the untreated plots the reduction in treated populations was significant. Heavy rains occurred within 24 hours after spray application, which may be responsible for the lower aphid mortality. Aphid control has been quite adequate using any of the first three insecticides listed in the table above.

Table 62. Effect of five insecticides against thrips on lentils, RPIP, Karaj, 1968.

Pesticide	No. of thrips per treatment (1) 3 days Before Spray	2 days After Spray	4 days After Spray
Dimethoate 250 gr/ha	247	49	24++
Malathion 1 kg/ha	203	62	19++
Diazinon 600 gr/ha	183	30	57++
D.D.T. 500 gr/ha	212	60	47++
Check	162	95	87

Pesticide	7 days After Spray	Total	% Reduction	Seed Weight
Dimethoate 250 gr/ha	102	175++	50.9	5210
Malathion 1 kg/ha	114	195++	45.3	4730
Diazinon 600 gr/ha	126	213++	40.3	5320
D.D.T. 500 gr/ha	118	225++	36.9	6130
Check	175	357	----	4760

(1) No. of thrips were counted on 10 single plants per plot x four replications.

++ Significant at 1% level.

Heavy rain occurred the day following spray application, which may have resulted in the low thrip mortality.

Table 63. Effect of four insecticides on thrip populations on lentils, RPIP, Ghazvin, 1968.

Pesticide	No. of thrips per treatment (1) 7 days Before Spray	6 days After Spray	% Reduction
Dimethoate gr/ha	244	3^{++}	95.6
D.D.T. 500 gr/ha	324	4^{++}	94.2
Malathion 1 kg/ha	215	3^{++}	95.6
Diazinon 600 gr/ha	256	3^{++}	95.6
Check	207	69	----

Pesticide	13 days After Spray	% Reduction
Dimethoate 250 gr/ha	156^{+}	50.1
D.D.T. 500 gr/ha	208^{+}	33.5
Malathion 1 kg/ha	209^{+}	33.2
Diazinon 600 gr/ha	252	19.4
Check	313	----

(1) No. of thrips were counted on 10 single plants per plot x four replications.

\+ Significant at 5% level.

++ Significant at 1% level.

It has not been determined whether thrips in general are a serious pest of lentils. In addition the rather erratic population levels recorded are quite characteristic of thrips, and while the data obtained has some value it should be supported by further work.

Table 64. Effect of insecticides on Heliothis armigera (bollworm) on chickpeas, RPIP, Meshed, Iran, 1968

Pesticide	No. of damaged pods 10 days after 2nd Spray (1)	% Damage	% Reduction
D.D.T. + Lindane (30-9) (1500 + 450 gr/ha)	0++	0	100.0
Toxaphene 2.5 kg/ha	0++	0	100.0
Sevin or Carbaryl 1 1/2 kg/ha	1++	0.25	98.6
Supracid 600 gr/ha	19++	4.75	73.9
Diazinon 600 gr/ha	43	10.75	41.0
Check	73	18.75	----

(1) 400 chickpea pods were examined for Heliothis damage from each treatment. Spray applications were 15 days apart.

++ Significant at 1% level.

Heliothis armigera has been observed causing severe damage in Iran to chickpeas in some areas of production every year. During years of high infestation it is not unusual to record damage at over 90% of the chickpea crop in scattered areas. Control results in the entomology plots and crop protection sprays have indicated damage can be kept to a minimum using D.D.T., Lindane, Toxaphene, and Carbaryl at recommended rates. Time of application is quite important, however, as larvae already inside seed pods are not controlled by sprays. In addition, new plant growth and the length of insect attack very often may necessitate more than one spray application.

Table 65. Effect of date of planting and soil temperature on seed corn maggot, Hylemia cilicrura, damage in dry beans, RPIP, Karaj, Iran, 1968.

Date of Planting	Soil temperature 7 cm. depth (1)	% Damage (2)
March 31, 1968	10°C	44++
April 14, 1968	18°C	29++
May 1, 1968	18°C	27++
May 15, 1968	22°C	2++

(1) Soil temperature: Averages 7 days before and 7 days after planting.

(2) Sample: 100 newly emerged plants pulled from each treatment and number of damaged plants were counted.

++ Significant at 1% level.

Information from date of planting trials indicate acceptable control can be obtained on dry beans by utilizing the most advantageous date of planting. Soil temperature of 22°C result in a lower population of seed corn maggot H. cilicrura, and also in a rapid growth of the bean plant minimizing the effect of the maggot attacks. This date of planting also occurs within the period of time which results in maximum bean production as reported by Dr. Horner and M. Mostahidi in trials conducted by the RPIP soils agronomists.

Table 66. Effect of seed treatment before planting using two insecticides on the seed corn maggot Hylemia cilicrura on dry bean plots, RPIP, Karaj, 1968

Pesticide	No. of Larvae per Treatment (1)	Reduction
Dieldrin 0.33 gr/kg seed	52+	46.5
Lindane 1.25 gr/kg seed	85	12.3
Check	97	----

(1) Data was taken from 100 newly emerged plant roots.

+ Significant at 10% level.

Investigations will be continued to acertain control possibilities using seed treatments. Preliminary results, while not giving acceptable control have indicated further investigations should be conducted.

Figure 20. Seed corn maggot (Hylemia cilicrura) pupae and adults.

Figure 21. Various stages of seed corn maggot (Hylemia cilicrura) damage on beans (Phaseolus vulgaris). Healthy plant on right.

Table 67. Effect of pesticides on mite populations, Tetranychus bimaculatus, on dry beans, RPIP, Karaj, Iran, 1968.

	No. of mites per treatment (1)		
Pesticide	5 days After Spray	8 days After Spray	12 days After Spray
Kelthane 1 kg/ha	160^{+}	53^{++}	139^{++}
Schering 1143 1 kg/ha	126^{+}	100^{++}	209^{++}
Tedion V.18 1/2 kg/ha	221^{+}	252^{++}	150^{++}
Ethion 600 gr/ha	200^{+}	269^{++}	663^{++}
Check	870	879	1289

Pesticide	Total	% Reduction	Seed Wt. Gr.
Kelthane 1 kg/ha	351^{++}	88.4	31780
Schering 1143 1 kg/ha	435^{++}	85.6	28900
Tedion V.18 1/2 kg/ha	623^{++}	79.4	29360
Ethion 600 gr/ha	1112^{++}	63.3	25860
Check	3038	----	27030

(1) Sampling: 25 leaves per plot x four replicatings using 1.5 cm^2 leaf sections.

\+ Significant at 5% level.

++ Significant at 1% level.

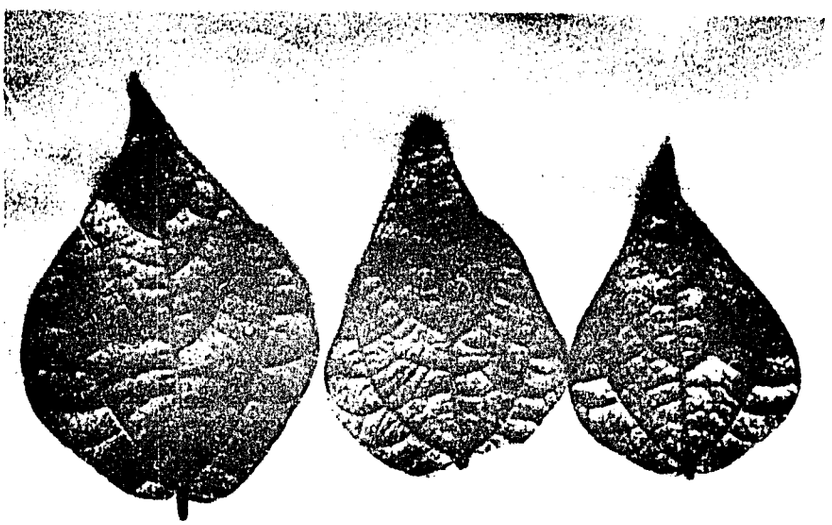


Figure 22. Symptoms of mite (Tetranychus bimaculatus) damage on leaves of beans, (Phaseolus vulgaris).

Table 68. Effect of pesticide on mite populations, Tetranychus bimaculatus, on mungbeans, RPIP, Karaj, Iran, 1968.

	No. of Mites per treatment (1)				
	5 days after Spray		13 days after Spray		
Pesticide	No. of Mites	% Reduction	No. of Mites	% Reduction	% Total Reduction
Schering 1143 1 kg/ha	5++	94.1	23++	80.0	87.0
Kelthane 1 kg/ha	8++	90.5	35++	69.5	80.0
Ethion 600 kg/ha	17++	80.0	21++	81.7	80.8
Tedion V.18 1/2 kg/ha	24++	71.0	19++	83.4	77.1
Dimethoate 600 gr/ha	23++	72.9	84++	26.9	48.9
Check	85	----	115	----	----

(1) Sampling: 25 leaves per plot x four replications with 1.5 cm^2 leaf sections sampled per leaf.

++ Significant at 1% level.

Mite attacks have caused severe defoliation on mungbeans and dry beans in the Karaj and Varamin areas. However, populations have generally reached a peak after the crops have matured to a point where damage does not take place or is minimal. In the event of earlier infestations results indicate mites can be controlled with Kelthane, Tedion, or Ethion.

Additional trials were conducted on bruchids (C. macalatus, B. lentis), aphids (A. sesbaniae), bollworm (H. armigera), and leaf miner (L. congesta) at locations in Karaj, Varamin, and Gazvin, but no significant results were recorded.

Crop Production

Protection was provided the other disiplines at Karaj for control of leaf miner (L. congesta), thrips (C. impurus), aphids (A. sesbaniae), mites (T. bimaculatus), beet army worm (S. exigua), leafhoppers (E. fabae), and bollworm (H. armigera). However, with the exceptions of aphids (A. sesbaniae) where control was needed to help reduce the disease incidence for the plant pathologist on cowpeas, on chickpeas and the thrips (C. impurus) on lentils it is doubtful that protective sprays were needed. Control results were good with the exception of leaf miner (L. congesta) where results were poor.

Stored Pulse Pests

The stored cowpeas in the pulse project storage were attacked by bruchids (C. maculatus) and C. (chinensis). Fumigation was conducted using methyl bromide at 1 lb/1000 cubic feet of storage. Results were good.

Storage areas checked in western, northwestern, and central Iran showed losses ranging from 1 to 45% of the stored cowpeas and lentils. Overall average of the damage was estimated at approximately 9%.

Initial screening for varietal resistance to C. maculatus was conducted using 10 varieties of mungbeans and 10 varieties of cowpeas.

One hundred bruchids C. maculatus were placed in 50 grams of seed, which was put in small baby food jars. The jars were kept at a constant 80°F and 80% humidity. Each treatment was replicated twice.

A second and third screening were conducted with the same technique except for bruchid populations used.

There were four replications for both the second and third screening. In the 2nd screening, 20 males x 20 females were placed in each replication. For the 3rd screening, 25 males x 25 females were placed in each replication.

Observations indicate that the number of eggs laid on each variety was approximately the same. However, the larvae failed to develop to the pupal stage to a much greater degree in the Alabama, Dasht Sar Amol, and FAO varieties.

It appears that there is a certain degree of resistance to C. maculatus in some varieties although inconsistencies in the results require further investigation. Whether this resistance will hold up in the field and storage remains to also to be clarified in further testing.

Additional screening will be conducted on other varieties as well as the varieties already tested.

The following table tabulates the initial screening

Table 69. Differences in emergence of first and second generations of bruchids (C. maculatus) on several varieties of cowpeas and mungbeans, RPIP, Karaj, Iran, 1968.

First Screening

Cowpea Varieties	Total 1st Generation	Total 2nd Generation	Mungbean Varieties	Total 1st Generation	Total 2nd Generation
Mississippi Silver	5	1	AYT 8002	85	209
Alabama Brown	14	1	AYT 8005	83	112
Black Eye No. 5	15	12	AYT 8007	6	0
South African	52	2	AYT 8010	30	16
Early Red	56	1	AYT 8012	41	162
Dasht Sar Amol	65	1	AYT 8015	97	222
FAO	82	6	AYT 8018	80	157
Cowpea Meshed	89	65	AYT 8019	1	0
Soils 195	132	61	AYT 8021	54	122
Early Ramshorn	309	434	AYT 8023	20	95

Second Screening

Cowpea Varieties	Total adults first generation	Total adults second generation
Meshed	164	949
AYT 81	167	703
Early Ramshorn	13	76
AYT 75	179	1079
Alabama Brown	2	1
PYT 18	39	369
Var. 195 Soils	225	1211
PYT 47	95	1600
Early Red	27	323
Dasht Sar Amol	0	0
FAO	0	0

Third Screening

Cowpea Varieties	Total adults first generation	Total adults second generation	% Reduction from check variety
Meshed (check)	1654	2394	--
Alabama	540	1853	24
FAO	510	1376	44
Dasht Sar Amol	417	1232	49

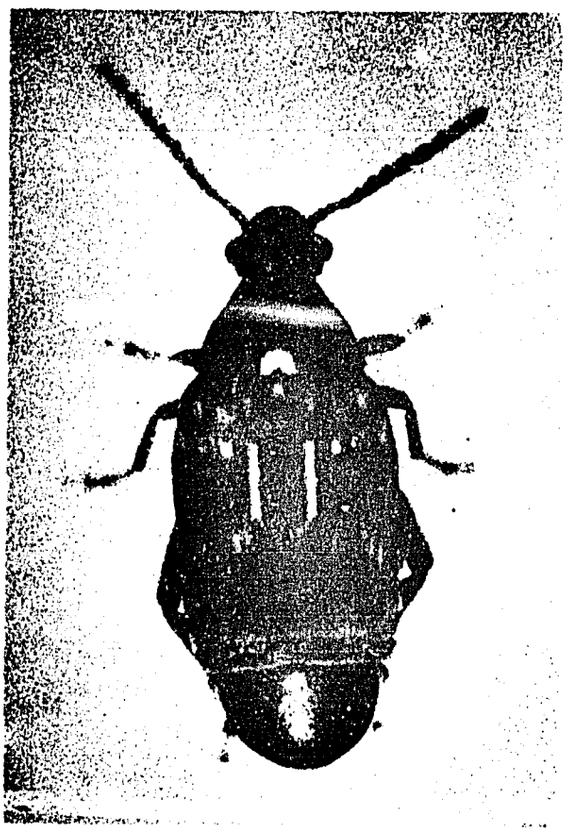


Figure 23. Adult bruchid (Callusobruchus maculatus).

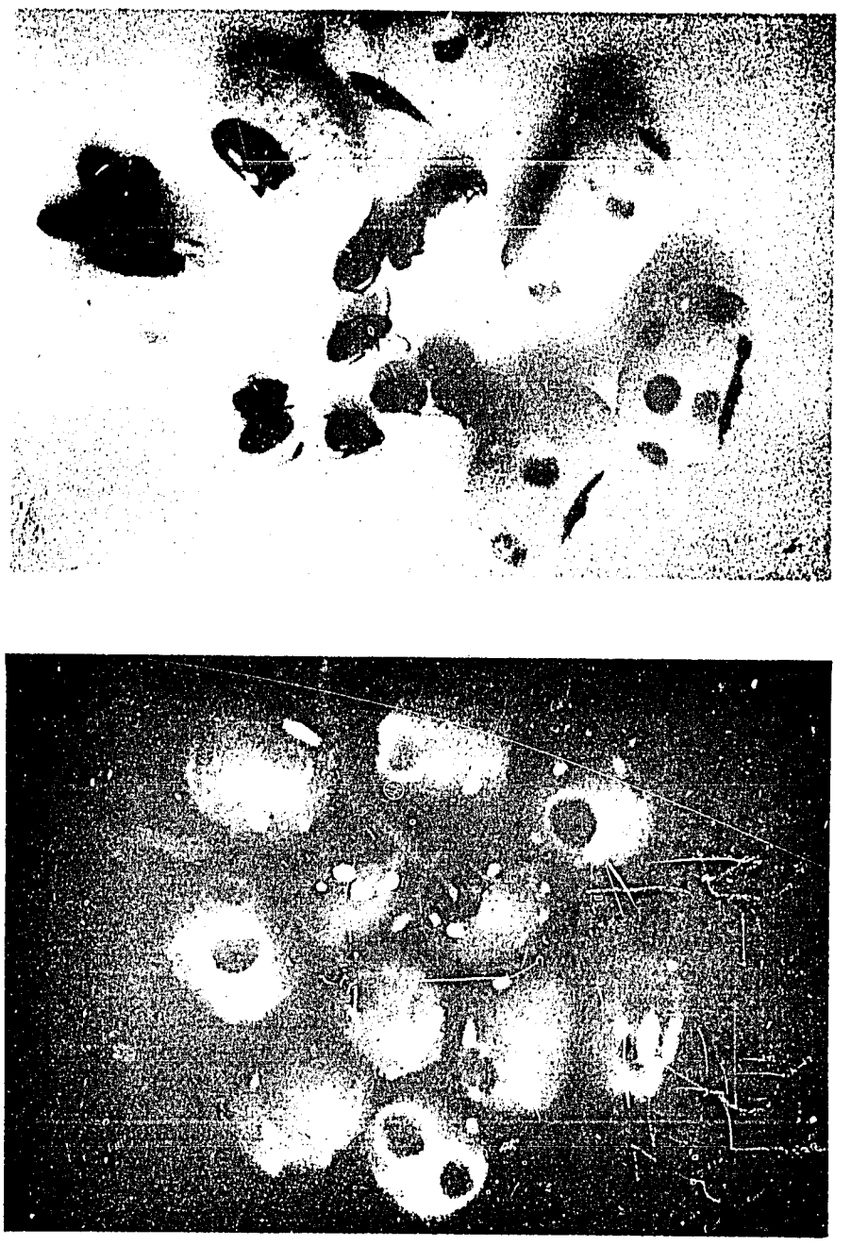


Figure 24. Damage to stored pulses by bruchids, (Callusobruchus maculatus). Top, cowpeas; bottom, mungbeans.

INDIA

VARIETAL IMPROVEMENT

RPIP
K. H. Evans, P. H. van Schaik
V. R. Gadwal, R. K. J. Narayan
D. N. Sajnani, K. L. Jagiasi,
H. L. Chablani, V. K. Madan,
and S. R. Dass

AICPP/IARI
L. M. Jeswani
S. P. Singh

Germplasm

The germplasm collection has been increased by introduction and collections. The total collection is indicated in the table below.

Crop	Exotic	Indigenous	Total	Countries Represented
Cicer arietinum (Chickpea)	2374	1303	4177	24
Cajanus cajan (Pigeon Pea)	108	5130	5244	17
Phaseolus aureus (Mungbeans)	1074	526	1647	15
Phaseolus mungo (Urdbean)	----	310	310	1
Vigna sinensis (Cowpea)	707	723	1434	49
Lens esculenta (Lentils)	743	415	1184	--
Pisum sativum (Peas)	----	407	407	1
Lathyrus sativus (Khesari)	87	752	839	7

The chickpea (Cicer arietinum) collection has been reduced by removing duplicates and bulking similar accessions from identical sources. Good crops of this collection have been grown at Delhi, Hissar, Ludhiana, Gurdazpur, Abohar, Pant Nagar, Varanasi, and Jabalpur. The Hissar and Gurdazpur locations have provided excellent opportunities for screening for chickpea wilt resistance.

Chickpea germplasm (43 accessions) was sent to Lima, Peru at the request of Dr. Eddie Echandi.

Two strains of chickpea were obtained from Israel via RPIP/Iran, with reported resistance to chickpea blight (Ascochyta rabeii) (see Pathology section)

Germplasm of pigeon peas (Cajanus cajan) was grown at Hyderabad in 1967-68 season and a good supply was obtained in addition to agronomic data. Bruchid infestation reduced the seed supply in storage, but seed was furnished for four locations in 1968-69; Hyderabad (A.P.), Varanasi (U.P.), Jabalpur (M.P.) and Kampala, Uganda.

In addition partial sets of seed were sent to Pant Nagar (U.P.), Orissa, (West Bengal), and Senegal, West Africa.

The Phaseolus mungo (Urd bean) and Phaseolus aureus (mungbean) germplasm and selections were planted at Delhi, but due to nematodes, disease and other problems, very little seed was obtained. The remaining seed will be divided between two locations in 1969 for seed increase to fill seed requests.

Germplasm of Vigna sinensis (Cowpeas) was planted at IARI, Delhi and suffered from problems similar to Urd and Mungbeans, but produced somewhat more seed. Partial sets of cowpea germplasm were also grown at Pant Nagar, Jabalpur, Ludhiana and Hissar. Seed was obtained from Pant Nagar to replenish seed stocks in storage. Cowpea germplasm was also distributed to Thailand, Vietnam, and Senegal, West Africa.

Lens esculenta (Lentil) germplasm was planted at Ludhiana (Punjab), Berhampore (West Bengal) and Delhi. A lentil strain reported to be bruchid resistant was obtained from a Hamadan merchant through RPIP/Iran and is being tested for resistance (see Entomology section).

Lathyrus sativus (Khesari) was planted in Delhi and Jabalpur. Selections were made in the low neurotoxin lines and crosses were made to study the inheritance of neurotoxin production.

Seed of five species of beans (Phaseolus vulgaris) were obtained for Dr. Bhaduri at Burdvan (West Bengal). Small samples of other seeds were also sent to other locations.

All-India Coordinated Yield Trials

These trials, which include varieties, released or considered for release, by various state agencies, were continued essentially unchanged.

The Plant Breeding Working Committee decided the varieties and locations during the annual workshop conference. The following varieties and locations were planned:

Rabi 1967-68

Chickpeas	22 varieties	18 locations
Lentils	11 varieties	10 locations
Peas	6 varieties	7 locations

Kharif 1968

Pigeon peas		
early maturing	6 varieties	21 locations
medium maturing	10 varieties	23 locations
late maturing	8 varieties	23 locations
Mungbeans	14 varieties	35 locations
Urd beans	16 varieties	34 locations
Cowpeas	10 varieties	23 locations

The results for 1968 followed the same trend as in previous years. Yields were generally low and often extremely variable (Tables 70 to 75). The statistical analysis was performed by Mr. Daljit Singh, AICPP statistician.

It would in many respects be better to limit these trials to only those varieties and strains which are promising for superior performance rather than continue testing present varieties year after year. It would also be better to limit the number of locations to only those which are able to look after them and provide meaningful data. At present only very few stations return reliable data. By March 1968, out of 75 trial locations only 28 had returned data. At a large number of stations the trials are planted but because of lack of irrigation, poor seedling emergence, low soil fertility, severe insect or disease occurrence the data are either not submitted or are sent in without sufficient information to allow proper interpretation.

A set of uniform data sheets and background information forms were developed and included with seed shipments to facilitate the taking of data and having them returned to the AICPP coordinating office.

Other Activities

Germplasm of mungbeans, urd beans, cowpeas, and chickpeas were planted in March at Delhi for evaluation for the short 60-70-day season between rabi harvest and kharif plantings. The cowpea material did not even begin to bloom in the time available and the chickpea lines died (probably due to salinity and wilt). A considerable number of line and plant selections were made in the mungbean germplasm. These were planted again in the regular kharif season and will be evaluated at one or more locations in 1969.

Several very early maturing strains of pigeon peas were selected from the germplasm. These were increased and are to be included in 1969 yield trials. Most outstanding among these were P4758, P4785 and P4839. In the 1968-69 season a study was started to determine the amount of natural crossing, an important consideration in maintaining purity in breeding material. Crossing work was also started in this crop to combine various desirable characteristics with earliness.

Crosses were made in chickpeas to study inheritance yield components and other factors, and to combine disease resistance, particularly Ascochyta rabeii (blight) with desirable agronomic characters.

F_1 seed has been sent to RPIP/Iran for summer crop planting to obtain F_2 seed for rabi planting in India.

Mungbean and urd bean crosses have been made primarily to incorporate yellow mosaic virus resistance into early maturing varieties.

Papers and Publications

Report on the results of the All-India Coordinated Varietal Trials. L. M. Jeswani, Proceedings 2nd Annual Workshop Conference on Pulses, Delhi, April, 1968.

Some considerations on reorientation of research on genetic improvement of Pulse crops. L. M. Jeswani, Proceedings 2nd Annual Workshop Conference on Pulse crops. Delhi, April, 1968.

Handling of the introductions and their distribution to the breeding centers. P. H. van Schaik, Proceedings 2nd Annual Workshop Conference on Pulse Crops, Delhi, April, 1968.

Jeswani, L. M., van Schaik, P. H. Coordinated Pulse Project - Its Prospects. Indian Farming. February, 1968.

Pulse Crops. P. H. van Schaik, Proceedings Summer Institute on Plant Diseases, IARI, New Delhi, May, 1968.

Table 70. Yields in kilograms per hectare, chickpea coordinated yield trial, India, rabi 1967/68

Location within States

Sl. No.	Varieties		Punjab	Uttar Pradesh				Bihar	W. Bengal	M. P.	Maharashtra		Gujarat			Andhra Pradesh
			Hissar	Kanpur	Hardoi	Meerut	Jagannathpuri	Dholi	Nadia (Kalyani)	Gwalior	Kopargaon	Jalgaon	Dhandhuka	Jamnagar	Dohad	Hyderabad
	Name	Origin														
1	B.G. 482	A. P.	1115	1719	2333	1345	1058	----	1475	1166	----	1389	945	1020	1507	430
2	Co. 1	Madras	894	1794	1808	947	1097	1592	1052	821	2129	1494	928	863	1498	332
3	Chaffa	Gujarat	1167	1644	2731	1096	1095	1615	1897	812	2284	1331	945	843	1844	446
4	Dahad yellow	Gujarat	1504	1495	2013	1769	1678	1390	1500	1121	2786	1270	692	1018	2027	338
5	Gwalior 2	M.P.	1702	1121	2872	2143	1605	2041	1486	1794	2558	1696	683	1002	1216	---
6	S.T. 4	Bihar	1684	1644	2577	1669	1981	1570	1151	1942	2412	1548	776	927	1428	488
7	B.R. 77	Bihar	1735	1465	2641	1296	1393	1413	1535	1211	2003	1359	413	1131	1473	374
8	B.R. 17	Bihar	1667	1570	2910	1694	1675	1458	2009	1736	1679	1457	543	1050	1659	---
9	R.S. 10	Rajasthan	2001	1914	2205	1370	1741	----	1719	1749	----	1303	---	943	1803	254
10	R.S. 11	Rajasthan	1980	1495	2205	1545	1654	1547	1663	1502	2461	1417	489	1117	1418	297
11	Pb 7	Punjab	1865	1794	2795	2043	2054	1547	1118	942	2027	1416	354	906	1350	272
12	C 235	Punjab	2530	2168	2026	2591	1793	1596	1321	1561	1856	1648	548	1031	1489	463
13	G 24	Punjab	1749	1719	2820	1844	1553	1121	1603	1332	2226	1350	320	995	1628	---
14	S 26	Punjab	1856	1869	2654	----	2367	1906	1587	----	2474	1752	363	960	1249	233
15	G-62-404	M.P.	1062	1749	2974	1644	1614	1794	1348	987	1764	1317	987	1256	868	385
16	N.P. 100	IARI	1520	1121	1897	1644	1741	1256	1466	1480	1310	----	236	604	751	283
17	E.G. 742-7	U.P.	1090	1869	2641	1520	1668	2310	1228	1148	2363	----	---	787	----	319
18	Gram B-75	W. Bengal	1916	1809	2449	2043	1974	----	1346	1032	----	----	---	1006	----	---
19	B-98	W. Bengal	1866	1570	2923	1520	2082	1771	1317	1861	2127	1556	---	985	----	---
20	T 2	U.P.	1339	2094	2282	1968	1693	1682	1545	1772	2579	1435	---	991	----	246
21	Gram 736-1	U.P.	1814	2242	2654	2342	1887	----	1856	1624	----	1303	---	----	----	---
22	T 1	U.P.	1564	2003	2949	1370	2054	1704	1220	1166	2196	1423	---	1187	----	308

Table 71. Yields in kilograms per hectare, lentil coordinated yield trials, RPIP, India, rabi 1967/68.

Sl. No.	Varieties		Locations within States					
			Punjab		Uttar Pradesh		Bihar	West Benga
			Gurdaspur	Hissar	Mathura	Meerut	Pusa	Kalyani
	Name	Origin						
1	T 36	U. P.	722	377	2409	2342	404	517
2	N.P. 47	IARI	198	335	1577	498	---	758
3	B 77	W. Bengal	267	362	1332	947	269	947
4	T 3	Punjab	329	354	1777	1345	---	2089
5	B 62	W. Bengal	276	429	1242	1246	239	997
6	B 25	Bihar	794	374	2195	2193	314	615
7	L-9-12	Punjab	1464	677	2616	2691	299	387
8	C 31	W. Bengal	232	362	1360	698	209	816
9	T 8	U. P.	323	238	1560	1196	179	445
10	N.P. 11	IARI	411	336	2139	2093	---	819
11	Hyb. 1	IARI	---	---	-----	----	299	---

Table 72. Yields in kilograms per hectare, pea coordinated yield trial, RPIP, India, rabi 1967/68.

Sl. No.	Varieties		Punjab	
			Gurdaspur	Indore
	Name	Origin		
1	T 61	U. P.	1205	377
2	T 56	U. P.	1047	464
3	T 19	U. P.	1080	160
4	T 163	U. P.	2063	118
5	P 6113	U. P.	1995	174
6	Early December	M. P.	84	68

Table 73. Yields in kilograms per hectare, Mungbean, Coordinated varietal trial, India, Kharif, 1968.

Locations within States

Variety		Punjab				Haryana				Rajasthan		U.P.		M. P.		Bihar		Orrisa		Madras		Maharashtra				MEAN	RANK
		Gurdaspur		Ludhiana		Hissar		Gurgaon		Durgapura		Etawah		Gwalior		Dholi		Nayagarh		Coimbatore		Akola		Jalgaon			
Name	Origin	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank		
D-2-15	Gujarat	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	233	15	---	-	---	-	762	8	498	12
D-45-6	Gujarat	---	-	507	3	2197	3	89	3	132	7	246	13	399	6	486	14	332	13	173	1	725	5	863	3	559	7
B-1	W.Bengal	---	-	18	14	902	13	7	12	171	4	305	12	285	11	973	5	843	5	143	4	583	8	524	14	432	13
T-2	U.P.	17	8	444	5	1360	6	17	11	84	9	660	2	524	2	1065	4	933	4	61	13	569	9	648	11	534	9
T-44	U.P.	21	7	147	11	951	12	21	10	31	12	967	1	365	7	1135	3	1174	1	117	7	661	6	903	1	540	8
T-51	U.P.	---	-	461	4	992	10	73	4	132	7	459	6	257	12	1227	1	1063	2	68	12	761	4	704	9	564	6
Krishna 11	A.P.	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	597	8	---	-	---	-	781	6	689	3
Khargoan 1	M.P.	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	647	7	---	-	---	-	765	7	706	2
Hybrid-45	M.P.	47	5	832	1	3181	1	143	1	27	13	473	5	558	1	867	11	975	3	146	3	991	2	901	2	761	1
24-2	Punjab	219	1	279	7	1188	8	164	5	20	14	324	11	445	4	973	5	---	-	78	11	224	11	297	18	376	18
24-3	Punjab	160	2	267	8	1209	7	52	7	---	-	353	9	411	5	973	5	---	-	57	14	244	11	311	17	404	16
No. 44	U.P.	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	191	17	---	-	---	-	---	-	191	20
No. 305	Punjab	42	6	713	2	2368	2	96	2	60	10	387	7	327	9	949	8	---	-	93	10	530	10	648	11	565	5
BR-2	Bihar	78	3	93	13	980	11	29	9	---	-	---	-	325	10	926	10	---	-	141	5	56	13	77	19	309	19
J-781	Mahar	---	-	185	9	1021	9	35	8	145	6	574	4	167	14	533	13	422	11	154	2	1061	1	800	5	463	14
Khargoan	Mahar	---	-	321	6	---	-	---	-	241	1	652	3	213	13	949	8	403	12	---	-	778	3	690	10	531	10
RS-4	Rajasthan	---	-	182	10	1923	4	60	6	152	6	344	10	450	3	556	12	173	18	94	9	597	7	820	4	486	13
ST-7	Bihar	57	4	107	12	1744	5	---	-	---	-	---	-	349	8	---	-	234	14	112	8	33	14	---	-	377	17
NP 18	IARI	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	663	6	---	-	---	-	608	13	636	4
NP 23	IARI	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	521	9	---	-	---	-	506	15	514	11
Sub.Var.(1)		---	-	---	-	---	-	---	-	178	3	383	8	---	-	158	2	211	16	125	6	---	-	503	16		
Sub.Var.(2)		---	-	---	-	---	-	---	-	60	10	---	-	---	-	---	-	504	10	---	-	---	-	---	-		
Sub.Var.(3)		---	-	---	-	---	-	---	-	208	2	---	-	---	-	---	-	---	-	---	-	---	-	---	-		
Sub.Var.(4)		---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-		
G.M. =		80.0		325.0		1541.0		57.0		117.0		471.0		362.0		911.0		562.0		111.0		559.0		637.0			
S.E.(M) =		4.70		68.30		165.70		19.90		59.80		72.0		48.70		45.60		99.90		21.70		40.80		63.30			
C.D. =		14.0 Sig.		195.0 Sig		476.0 Sig		57.0 Sig		171.0 NS		227.0 Sig		139.0 Sig		131.0 Sig		287.0 Sig		62.0 Sig		117.0 Sig		179.0 Sig			
C.V. =		11.7		42.0		21.5		69.8		102.2		33.6		26.9		10.0		30.7		38.9		14.5		19.8			

Table 74. Yields in kilograms per hectare. Urdbean, Coordinated yield trials, India, Kharif, 1968.

Variety		Locations within States																				MEAN	RANK
		Punjab				Haryana				U. P.		M. P.		Bihar				Orissa		Maharahsthra					
		Gurdaspur		Ludhiana		Hissar		Gurgaon		Etawh		Gwalior		Dholi		Pusa		Nayagarh		Akola		Jalgaon			
Name	Origin	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank		
T-9	U.P.	250	8	562	1	1396	12	237	7	277	11	263	16	857	10	207	1	---	-	325	14	430	11	480	13
T-27	U.P.	549	3	164	6	1620	8	271	6	516	8	578	6	1088	1	120	6	1409	2	513	6	188	16	638	6
T-85	U.P.	319	7	64	8	1615	9	307	3	871	5	726	1	949	5	66	10	1490	1	361	13	219	14	636	7
No.1766		---	-	---	-	1704	5	96	12	264	13	383	16	463	16	23	14	---	-	713	4	479	7	513	12
No.212	-	---	-	---	-	1493	16	10	13	37	15	395	13	509	14	15	14	---	-	172	15	465	8	262	16
D 6-7	Mah.	---	-	---	-	1396	12	135	11	262	12	421	12	672	12	33	13	---	-	780	1	635	2	542	11
No.55	Mah.	49	11	---	-	1833	3	---	-	148	14	692	2	1019	2	---	-	---	-	766	2	509	6	717	1
Sindhkheda	Mah.	---	-	---	-	1144	15	234	8	330	10	385	14	509	14	18	15	---	-	682	5	454	10	470	15
BR-61	Bihar	181	10	49	10	1671	7	---	-	---	-	520	11	625	13	66	10	553	6	155	16	---	-	478	14
BR-68	Bihar	229	9	51	9	1788	4	---	-	445	9	676	3	903	7	70	7	738	4	455	9	334	12	569	9
Khargaon-3	M.P.	---	-	---	-	2001	1	151	10	539	7	536	10	880	8	51	12	---	-	755	3	600	3	689	4
Mash-48	Punjab	517	4	253	4	1407	11	373	2	996	4	540	9	880	8	166	2	---	-	458	7	513	5	610	8
Mash-35-5	Punjab	563	1	303	3	1599	10	302	4	1562	1	568	7	996	4	158	3	---	-	413	12	552	4	702	2
Mash 41-13	Punjab	455	5	187	5	1867	2	219	9	1328	2	630	4	926	6	68	8	---	-	427	11	465	8	657	5
No. 1-1	Punjab	552	2	481	2	1682	6	399	1	793	6	542	8	1019	2	96	6	854	3	458	7	718	1	694	3
NP-14	IARI	375	6	92	7	1312	14	289	5	1058	3	584	5	811	11	68	8	---	-	433	10	---	-	558	10
Sub-Var.(1)		---	-	---	-	-----	-	---	-	---	-	---	-	---	-	121	4	683	5	---	-	251	13		
Sub-Var.(2)		---	-	---	-	-----	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-		
Sub-Var.(3)		---	-	---	-	-----	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-		
Sub-Var.(4)		---	-	---	-	-----	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-	---	-		
G.M. =		367.		220.		1532.		232.		627.		527.		819.		084.		961.		491.		454.			
S.E. (M) =		17.6		091.5		180.5		070.0		128.3		074.8		054.6		027.7		174.8		039.5		054.9			
C.D. =		51. Sig		266. Sig		514. Sig		201. Sig		366. Sig		213. Sig		156. Sig		079. Sig		551. Sig		113. Sig		157. 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			

Table 75. Yields in kilograms per hectare, Cowpeas coordinated yield trials, India, Kharif 1968.

Variety		Locations within States											
		PUNJAB		RAJASTHAN		MADRYA PRADESH		ORRISA		MADRAS			
		Gurdaspur		Durgapura		Gwalior		Mayagarh		Coimbatore			
Name	Origin	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Mean	Rank
T.2	U.P.	328	3	33	9	---	-	566	3	181	4	277	2
K.11	M.P.	396	1	257	3	309	1	204	7	188	2	271	3
K.14	M.P.	188	6	70	7	235	2	263	6	98	8	171	7
5286-3	U.P.	386	2	---	-	22	6	---	-	186	3	198	6
RS.9	Rajesthan	219	4	248	4	99	3	---	-	73	10	160	9
Meshed	Iran	156	7	54	8	94	4	289	5	164	6	151	10
Blackeye 7	U.S.A.	39	9	---	-	9	7	584	2	99	8	183	6
E.Ramshorn	U.S.A.	44	8	132	5	49	5	515	4	109	7	170	8
JC-10	Rajesthan	190	5	265	2	---	-	---	-	241	1	232	4
NP-2	IARI	---		444	1	---	-	---	-	175	5	310	1
G.M. =		216		178		116		434		151			
S.E. (M) =		011.8		057.4		032.2		050.8		013.7			
C.D. =		035 Sig		168 Sig		096 Sig		157 Sig		040 Sig			
C.V. =		10.9		64.3		55.2		20.2		18.1			

SOIL AND CROP MANAGEMENT

RPIP
R. J. Davis
C. S. Saraf, S. N. Kapoor,
A. Narayanan, A. Parkash,
and Miss G. Banda

AICPP/IARI
P. C. Bhatia,
S. L. Choudry,
and B. M. Sharma

SUMMARY

Rabi 1967/68

Experiments were conducted at four locations during the 1967-68 rabi season. Spacing experiments in which spacing between rows and between plants within the row were varied at three levels of fertilizer application and fertility experiments in which three levels of N, P, and K and rhizobia inocculation combined factorily were conducted at all locations. The experiments were conducted with chickpea (Cicer arietinum) at each location. Vegetative growth of chickpeas was very vigorous. The entire crop succumbed to disease at Hissar, Ludhiana, and Pant Nagar, however. At Delhi the crop remained in a vegetative condition long past normal flowering. Seed set was light and yields low.

Lentils (Lens esculenta) were planted at two locations. At Pant Nagar the crop was lost due to 2,4-D spray. At Ludhiana growth was very poor and yields low.

Field peas (Pisum sativum) were planted at Hissar and Pant Nagar. Good yields were obtained at both locations. Highest yields were obtained with a spacing pattern of 45 cm. between rows and 10 cm. between plants in the row with an application of 50 kg/ha of N, P, and K. With application of 0 and 100 kg/ha N, P, K yields decreased. There was no effect due to either N, P, K or rhizobial inoculation in the fertility experiments. There was interaction between N, P, and K.

At Delhi an experiment was conducted to check broadcast versus deep placement of super phosphate fertilizer at various levels. A response to fertilization was obtained but there was no difference between the two methods of application.

A chemical weed control trial was conducted at Delhi with chickpea, lentils, peas, and khesari (Lathyrus sativus). Five herbicides were used including the one being used routinely on all of the experiments based on past studies (Treflan). None of the herbicides treated were superior to this material.

Summer 1968 (March-July)

In the 1968 Summer season three varieties of mungbean (Phaseolus aureus) were used in an experiment with varying between row and within row spacings at three levels of fertilizer application. Sowing was accomplished in mid-March at three locations. Stand and growth was poor so two locations were replanted in mid-April but again growth was poor. The planting was repeated in Delhi in mid-May and good vegetative growth resulted but only one variety set seed. An irrigation experiment was planted in Delhi in March. Here also growth was very poor. The crop flowered but the small plants produced only 2-4 pods per plant.

From this season's data it is obvious that Kharif pulses cannot arbitrarily be planted in the summer season. There appear to be environmental effects on both plant growth and flowering. More than just photoperiod seems to be involved. The effects are more pronounced the earlier the crops are planted, and there are varietal differences in the effects.

Planting of Iranian chickpea and cowpea varieties in the summer season failed completely despite the similarity of the climate during the India summer season to that of the normal growing season for chickpeas and cowpeas in Iran.

More detailed studies of the environment-crop interaction under controlled conditions are being planned.

Kharif 1968

In the 1968 kharif season spacing-fertility trials and fertility-inoculation trials as described under rabi season were conducted on mungbean (Phaseolus aureus), urd bean (Phaseolus mungo), pigeon pea (Cajanus cajan) and cowpea (Vigna sinensis).

Trials with mungbean and urdbean were conducted at Delhi, Hissar, Kanpur, Ludhiana, and Pant Nagar. At Delhi trials were conducted on four varieties of mungbean and three varieties of urdbean. The entire crop was lost due to nematode damage. At Hissar where very good growth of these crops was obtained in the 1967 season growth was poor and yields low in 1968. At Kanpur a flash flood due to a heavy rain washed out the crop. At Ludhiana the problem of establishing a stand, encountered last season, was eliminated by use of a soil fumigant. About flowering time the plants became unthrifty apparently due to nematode infestation and yields were negligible. At Pant Nagar vegetative growth was very vigorous, but yields were low. There was no effect due to fertilization.

Trials were conducted at Delhi on two varieties of cowpea. This crop was lost due to nematode infestation.

Experiments with pigeon pea were conducted at four locations. Two of thes were in the frost free zone so that long term and short term varieties could be compared. The other two locations were in the area of frost danger so only a short term variety was used.

Long term varieties are still in the field and will be reported with the 1968-69 rabi crop. Short term variety T-21 of pigeon pea last season yielded as high as the long term varieties usually do when grown in the frost free zone. This gave the possibility of getting the same yield without tying up the land for two seasons.

At Hyderabad irrigation water became unavailable after the sixth week. The growth was slight and yield low.

At Kanpur and Delhi a wilt-like disease not previously known wiped out the experiments. (See Pathology Section.)

Growth at Pant Nagar was vigorous but a storm knocked off many blossoms reducing yields to less than half those obtained last year. Yields were in the range of 2000 kg/ha which is still twice the average farmers' yields. There was no effect due to fertilization but a decrease in yield was noted with decreasing plant density.

In a fertilizer placement experiment with T-21 pigeon pea at Delhi in which farm yard manure and super phosphate were broadcast and deep placed (25-30 cm.), an increase in yield was obtained with deep placement.

A chemical weed control trial was conducted at Delhi with twenty treatments on pigeon peas, cowpea and mungbean. The crop was lost to disease but data was obtained on weed control and herbicidal toxicity to seedlings. No treatment was superior to Treflan, the herbicide we are now using.

An experiment was conducted at two locations on the effect of Simazine on the protein content of mungbean and cowpeas. Low levels of Simazine have been reported to increase protein content of crops. This was part of an all-India program on many crops in which the Pulse Project agreed to participate. No meaningful data was obtained from the first season's trials.

An experiment was conducted on the foliar application of phosphate fertilization with mungbeans in the summer season and urdbeans in the kharif. No enhancement of phosphatic fertilization was noted due to foliar application.

An experiment was conducted to evaluate the effect of flat sowing, ridge sowing, and flat sowing and subsequent ridging on yield of pigeon pea, mungbean and urdbean. Under the conditions of this experiment with the soil waterlogged through much of the growing season but no standing water present, ridging gave higher yields.

A project on environmental studies on plant growth was initiated with the 1968 kharif season with the following objectives.

(a) Collecting and recording as much environmental information as possible in the pulse experimental plots and obtaining other data from available sources and filing permanently for use by members of the Project.

(b) Constant surveillance of the crops for any abnormalities and attempting to correlate these with the environmental data collected.

(c) Judicious modification of the environment where possible in the field.

(d) Growth chamber studies with varying plant environments. A plant growth chamber has been designed and is being constructed using entirely indigenous materials available in India without foreign exchange or import license.

The following papers were either presented or published by members of the Soil and Crop Management discipline during 1968:

Chowdhury, S.L., and Mukhtar Singh (1968). The problems of water management in rice crop. Indian Chemical Manuf. Vol. 6 (2) : 32-36, Feb., 1968.

Bains, S.S., Chowdhury, S.L., and Dayanand (1968). Relay cropping - Possibilities and Profits. Ind. Fmg. XVIII (4) : 31-34, July, 1968.

Chowdhury, S.L., (1969). Problems of Pulse Production in India. Crops in India, Vol. 1 (3 & 4) : 20-22, July-Dec., 1968.

Chowdhury, S.L., (1968). Cultural practices under rainfed farming. Paper presented at the Annual Conference of the Indian Society of Agronomy, U.P. Agricultural University, Pant Nagar, October, 1968.

Chowdhury, S.L., (1968). Pulse Crops are a neglected Lot. Ind. Fmg. 18 (8) : 25-28 November, 1968.

Davis, R.J. Report on the results of the Coordinated Agronomic Tables. Proceedings, 2nd Annual Workshop Conference on Pulses, New Delhi, 1968.

Chowdhury, S.L. The State of Knowledge concerning nutrition, plant population and other agronomic aspects of pulse crops in India. Proceedings, 2nd Annual Workshop Conference on Pulses, New Delhi, 1968.

Saraf, C.S., and Dastane, N.C. (1968). Water Use patterns in Maize-Cowpea mixtures under varying fertility conditions. Paper presented by Mr. J.K. Jain, Irrigation Advisor to G.O.I. and the leader of the Delegation at the 7th NESA Regional Irrigation Practices Seminar, held at Lahore (Pakistan), September, 22-30, 1968.

Rabi 1967-68

During the rabi season of 1967-68, the soil and crop management program included studies concerning fertilization, plant spacing, rhizobial inoculation, phosphorus placement and weed control. The work was done at Delhi, Hissar, Ludhiana and Pant Nagar.

A. Fertility - Spacing experiments:

1. Chickpea (Cicer arietinum) - Variety G-24

A fertilization-spacing experiment on chickpea was planted at Delhi, Hissar, Ludhiana and Pant Nagar. The experiment consisted of three between row spacings (30 cm., 45 cm., and 60 cm.), three plant spacings within rows (5 cm., 10 cm., and 15 cm.) and three levels of fertility, N, P_2O_5 and K_2O at the rate of 0, 50, and 100 kilogram per hectare. A split plot design was used with fertility levels and row spacings as main plot treatments and plant spacing within rows as sub-plot treatment. All the treatments were replicated four times. Fertilizer was broadcast and worked in before planting. Plot size used was 4.0M x 3.6 M. At Pant Nagar the experiment was duplicated with another variety No. 730 a large seeded "kabuli" type.

Plantings were completed in early October. However, the crop at Ludhiana was lost to blight, Hissar to wilt and Pant Nagar to sclerotia. At Delhi vegetative growth was very vigorous, timely rains precluded the need for irrigation except immediately after planting, and maturity was delayed. Yields, however, were lower than expected with a tendency towards lower yields at the higher fertility levels because of prolonged vegetative growth.

Table 'A' - Soil Analysis, Rabi - 1967-68

	Property				
Location	Texture	pH	Conductivity mmhos/cm.	Organic Carbon %	Available P lb/acre
Pant Nagar	Silty loam	6.9	0.25	0.90	32
Delhi	Clay loam	7.8	0.25	0.82	38
Hissar	Loamy Sand	8.7	0.12	0.15	4
Ludhiana (Lentil)	Sandy	8.5	0.16	0.09	40
Ludhiana (Gram)	Sandy	8.4	0.17	0.08	64 1/

1/ Normally would have very little available P but in both cases followed a heavily fertilized Kharif crop.

The crop at Delhi was harvested in the second half of April. There was interaction between row spacing and fertility levels (main treatments) and plant spacing within row (sub-treatment) as shown in Table 76.

Table 76. Effect of between row spacings and fertility levels (main treatment) and plant spacing with row (sub-treatment) on yield of chickpea (Cicer arietinum), Delhi, Rabi 1967-68.

Main Treatment		Yield (kg/ha Sub-treatment		
Between row Spacing (cm)	Fertility level Kg/ha each (of N, P_2O_5 and K_2O)	Plant Spacing within row in cm. 5	10	15
30	0	615 bcdef	531 bcdef	573 abcdef
30	50	531 bcdef	583 abcdef	573 abcdef
30	100	406 cdef	406 cdef	625 abcdef
45	0	490 bcdef	719 abcd	812 ab
45	50	448 bcdef	573 abcdef	427 cdef
45	100	375 def	281 f	333 e
60	0	510 bcdef	687 abcde	927 a
60	50	469 bcdef	646 abcdef	687 abcde
60	100	667 abcde	562 abcdef	760 abc
		S. Em. ±	13 kg/ha	
		C.D. 5%	37	

Note: Same letter denotes that the treatments do not differ significantly amongst themselves.

Data in Table 76 show that a row spacing of 60 cm. and plant spacing within row of 15 cm. with no fertilizer application gave a yield of 927 kg. per hectare of chickpea at Delhi. There was, however, no significant difference between the yields of chickpea with a row and plant spacings of 60 x 15, the widest spacing used and 30 x 5 cm. the closest at the same fertility level. These data are presented graphically in fig. 25. No recommendations therefore can be made on this crop with the data obtained to date.

2. Lentils (Lens esculenta) - Variety L 9-12

A fertility-spacing experiment was conducted on lentils at Ludhiana and Pant Nagar. The experiment consisted of three row spacings (20 cm., 30 cm., and 40 cm. three plant spacings within row (5 cm., 10 cm., and 15 cm.) and three levels of fertility each of N, P_2O_5 and K_2O at the rate of 0, 50, and 100 kilogram per hectare. A split plot design was used with fertility levels and row spacings as main plot treatments and plant spacing within rows as sub-plot treatment. All the treatments were replicated four times. Fertilizer was broadcast and worked in before planting. Plot size used was 4.0Mx3.6M. Planting at Pant Nagar was in early October and at Ludhiana in early November.

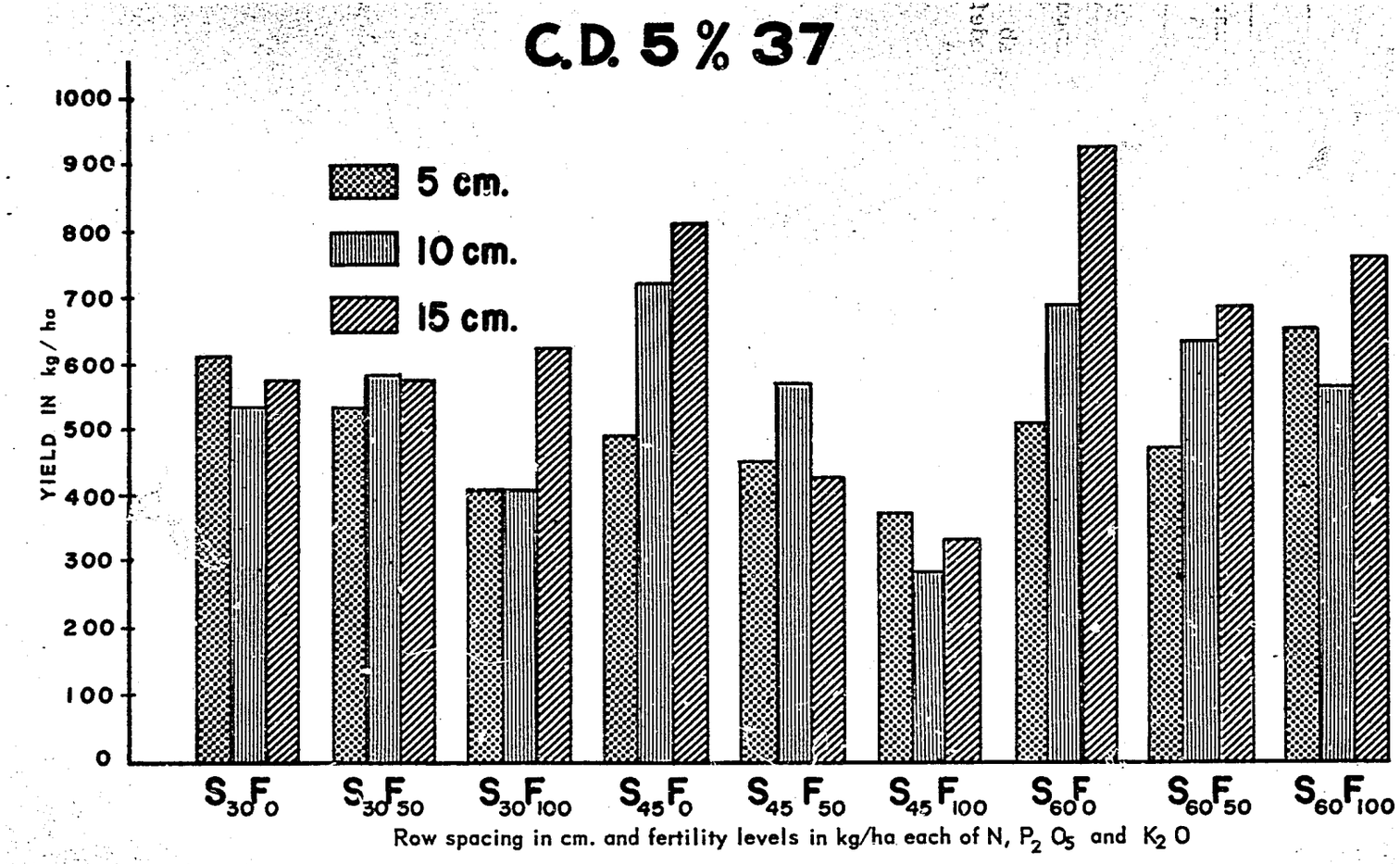


Fig. 25 - Effect of row spacings and fertility levels (Main treatments) and Plant spacings within row (sub-treatment) on yield of Chick pea, Delhi, Rabi, 1967-68.

The crop at Pant Nagar was lost because of an accidental 2,4-D spray. The crop at Ludhiana was harvested at the end of March. The yields were poor, but effects due to different row spacings and fertility levels (main treatments) are significant and the data are tabulated in Table 77. Low yields can probably be attributed in part to late planting, in part to nematode damage in the spring. The plants made little growth before cold weather set in and as soon as the weather warmed in the spring they flowered and set seed.

Table 77. Effect of different between row spacings and fertility levels (main treatments) on yield (kg/ha) lentils, Ludhiana, Rabi, 1967-68.

Treatments		
Between row Spacing (cm.)	Fertility level (kg/ha each N, P_2O_5, K_2O)	Yield (kg/ha)
20	0	165 d
20	50	300 b
20	100	316 b
30	0	206 cd
30	50	323 d
30	100	383 a
40	0	100 e
40	50	249 c
40	100	236 c
		S.Em. ± 16 kg/ha
		C.D. 5% 47

Data in Table 77 indicate that a row spacing of 30 cm. and a fertilizer dose of 100 kilograms each of N, P_2O_5 and K_2O gave the highest yield of 383 kilograms per hectare under Ludhiana conditions. With increasing levels of fertility in 30 cm. row spacing, the yield of lentils increased significantly. In 40 cm. row spacing, however, the yield decreased at 100 kilograms each of N, P_2O_5 and K_2O per hectare, even though the yields did not differ significantly at 50 and 100 kg. fertility levels. In 20 cm. row spacing, though the yields increased with increasing fertility levels, the yields at 50 kg. and 100 kg. fertility levels were equal. The data are also depicted in Figure 26.

3. Peas (Pisum sativum) - Variety T-163

A fertility-spacing experiment was conducted on peas (Pisum sativum) during rabi 1967-68 at Hissar and Pant Nagar. The experiment consisted of three row spacings (30 cm., 45 cm., and 60 cm.), three plant spacings within rows (10 cm., 20 cm., and 30 cm.) and three levels of fertility each of N, P_2O_5 and K_2O at the

rate of 0, 50, and 100 kg. per hectare. A split plot design was used with fertility levels and row spacings as main plot treatments and plant spacing within row as sub-plot treatment. All the treatments were replicated four times. Fertilizer was broadcast and worked in before planting. Plot size used was 4.0 M x 3.6 M.

Yield data from both these locations were collected and analyzed. At both the locations, the effects due to plant spacing within row (sub-treatment) are significant and the data are presented in Table 78. There was interaction between row spacing and fertility levels (main treatments) and plant spacing within row (sub-treatments) at Hissar and Pant Nagar. The data are presented in Table 79.

Table 78. Effects due to plant spacing within row (sub-treatment)on yield (kg/ha) of peas at Hissar and Pant Nagar, Rabi 1967-68.

Within row Spacing (cm.)	Location	
	Hissar	Pant Nagar
	Yield (kg/ha)	
10	2957 a	1443 a
20	2748 b	1332 ab
30	2632 b	1121 b
S.Em.±	53 kg/ha	50 kg/ha
C.D. 5%	147	139

Note: Same letter denotes that the treatments do not differ significantly amongst themselves.

Data in Table 78 show that the effects due to within row spacing at both the locations. Within row spacing of 10 cm. at both the locations gave the highest yield of peas (2957 kg/ha and 1443 kg/ha), but there was no difference between 20 cm. and 30 cm. within row spacings. The data are also depicted in Figure 27.

Data in Table 79 shows that a row spacing of 45 cm. with a fertility level of 50 kg/ha each of N, P and K gave a yield of 3323 and 1840 kg of peas per hectare with a plant to plant spacing of 10 cm. The yield decreased significantly at a dose of 100 kg/ha of N, P_2O_5 and K_2O irrespective of spacing, when the plant to plant spacing was maintained at 10 cm. These data are graphically shown in Figures 28 (a) and 28 (b).

Table 79. Effects due to row spacing and fertility levels (main treatments) and within row spacing (sub-treatment) on yield (kg/ha) of peas (Pisum sativum) at Hissar and Pant Nagar, Rabi, 1967-68.

Between row Spacing (cm.)	Fertility level (kg/ha each of N, P_2O_5, K_2O)	Location					
		Hissar			Pant Nagar		
		Within row spacing (cm.)					
		10	20	30	10	20	30
30	0	2624	2598	2207	1548	1479	1131
30	50	2832	2515	2374	1583	861	1298
30	100	2790	2748	2390	1180	1395	1402
45	0	2973	2857	3023	1250	1430	1277
45	50	3323	2424	2582	1840	1263	1284
45	100	2840	2515	2840	1493	1347	937
60	0	3248	3432	2807	1458	1263	1388
60	50	3123	2707	2673	1354	1381	1076
60	100	2915	2949	3015	1319	1590	1208
S.Em. ±			160 kg/ha			150 kg/ha	
C.D. 5%			444			417	

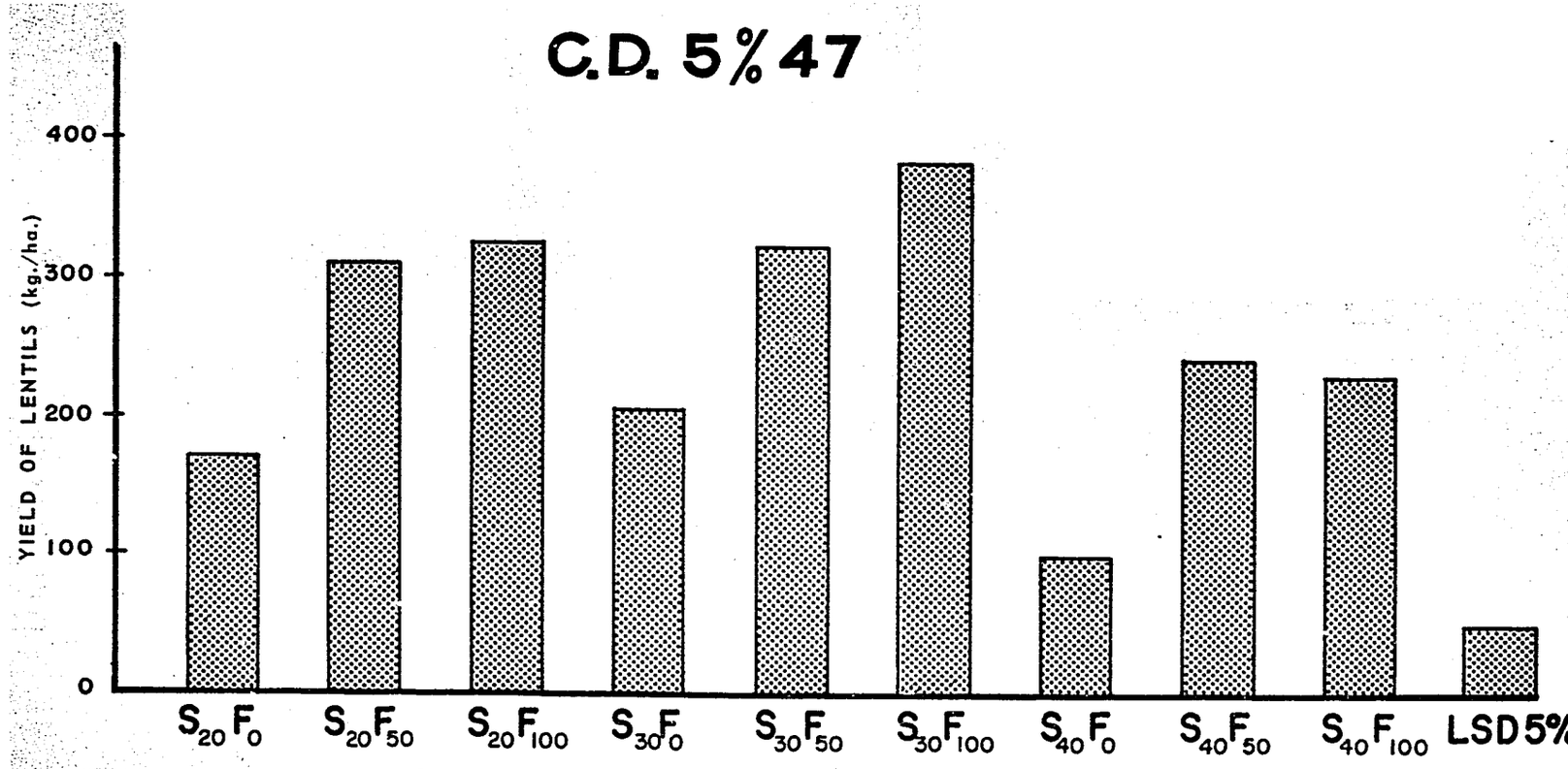
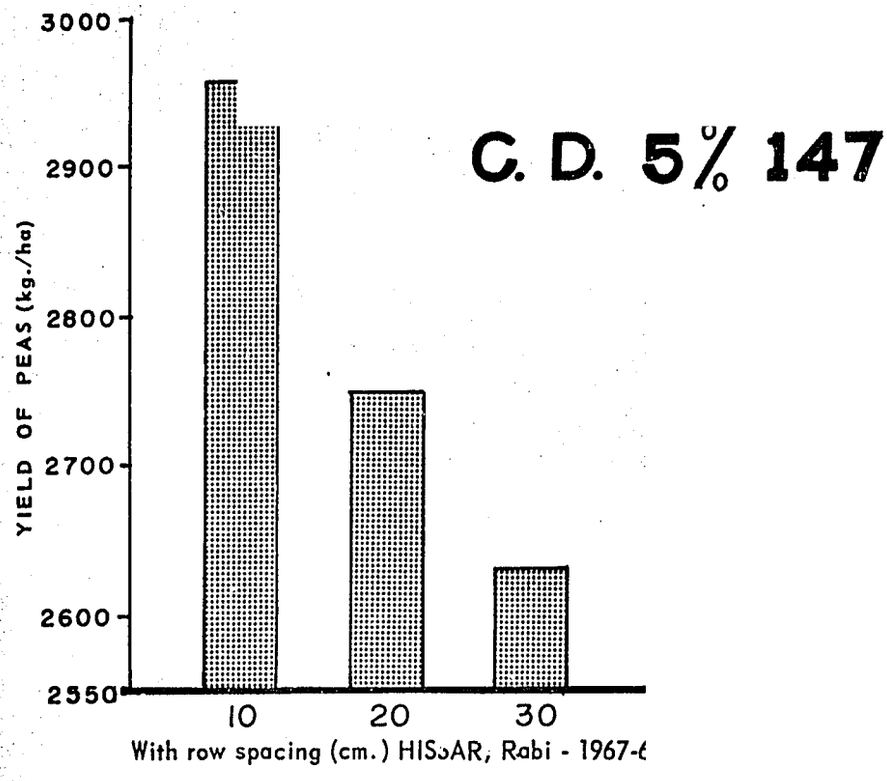
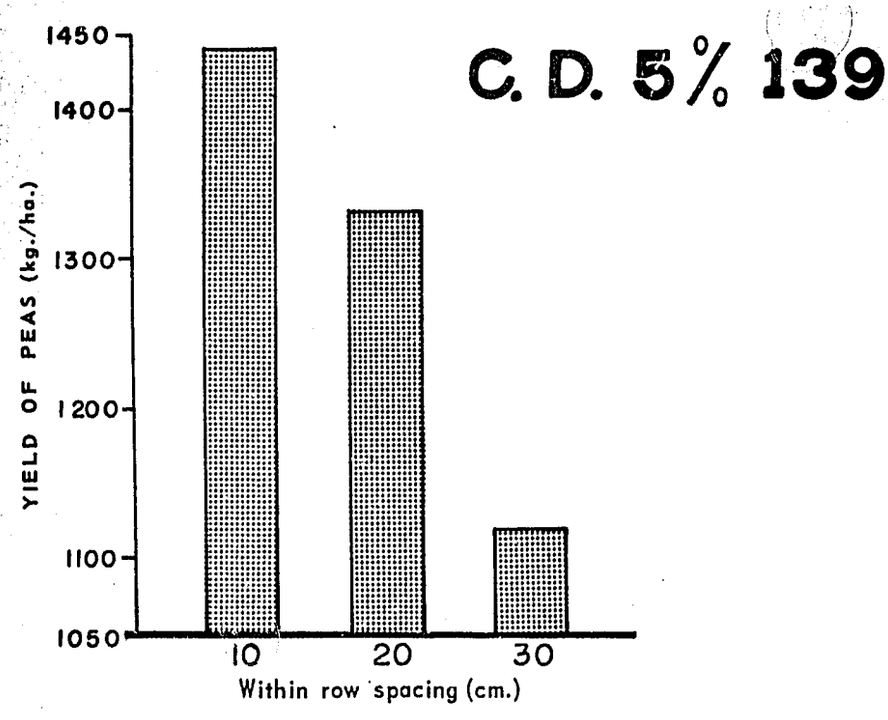


Fig.26 - Effect of different row spacings (cm) and Fertility levels (kg./ha.) Ludhiana, Rabi - 1967-68.





PANT NAGAR, Rabi - 1967-68

Fig.27: Effects due to plant spacing within row (sub-treatment) on yield of Peas (kg./ha.) at HISSAR and PANT NAGAR, Rabi, 1967-68.

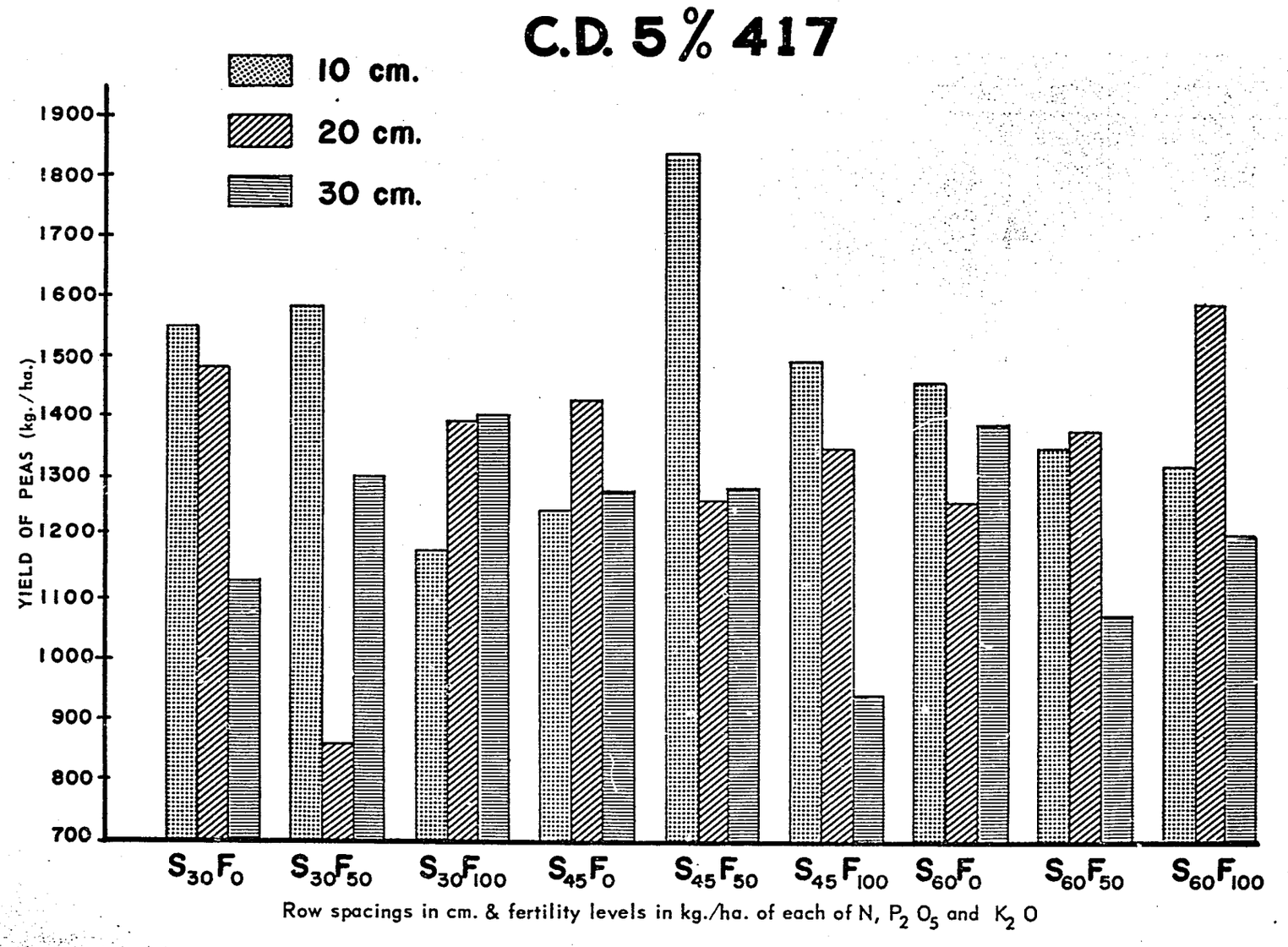
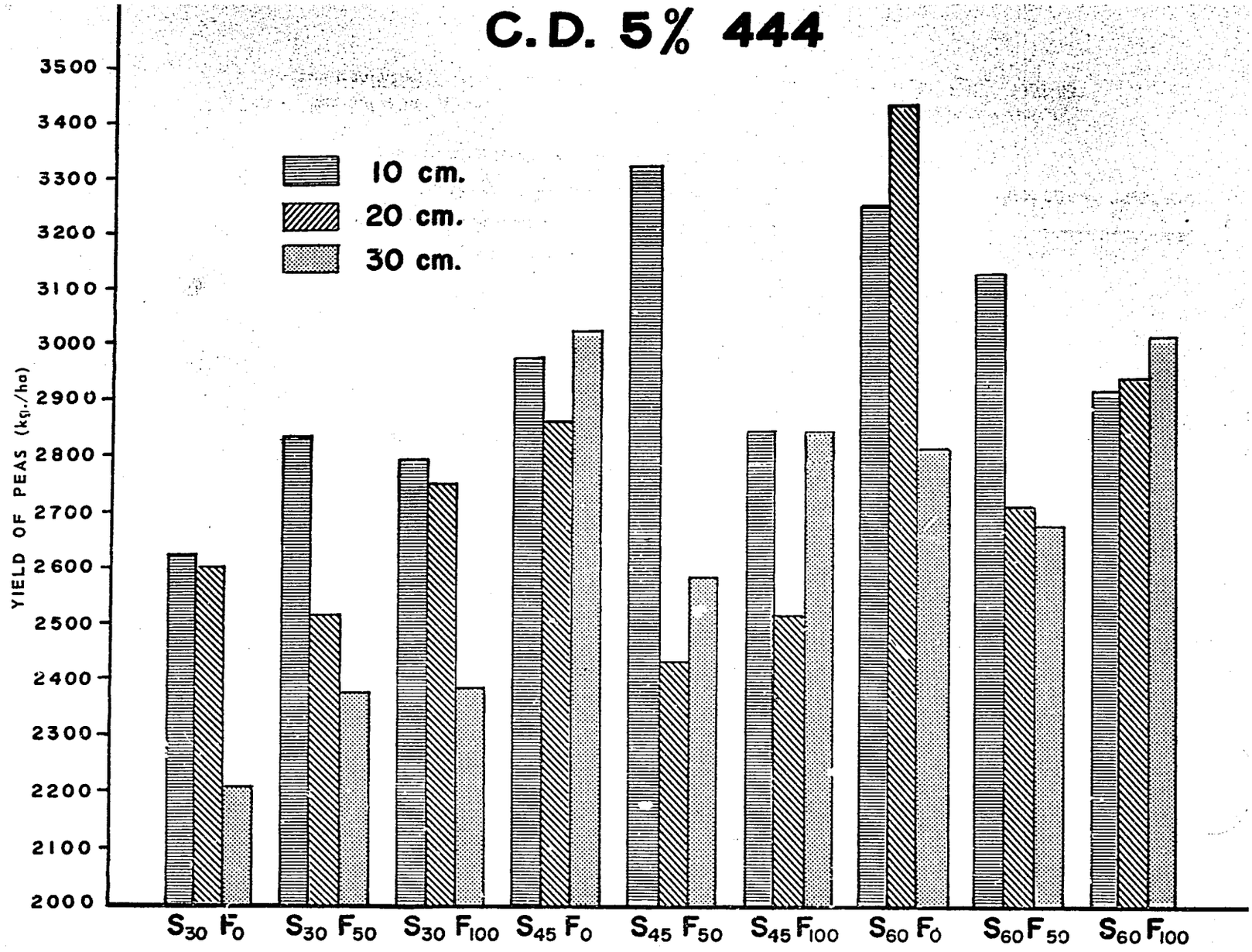


Fig.28A - Effects due to row spacing and fertility levels (Main treatments) and within row spacing (sub-treatment) on yield (kg./ha.) of Peas (Pisum sativum) at Pant Nagar, Rabi - 1967-68.



Row spacing in cm. and fertility levels in kg./ha. each of N, P_2O_5 and K_2O

Fig.28B - Effects due to row spacing and fertility levels (main treatment) and within row spacing (sub-treatment) on yield of peas (Pisum sativum) at HISSAR, Rabi - 1967-68.

B. Fertility - Inoculum Experiments

1. Chickpea (*Cicer arietinum*) - Variety G-24

An experiment was conducted at Delhi, Hissar, Ludhiana and Pant Nagar. The experiment was a factorial with four nitrogen treatments (0, 50, 100 kilogram per hectare of actual element) and rhizobial inoculum; and three levels of P_2O_5 and K_2O (0, 50, and 100 kilogram per hectare). A randomized block design was used with four replicates. Fertilizer was broadcast and then worked into the soil. Plot size used was 4.0 M. x 3.6 M. At Pant Nagar the experiment was duplicated with a "kabuli" variety, 730. Planting at all the locations was completed in October. However, as with the spacing experiments, disease completely wiped out all locations except Delhi.

The crop at Delhi was harvested in the second half of April. Effects were obtained with N, P and the interaction of P and K. The results are presented in Table 80.

Table 80. Effects of different levels of N on yield (kg/ha) of Chickpea, Delhi, Rabi, 1967-68.

N Treatment	Yield of Chickpea (kg/ha)
0 kg/ha	1437 a
50 kg/ha	1447 a
100 kg/ha	1240 a
Inoculum	1364 ab
S. Em. ±	56 (kg/ha)
C.D. 5%	158

Data in Table 80 show that the yield of chickpea increased when nitrogen was applied at 50 kg/ha. When the level of nitrogen application is further increased to 100 kg/ha, there was a decrease in the yield (1240 kg/ha) of chickpea. Data are graphically presented in Figure 29.

The effects due to different levels of P are presented in Table 81.

Table 81. Effects of different levels of P_2O_5 on yield (in kg/ha) of Chickpea. Delhi, Rabi, 1967-68

Levels of P_2O_5 (kg/ha)	Yield of Chickpea (kg/ha)
0	1510 a
50	1240 b
100	1385 a
S. Em. ±	49 kg/ha
C.D. 5%	238

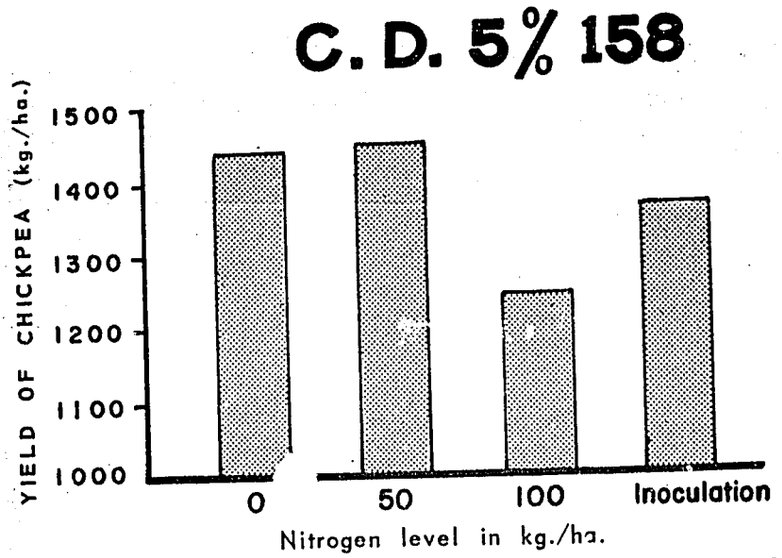


Fig.29 - Effect of different Nitrogen treatments on yield of chickpea (Cicer arietinum) DELHI, Rabi, - 1967-68.

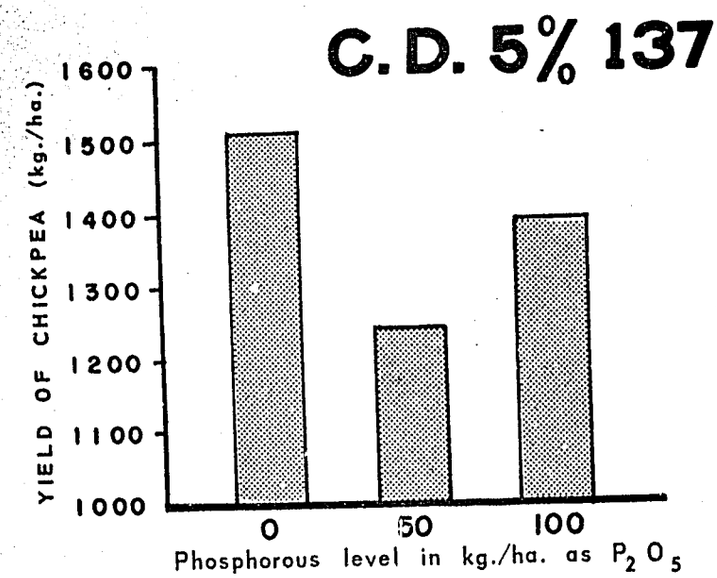


Fig.30 - Effect of different levels of Phosphorus on yield of chickpea (Cicer arietinum) DELHI, Rabi - 1967-68.

Data in Table 81 show that the yield of chickpea in the P_0 and P_{100} treatments did not differ, but the yields in these treatments, were superior to the P_{50} treatment. Data are graphically depicted in Figure 30.

The interaction effects due to P and K are statistically significant and the data are presented in Table 82.

Table 82. Effects due to interaction of P_2O_5 and K_2O on yield (kg/ha) of chickpea, Delhi, Rabi, 1967-68.

Levels of K_2O (kg/ha)	Levels of P_2O_5 (kg/ha)		
	0	50	100
0	1677 ab	1250 bc	1375 b
50	1458 ab	1385 b	1292 bc
100	1396 b	1083 c	1479 ab
S. Em. ±	85 kg/ha		
C.D. 5%	238		

Data in Table 82 reveal that in the absence of any P_2O_5, the increasing levels of K_2O had a depressing effect on yield of chickpea. There appears to have been some effect of P_2O_5 and K_2O on yield of chickpea at higher levels of these two nutrients (P_{100} and K_{100}). However, the chickpea yields were the highest (1677 kg/ha) at P_0K_0 level. Data are graphically shown in Figure 31.

2. Lentils (Lens esculenta) - Variety L-9-12

An experiment on lentils was conducted at Ludhiana and Pant Nagar during rabi 1967-68. The experiment was a factorial of four levels of nitrogen (0, 50, 100 kilogram per hectare of actual element) and inoculum, three levels of P_2O_5 (0, 50 and 100 kilogram per hectare of actual element) and three levels of K_2O (0, 50, and 100 kg. per hectare of actual element). A randomized block design was used with four replicates. Fertilizer was broadcast and then worked into the soil. Plot size used was 4.0 M x 3.6 M. At Pant Nagar the crop was lost due to 2,4-D spray.

The crop at Ludhiana was harvested at the end of March. Though the yields were poor, there were effects due to N, P, interactions between N and P and N, P. and K. These are presented in the following pages.

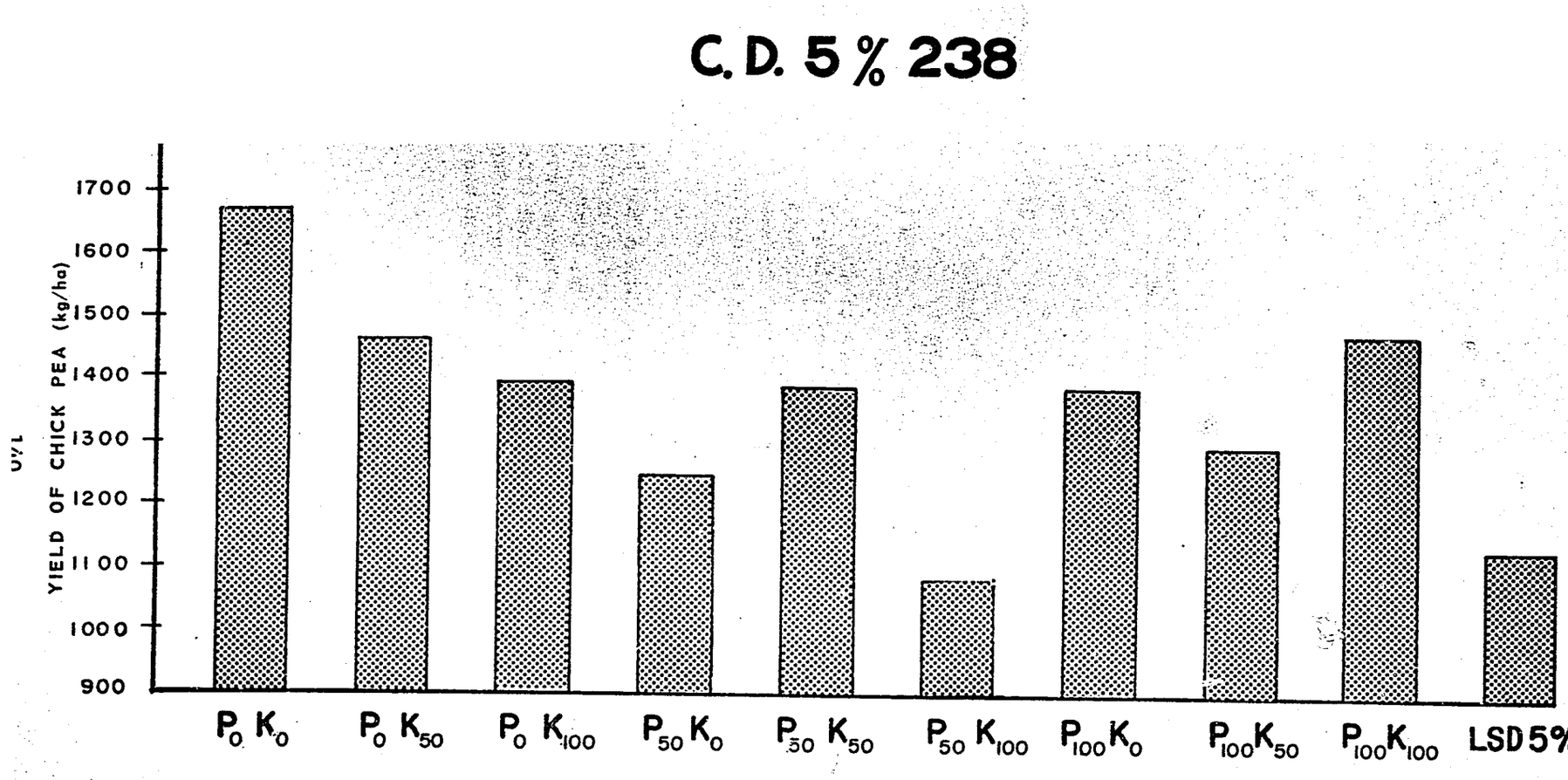


Fig. 31: Interaction of P_2O_5 and K_2O on yield of chick pea (Cicer arietinum), Delhi, Rabi, 1967-68

Table 83. Effects due to different levels of N on the yield of lentils in kg/ha at Ludhiana, Rabi, 1967-68.

Levels of N in g. per hectare.		Yield of lentils in kg/ha
0		417 a
50		365 ab
100		427 a
Inoculation		306 b
	S. Em. ±	29 kg/ha
	C.D. 5%	82

Data in Table 83 show that a dose of 100 kg. N per hectare gave a yield of 427 kg. of lentils per hectare. There was no significant difference between no nitrogen treatment and 100 kg. N per hectare. These two treatments were significantly superior to the inoculum treatment and nitrogen dose at 50 kg. per hectare. The extremely low yields obtained essentially erase the value of the statistical significance and preclude drawing of any conclusions on fertilizer effects.

Table 84. Effects of different levels of P on the yield (kg/ha) of lentils at Ludhiana, Rabi, 1967-68.

Levels of P_2O_5 in kg/ha		Yield of lentils in kg/ha
0		287 a
50		419 b
100		429 b
	S. Em. ±	26 kg/ha
	C. D. 5%	71

a in Table 84 indicate that there is a response to phosphate application, under Ludhiana conditions. The yield of lentils increased with increasing levels of P_2O_5. However, there was no significant difference in yield of lentils between 50 kg. and 100 kg. P_2O_5 per hectare. These data are graphically presented in Figure 33.

The interaction effects due to N and P_2O_5 are also significant and the data are tabulated in Table 85.

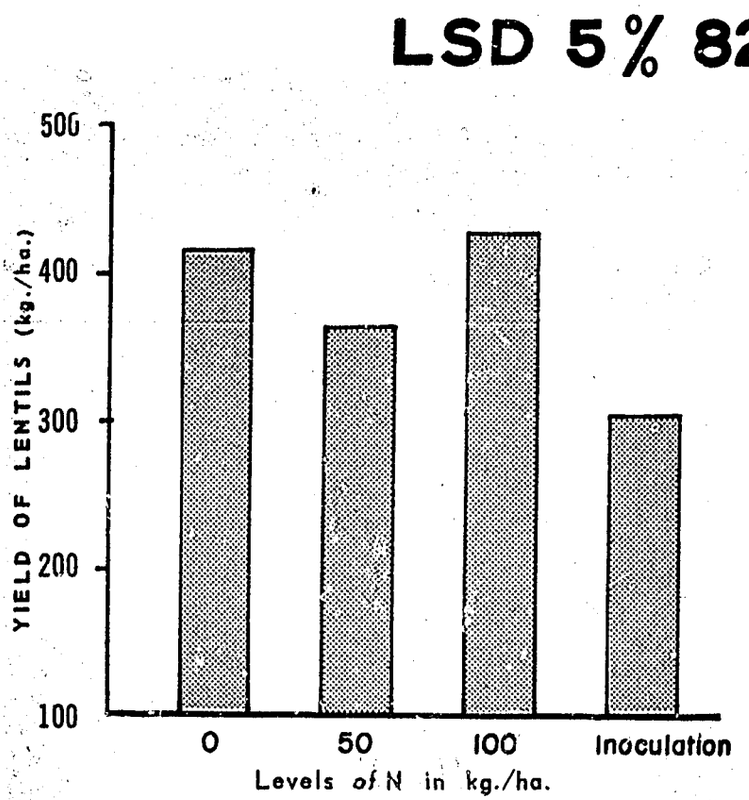


Fig.32 - Effect of different levels of Nitrogen on yield of Lenti (Lens esculenta), LUDHIANA, Rabi - 1967-68.

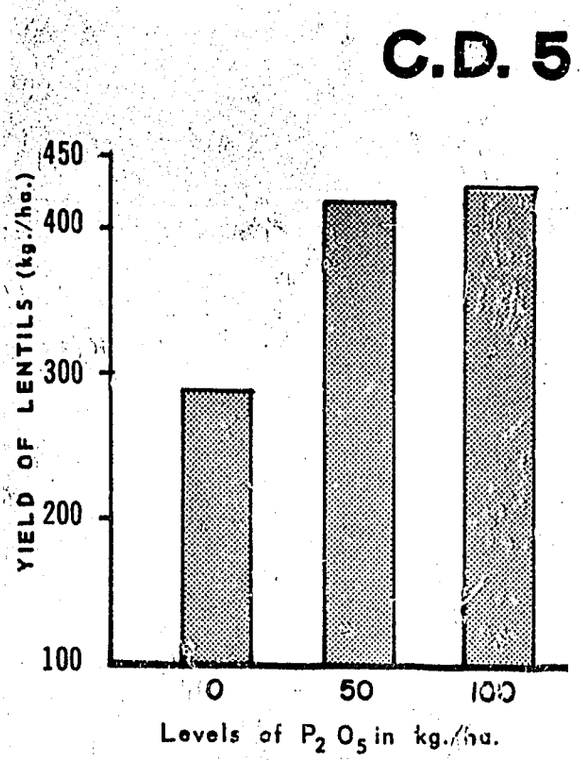


Fig.33 - Effect of different levels of Phosphorus on yield of Lentils (Lens esculenta) LUDHIANA, Rabi - 1967-68.

Table 85. Interaction of N and P on the yield of lentils at Ludhiana, Rabi, 1967-68.

Levels of P_2O_5 in kg/ha	Levels of N in Kg/ha			
	0	50	100	Inoculation
0	356 bcd	227g	303 def	265 fg
50	560 a	409 bc	409 bc	303 def
100	333 def	334 def	418 b	342 cde

S. Em. ± 51 kg/ha

C. D. 5% 72

Data in Table 85 show that the yield of lentils was the highest (560 kg/ha) at 50 kg. per hectare of P_2O_5 in the absence of any nitrogen application. With further increase in the level of P_2O_5 application, in the absence of any nitrogen application, the lentil yields are decreased. Even with a nitrogen application of 50 kg. and 100 kg. per hectare, the yield of lentils is increased with an increase in the level of P application up to 50 kg. per hectare dose, after which at 100 kg. per hectare of N and P, there is a decline in yield. These data are graphically depicted in Figure 34. The effects due to interaction of N, P, and K are also significant and data are presented in Table 86.

Data in Table 86 show that lentil yields responded differently to varying fertility levels. The highest yield obtained was 742 kg. per hectare from N_{100} P_{100} K_0 treatment. When $N_{50}K_{50}$ was combined with increasing levels of P, the yield of lentils increased. These interactions are shown graphically in Figure 35. Whether this situation would still hold if the crop had been planted earlier so that the plants could have made full growth must await further experimentation.

Table 86. Interaction of N, P_2O_5 and K_2O on yield of lentils, Ludhiana, Rabi 1967-68.

Fertility Levels (kg/ha of actual element)			Yield of lentils in kg/ha
N	P	K	
0	0	0	280
0	0	50	363
0	0	100	416
0	50	0	439
0	50	50	560
0	50	100	674
0	100	0	280
0	100	50	477
0	100	100	242
50	0	0	249
50	0	50	189
50	0	100	227
50	50	0	340
50	50	50	356
50	50	100	530
50	100	0	234
50	100	50	477
50	100	100	666
100	0	0	242
100	0	50	484
100	0	100	196
100	50	0	409
100	50	50	409
100	50	100	409
100	100	0	742
100	100	50	454
100	100	100	499
1	0	0	174
1	0	50	310
1	0	100	303
1	50	0	265
1	50	50	348
1	50	100	287
1	100	0	257
1	100	50	348
1	100	100	454

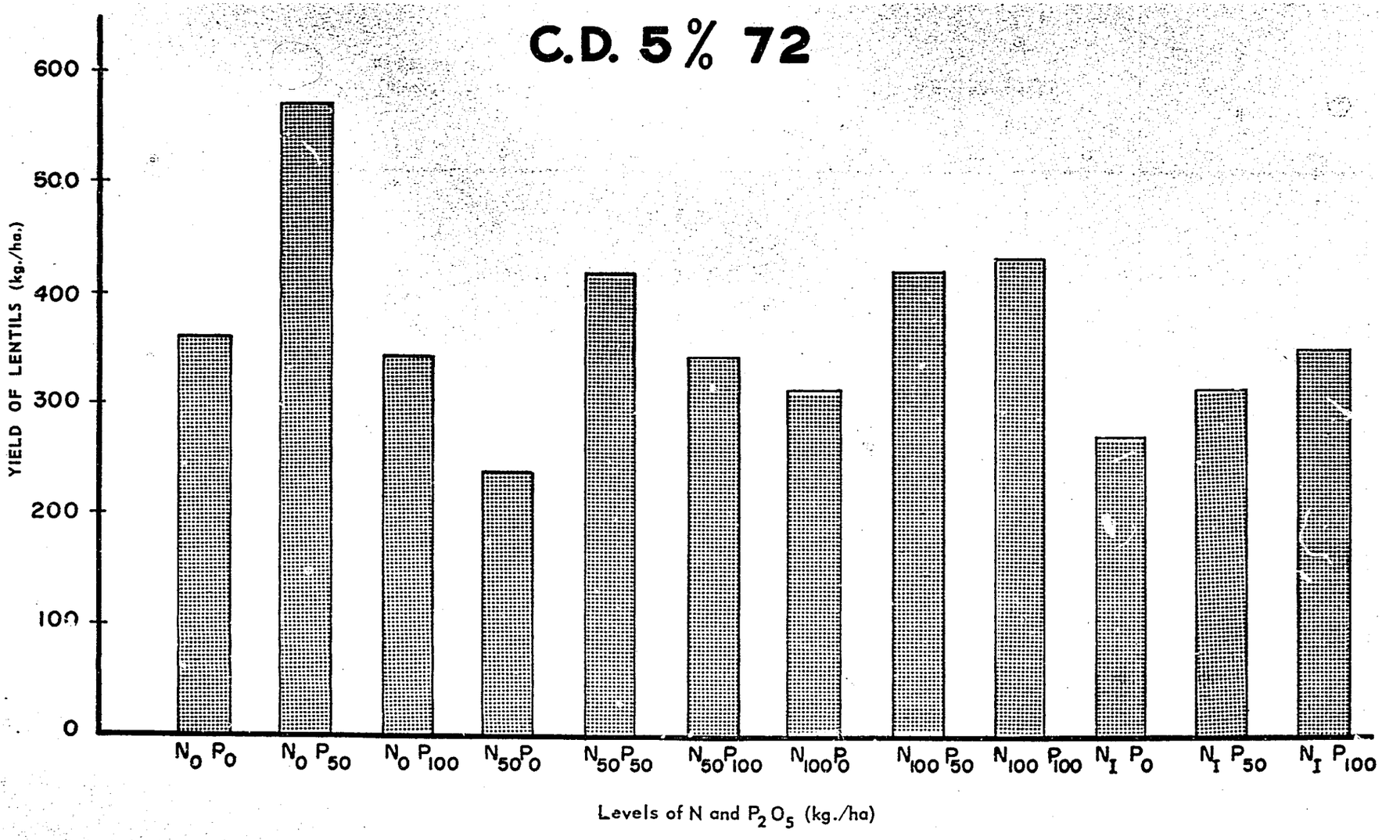


Fig. 34 - Interaction of Nitrogen and Phosphorus on the yield (kg./ha) of lentils (Lens esculenta) at Ludhiana, rabi - 1967-68.

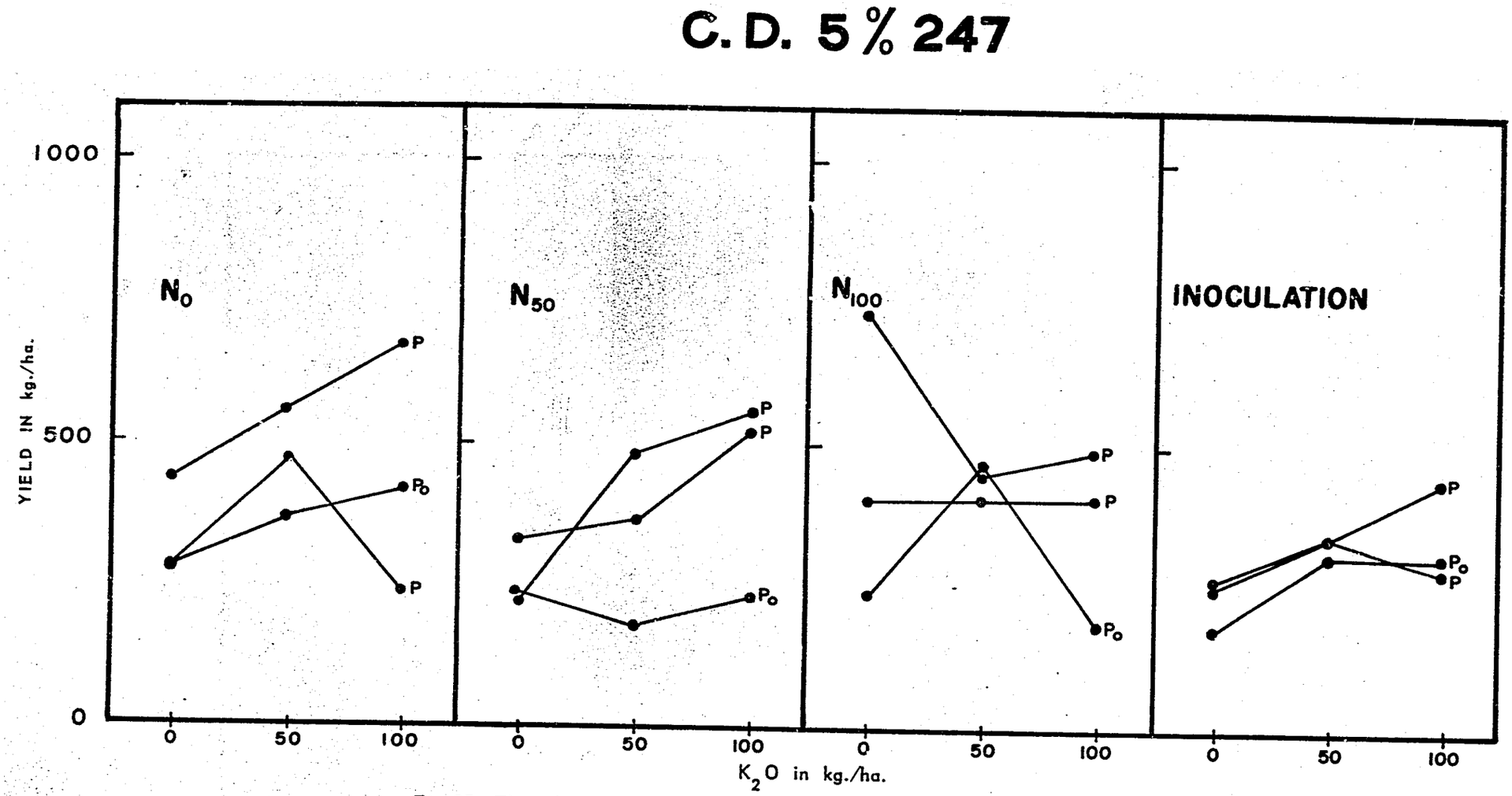


Fig. 35 - Three factor interaction of N, P_2O_5 and K_2O with Lentils (Lens esculenta) at LUDHIANA, Rabi – 1967-68.

3. Peas (Pisum sativum) - Variety T-163

An experiment was conducted at Hissar and Pant Nagar. The experiment was a factorial of four nitrogen treatments (0, 50, and 100 kilogram per hectare of actual element and inoculum) three levels of Phosphorus (0, 50, and 100 kilogram per hectare) and three levels of Potassium (0, 50, and 100 kilogram per hectare). A randomized block design was used with four replicates. Fertilizer was broadcase and then worked into soil. Plot size used was 4.0 M. x 3.6 M. No effect was obtained due to either N, P_2O_5 and K_2O nor their two-factor interactions. At both locations, the interaction effect, due to N, P_2O_5 and K_2O was significant. The data are presented in Table 87.

Data in Table 87 reveal that the yield of peas due to different fertility treatments varied from 3052 kg. per hectare to 4366 kg. per hectare at Hissar and from 1428 kg per hectare to 2496 kg. per hectare at Pant Nagar location. This is shown graphically in Figure 36.

C. Phosphorus Placement, Chickpea, Variety G-24.

An experiment was conducted at Delhi to evaluate the effect of phosphorus fertilization at five levels in varying combinations with two levels of nitrogen and potassium. In all cases N and K was broadcast and rototilled before planting. With P in one case the same procedure was followed. In the other P was placed in a furrow and covered before planting.

There was no difference between treatments. Yields are reported below:

Broadcast	Placement
1600 kg/ha	1637 kg/ha
S. Em. ±	42
C. D. 5%	120

D. Weed Control Trial

A preliminary weed control trial was conducted at Delhi to (a) assess the losses due to unrestricted weed competition in four important rabi pulses, viz., chickpea (Cicer arietinum), lentil (Lens esculenta), lathyrus (Lathyrus sativus), and peas (Pisum sativum), and (b) to study the tolerance of these pulse crops to Treflan (trifluore, 2, 6-dinitre, N.N. dipropyl -p- toluidine) at 1 kg/ha; Balan (2, 6- dinitre -p- toluidine) at 1 kg/ha; Eptam (S-Ethyl dipropyl - thiocarbamate) at 3 kg/ha; knoxweed (S-Ethyl dipropyl - thiocarbamate 46.9% + iso Octyl ester of 2,4-D 35-4%) at 3 kg/ha; and Amiben (3 amino, 2,5 - dichlorobenzoic acid) at 3 kg/ha.

Table 87. Interaction of N, P, and K on yield of peas, Hissar and Pant Nagar, Rabi, 1967-68.

Fertility Levels (kg/ha)			Yield of Peas (kg/ha)	
			Hissar	Pant Nagar
N	P_2O_5	K_2O		
0	0	0	3885	2147
0	0	50	3885	1163
0	0	100	4366	1491
0	50	0	3468	1819
0	50	50	3931	1914
0	50	100	3931	2063
0	100	0	3811	1661
0	100	50	3792	1893
0	100	100	3903	2190
50	0	0	3875	1946
50	0	50	3607	2042
50	0	100	3903	2370
50	50	0	3626	1428
50	50	50	3653	1227
50	50	100	4042	1692
50	100	0	3700	1672
50	100	50	3394	2232
50	100	100	3533	1788
100	0	0	4301	1946
100	0	50	3441	2105
100	0	100	3764	1989
100	50	0	3746	1957
100	50	50	2960	1925
100	50	100	3376	1946
100	100	0	3283	2412
100	100	50	4023	1555
100	100	100	4116	1999
Inoculum	0	0	3700	1999
Inoculum	0	50	3302	2158
Inoculum	0	100	3052	2063
Inoculum	50	0	3579	1978
Inoculum	50	50	3579	1766
Inoculum	50	100	3487	2020
Inoculum	100	0	3579	1618
Inoculum	100	50	3764	2496
Inoculum	100	100	3348	2200
		S. Em ±	308 kg/ha	269 kg/ha
		C.D. 5%	855	746

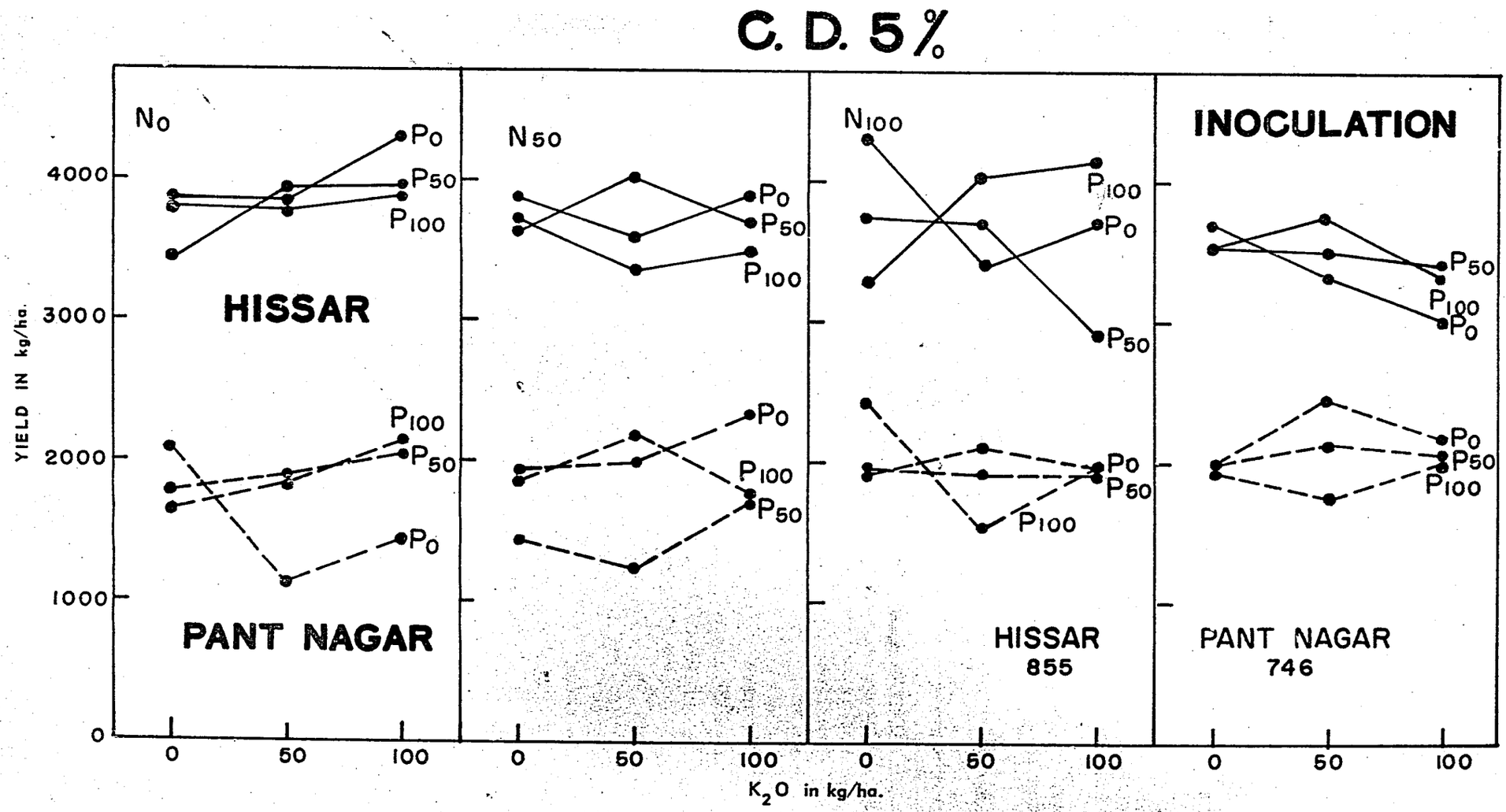


Fig.36: Three factor interaction of N, P_2O_5 and K_2O with Peas (Pisium sativium) at PANT NAGAR and HISSAR, Rabi, 1967-68

Requisite amounts of herbicides, except Amiben, were sprayed before the final cultivation and incorporated into the soil with a rototiller immediately after application. The crop was sown the next day (October 21, 1967).

Observations at regular intervals showed that the germination of these pulses was not affected by the herbicides except in the case of knoxweed treated plots, small patches were seen here and there. Eptam and knoxweed caused slight crinkling of the leaves but the symptoms later on disappeared.

The major weeds in the experiment plot were wild oats (Avena fatua), Senji (Melilotus parviflora), and Medicago denticulata. Other weeds like Chenopodium album, Spergula arvensis, Fumaria parviflora and Anagallis arvensis were also seen.

Data in Table 88 gives an idea of weed population count taken from five spots at random in each plot.

Table 88. Weed population per 2.50 sq. meters.

Crop	Treatment	Dicot	Monocot	Total weed population
Chickpea	Average of plots having no herbicide sprayed.	139.3	55.0	194.3
	Treflan	52	7	59
	Balan	100	38	138
	Eptam	73	2	75
	Knoxweed	87	10	97
	Amiben	107	68	175
Lentil	Av. of plots having no herbicide sprayed.	172.0	40.3	212.3
	Treflan	82	11	93
	Balan	92	24	116
	Eptam	116	6	122
	Knoxweed	112	10	122
	Amiben	119	44	163
Lathyrus	Av. of plots having no herbicide sprayed.	189.3	38.6	227.3
	Treflan	65	7	72
	Balan	129	19	148
	Eptam	101	4	105
	Knoxweed	121	10	131
	Amiben	137	53	180
Peas	Av. of plots having no herbicide sprayed.	149.6	40.6	190.2
	Treflan	73	1	74
	Balan	106	31	137
	Eptam	115	5	120
	Knoxweed	65	9	74
	Amiben	135	28	163

Data in Table 88 indicate that Treflan and Eptam were most effective in reducing weed infestation. The weed population under these treatments ranged from 59 to 180 and 190.2 to 227.3 respectively of that under plots not sprayed with herbicides. Out of these five herbicides tried, Amiben gave the poorest control of weeds in these four crops.

To get an idea of weed growth in different treatments green weight of weeds was noted after about five month's of sowing of crops (in the second week of March, 1968) and the data are presented in Table 89.

Table 89. Weight of fresh green weeds in kg/ha.

Treatments	Crop			
	Chickpea	Lentils	Lathyrus	Peas
Control (no weeding)	57140	57330	59620	13330
Handweeding once	14190	10470	37330	2950
Handweeding twice	570	450	11240	Nil
Treflan	31800	31050	29900	1900
Balan	49330	38280	56570	4190
Eptam	35600	49900	40950	6000
Knoxweed	43620	41140	42670	8000
Amiben	60000	62860	58480	10280

Data in Table 89 shows that only the pea crop had the ability to compete successfully with the weeds. Tall growing weeds like wild oats and senji were responsible for the death or very poor stand of chickpea, lentil, and lathyrus plants.

One hand weeding was not found to be sufficient control of weeds in lathyrus. Almost complete weed control was possible with two hand weedings.

Of all the herbicides screened in this trial, Treflan alone appears to be of value.

Summer 1968

A. Spacing-fertility trials:

During the 1968 summer season (March-June) work was initiated on mungbean and chickpea. An experiment for testing the performance of mungbean and chickpea varieties at different between row spacing, within row spacing and fertilizer levels was planted at Delhi, Kanpur, Hissar, and Pant Nagar.

Mungbean varieties were T-1, Jalgaon 781, and Pusa Baisakhi. Chickpea varieties were three Iranian varieties. As growing conditions in Iran during this season are similar to those of Northern India it was thought that the Iranian varieties might be better adjusted than the Indian varieties which are grown as a cool season winter crop.

At all locations the chickpeas planted in March came up, made good growth for a few weeks but then died. The cause was not determined. Salinity and gram wilt are probable causes. The mungbean crop at Pant Nagar was destroyed by caterpillars. At Hissar lack of timely irrigation due to the canal being dry destroyed most of the stand. At Kanpur the mid-March sowing had a very poor stand. It was replanted in mid-April and a good stand was obtained. However, the plants were never very thrifty and there was moderate virus infection, both yellow mosaic and crinkle virus.

Land for fertilizer trials was not available at Delhi until mid-May. The experiment was planted there on 16 May, 1968. Variety Jalgaon J-781 was heavily infected by crinkle virus symptoms and did not set seed. Whether this was due to climatic conditions or virus infection could not be ascertained. Variety T-1 made good growth but in late June when it should have been harvested it had not yet flowered. It then started growing again and this late growth was heavily infected with yellow mosaic virus, so no yield was obtained. Pusa Baisakhi made good growth. Details of the experiment and data on this variety follow.

A split plot design was utilized with varieties and between row spacing in the main plots and within row spacing and fertilizer levels in the sub-plots. Plot size was 1.8 x 3 m. There were three replications. Between row spacings were 20 and 30 cm., within row spacings were 2.5, 5, and 7.5 cm., fertility levels were no fertilizer, 50 kg/ha of N and P_2O_5 and 100 kg/ha of N and P_2O_5.

The crop was harvested in four pickings. When the rains came, there was a problem of slightly immature seed germinating in the pods. Despite this when mature pods were picked and utilized immediately for the Kharif planting, the seed was dormant. There was no difference in yield due to treatment. Lack of fertilizer response could have been due to the fact that the crop followed a heavily fertilized wheat crop. Yields are reported in Table 90.

Table 90. Effects of different between row and within row spacing and fertility levels on yield of mungbean variety Pusa Baisakhi, Delhi, Summer, 1968.

Fertility Level kg/ha N & P_2O_5	Within row spacing in cm.	Yield in kg/ha Row spacing (cm.)	
		20	30
0	2.5	950	664
	5.0	955	646
	7.5	874	524
50	2.5	855	409
	5.0	806	376
	7.5	645	679
100	2.5	874	551
	5.0	751	553
	7.5	598	377

The most interesting observation about all of the summer trials is that all varieties made poor growth when planted in March, better but not good growth when planted in April and good growth when planted in May. Climatic factors appear to be involved and these are being tested in growth chambers.

B. Foliar application of Phosphate:

An experiment was laid out at Delhi and Pant Nagar to study the response of mungbean variety Pusa Baisakhi to soil and foliar applications of phosphate. The experimental design is the same as that reported under Kharif 1968. Yield data is shown in Table 91 for Delhi. As with the spacing fertility trial the high level of residual phosphorus from the preceeding wheat crop may have precluded getting any response. The Pant Nagar planting was lost to a caterpillar attack.

Table 91. Effect of different doses of phosphates applied through soil and foliage on yield of mungbean Variety Pusa Baisakhi, Summer 1968, Delhi

P_2O_5 Treatments	Yield kg/ha
Control	624
25 kg/ha - all foliage	608
50 kg/ha - all soil	762
50 kg/ha - 1/2 soil and 1/2 foliage	674
50 kg/ha - 1/2 foliage	724
75 kg/ha - all soil	663
75 kg/ha - 1/2 soil and 1/2 foliage	803
100 kg/ha - all soil	718
100 kg/ha - 1/2 soil and 1/2 foliage	721
S. Em±	285

C. Water requirement of summer Mungbean:

An experiment was designed to determine the water requirement of two varieties of summer mungbean varieties T-2 and Jalgaon 781. The experiment was planted in early March. Both varieties flowered and set seed. However, vegetative growth was slight, the plants grew only 3-4" tall and produced but 3-4 pods per plant. Even with this low yield per plant a fair yield could have been harvested with high enough plant populations. No conclusions were drawn on water consumption and efficiency.

D. Pot experiment on placement of phosphorus:

A pot experiment was conducted to study the effect of three levels of phosphorus (25, 50 and 75 kg/ha of P_2O_5) and give methods of application (mixing in top 10 cm., placement at 5 cm., 10 cm, and 15 cm. deep) and half soil + half foliar on moong (variety Pusa Baisakhi) at Delhi. Four plants per pot were maintained. Randomized block design with three replicates was used. Sowing was done on April 24, 1968 and the crop was harvested in eight pickings starting from June 10 to September 15, 1968.

Different levels of P_2O_5 did not have any significant effect on yield of moong. Various methods of application, however, had significant effects. Placement of 10 to 15 cm. gave the best yield (23.61 gm/pot and 24.64 gm/pot). There was a significant interaction between different levels of P_2O_5 and methods of application. Placement at 15 cm. below seed and 50 kg/ha of P_2O_5 treatment yielded maximum (25.63 gm/pot) as compared to 1/2 soil + 1/2 third foliage at 75 kg/ha of P_2O_5.

E. Summarization of Summer Season 1968 results:

The results with the Pusa Baisakhi mungbean at Delhi as well as results obtained by university scientists at Hissar and Pant Nagar on selected mungbean varieties show that this crop has potential as a summer crop. However, our results as well as observations made on several cultivators fields indicate the need for extreme caution in recommending pulses for the summer season. The failures with chickpea, and with several varieties of mungbean at various planting dates point out the fact that there are environmental effects which influence performance and that these vary from variety to variety. Also water use is much higher and an assured irrigation supply is essential if the crop is not to be lost.

Kharif 1968

During Kharif 1968, soil and crop management experiments were conducted on fertilization, plant density, foliar nutrition, chemical weed control and influence of simazin on protein content. These trials were conducted at Delhi, Hissar, Hyderabad, Kanpur, Ludhiana and Pant Nagar. The crops studied were mungbeans (Phaseolus aureus), urd beans (Phaseolus mungo), and pigeon pea (Cajanus cajan) and cowpea (Vigna sinensis).

A. Fertility - Spacing Experiments:

1. Pigeon Pea (Cajanus cajan)

A fertility spacing experiment was conducted at Delhi, Hyderabad, Kanpur, and Pant Nagar. At Hyderabad and Kanpur the experiment was identical to the spacing fertility experiments described for rabi crops. At Delhi and Pant Nagar a slightly different design was used as described below.

At Kanpur and Hyderabad both long term and short term varieties were tested. The commonly grown pigeon pea is the long term one, but last year s results indicated that the short term varieties, if properly managed would compete favorably with the long term varieties. Testing of long term varieties at Delhi and Pant Nagar is precluded because of danger of frost.

The results of the trials with short term varieties is reported here, the results of the long term varieties will be reported with the 68-69 rabi crops. Variety T-21 was planted at Delhi and Hyderabad. At Kanpur three varieties were used, T-21, T-7, a long term variety with erect habit of growth, and T-17, a long term variety with a spreading habit of growth (Figure 37). At Hyderabad variety T-17 and T-21 were planted. In addition a trial was conducted with three short term lines from the germ plasm, No. P-4758, P-4785, and P-4839. The experimental layout was the same as the T-21 spacing trial at the high fertility level so that results would be directly comparable with the T-21 trial. Spacings with the long term varieties were 90, 120, and 150 cm. between rows and 40, 60, and 80 cm. between plants within the row. With the short term varieties between row spacings were 60, 90, and 120 cms., and distance between plants within the rows was 20, 40, and 60 cm.

At Kanpur flood destroyed most of the crop. Replanting was accomplished but the replants did not catch up with the original planting. In addition a wilt-like disease not previously reported (which is described more fully in the pathology section) destroyed most of the plants remaining from the original planting. Therefore no meaningful data was obtained from the Kanpur location.

Planting dates were last week of July at Delhi, first week of July at Hyderabad, week of June 17 and July 1 at Kanpur, June 14 at Pant Nagar, July 10-13 at Hissar and July 20-21 at Ludhiana. In Delhi the same disease mentioned

Figure 37. Pigeon pea varieties.
Left: T-7, tall, erect, late maturing (250-300 days).
Middle: T-17, tall, spreading, late maturing.
Right: T-21, short, semi-spreading, early (130-150 days).

above wiped out the entire experiment. There was no monsoon in Hyderabad this season and irrigation water became unavailable after mid-August. As a result all yields were extremely low. There were no yield differences due to fertility levels in the T-21 trial. There were yield differences due to between row and within row spacings. However, because of the poor growth the plants had not filled in the rows in any of these spacings. Results of spacing effects for both the germplasm trial and the T-21 trial are consolidated in Table 92.

Table 92. Average yield of treatments (kg/ha), T-21 and germplasm lines, pigeon pea, Hyderabad, 1968.

Between Row Spacing (cm)	Varieties					Within Row Spacing (cm)		
	P-4758	P-4785	P-4839	T-21	Mean	20	40	60
50	938	747	369	682	684	1033	579	441
90	524	513	266	482	434	650	372	280
120	453	450	186	386	363	558	322	211
Mean	638	570	274	496	Mean	747	424	311
Within Row Spacing	996	840	405	697	747			
	502	536	235	452	424			
	417	334	181	341	311			
	Varieties Between Row Spacing					Within Row Spacing		
	S.E./M. ±		106		62	45		
	C.D. 5%		---		191	129		

At Pant Nagar response of pigeon pea (T-21) to three fertility levels and three plant population rates was tested for the second year. The treatments consisted of three within row spacings 20, 33, and 66 cms. calculated to give plant population rates of 30,000, 40,000, and 50,000 plants per hectare, three between row spacings 50, 75, and 100 cm. and three fertility levels 30N+40P+20K, 60N+80P+40K, and 90N+120P kg/ha each of actual element. Data are shown in Table 93.

Data in Table 93 show that there was no significant difference in yield between 40,000 and 50,000 plants/hectare (2038 and 2050 kg/ha). These treatments, however, were significantly better than 30,000 plants/ha (1904 kg/ha). As regards the effect of between row spacing, the yields were the same in the 50 and 75 cm. row spacing (2108 and 2036 kg/ha) which were higher than the yield (1850 kg/ha) in 100 cm. spacing treatment.

Table 93. Effect of varying plant population rates, row spacings, and fertility levels on the yield of pigeon peas, Variety T-21, Pant Nagar, Kharif, 1968.

Within row spacing (cm)	Yield kg/ha	Between row spacing	Yield kg/ha
66	1904 b	50	2108 a
33	2038 a	75	2036 a
20	2050 a	100	1850 b
S.Em. ±	35		35
C.D. 5%	101		101

Note: Same letter denotes that the treatments do not differ significantly amongst themselves.

There was no effect due to the various fertility levels. This is in agreement with last year's results. However, yields this year were lower than last year's. This is attributable to heavy hail storms on October 1 and 2 which knocked off many blossoms.

2. Mungbean (Phaseolus aureus) and Urd bean (Phaseolus Mungo)

Because of the similarity of growth and cultural practices these two crops will be treated in one section. Fertility spacing experiments on mungbeans and urd beans were planted at Delhi, Hissar, Ludhiana, Kanpur, and Pant Nagar. Short term varieties were planted at Hissar, long term varieties at Ludhiana, Kanpur and Pant Nagar, and both long and short term varieties at Delhi. Experimental design was the same as described for pigeon pea at the first location except that plot size was reduced to 1.8 x 4 meters. At Pant Nagar the experiment was modified somewhat to fit local conditions. Between row spacings from short term varieties were 15, 25, and 35 cm. and within row spacing 2.5, 5, and 7.5 cm. In long term varieties the between row spacing 30, 45, and 60 cm., and within row spacing 5, 10, and 15 cm. at Ludhiana and Pant Nagar. At Delhi the same spacing as with the short term varieties was maintained. At Ludhiana because of the sandy nature of the soil, nitrogen was applied in split doses. Varieties used were: at Delhi short term mungbean T-1, Jalgaon, 781, and Pusa Baisakhi, long term mungbean 6009, short term urd bean T-9, and long term urd bean T-65 and 1-1; at Hissar short term mungbean variety Jalgaon, 781, and short term urd T-9; at Kanpur long term mungbean 6009; at Ludhiana long term mungbean 54 and long term urd 64; at Pant Nagar long term mungbean 6009.

At Delhi none of the varieties gave good growth. Several trials were completely lost due to nematode damage. In the varieties that survived growth was poor and stand too spotty to get any information.

At Kanpur the crop was completely washed out by a flood resulting from heavy rains.

Data from the trial at Hissar in Table 94 show that close within-row plant spacings generally depress yields while row width has little or no effect. Thes data are also shown in Figure 38.

Table 94. Effect due to between row and within row spacings on the yield of urd bean at Hissar, Kharif, 1968.

Spacings (cm.)		Yield of Urd beans (kg/ha)
Between row	Within row	
15	2.5	834 b
15	5.0	1009 ab
15	7.5	1179 ab
25	2.5	623
25	5.0	1053 ab
25	7.5	972 ab
35	2.5	935 ab
35	5.0	845 b
35	7.5	1099 ab
C.D. 5%		318

Data in Table 95 (Interaction Table) reveal that with high fertility (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 and with low fertility and low population, the yield was 1633 kg/ha. The high yield with low fertility treatment is explained by the initial fertility status of the experimental field.

Table 95. Effects due to different fertility levels (Main Treatments) and row a plant spacings (sub-treatments) on the yield of urd beans Variety T-9 at Hissar, Kharif - 1968.

Yield in kg/ha

Spacing		Fertility Levels (kg/ha) each of N, P_2O_5 and K_2O of actual element		
Between row (cm.)	Within row (cm.)	0	50	100
15	2.5	857	620	1026
15	5.0	679	1072	1275
15	7.5	579	1379	1579
25	2.5	662	558	646
25	5.0	873	1320	966
25	7.5	906	948	1062
35	2.5	863	743	1200
35	5.0	1002	632	901
35	7.5	1633	637	1027
C.D. 5%			551 kg/ha	

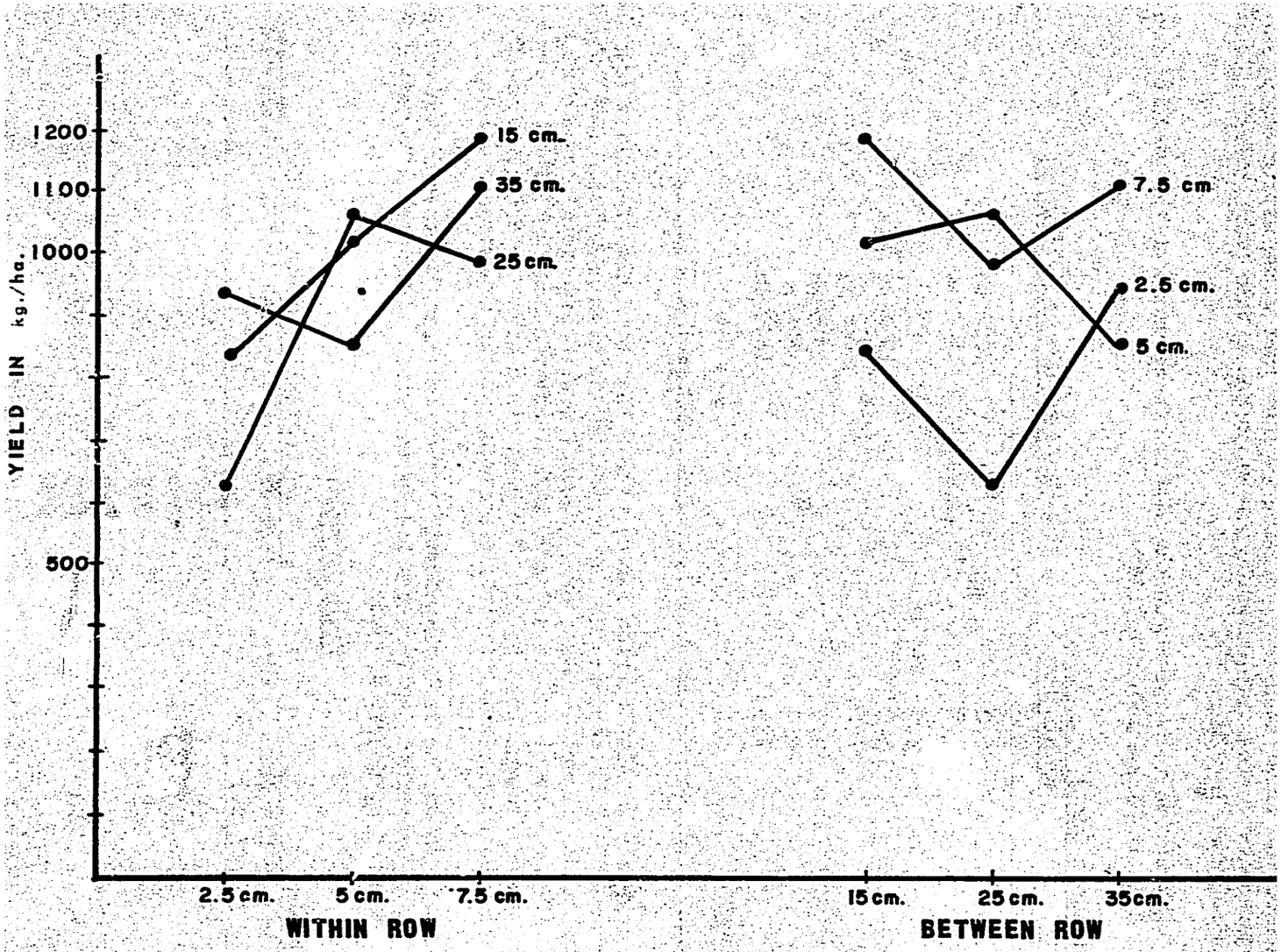


Fig.38 - Effect of between row and within row spacing on yield Kg./ha of Urad Beans (T-9 Variety), HISSAR, Kharif - 1968.

At Hissar in 1968 the growth of urd beans was better than that of mungbeans. Last year at this location the reverse was true. With the closer within row spacings with urd beans the yield decreased with the 2.5 cm. spacing this year. With mungbeans where the growth and yield was poorer this effect was not noticed. Although more years' data are needed, 15 x 7.5 cm. appears to be a good spacing pattern for getting maximum yield in a poor season without decreasing yield due to crowding in a good season. Wider than 7.5 cm. within row spacings need to be investigated. The poor growth of mungbean J-781 at this location precludes any conclusions. Data are given in Table 96.

Table 96. Effects due to between row and within row spacings on seed of mungbean, Variety J-781, Hissar, Kharif, 1968.

Spacing (cm.)		Yield (kg/ha) Fertility Level (kg/ha of N, P_2O_5, K_2O)		
Between row	Within row	0	50	100
15	2.5	80	139	197
15	5.0	68	112	171
15	7.5	106	149	217
25	2.5	53	156	81
25	5.0	79	161	142
25	7.5	73	117	161
35	2.5	78	117	198
35	5.0	139	147	173
35	7.5	159	113	171

No statistical significance.

At Ludhiana the results with mungbean (No. 54) were too low to make any valid conclusion. Results are given in Table 97.

With urd variety No. 64 yields were also low although somewhat higher than mung yields and showed a decrease with fertility levels (Table 98).

Table 97. Effects of between row and within row spacing on yield of mungbean Variety No. 54, Ludhiana, Kharif, 1968.

Spacing (cm.) Between row	Within row	Yield (kg/ha)
30	5	190 ab
30	10	169 abcd
30	15	176 abc
45	5	155 abcd
45	10	124 d
45	15	201 a
60	5	137 cd
60	10	125 d
60	15	144 bcd
S.Em ±		17 kg/ha
C.D. 5%		47 kg/ha

Note: Same letter denotes that the treatments do not differ significantly amongst themselves.

Table 98. Effects due to fertility levels on yield (kg/ha) of urd beans Variety No. 64, Ludhiana, Kharif, 1968.

Fertility levels (kg/ha)	Yield (kg/ha)
0	414 a
50	353 ab
100	322 b
S. Em. ±	24 kg/ha
C.D. 5%	83 kg/ha

One reason for not getting any response to N, P_2O_5 and K_2O could be the high fertility status of the soil.

At Pant Nagar the experiment consisted of 0, 25, and 50 kg/ha each of N and K_2O of actual element and 0, 50, and 100 kg/ha P_2O_5 of actual element three between row spacing (30, 45, and 60 cm.). The three within row spacings were

18.5 cm., 9.25 cm., and 4.6 cm. to get 180,000, 240,000, and 360,000 plant populations per hectare. There were, thus, thirty-six treatment combinations laid out in a single split plot design with three levels of each factor.

Data are analyzed and interpreted in Table 99.

Table 99. Effect of different fertility levels, row spacings and plant population rates on yield of mungbean (T-6009) at Pant Nagar, Kharif, 1968.

Fertility levels (kg/ha)			Yield (kg/ha)	Between row spacing(cm)	Yield (kg/ha)	Plant population per hectare	Yield (kg/ha)
N	P_2O_5	K_2O					
0	0	0	547	30	485	180,000	526
25	50	25	517	45	506	240,000	497
50	100	50	475	60	549	360,000	516
"F" Test			Significant		Significant		Significant
S. Em ±			14		2		2
C.D. 5%			24		9		9

Data in Table 99 show that maximum yield (547 kg/ha) was obtained from control treatment and the increasing fertility levels showed significant reduction in yield. As regards row spacing, increasing spacing resulted in significant increase in yield of mungbeans. Lowest plant population (180,000 plants/ha) gave the highest yield of 526 kg/ha. With increasing plant population, there was a significant reduction in yield.

4. Cowpea (Vigna sinensis)

The same experimental design as used with mungbeans and urd beans was initiated in Delhi with cowpea variety Blackeye-7 and Meshed. This crop had the same poor stand and unthrifty plants as reported for mungbean and urd bean because of nematode infestations.

B. Fertility - Inoculum experiment:

1. Pigeon Pea (Cajanus cajan)

Fertility - Inoculum experiments were conducted at Delhi, Hyderabad, and Kanpur. Details of the experiments were the same as that described for the rabi crops - Factorial Randomized block design with 0, 50, 100 kg/ha. N, P_2O_5, K_2O

and rhizobial inoculation having plot size 3.6 x 4 m. was used. Fertilizer was broadcast before planting and worked in with disc or rototiller. Inoculum was standard commercial peat base product applied immediately before planting with a sticking agent (supplied by Nitrogen Co., Milwaukee, Wisconsin, USA). Between row spacing was 60 cm. for short term and 90 cm. for long term varieties, within row spacing 20 cm. for short term and 40 cm. for long term. Varieties were same as reported for fertility spacing trials at each location. A modified design was employed at Delhi.

At Delhi the experiment was wiped out as described under fertility spacing experiments. At Kanpur the same problem of flooding and disease was present as in the spacing experiment. Results of long term variety will be reported with the 68-69 rabi.

Therefore no data was obtained with short term variety T-21 for either of these two locations.

At Hyderabad one replication was eliminated due to a sterility disease. This has not been identified but is not the common sterility mosaic virus. Yield was obtained from three replications, but the growth and yield was poor due to lack of irrigation as was the case with the spacing experiment at this location. There was significant interaction between N, K, and NPK as shown in Tables 100 and 101 and Figure 39.

Table 100. Effects of different levels of N and K on the yield of pigeon pea (T-21) at Hyderabad, Kharif, 1968.

K_2O levels kg/ha	Yield (kg/ha) N levels in kg/ha.			
	0	50	100	Inoculum
0	419	613	702	443
50	513	551	443	539
100	626	511	555	531
	S. Em. ±		50 kg/ha	
	C. D. 5%		141 kg/ha	

Table 101. Interaction effect of N, P_2O_5 and K_2O on yield of Pigeon pea (Cajanus cajan) (T-21) at Hyderabad - Kharif, 1968.

Treatment kg/ha			Yield (kg/ha)	Treatment kg/ha			Yield (kg/ha)
N	P_2O_5	K_2O		N	P_2O_5	K_2O	
0	0	0	551	100	0	0	826
0	0	50	410	100	0	50	406
0	0	100	613	100	0	100	530
0	50	0	221	100	50	0	615
0	50	50	581	100	50	50	563
0	50	100	527	100	50	100	584
0	100	0	485	100	100	0	666
0	100	50	549	100	100	50	361
0	100	100	737	100	100	100	550
50	0	0	570	Inoc	0	0	458
50	0	50	567	Inoc	0	50	555
50	0	100	471	Inoc	0	100	661
50	50	0	562	Inoc	50	0	476
50	50	50	529	Inoc	50	50	639
50	50	100	664	Inoc	50	100	559
50	100	0	708	Inoc	100	0	395
50	100	50	559	Inoc	100	50	422
50	100	100	397	Inoc	100	100	373
			E.Em. ±	87 kg/ha.			
			C.D. 5%	245			

Yield with different N and K_2O treatments ranged from 221 kg/ha ($N_0P_{50}K_0$) to 826 kg/ha ($N_{100}P_0K_0$). There was an increase over control due to 50 kg/ha N treatment. There was no increase over control with rhizobial innoculation nor over 50 kg/ha N with 100 kg/ha N. There was an increase in yield due to K application in the absence of N and a decrease with 100 kg/ha.

Several interesting observations were made on Variety T-21 this season. Plantings made by project personnel and others were observed with planting dates from mid-May to early August and latitudes from Hyderabad (17°) to Pant Nagar (29°). T-21 this season always flowered in the second half of August, late plantings being no more than two weeks later than early plantings. Maturity also

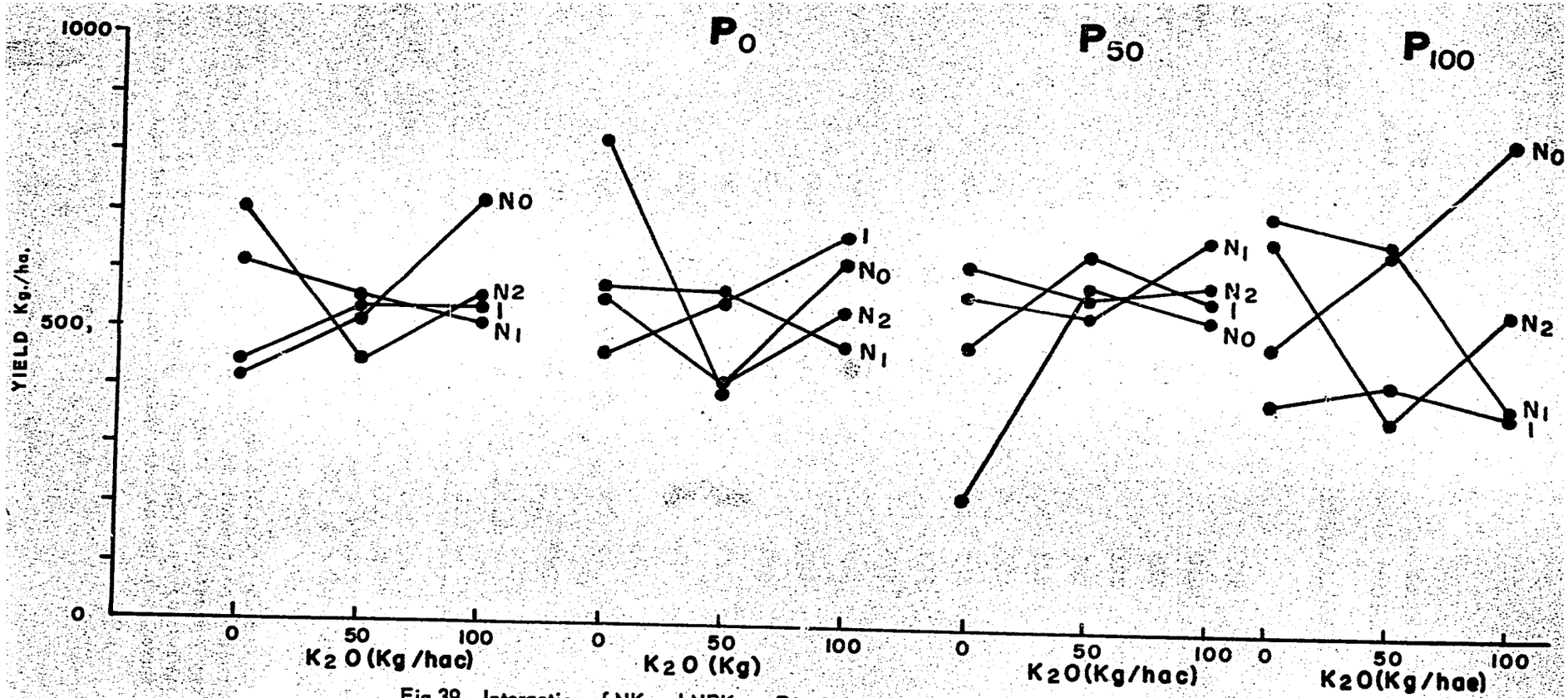


Fig.39 - Interaction of NK and NPK on Pigeon pea (Variety T-21), HYDERABAD, kharif 1968.

appeared to be faster at the lower latitude. However, the drought at Hyderabad undoubtedly hastened maturity so this cannot be ascertained without further observations. At Hyderabad this variety segregated into two separate plant types - one shorter and slightly earlier in flowering. At Delhi this difference in plant type was less noticeable. At Pant Nagar only the difference in flowering was discernable.

2. Mungbeans (Phaseolus aureus) and Urd beans (Phaseolus mungo)

Fertility inoculum trials were conducted with mungbean and urd bean at the same location using the same varieties reported under fertility-spacing trials. Experimental design was the same as that described for previous crops except that the plot size was reduced to 1.8 x 4 meters. A modified design was used at Pant Nagar. At Ludhiana because of sandy soil N was applied in a split dose.

At Delhi and Kanpur the entire crop was ruined as described previously. At Hissar there was no effect due to treatment with mungbeans. Yields, which were very low, are reported in Table 102. (See discussion under spacing trials.)

Table 102. Fertility-Inoculum Trial, mungbean, Variety No. J-781, Hissar, Kharif, 1968.

	Yield (kg/ha)				
Levels of N (kg/ha)	Yield	Levels of P_2O_5 (kg/ha)	Yield	Levels of K_2O (kg/ha)	Yield
0	41	0	51	0	38
50	48	50	41	50	51
100	47	100	40	100	43
Inoculum	40	---	--	---	--
S.Em. ±	20 kg/ha		20 kg/ha		20 kg/h

Differences were not statistically significant.

With urd bean T-9 there was no effect of treatments but there was negative NK interaction. The 100 kg/ha K treatment without nitrogen gave the highest yield. (Table 103, Figure 40.)

At Ludhiana yield was low with mungbean due to nematodes and urdbeans due to virus. But again the interesting effect of NPK interaction with low yields. (Tables 104 and 105 and Figure 41).

Table 103. Interaction effect due to different levels of N and K_2O on the yield (kg/ha) of urd beans, Variety T-9, Hissar, Kharif, 1968.

Levels of K_2O (kg/ha)	Yield (kg/ha) Levels of N (kg/ha)			
	0	50	100	Inoculation
0	902	898	979	773
50	748	929	666	875
100	1193	937	936	752

S. Em. ± 54 kg/ha

C.D. 5% 148 kg/ha

Table 104. Fertility Inoculum Trial urd bean, late variety No. 64, Ludhiana, Kharif, 1968.

Yield (kg/ha)

N, P, K Interaction

Levels of N, P_2O_5, K_2O (kg/ha)			Yield (kg/ha)	Levels of N, P_2O_5, K_2O (kg/ha)			Yield (kg/ha)
N	P	K		N	P	K	
0	0	0	535	2	0	0	260
		1	324			1	639
		2	556			2	472
0	1	0	500	2	1	0	484
		1	266			1	366
		2	495			2	542
0	2	0	394	2	2	0	375
		1	369			1	448
		2	514			2	554
1	0	0	582	0	0	0^+	330
		1	528			1^+	416
		2	358			2^+	538
1	1	0	297	0	1	0^+	495
		1	420			1^+	383
		2	339			2^+	533
1	2	0	590	0	2	0^+	411
		1	347			1^+	519
		2	476			2^+	450

S. Em ± 91 kg/ha

C.D. 5% 251 kg/ha

Table 105. N P K Interaction effect on yield of mungbean, late variety No. 54, Ludhiana, Kharif, 1968.

Levels of N, P_2O_5, K_2O (kg/ha)			Yield (kg/ha)	Levels of N, P_2O_5, K_2O (kg/ha)			Yield (kg/ha)
N	P	K		N	P	K	
0	0	0	238	2	0	0	197
		1	184			1	251
		2	205			2	227
0	1	0	250	2	1	0	179
		1	247			1	158
		2	223			2	224
0	2	0	205	2	2	0	198
		1	188			1	156
		2	208			2	193
1	0	0	200	0	0	0^+	189
		1	150			1^+	223
		2	232			2^+	277
1	1	0	154	0	1	0^+	174
		1	208			1^+	248
		2	212			2^+	226
1	2	0	177	0	2	0^+	229
		1	269			1^+	271
		2	250			2^+	198

S. Em ± 34 kg/ha

C.D. 5% 94 kg/ha

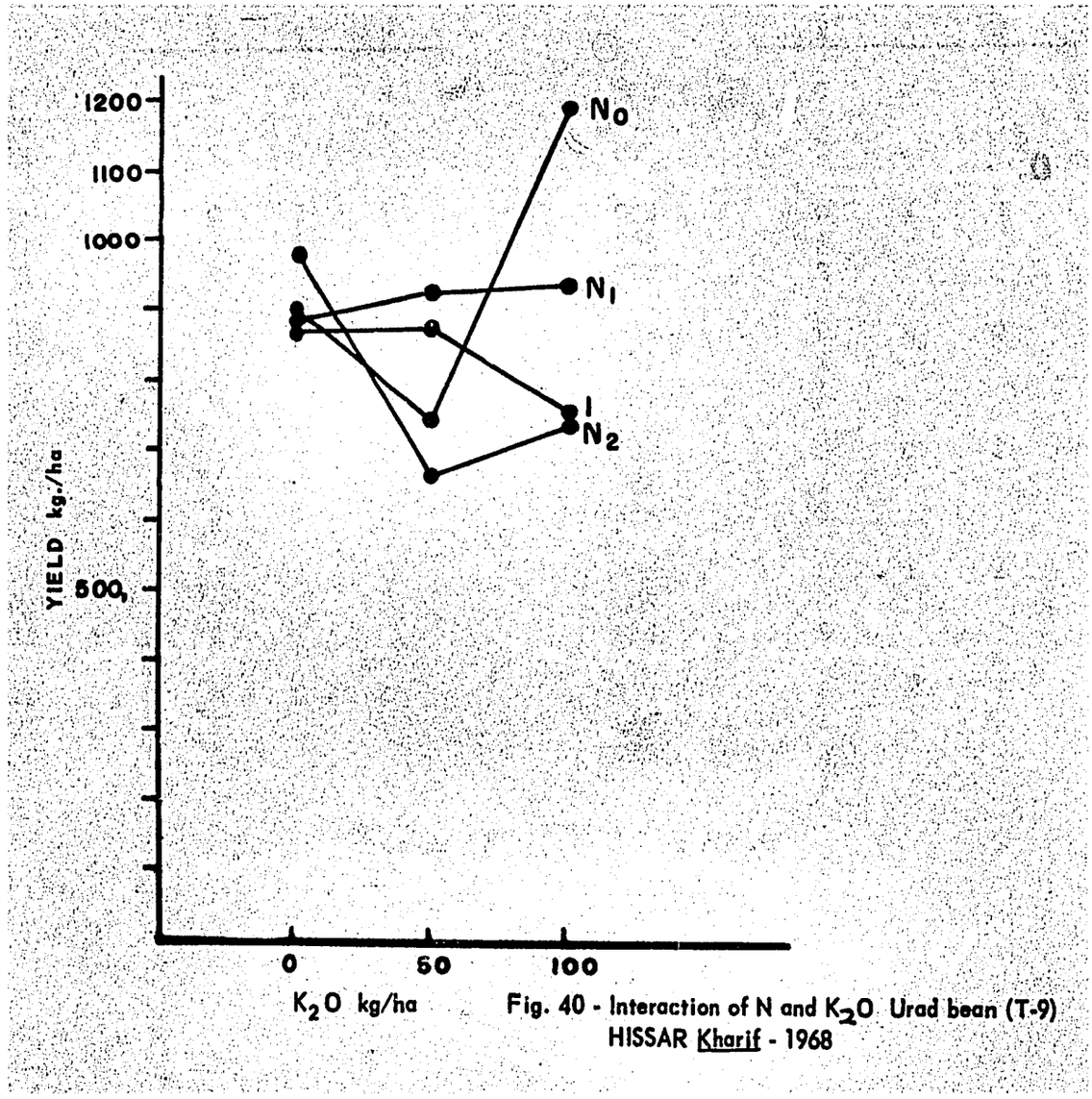


Fig. 40 - Interaction of N and K_2O Urad bean (T-9)
HISSAR Kharif - 1968

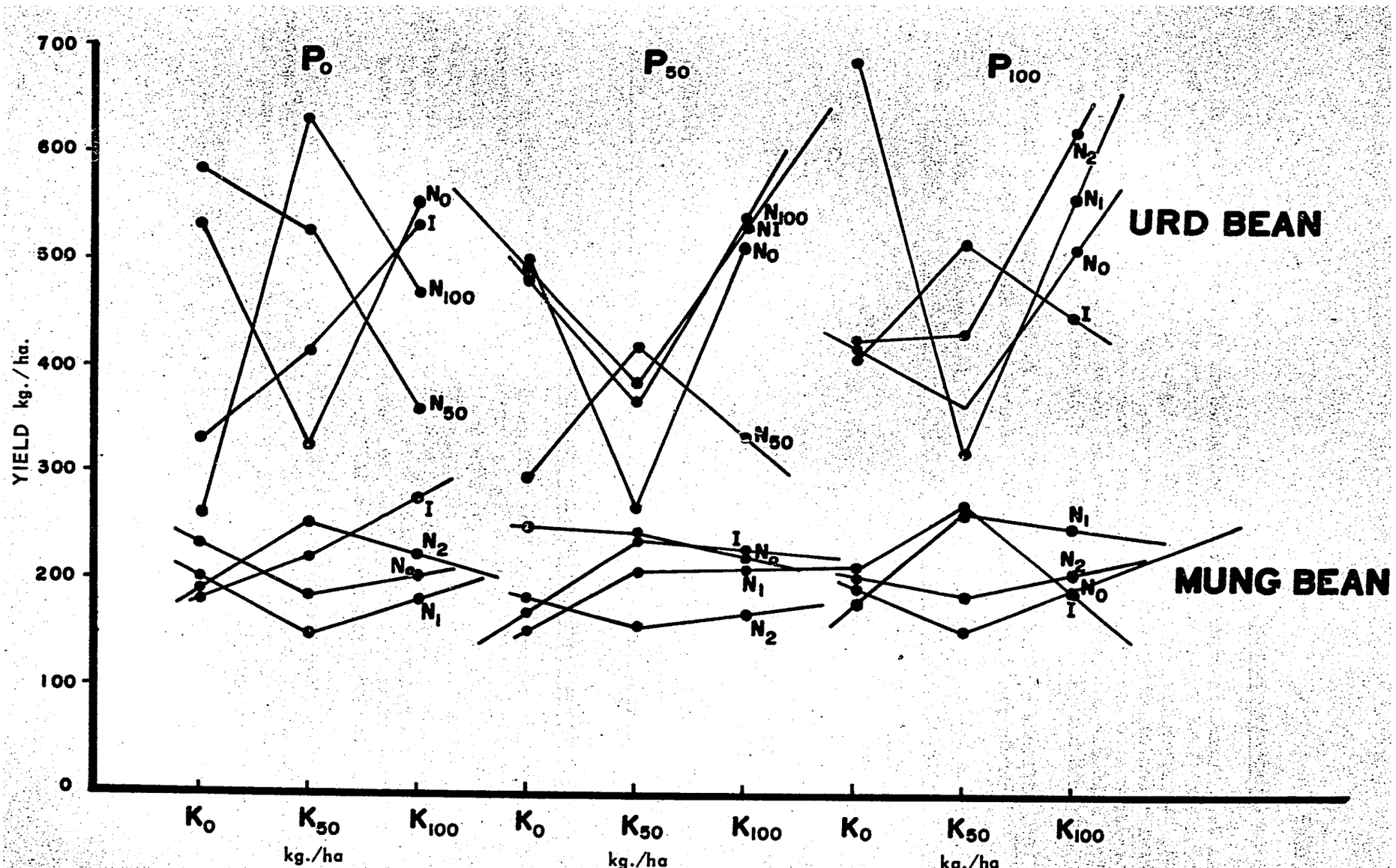


Fig.41 - Interaction of N.P.K. Mung beans variety T-54 and Urd beans Variety No.64 LUDHIANA, Kharif - 1968.

Pant Nagar

Mungbeans (Phaseolus aureus)

At Pant Nagar, an experiment was conducted to find out the effect of different levels of N, P, K, and inoculum on grain yield of mung (Variety No. T-6009). Nitrogen treatments were 0, 25, 50 kg/ha of actual element and rhizobial inoculum, phosphorus treatments were 0, 50, and 100 kg/ha as oxide, and potassium at o and 50 kg/ha as oxide. There were, thus, 24 treatment combinations laid out in a factorial randomized block design. The crop was planted on 9th July and harvested on 31st October. Data are presented in Table 106.

Table 106. Effects of different levels of N, P, K, and inoculum on yield of mungbeans, Variety No. T-6009, Pant Nagar, Kharif, 1968.

N levels (kg/ha)	Yield (kg/ha)	P_2O_5 levels (kg/ha)	Yield (kg/ha)	K_2O levels (kg/ha)	Yield (kg/ha)
0	620	0	631	0	647
25	586	50	638	50	620
50	629	100	608	--	--
Inoculum	698	---	---	--	---
'F' Test	Not significant		N.S.		N.S.
S.Em. ±	25		31		25

Levels of N, P_2O_5, and K_2O did not have any effect on the grain yield of mungbeans.

C. Deep placement of Farm Yard Manure and Phosphorus:

Effect of deep placement of farm yard manure (FYM) and phosphorus on the yield of dryland pigeon pea was studied at Delhi during Kharif, 1968. The treatments consisted of FYM at 15, 30, and 45 tons/ha and 14, 28, and 43 kg/ha P actual element and a control. Two methods of application - broadcast (mixed in top 8 - 10 cm. depth) and 25 - 30 cm. deep placement - were tested. A split plot design was used with combination of different levels of FYM and P as main plot treatments and method of application as sub-plot treatments. Gross plot size used was 5.0 M x 4.0 M. Data are presented in Table 107.

The reason for deep placement of FYM was to increase the water holding capacity of the soil in hopes that enough moisture could be held from the monsoon to increase yield of the crop. However, due to the scanty monsoon the crop had to be irrigated throughout.

Table 107. Effect of different levels of FYM and P along with methods of application on yield of pigeon pea, variety T-21, Delhi, Kharif, 1968.

Treatments	Grain Yield (kg/ha)
FYM tons/ha	
15	1668
30	2185
45	2752
P (kg/ha) actual element	
14.5	1884
29.0	2210
43.5	2535
Control	1210
S. Em ±	56 kg/ha
C.D. 5%	167 kg/ha
Method of Application:	
Broadcast and surface mixed	2116
Deep placement 25-30 cm.	2026
S. Em ±	23 kg/ha
C.D. 5%	68 kg/ha

Data in Table 107 show that the application of 15 tons of FYM per hectare, the usual quantity used by farmers, increased the grain yield above the control plot by about 400 kg/ha. Increasing levels of FYM significantly increased the yield of pigeon pea. Similarly, yield increased significantly with increasing levels of P. Broadcast application and surface mixed treatment gave significantly higher yield (2116 kg/ha) than deep placement at 25/39 cm. (2026 kg/ha). From an economic point of view, the use of both FYM and Phosphorus are shown to be highly profitable, each bringing in about Rs. 1200 and 1000 rupees net profit/ha respectively as compared to unmanured treatment.

D. Chemical Weed Control (Delhi)

An exploratory weed control trial was conducted at Delhi during Kharif 1968, to (a) assess the losses due to unrestricted weed competition mungbean (Phaseolus aureus) Variety No. Jalgaon-781, cowpea (Vigna sinensis) Variety No. Black eye 7, and pigeon pea (Cajanus cajan) Variety No. T-21 and (b) to study the degree of weed control achieved by and tolerance of these three crops to Treflan (trifluore, 2, 6 dinitre, N.N. dipropyl - p - toluidine) at 0.5 and 1 lb/ac Eptam (S-Ethyl

dipropyl - thio carbamate) at 2 and 6 lb/ac and combination of these two chemicals, Amiben (3 amino, 2, 5 - dichlorobensoic acid) at 2 and 6 lb/ac, Knoxweed (S-Ethyl dipropyl thio carbamate. 46.9% + iso-octyl ester of 2, 4-D 35.4%) at 2 and 6 lb/ac, Randox at 15 and 20 lb/ac. Tok-EC-25 at 2 and 6 lb/ac, Vernam at 2 and 4 lb/ac, and Tillam at 2 and 6 lb/ac. Hand weeding and no weeding were also included as check treatments. The twenty treatments consisting of 8 herbicides at different doses and combinations were duplicated for each crop. This gave two replications for assaying crop injury and six replications for checking weed control.

Requisite amount of herbicides, except Amiben, Randox, and Tok, were sprayed before the final cultivation and incorporated into the soil with a rototiller immediately after application. Amiben, Randox, and Tok were applied immediately after the crop was planted. The three crops, mungbean (J-781), cowpea (Black-eye 7), and pigeon pea (T-21), were planted on August 1, 1968.

Observation on crop injury due to herbicides was taken ten days after planting. The results are presented as percentage over control in Table 108 and Figure 42.

Data in Table 108 show that in mungbeans Eptam, Tok, and Treflan + Eptam caused severe injury. Although Knoxweed did not show any specific injury, it delayed emergence of seedlings which were small in stature as compared to control. No injury to crops was observed with other herbicides. In cowpea, severe injury was caused by Tok, Knoxweed, and Treflan + Eptam. Slight to moderate injury was noticed in case of other herbicide treatments. In case of pigeon pea, higher concentrations of Amiben, Eptam, Tok, and Treflan + Eptam caused severe injury. Knoxweed, even at low concentration, was very toxic to pigeon pea seedlings.

In general, Knoxweed, Eptam, Tok, and a combination of Treflan + Eptam were very toxic to all the three crops under study. The injury caused by Eptam and Treflan + Eptam, however, recovered as the seedlings advanced in growth, whereas the injury caused by Knoxweed and Tok was persistent throughout the growth of crops.

Weed control rating was taken 45 days after planting and herbicide spray. The results are presented as percentage over control in Table 109 and Figure 43.

Data in Table 109 show that Amiben (6 lb/ac), Eptam (2 and 6 lb/ac), Treflan (1 lb/ac), Tok (2 and 6 lb/ac), Knoxweed (2 and 6 lb/ac), and Treflan + Eptam at both high and low concentrations were more effective in controlling the weeds than other herbicides tested.

The four major weeds which were seen in the experimental field were, Cyperu rotundus (Monocot), Eleocharis atropurpurea (Monocot), Trianthena portulacastrum (Dicot) and Digera arvensis (Dicot). Since the major problem during Kharif

Table 108. Crop injury rating of various herbicides to mungbean, cowpea, and pigeon pea 10 days after planting, Delhi, Kharif, 1968.

Treatment	Rate lb/acre	Mungbean	Cowpea	Pigeon pea
Amiben	2.0	0	2.0	1.5
Amiben	4.0	2.5	3.5	5.0
Eptam	2.0	4.0	2.0	1.5
Eptam	6.0	6.5	4.0	8.0
Treflan	0.5	0	0	0
Treflan	1.0	0	2.0	1.0
Randox	15.0	0	2.5	0
Randox	20.0	0	0	0
Tok EC-25	2.0	4.0	3.5	2.5
Tok EC-25	6.0	9.0	9.0	9.0
Treflan + Eptam	0.5 + 2	1.5	2.5	2.5
Treflan + Eptam	1.0 + 6	4.0	7.5	6.5
Vernam	2.0	0	2.5	0
Vernam	4.0	0	0	1.0
Knoxweed	2.0	0 1/	8.5	8.5
Knoxweed	6.0	0 1/	10.0	10.0
Tillam	2.0	0	2.0	1.0
Tillam	6.0	0	3.0	1.0
Hand weeding		0	0	0
No weeding		0	0	0

1/ No injury, delayed germination, small plants.

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

Fig. 42

CROP INJURY CAUSED BY HERBICIDES

Delhi, Kharif - 1968

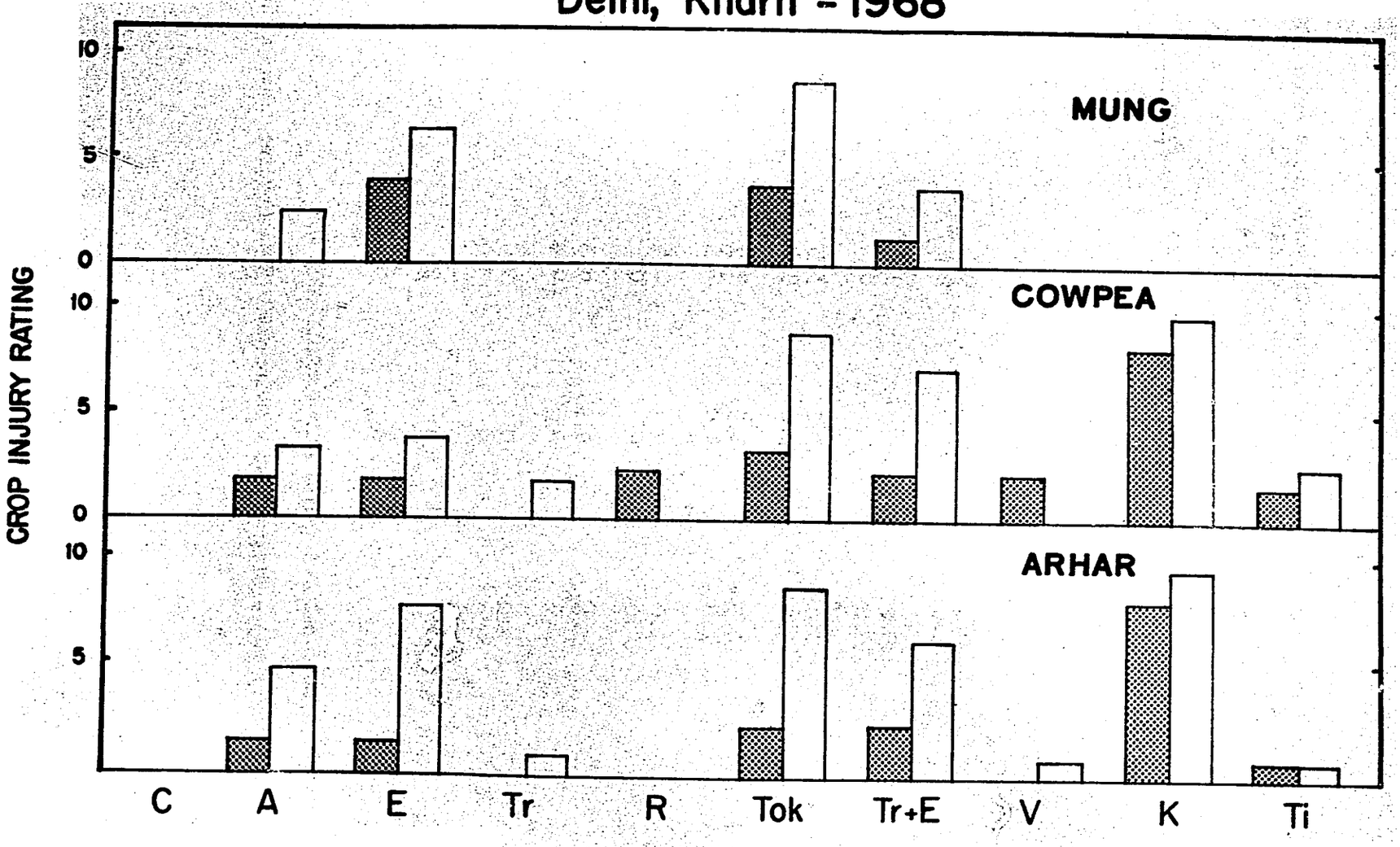


Table 109. Weed control ratings of different herbicidal treatments 45 days after planting, Delhi, Kharif, 1968.

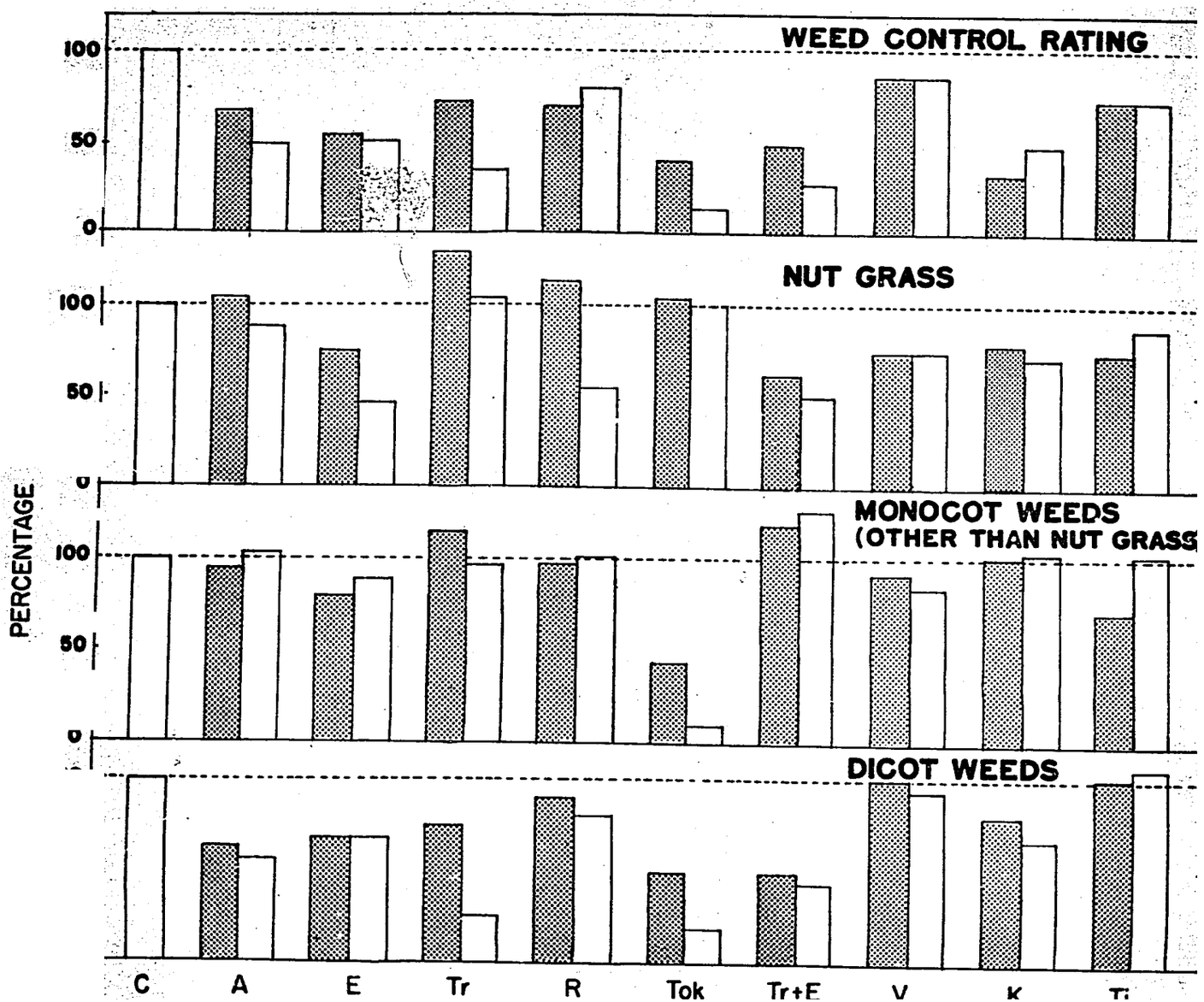
Treatment	Rate /acre	1	2	3	4	5	6	Total	Average	% Weeds remaining over control
Amiben	2	6	3	3	4	1	3	20	3.3	67
Amiben	6	6	5	3	8	4	5	31	5.1	49
Eptam	2	6	7	7	1	1	5	27	4.5	55
Eptam	6	8	3	7	8	1	3	30	5.0	50
Treflan	5	6	4	1	0	0	5	16	2.7	73
Treflan	1	8	9	8	7	6	1	39	6.5	35
Randox	15	2	3	7	6	0	0	18	3.0	70
Randox	20	1	5	6	0	0	0	12	2.0	80
Tok EC-25	2	9	7	9	3	3	5	36	6.0	40
Tok EC-25	6	10	9	7	8	9	9	52	8.7	12
Treflan + Eptam	0.5+2	2	9	8	9	1	2	31	5.1	49
Treflan + Eptam	1.0+6	9	8	9	9	8	1	44	7.3	27
Vernam	2	0	1	0	7	0	0	8	1.3	87
Vernam	4	2	4	0	1	1	0	8	1.3	87
Knoxweed	2	5	6	6	3	0	3	23	3.8	62
Knoxweed	6	4	6	6	8	5	2	31	5.1	49
Tillam	2	4	5	1	2	0	3	15	2.5	75
Tillam	4	5	2	4	4	0	0	15	2.5	75
Hand Weeding		10	10	10	10	10	10	60	10	0
No Weeding		0	0	0	0	0	0	0	0	100
Total:		103	106	102	98	50	57	516		

0 = No Weed Control

10 = Complete Weed Control

Fig. 43

WEED CONTROL RATING
Delhi, Kharif - 1968



season was nut grass (Cyperus rotundus) effect due to different herbicides on control of nut grass and other weeds was studied and the data are presented in Table 110 as percentage over control and graphically represented in Figure 43.

Data in Table 110 show that an effective control of nut grass was obtained with the application of Eptam (6 lb/ac) alone and in combination with Treflan (1 lb/ac). These two treatments, however, failed to control the monocot weeds other than nut grass. However, Tok brought down the monocot weeds to a considerable extent. Tok (2 and 6 lb/ac), Treflan (1 lb/ac) and its combination with Eptam (6 lb/ac) controlled dicot weeds most effectively. The response of various herbicides to Trianthema and Digera were not clear from the data.

Yield data of these crops were not collected because of disease incidence in the field occurring later in the season.

From this trial, it appears that the herbicides, Treflan, Eptam, combination of Treflan + Eptam and low doses of Tok and Knoxweed show promise in future weed control studies in Kharif pulse crops.

Table 110. Mean Number of Weeds Per Four Square Feet for Various Herbicidal Treatments, Delhi, Kharif, 1968.

		Percentage Over Control		
Treatment	Rate	Nutgrass (Cyperus rotundus)	Other monocot	Broad leaves
Amiben	2	104.0	94.0	63.0
Amiben	6	87.5	104.0	56.0
Eptam	2	75.0	78.0	68.0
Eptam	6	45.8	89.0	68.0
Treflan	0.5	I29.2	115.0	75.0
Treflan	1.0	104.0	96.0	25.0
Randox	15.0	112.5	96.0	88.0
Randox	20.0	54.2	102.0	81.0
Tok EC-25	2.0	104.0	44.0	50.0
Tok EC-25	6.0	100.0	87.0	19.0
Treflan + Eptam	0.5 + 2	62.5	119.5	50.0
Treflan + Eptam	1.0 + 6	50.0	126.0	44.0
Vernam	2.0	75.0	91.0	100.0
Vernam	4.0	75.0	85.0	94.0
Knoxweed	2.0	79.0	102.0	81.0
Knoxweed	6.0	71.0	104.0	68.0
Tillam	2.0	75.0	72.0	100.0
Tillam	6.0	87.5	104.0	106.0
Handweeding		0	0	0
No Weeding		100	00	100

E. Effect of simazine on protein content of pulses:

Recent literature indicates that simazine at low doses increases the protein content of certain crops. With this object in view, an experiment was planned to find out the effect of simazine on protein content of pulse crops (mungbean, Var. T-1 and cowpea Var. Black Eye 7) at Delhi and Hyderabad, during Kharif, 1968. Treatments consisted of control, 1/16 lb/ac, 1/8 lb/ac, and 1/4 lb/ac of simazine. There were three application methods: all applied at planting, all applied at pre-bloom stage and split planting + pre-bloom stages. A uniform dose of N, P, and K was applied in the experimental area. A split plot design was used with time of application as main plots and simazine doses as sub-plot treatments. There were four replications. Gross plot size used was 24 ft. x 15 ft. The crop was planted on July 25 at Delhi and July 5 at Hyderabad. Pre-bloom spray was given on September 4, 1968, at Delhi and August 8 at Hyderabad. DDT + Thiodan spray was given on August 7 to control flea beetles. This experiment was part of an all India Scheme conducted on many crops at various locations.

Percentage protein is given in Table 111. Results on enhancement of protein quantity are erratic. Yield data was not obtained because of the erratic stand obtained at Hyderabad because of treatment effects and at Delhi because of both treatment effects and other factors. These levels border on the toxic level so a refinement in the method of applying treatments must be worked out. Protein percentage even if clear-cut is only on indication without yield data since any impairment of metabolic function could give a higher protein percentage but reduce yield so that total protein produced would be less.

Table 111. Effect of different doses and time of application of simazine on protein percentage in mungbean and cowpea at Delhi and Hyderabad, Kharif, 1968.

Treatment		Mungbean		Cowpea	
Rate lb/ac	Time	Delhi	Hyderabad	Delhi	Hyderabad
0	D_0	25.9	26.6	26.4	24.7
1/16	D_0	25.2	27.0	27.1	23.3
1/16	D_1	25.0	26.6	28.4	24.4
1/16	D_2	24.8	26.0	28.6	24.4
1/16	D_3	24.5	27.5	27.7	25.2
1/8	D_0	25.0	25.2	28.1	26.4
1/8	D_1	26.1	26.0	27.0	24.6
1/8	D_2	24.2	26.0	27.3	24.4
1/8	D_3	24.8	26.9	27.3	24.6
1/4	D_0	24.2	26.0	26.8	22.9
1/4	D_1	23.6	26.8	28.3	24.0
1/4	D_2	25.3	25.2	28.0	22.8
1/4	D_3	24.5	26.1	26.5	23.1

D_0 = no simazine; D_1 = all applied at planting; D_2 = all applied at pre-bloom; D_3 = 1/2 at planting, 1/2 at pre-bloom.

F. Foliar Application of Phosphate:

An experiment was planned and conducted at Delhi with the object of studying the response of Urd late, variety T-65 to soil and foliar application of phosphate. The treatments were no phosphate, 25 kg/ha all through foliage, 50 kg/ha, half through soil and half through foliage, 50 kg/ha all through foliage, 75 kg/ha all through soil, 75 kg/ha, half through soil and half through foliage, 100 kg P_2O_5/ha all though soil and 100 kg/ha, half through soil and half through foliage. All plots received a basal application of 25 kg/ha of N at planting and phosphorus was applied in the form of single superphosphate. Simple randomized block design was used with four replicates. Gross plot size used was 3.0 M x 1.8 M. The crop was sown on August 1, 1968. Data are presented in Table 112.

Table 112. Effect of different doses of phosphate applied through soil and foliar on yield (kg/ha) of urd beans, Delhi, Kharif, 1968.

Treatment	Yield of Urd beans (kg/ha)
Control	836 ab
25 kg. P - all foliage	358
50 kg. P - all foliage	642 abc
50 kg. P - 1/2 soil + 1/2 foliage	806 abc
50 kg. P - all soil	698 abc
75 kg. P - all soil	869 a
75 kg. P - 1/2 soil + 1/2 foliage	831 abc
100 kg. P - all soil	541
100 kg. P - 1/2 soil + 1/2 foliage	740 abc
C.D. 5%	280 kg/ha

Data in Table 112 do not indicate a response to phosphate fertilization. The yield of check plots was the same or higher than where fertilizer was applied. Although the low yield of the foliar applications would tempt a conclusion in favor of soil application the high yield level of the control eliminates that, at least under the conditions of this experiment.

G. Effect of ridging on plant growth:

In North India, water logging is a common problem during monsoon season. Crops generally fail due to excess water around the active root zone, because of lack of aeration and unavailability of nutrients. Pulses are no exception to this. An experiment was therefore conducted at Delhi to study the performance of mung. beans (Phaseolus aureus) urd beans (Phaseolus mungo), and pigeon pea (Cajanus cajan) under different cultural practices and plant spacings. The three cultural practices were sowing flat, sowing flat but subsequent ridging, and sowing on ridges. Three plant spacings tried were 5 cm, 10 cm., and 15 cm. There were, therefore, nine treatment combinations laid out in randomized block design. Gross plot size used was 4.0 x 3.0 M. Mung and urd were planted at 30 cm. row distance and pigeon pea at 75 cm. apart.

Data are shown in Table 113 and Figure 44.

Table 113. Effect of sowing methods on yield of Kharif pulses (Yield - kg/ha).

Treatments	Pigeon Pea	Urd bean	Mungbean
Ridge Sowing	2712 a	1182 a	529 a
Flat Sowing	2111 b	749 b	333 b
Flat sowing and subsequent ridging	1822 b	762 b	323 b
S. Em. ±	153	52	60
L.S.D. 5%	457	157	181

These data indicate a considerable advantage for ridging under the conditions of this experiment during the Kharif season. The soil was completely waterlogged for most of the monsoon season but without standing water on the surface. The ridges apparently gave the plant roots enough aeration to produce the enhanced growth and yield. However, observations were made on other ridged blocks where standing water was a problem. Here plants suffered considerably and in light soil the ridges soon fade away. Therefore, ridging cannot be considered a substitute for surface drainage. It is possible that soil drainage which would give the roots a larger aerated zone would cause even larger increases in yield than would ridging.

H. Soil treatment trial:

An experiment was conducted at Ludhiana to determine the cause of crop failure in the Pulse Block in 1967. In that season the plants in large areas were very unthrifty. Several things were suspected without good evidence to make even a tentative diagnosis. Therefore all possible factors were included in a small experiment. A split-plot design was utilized with main treatments being various soil treatments:

1. Fungicide - PCNB (Brassical) 20 kg/ha
2. Nematicide - Nemagon 3 gal/acre
3. Fungicide + Nematicide
4. Soil Sterilant - Methyl bromide 1 lb/100 sq. feet
5. Control

The sub-plot treatments consisted of no fertilization and 100 kg/ha of N, P, and K. N was applied in these doses to prevent leaching in irrigation treatment.

The sub-sub-plot treatments are listed below:

1. Excessive irrigation - Irrigation at least weekly when no rain and often if necessary to keep root zone always at or near field capacity.

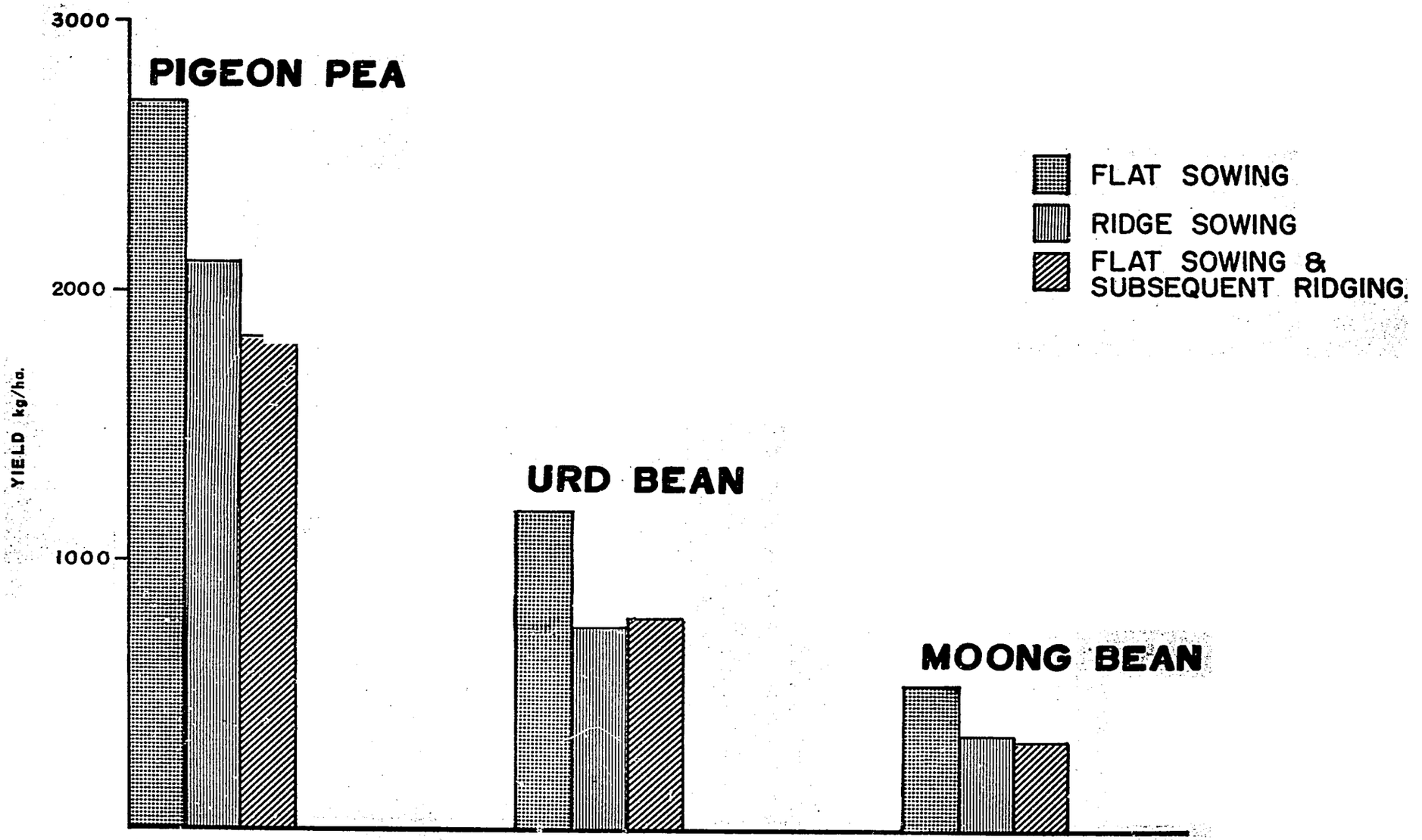


Fig.44 - Effect of sowing methods on yield of pulses, DELHI, kharif 1968.

2. Minor elements - Commercial minor element mixture (Nutramin 6) containing Mn, Fe, Cu, Zn, B, and Mo.

3. Farm Yard Manure

4. Control

The irrigation treatment was invalidated because the plants reached the wilting point at about the fifth week. In pot studies with soil from the Pulse Block at Ludhiana the effect noted in 1967 had been obtained where the plants had accidently been allowed to wilt only once. Although subsequently watered they never recovered completely. This indicated root damage which might be overcome with better irrigation.

The farm yard manure plots showed severe toxicity symptoms at two weeks. By four weeks these had completely disappeared and the plants in this treatment looked much better than the others. This treatment also had many more weeds.

The methyl bromide plots showed some toxicity at four weeks which they outgrew. The methyl bromide had been applied two weeks before planting.

The growth of all plants in this experiment was very spotty with some plants much more thrifty than others. There was no pattern to this within individual plots and it was not correlated with treatment.

Unfortunately the cause of the crop failure in 1967 although severe that year was not present in the area where this experiment was conducted. There was no effect of any treatment on grain yield. Yield data is given in Table 114.

Table 114. Yield of urd bean, var. 1-1, soil treatment experiment, Ludhiana, Kharif, 1968. (Urd Late, Variety 1-1)

Treatment	Yield (kg/ha)
PCNB	486
NEMAGON	587
PCNB + NEMAGON	576
Methyl Bromide	763
Control	673
No Fertilizer	651
100 kg/ha (each of N, P, K)	580
Control	621
Irrigation	632
Minor Elements	617
Farm Yard Manure	602

None or the effects were statistically significant.

I. Plant Environmental Studies:

The effects noted with the growth of Pulse Crop in the summer season strongly indicated that growth and flowering were at least partially controlled by environmental conditions and that this was not wholly a matter of day length. Also, during the rabi season, some observations on abnormal plant growth had been made which was assumed to be tied up with weather conditions.

The above situation led to the initiation of plant environmental studies with the 1968 Kharif season. These studies involve the following: collecting and recording as much environmental information as possible in the pulse fields and obtaining other data from available sources; constant observation of the crops for any abnormalities and attempting to correlate these with the environmental data collected; judiciously modifying the environment where possible in the field; and growth chamber studies with varying plant environment. A growth chamber has been designed and is being constructed for this work using entirely indigenous materials available in India without foreign exchange or import license.

PLANT PATHOLOGY

RPIP

F. J. Williams
B. Baldev
K. S. Amin

AICPP/IARI

J. S. Grewal

SUMMARY

Rabi - 1967-68

Cicer arietinum (Chickpea)

Treating Cicer NP-58 seed with fungicides increased percent germination, but did not result in increased yields at Delhi. Captan treatment resulted in highest percent germination.

Fusarium wilt was insufficiently severe at Delhi to effectively screen 18 varieties of Cicer for resistance. At Hissar, the Cicer germplasm was screened for wilt resistance. Of about 5,000 lines, 220 were selected as possible sources of resistance and are being tested again for further selection.

The time of planting of Cicer NP-58 did not significantly affect incidence of Fusarium wilt or Sclerotinia wilt at Delhi. Disease incidence was low. Plantings were made fortnightly from September 23 to December 1. Yield was highest from the October 6 planting.

Irrigation of Cicer NP-58 at time of podfilling resulted in premature death of plants at Delhi. There was abundant soil moisture at time of irrigation. The soil was a heavy clay and the plant roots apparently suffocated. Yields from non-irrigated ridged plots were 30% higher than from non-irrigated, non-ridged plots.

Chickpea blight (Ascochyta rabiei), was serious in Punjab, occurring in epiphytotic form on heretofore resistant varieties. There is evidence of two or more races of the pathogen. Isolations were made from 60 varieties, the cultures mixed and 160 lines of germplasm inoculated. Two exotic lines were resistant and are being crossed with previously existing varieties to combine sources of resistance. Some 1,500 lines of germplasm at Gurdaspur, Punjab have been inoculated with the mixture of isolates. Current research includes race and differential variety identification.

Several Cicer plants have been seen with virus-like symptoms. One was successfully transmitted mechanically. None are of sufficient incidence to be important at this time.

Pathogenicity of Fusarium isolated from wilting Cicer plants has been erratic. Many isolations made in 1966 could not be proven pathogenic. In 1967 more isolates were made and three were pathogenic when tested under field conditions. These isolates have retained their pathogenic character when tested in pot culture and are being tested in the field in 1968-69. If they are pathogenically stable, the germplasm can be screened for resistance.

Cajanus cajan (Pigeon pea)

With evidence that resistance of Cajanus to Fusarium wilt is location dependent (indicating pathogen races), the two major Cajanus growing areas of India were surveyed in 1967-68 rabi season. Some 600 isolates of Fusarium were obtained. Current research includes proof of race existence by testing pathogenicity of several isolates on several varieties. Future research will involve finding geographic distribution of races and development of resistance to specific races of the wilt pathogen.

Many reciprocal grafts between healthy and yellow mosaic affected Cajanus plants were made at Hyderabad. Because of a high incidence of yellow mosaic in healthy to healthy grafted controls, the viral nature of yellow mosaic was not proved conclusively. The grafting work will be continued.

A new disease of Cajanus, suspected to be virus induced, was seen at Hyderabad. Symptoms include leaf rugosity and malformation. Reciprocal grafts between healthy and diseased plants were unsuccessful. The diseased plants are being maintained for additional grafts when a new flush of growth occurs.

A new disease of Cajanus was seen at Delhi, and at Deeg and Kanpur in Uttar Pradesh. Gross symptoms resembled those of Fusarium wilt, and the two diseases can be discerned only by careful examination. The new disease is a collar and stem rot, caused by Phytophthora sp. It occurred only in plantings that had been subjected to flooding for a period of 2 or 3 days (This is not unusual in bunded fields during the monsoon). The pathogenicity of the fungus was proven repeatedly by inoculating healthy Cajanus stems and by infesting soil. A paper on the occurrence of the disease, symptomatology, pathogen identification, etiology and resistance is being prepared.

Kharif - 1968

Phaseolus aureus (Mungbean)

The mung germplasm was screened for resistance to several diseases under field conditions at Delhi. In each disease, further testing under controlled screen-house conditions will be essential before resistance can be identified with certainty.

Six lines were free from yellow mosaic, 48 were free from leaf crinkle (suspected virus), 7 were free from top necrosis (cause unknown), and 7 were free from bacterial blight. Eleven lines were identified that had some resistance to all the diseases.

Some 30 single plant selections were made in 1967 on the basis of multiple disease resistance. In 1968, 4 selections were free from yellow mosaic, 7 were free from leaf crinkle, 25 were free from top necrosis (cause unknown), and 27 were free from bacterial blight. These selections will be used for crossing in 1969.

The varieties of mung in the coordinated trials were scored for disease resistance at several locations. No important departures from previous years' performance was noted. Cercospora leaf spot was serious at two locations in Uttar Pradesh for the first time. There was considerable variation in susceptibility among varieties.

Seed of mung variety T-51 was treated with several fungicides and planted at 7 locations. Results were received from 4 locations. None of the treatments resulted in increased germination.

Mung variety T-2 was sprayed at 10-day intervals with 5 different foliar fungicides at 6 locations. No treatment effectively controlled foliar diseases at any of the 4 reporting locations. The 10-day interval was apparently too long for monsoon conditions. The trial will be repeated with a shorter interval and the addition of stickers.

Phaseolus mungo (Urd)

Some 400 lines of urd germplasm were screened for resistance to several diseases under field conditions at Delhi in 1968. The screened material included some single plant selections (based on disease resistance), made in 1967. Thirty lines were free from yellow mosaic, the most serious disease of urd in India. Seven lines were identified as having resistance to several diseases. They must be tested under controlled conditions.

The urd varieties in the coordinated trials were screened for disease resistance at several locations. No departures from previous years' performance was noted. Leaf spot diseases (primarily Cercospora), were serious at two locations in Uttar Pradesh. Variation in varietal susceptibility was noted.

Treating urd variety T-27 with any of several fungicides did not significantly increase germination at any of 4 locations.

Vigna sinensis (Cowpea)

The germplasm of cowpea (about 1,200 lines), was screened for disease resistance at Delhi under field conditions. Bacterial blight was serious and 137 lines were free from the disease. Top necrosis (cause unknown), was serious. Some 50 lines were free of both diseases and will be tested for resistance to bacterial blight under controlled conditions.

Seed of cowpea (variety Meshed), were treated with several fungicides and planted at 7 locations. Of 4 locations reporting results, several fungicides significantly increased germination at two locations. Captan was as effective as any treatment and has been recommended since it is readily available.

Pisum sativum (Pea)

Several tests were conducted with peas, including variety tests and time of planting experiments. No serious diseases occurred and no significant results for pathology were obtained. A trace of pea streak was present and the virus was mechanically transmitted to healthy plants. Varieties Bonneville, Bridger and 326 yielded best. Varieties Early Badger, Early December and Early Frosty yielded poorly (They flowered after very little vegetative growth when planted at Delhi on October 6).

Important diseases of unknown etiology.

In the past 2 years several diseases (causing serious damage to urd, mung, cowpea and Cajanus), have occurred, with which we have been unable to prove the association of a specific pathogen. In each case, many isolations from diseased plants, or grafts between diseased and healthy plants, as appropriate, have been made in attempts to identify the pathogens involved. Lacking effective facilities, all attempts to prove pathogenicity must be done under field conditions with the accompanying uncertain results. A screen-house has been constructed and should be useful during the kharif season for virus work, but the lack of glasshouse facilities precludes important off-season work with kharif crops. Growth chambers have been ordered to extend the pathology work on Cicer into the off-season and to study the important effects of environment on Cicer wilt. Generally, the lack of minimal facilities has greatly retarded important work in pathology.

Papers and Publications

F. J. Williams; J. S. Grewal and K. S. Amin, 1968. Serious and New Diseases of Pulse Crops in India in 1966. Plant Disease Reporter 52:300-304.

F. J. Williams and J. S. Grewal. Screening the world genetic stock of pulse crops for disease incidence and identification of sources of resistance for the utilization in breeding programs. Proceedings Second Annual Workshop Conference on Pulse Crops, New Delhi, April, 1968.

F. J. Williams. Present status of pathological studies in respect of virus diseases with special reference to mung, urd, cowpea, and sterility mosaic of arhar. Proceedings Second Annual Workshop Conference on Pulse Crops New Delhi, April 1968.

F. J. Williams. Plant Diseases. Annual Conference, Office of Agricultural Development, USAID/India. 1968.

Cicer arietinum (Chickpea)

Wilt - Fusarium wilt of chickpea was not severe in our plantings at New Delhi in 1967-68, and no differential response was evident in a replicated trial of 18 varieties.

The chickpea germplasm was screened for resistance to wilt under field conditions at Hissar, Haryana. From 5,000 lines, 220 were selected as possibly resistant to wilt (Figure 45). They were planted in the same field in 1968-69 and are being rated for resistance again.

Of over 100 isolates of Fusarium sp. from wilted chickpea plants made during 1967-68, only three were pathogenic. Of these, the most pathogenic isolate has maintained pathogenicity in pot culture experiments, but was not pathogenic in one field test at New Delhi. Work is continuing to find the conditions necessary for pathogenicity.

Blight - Ascochyta blight was epiphytotic on chickpea in Punjab in 1967-68. Varieties that had been developed as blight resistant were susceptible and widespread damage occurred (Figure 46). The pathogen was isolated from each of 60 varieties of chickpea growing at Gurdaspur, Punjab. The isolates formed several morphological groups on PDA. Spores from all isolates were mixed and 160 varieties and lines of gram germplasm inoculated at New Delhi, and 1,500 lines inoculated at Gurdaspur in 1969. Inoculation at Gurdaspur was ineffective. At New Delhi, all but two exotic lines were susceptible. Crosses between the two exotic lines and susceptible varieties have been made and the F_2 material will be evaluated at New Delhi in 1969-70. There is evidence of 2 or more races of the pathogen. Current research includes studies of race flora, selection of differential varieties for identification of races and genetics of disease resistance.

Time of planting - Disease incidence was unaffected by time of planting of chickpea variety NP-58 at New Delhi when plantings were made fortnightly from September 23 to December 1. Disease incidence was low. Yield was highest from the October 6 planting.

Effect of irrigation - Irrigation of NP-58 chickpea growing on ridges or plane surface caused premature death of plants at New Delhi. The plants were in pod-filling stage and the heavy clay soil contained sufficient water when irrigated. Ridged, non-irrigated plots yielded 30% more than plane surface, non-irrigated plots. Yields from irrigated plots, either ridged or plane surface, were less than half that of the ridged, non-irrigated plots. The premature death of the plants was probably due to asphyxiation of roots.

Cajanus cajan (Pigeon pea)

Wilt - With evidence that resistance to pigeon pea wilt is location dependent (indicating pathogen races), over 600 isolates of Fusarium udum were made from

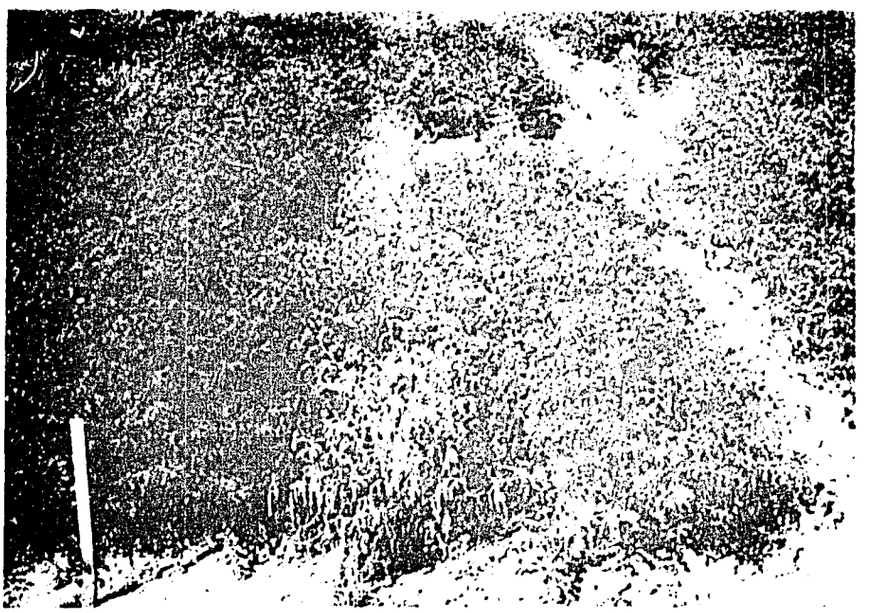


Figure 45. Relative resistance to chickpea wilt among germplasm lines at Hissar, (Haryana), India.

Figure 46. Ascochyta blight on varieties PB7, S26 and C104 at Ludhiana, Punjab in 1968.

specimens collected throughout the major pigeon pea growing areas. Current research includes attempts to prove race existence, identification of differential varieties, and race distribution.

Yellow mosaic - Many reciprocal grafts between healthy and yellow mosaic affected plants were made at Hyderabad. Because of a high incidence of yellow mosaic in the controls, the viral nature of yellow mosaic was not proven.

Phyllosticta leaf spot - A leaf spot disease of pigeon pea, caused by Phyllosticta cajani, was seen at several stations in Uttar Pradesh in 1968. The disease was not serious, but could become damaging during the monsoon.

New diseases - A new disease of pigeon pea, suspected to be virus induced, was seen at Hyderabad. Symptoms include leaf rugosity and malformation. Reciprocal grafts between healthy and diseased plants were unsuccessful.

A new collar and stem rot disease of pigeon pea was found at New Delhi, at Deeg and Kanpur, Uttar Pradesh. Gross symptoms of wilting and death resemble those of Fusarium wilt and the two diseases could be confused (Figures 47 and 48). The disease is caused by an undescribed species of Phytophthora. It was found only in plantings of variety T-21 that had been subjected to flooding for a period of 2-3 days. Such flooding is common in bunded fields during the monsoon. The pathogenicity of the fungus was proven repeatedly by inoculating healthy plants. A paper describing the disease and the pathogen is being prepared.

Phaseolus aureus (mungbean)

Resistance of varieties - The varieties in the coordinated trial at New Delhi were evaluated for disease resistance (Table 115). Yellow mosaic was more severe in 1968 than in 1967, and varieties T-44, T-51, and Koparagaon were more severely affected in 1968. No other significant departures from previous performance were noted. Varieties 24-2, 24-3, and BR 2 were most resistant to all diseases present at New Delhi in 1968.

Leaf crinkle and top necrosis (Figure 49) are suspected to be virus diseases. Yellow mosaic is caused by a whitefly vectored virus. Bacterial blight is caused by Xanthomonas sp.

The mungbean varieties in the coordinated trial at Hardoi and Etawah, U.P. were evaluated for resistance to leaf spot diseases (primarily Cercospora), during the last week of August, 1968 (45 days after sowing). The data are presented in Table 116.

Resistance of germplasm - The mung germplasm (681 lines), was evaluated for resistance to several diseases under field conditions at New Delhi in 1968. Lines selected for disease resistance are listed in Table 117.

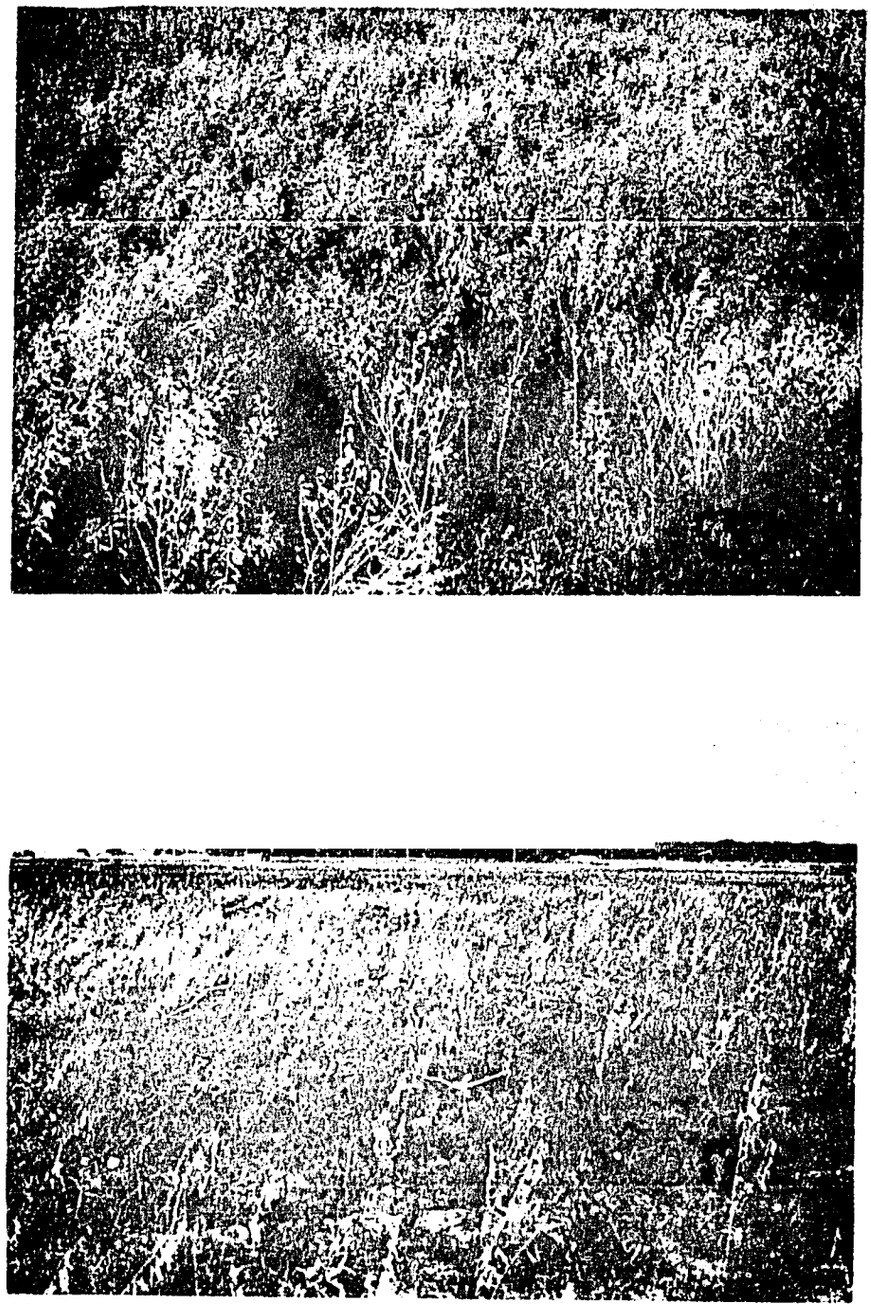


Figure 47. Phytophthora stem rot of Pigeon pea (Field view).

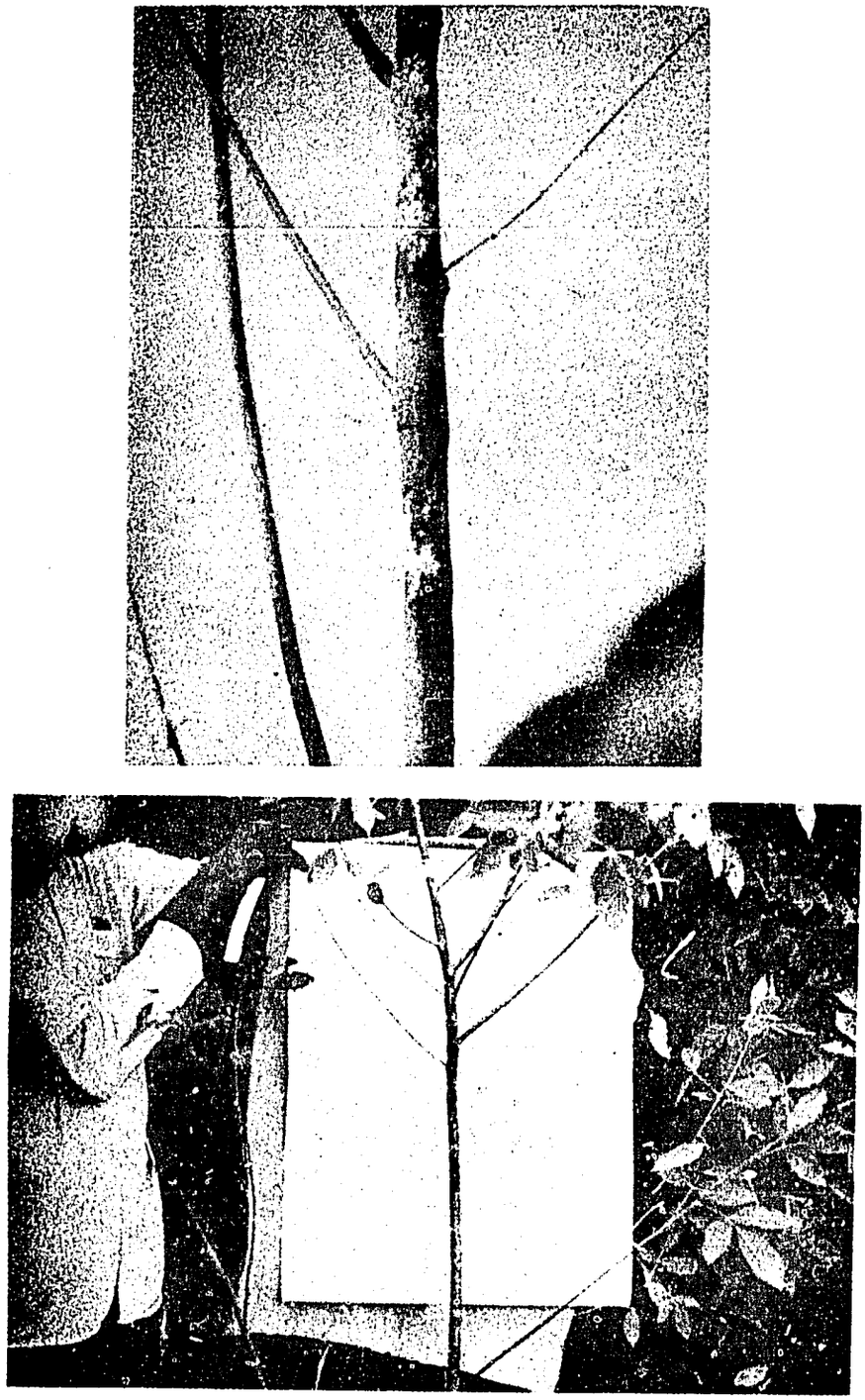


Figure 48. Phytophthora stem rot of Pigeon pea (Close-up)

Table 115. Disease ratings of mungbean, New Delhi, 1968.

Variety	Disease Index 1/			
	Yellow Mosaic	Leaf Crinkle	Top Necrosis	Bacterial Blight
D 45-6	6.8	2.0	7.0	3.5
T-1	2.0	1.5	5.5	3.1
T-2	5.8	3.0	5.8	4.0
T-44	3.5	1.1	6.6	3.1
T-51	4.3	1.8	5.8	3.5
No. 305	6.1	2.5	2.6	3.0
24-2	2.0	1.0	1.0	1.3
24-3	2.0	1.3	1.1	1.5
BR-2	2.8	2.1	2.6	3.3
RS-4	6.5	2.3	7.0	3.6
Hybrid 45	4.8	2.0	6.5	2.8
Kopargaon	3.3	1.1	8.0	3.3
Jalagon 781	7.0	1.3	6.6	3.5
ST-7	3.0	2.8	4.0	2.8

1/ Mean of 6 replicates, based on 1 - 9 rating; 1 = healthy, 9 = all dead.

Table 116. Comparative resistance of mungbean varieties to Cercospora leaf spot at Hardoi and Etawah, U.P.

Variety	Disease Index 1/	
	Hardoi	Etawah
Kopergaon	+ +	+ +
B-1	++++	+++++
T-2	+++	++++
No. 305	+++	+++
T-44	+++	++
BR-2	++	++
24-2	+	+
24-3	+	+
D45-6	+++	++
Hyb-45	++	

1/ Leaf area destroyed was 15-25% on mature leaves in varieties T-2. No. 305, and B-1 at Etawah.

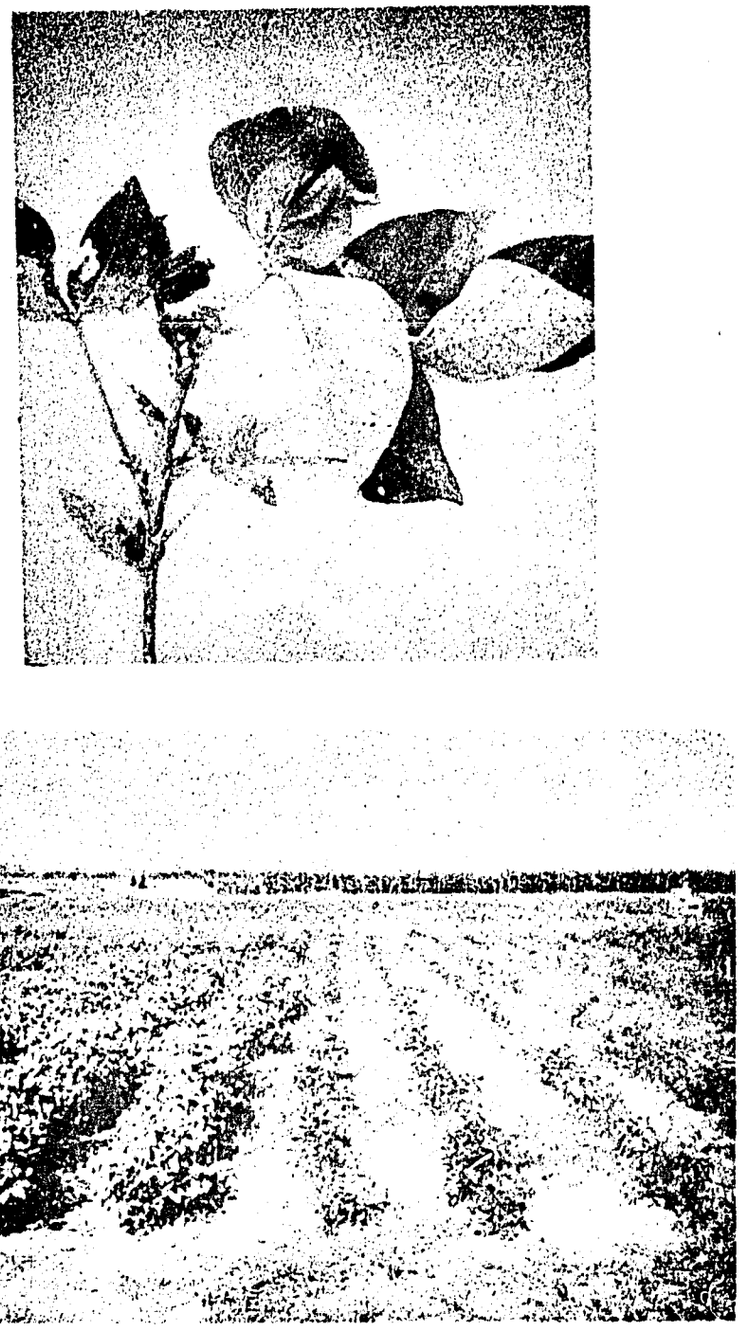


Figure 49. Top necrosis of mung. The same symptoms were seen on urd and cowpea.

Table 117. Mungbean lines selected at New Delhi in 1968 for possible disease-resistance.

Accession No.	Disease Rating 1/			
	Yellow Mosaic	Leaf Crinkle	Top Necrosis	Bacterial Blight
48-113-98	1.5	2.0	2.0	2.0
48-069-271	2.0	2.0	2.0	2.0
48-069-326	2.0	2.0	4.0	2.0
48-069-328	1.0	2.0	1.0	2.0
48-069-329	2.0	2.0	2.0	3.0
48-069-336	2.0	2.0	1.0	1.0
48-069-351	1.0	1.0	1.0	2.0
48-069-353	1.0	1.0	1.0	3.0
48-069-364	1.0	3.0	3.0	4.0
48-069-365	2.0	2.0	2.0	2.0

1/ Disease rating on 1-9 scale; 1 = free of disease, 9 = dead.

Seed treatment - Seed of T-51 mung was treated with several fungicides at recommended rates (see Vigna sinensis - seed treatment) and planted in replicated trials at New Delhi, Hyderabad, Jabalpur, Pant Nagar, Coimbatore, Ludhiana, and Hissar. Data were not reported from Coimbatore or Hissar. Of the trials reported, no treatment significantly increased germination in comparison to untreated controls.

Foliar spray - Variety T-2 mung was sprayed five times at 10-day intervals with Captan, Zineb, Manzate D, Fytolan or Aureofungin at recommended rates. The first spray was applied 30 days after planting. Data were reported from New Delhi, Ludhiana, Pant Nagar, Hyderabad. and Jabalpur. None of the treatments effectively controlled foliar diseases at any location. The trial will be repeated in 1969 with a 5-day interval.

Phaseolus mungo (urd)

Resistance of varieties - The varieties in the coordinated trial at New Delhi were evaluated for disease resistance and the results are in Table 118.

Table 118. Disease ratings of urd bean varieties, New Delhi, 1968.

Variety	Disease Index 1/			
	Yellow Mosaic	Leaf Crinkle	Top Necrosis	Bacterial Blight
T-9	4.8	1.6	6.0	2.0
T-27	1.6	2.0	4.0	1.6
T-65	1.6	3.1	4.0	2.0
1766	7.6	1.6	7.5	2.0
No. 1-1	1.0	3.1	2.0	1.3
D 6-7	7.0	1.5	7.5	2.0
Sind Kheda 1-1	7.0	1.6	7.6	2.0
BR-61	3.3	2.0	4.3	2.0
BR-68	2.6	2.1	5.0	2.0
No. 55	6.5	1.6	6.0	1.5
N 212	8.0	1.5	7.0	2.0
Khargon 3	7.5	1.5	7.5	2.0
Mash - 48	1.6	3.3	2.6	1.6
No. 35-5	1.0	4.0	2.0	2.0
Mash 41-13	1.3	2.3	2.5	1.3
NP-14	2.0	3.3	4.3	2.3

1/ Disease index based on 1-9 scale; 1 = no disease, 9 = plants dead. Mean of six replicates.

Yellow mosaic, leaf crinkle and bacterial blight ratings at New Delhi were generally less in 1968 than in 1967, and 1967 data should be considered in evaluating resistance and susceptibility (see page 176 of Progress Report Number 5, 1967).

Combining 1967 and 1968 data, varieties T-27, T-65, and No. 1-1 are among the most resistant and varieties No. 55, N212, and NP14 among the most susceptible to yellow mosaic under field conditions. Varieties Mash 48, 41-13, and 35-5 may be resistant, but have not been evaluated under severe conditions.

Leaf crinkle was less severe at New Delhi in 1968 than in 1967, but no variety was free of the disease either year.

Top necrosis (cause unknown) was severe at New Delhi in 1968. Varieties No. 1-1, 35-5, Mash 48, and Mash 41-13 had lowest ratings for this disease. Resistance to top necrosis and yellow mosaic are in the same varieties. No variety has resistance to top necrosis, leaf crinkle and yellow mosaic.

Resistance of germplasm - The urd germplasm (398 lines), was evaluated for resistance to yellow mosaic and top necrosis under field conditions at New Delhi in 1968. Lines selected for resistance are listed in Table 119.

Table 119. Urd bean lines selected at New Delhi in 1968 for possible disease resistance.

	Disease Index [1]			
Accession No.	Yellow mosaic	Leaf crinkle	Top necrosis	Bacterial blight
49-069-2-1	2	1	1	1
49-069-13-1	1	3	1	1
49-069-15-1	1	2	1	1
49-069-144-1	2	3	1	1
49-069-151	2	1	1	1
49-069-162	1	1	3	3
49-069-205	1	1	3	1

1/ Disease index based on 1-9 scale; 1 = no disease, 9 = plants dead.

Seed treatment - Seed of urd variety T-27 was treated with any of several fungicides and planted at several locations (see Vigna sinensis, seed treatment). As in mung, no treatment significantly increased germination in comparison to the control at any reporting location.

Vigna sinesis (cowpea)

Seed treatment - Seed of cowpea variety Meshed was treated with any of several fungicides and planted in four replications at several locations. Plants emerged were counted 10 days after sowing. Several treatments increased germination in comparison to the untreated control at Ludhiana and Pant Nagar. The data is presented in Table 120.

Resistance of varieties - The varieties in the coordinated trial at New Delhi were evaluated for resistance to bacterial blight and top necrosis. The results are in Table 121.

Resistance of germplasm - The cowpea germplasm (1,100 lines), was evaluated for resistance to bacterial blight and top necrosis (cause unknown), at New Delhi in 1968. Under field conditions 45 lines were resistant to both bacterial blight and top necrosis. Their accession numbers are: 9, 14, 31, 80, 82, 92, 136, 146, 149, 150, 154, 187, 189, 271, 431, 467, 498, 576, 588, 591, 592, 593, 597, 673, 702, 706, 739, 878, 882, 908, 909, 915, 922, 953, 962, 963, 1174, 1199, 1251, 1265, 1282, 1325, 1345, 1366, 1400.

Table 120. Effect of seed treatment on germination of cowpea, variety Meshed, at Ludhiana and Pant Nagar in 1968.

Treatment	Ludhiana		Pant Nagar	
	% Germination	Sig.[1]	% Germination	Sig.[1]
Captan	85	a	93	a
Thiram	85	a	90	a
Vitavax	84	a	92	a
Ceresan M	83	a	87	a
Chloroneb	82	a	86	a
Copper Carbonate	81	a	93	a
Panogen 15	78	ab	83	a
Control	74	bc	66	bc
PCNB	71	bc	70	b
Busan 72	65	c	59	c

1/ Means followed by a common letter are not different at the 1% confidence interval according to Duncan's multiple range test.

Table 121. Disease ratings of cowpea varieties at New Delhi in 1968.

Variety	Disease Rating [1]	
	Top Necrosis [2]	Bacterial Blight [2]
T-2	3.8	2.8
5826-3	2.0	3.6
K-11	6.8	3.1
K-14	6.0	3.1
Meshed	7.8	6.8
BE-7	8.3	7.6
Early Ramshorn	8.5	7.6
NP-2	6.5	5.5
R.S.-9	6.5	5.0
J.C.-10	6.8	5.3

1/ Mean of 6 replicates. Disease rating on 1-9 scale; 1 = no disease, 9 = plants dead.

2/ Top necrosis is of unknown etiology, bacterial blight is caused by Xanthamonas sp.

When 56 lines that were free of bacterial blight in the field were inoculated while growing in pots, 25 were resistant, 8 were tolerant, 16 were heterogeneous and only 7 were susceptible. A paper on testing procedure and results is being prepared by Dr. P. N. Patel and J. K. Jindal, Plant Pathology Division, IARI, New Delhi. Susceptibility ratings of all lines are available from the project coordinator.

ENTOMOLOGY

RPIP
K. E. Gibson
A. K. Raina
Miss V. Motwani

AICPP/IARI 1/
H.P. Saxena
S. Kumar
Prasad Sircar
Miss Amrit Phokela

SUMMARY

Rabi 1967/68

During the first four months of 1968, the three rabi or winter crops that had been planted in October and November, 1967, were given normal cultural care, experimental insecticide sprays were applied for insect control, and harvest of the mature seed was completed during the latter part of April and early May, 1968. The three crops were gram (chickpeas), dry peas, and lentils. Foliar sprays of 9 different insecticides were applied to chickpeas for control of bruchids in the field, and for pod-borers; to dry peas for bruchids and a dipterous leafminer and to lentils for bruchids and aphids.

Bruchid damage and pod-borer damage in all the experimental chickpea plots was very low, including the untreated checks, and there were no significant differences in the amount of seed damage due to bruchids or pod-borers, between the various insecticide treatments. Low damage in check plots may have been due to spray drift into them, when applications were made on windy days to other plots.

The dry pea plots also showed relatively little bruchid damage in either sprayed or check plots. The damage ranged from approximately one, to slightly over two percent in the seed samples. Yield records from dry pea plots sprayed for leaf-miner control, showed all treatments except one (Metasystox), to have produced appreciably higher yields than the untreated checks.

The incidence of bruchid damage was also very low in the seed from the experimental lentil plots, including untreated checks.

The lentil plots sprayed for aphid control showed from about $2\frac{1}{2}$ to $3\frac{1}{2}$ times greater yields than the check plots. Since the aphid populations never built up to appreciable numbers, the beneficial effect must have been due to the control of some insidious and unknown pest.

1/ Joined the All India Coordinated Pulse Project in July, 1968.

During the latter part of January, February, March, and early April, a program of sweeping the above crops, as well as a planting of Lathyrus sativus, was carried on, to quantitatively determine the incidence of adult bruchids on these crops in the field. From 19 January to 9 April, 1968, bi-weekly sweepings were made in all four crops, totaling 50,500 sweeps for the entire period. It was definitely established that bruchid adults were present in all four of these crops during the sweeping period. While not present in large numbers, nevertheless these field infesting bruchids were a proven, potential source of infestation of mature seed when it was harvested and brought into storage.

Kharif 1968

During the kharif season of 1968, four granular systemic insecticides were tested at four rates as soil treatments for the control of flea beetles (Madurasia obscurella Jacoby), which are a perennial, serious pest of pulse crops in the kharif season, from the time the plants first emerge from the soil, until about two months later. The insecticides used were Disyston. Solvirex, Temik, and Thimet. The application rates were 1/2, 1, 1 1/2, and 2 pounds of actual toxicant per acre. These materials caused some phytotoxic symptoms in the plants grown on treated plots. The symptoms did not appear to be serious, consisting of tip and edge-burning of the foliage, and the plants soon apparently outgrew them. Flea beetle control was quite satisfactory; there was some early leaf injury, but it was insignificant. Somewhat later there was an amazing growth response to these granular, systemic insecticide soil treatments, and the plants on treated plots outgrew the untreated check plots. This cannot all be attributed directly to insect control, and is a matter of considerable interest. A heavy infestation of soil nematodes was discovered before the plants began to mature, and resulted in the early death of many plants which greatly reduced yield in certain areas. The startling results of this experimental work justify its being repeated again next year.

A foliar spray of DDT (0.75 pound actual toxicant per acre) plus Thiodan (endosulfan) (/.50 pound per acre) also proved very effective against these flea beetles.

Experiments in field bruchid control on both cowpeas and mungbeans, indicated that of five insecticide treatments used, the most promise was shown by Thiodan or a combination of Thiodan and DDT.

Laboratory experiments testing Bromodan, a chlorinated hydrocarbon, formulated as both a five percent dust and a 50 percent wettable powder, as a protectant for mature pulse seeds in storage, against bruchid attack, have shown the material to have much promise. When used at the rate of 1/2 to 1 gram of actual toxicant per kilogram of mature seed, and intimately mixed with the seed, it kills 95 to 100 percent of bruchids infesting the seed in 24 hours. It has no ovicidal properties, but does have a relatively long life, and is very effective against both adults and larvae. It shows much promise in keeping infestations from building up to

large numbers, or even surviving, in lots of mature seed. It is relatively safe material, having an acute oral LD-50 of approximately 5000 milligram per kilogram of body weight, according to the producers, Hoechst Pharmaceutical Co. of West Germany. Research work on this promising material will be a major entomological effort in the immediate future. Availability of this material appears to pose a problem.

Screening germplasm for insect resistance resulted in one line of cowpea (Accession 62-069-00576) with considerable field resistance to several insects (flea beetle, leafminers, lepidopterons larvae, jassids) as well as being free of virus symptoms.

A variety of lentil from Iran with reported resistance to bruchid attack was found to be resistant to Callusobruchus maculatus larval penetration but not to C. chinensis.

A black light (20% ultra-violet light) insect trap has been operated nightly throughout the year in various pulse crop plantings. The insect catches are sorted; series of the various species, genera, families and orders of insects, pinned and labelled for the Project insect collection, the excess stored for future reference, and 112 different lots of economic insects have been sent to the National Museum in Washington, D. C., and identifications made and returned for the Project files.

Papers and Publications

K. E. Gibson. Identification of pest problems of pulse crops. Proceedings Second Annual Workshop Conference on Pulse Crops, New Delhi, April, 1968.

K. E. Gibson. Research on pulse insects. Annual Conference 1968. Office of Agricultural Development, USAID/India.

Rabi 1967-68

1. Objective - To determine wheter or not any of 918 lines of chickpea germplasm had any tolerance or resistance to insect attack, particularly the gram pod-borer (Heliothis armigera).

The original planting of these lines was accomplished on 3 and 4 October, 1967. Some replanting was necessary, and was done between 25 and 27 October, 1967.

After these lines were harvested in April, 1968, 50 were selected showing promise of having resistance or tolerance to pod-borer attack which merit further screening.

2. Objective - To determine the effectiveness of insecticide applications in the field for bruchid control.

Nine insecticide applications, plus an untreated check, were made. There were three applications; the first on 20-21 December, 1967, the second on 10 January, and the third on 24 January, 1968.

After harvest, 2000 seed from each treatment were examined for bruchid damage, and the seed yield of each treatment determined. The results are shown in Table 122.

Table 122. Bruchid damage to chickpea seed and yield records for all insecticide treatments applied as field sprays, New Delhi, India, Rabi 1967-68.

Treatment	No. seed examined and bruchid damage to seed		Yield Grams of 1/ Seed per treatment
	Seed	% Damaged	
DDT - 1 lb/acre	2000	0.1	3060
DDT - 2 lb/acre	2000	0.05	2780
Diazinon - 1/4 lb/acre	2000	0.05	3530
Diazinon - 1/2 lb/acre	2000	0.05	3067
Dimecron - 1/4 lb/acre	2000	0.05	2659
Dieldrin - 1/2 lb/acre	2000	0.0	2969
BHC - 1 lb/acre	2000	0.05	4571
DDT+BHC - 1 lb + ½ lb/acre	2000	0.1	3277
Thiodan - 1/2 lb	2000	0.0	2101
Check	2000	0.1	2388

1/ Acreage per treatment - 0.018 acre.

The percent of damage to the seed from bruchids was very low. Indications are that chickpeas represent one of the least favored hosts of this insect. The real concern is how many bruchids are brought into storage from the field, and how fast they multiply.

There are some rather wide differences in yield, but probably not due to treatments. One of the two lowest yields was in the check, but the other was in the Thiodan treatment, which has proved quite effective against other insects. A somewhat spotted, high saline content of the soil was probably at least partially responsible for confounding the issue.

3. Another set of chickpea plots in this same planting was given two applications of sprays for experimental pod-borer (primarily Heliothis armigera) control. The first application was made on 27 February and the second on 25 March, 1968. There were nine insecticide treatments plus the check.

Harvest was started on 22 April and completed the first week in May, 1968. After harvest, 2000 seeds per treatment were examined for insect damage, and the yield records per treatment determined. The results are shown in Table 123.

Table 123. Insect damage and yield records in chickpea plots which received insecticide sprays for pod-borer control, New Delhi, India, rabi, 1967/68.

Treatment	No. Seed Examined	% Bruchid Damage	% Pod-borer Damage	Yield-Grams of seed per Treatment 1/
DDT - 1 lb/ac.	2000	None	0.8	6939
DDT - 2 lb/ac.	2000	None	0.7	5240
Diazinon - 1/4 lb/ac.	2000	None	1.4	6869
Diazinon - 1/2 lb/ac.	2000	None	1.3	6220
Thiodan - 1/2 lb/ac.	2000	None	0.4	7728
Thiodan - 1 lb/ac.	2000	None	0.5	8004
Carbaryl - 1 lb/ac.	2000	None	1.1	8099
Carbaryl - 2 lb/ac.	2000	None	0.6	8756
Dimethoate - 1/2 lb/ac.	200	None	1.2	6450
Check	2000	None	0.6	6047

1/ Acreage per treatment - 0.018 acre

There are no significant differences between the pod-borer damage figures for the various treatments. The damage figures are quite low, even in the checks. There may have been some spray drift, which affected the check plots, since they were randomized among the treated plots. Certainly the damage figures in all the treatments are low enough to indicate they were effective against the pod-borer, which is ordinarily quite a devastating pest in this crop.

These seed samples, taken at harvest time, showed no evidence of bruchid damage.

The yield for the untreated check plots was about half-way between the two extremes of yield. Differences are probably due to factors other than insecticide applications for insect control.

4. Dry pea plots were planted on 21 November, 1967, for experimental bruchid control in the field, and for leaf-miner control experiments.

For bruchid control, the same insecticides were used as on the chickpeas. Three spray applications were made; the first on 25 January, the second on 9 February, and the third on 29 February, 1968.

Harvest was completed on 20 April, 1968, and 2000 seed from each treatment were examined for both bruchid and lepidopterous larvae (primarily Heliothis armigera) feeding damage. Seed yield records were also obtained, and both the damage and yield records are shown in Table 124.

Table 124. Insect damage and yield records of dry pea plots which received insecticide sprays for bruchid and pod-borer control, New Delhi, India, rabi, 1967/68.

Treatments	% Bruchid Damage	% Lepidopterous larvae damage	Yield-Grams of seed per Treatment 1/
DDT - 1 lb/ac.	0.9	6.1	6528
DDT - 2 lb/ac.	1.4	7.2	6076
Diazinon - 1/4 lb./ac.	2.4	7.8	9162
Diazinon - 1/2 lb/ac.	2.2	6.2	7625
Dimecron - 1/4 lb/ac.	2.0	5.6	6709
Dieldrin - 1/2 lb/ac.	1.7	6.7	7479
BHC - 1 lb/ac.	2.3	8.3	6272
DDT + BHC - 1 lb + 1/2 lb/ac.	1.8	7.7	4288
Thiodan - 1/2 lb/ac.	2.1	7.5	5863
Check	2.1	5.6	7429

1/ Acreage of each treatment - 0.023 acre.

Bruchid damage in the field was at a low level, but the treatments were not significantly below the checks. The same was true of the lepidopterous larvae injury. The yields are not consistent with treatments or application rates. Plant stands were irregular, and this is doubtless reflected in yield differences.

A portion of these pea plots was also used for experimental control of a dipterous leaf-miner of peas, Phytomyza horticola Gourean. Two applications of

six insecticides were made. After harvest, seed samples were examined for insect injury, and yield records were taken. Results are shown in Table 125.

Table 125. Insect damage and yield records of dry peas which received insecticide sprays for leaf-miner control, New Delhi, India, rabi, 1967/68.

Treatment	% Bruchid Damage	% Lepidopterous larvae damage	Yield-Grams of seed per Treatment [1/]
Diazinon - 1/2 lb/ac.	1.3	3.9	7861
Dimecron - 1/4 lb/ac.	2.8	7.1	6737
Thiodan - 1/2 lb/ac.	1.7	9.1	7605
Malathion - 1 lb/ac.	2.0	5.5	6923
Metasystex - 1/2 lb/ac.	2.9	9.0	5969
Dipterex - 1 1/2 lb/ac.	2.2	7.3	7557
Check	2.5	7.7	5970

1/ Acreage of each treatment - 0.017 acre.

There was more damage attributable to feeding by lepidopterous larvae than to bruchids, although the figures for both were relatively low. There was insufficient consistency, when the treatments were compared with the checks to definitely establish the value of any of the treatments for either kind of insect attack. It may be necessary to use higher dosage rates to determine the effectiveness of the materials.

The yields from all treatments except Metasystox are appreciably higher than the untreated check. This reflects a corresponding difference in foliage damage occasioned by leaf-miner larvae, observed prior to maturity of the plants.

5. Lentil plots were planted on 16 November, 1967, and two insecticide applications were made for experimental bruchid and aphid control. No significant aphid infestations materialized, but the planned insecticide applications were made, and after harvest on 22 April, 1968, seed samples from both sets of plots were examined for bruchid damage, and yield records were taken. The results are shown in Tables 126 and 127.

The incidence of bruchid damage to the seed was very low in both sets of experiments. The highest incidence was in the untreated check plots, but the differences were not statistically significant. Damage from other insects was greater, but with one exception was under one percent in all cases, and there were no significant differences.

In the bruchid control experiment, yields in both DDT treatments, the high rate of Diazinon, and the Thiodan were all significantly higher than the untreated

Table 126. Insect damage and yield records of lentils which received insecticide sprays for bruchid control, New Delhi, India, rabi, 1967/68.

Treatment	% Bruchid Damage	% Other insect Damage to Seed	Yield-Grams of seed per Treatment [1/]
DDT - 1 lb/ac.	0.1	0.2	3685
DDT - 2 lb/ac.	0.1	0.45	3501
Diazinon - 1/4 lb/ac.	0.0	0.25	2117
Diazinon - 1/2 lb/ac.	0.05	0.35	4061
Dimecron - 1/4 lb/ac.	0.1	0.45	2218
Dieldrin - 1/2 lb/ac.	0.1	0.35	2426
BHC - 1 lb/ac.	0.1	0.95	2807
DDT + BHC 1 lb + 1/2 lb/ac	0.15	0.45	2602
Thiodan - 1/2 lb/ac.	0.05	0.55	3400
Check	0.25	0.6	2287

1/ Acreage of each treatment - 0.009 acre.

Table 127. Insect damage and yield records of lentils which received insecticide sprays for bruchid and aphid control, New Delhi, India, rabi, 1967/68.

Treatment	% Bruchid Damage	% Other insect Damage to Seed	Yield-Grams of seed per Treatment [1/]
Diazinon - 1/2 lb/ac.	0.10	0.65	4662
Malathon - 1 lb/ac.	0.05	0.95	3310
Metasystox - 1/2 lb/ac.	0.00	0.30	4732
Thiodan - 1 lb/ac.	0.05	0.85	3287
Dimethoate - 1/2 lb/ac.	0.15	1.05	3164
Check	0.20	0.70	1467

1/ Acreage of each treatment - 0.009 acre.

check. In the aphid control plots the increase in yields in the treated plots over the check plots was outstanding. The highest yield in both sets of plots was in the 1/2 pound per acre Diazinon treatment. This material and application rate merit further attention.

In view of the low incidence of bruchid damage to check plots, and non-appearance of an appreciable aphid population, it is apparent the increased yields from the insecticide treatments reflect the control of insects or other noxious factors, besides bruchids and aphids.

blot 6. All the entomology plantings of pulse crops were swept routinely twice a week(500 net sweeps per crop in five crops each day - 2,500 sweeps each day, or 5,000 per week) to see if incipient bruchid infestations could be detected and followed.

The sweepings were continued to as nearly harvest as possible in all five plantings in order that the record of bruchid movement and incidence might be as complete as possible. After the insecticide tests were started in some of the fields, only the untreated check plots were swept. The complete record of the sweepings in the various crops is tabulated below in Table 128.

Table 128. Record of adult bruchid movement to, and incidence in, five experimental fields of pulse crops, 19 January - 9 April, 1968, New Delhi.

Date	No. of Sweeps per crop	Number of Bruchids swept in: Chickpeas Germplasm	Chickpeas Insecticide Plots	Peas	Lathyrus	Lentils
19 Jan.	500	0	0	0	0	- 1/
23 Jan.	500	0	0	0	- 2/	- 1/
27 Jan.	500	0	0	0	- 2/	- 1/
30 Jan.	500	0	0	0	- 2/	- 1/
2 Feb.	500	0	0	0	- 2/	- 1/
6 Feb.	500	0	0	0	- 2/	0
9 Feb.	500	0	0	0	- 2/	0
13 Feb.	500	0	0	0	- 2/	1
16 Feb.	500	0	0	0	- 2/	0
20 Feb.	500	0	0	0	0	4
23 Feb.	500	1	0	0	1	22
27 Feb.	500	0	0	1	0	1
1 Mar.	500	0	0	1	0	0
5 Mar.	500	0	0	1	0	15
8 Mar.	500	1	0	1	1	23
12 Mar.	500	- 3/	0	3	0	3
16 Mar.	500	- 4/	- 4/	- 4/	- 4/	- 4/
22 Mar.	500	1	0	1	1	2
27 Mar.	500	9	1	7	1	45
29 Mar.	500	1	0	4	0	14
3 Apr.	500	5	0 5/	18	0	28
5 Apr.	500	1	0	19	1	14
9 Apr.	500	2	0	6	1	0

1/ Lentil plants too small to sweep.
2/ Lathyrus plants were very small and growing close to the ground, without any evidence of buds or blooms, so sweeping of this crop was discontinued until 20 February 1968.
3/ The chickpea germplasm plots were not swept on this date.
4/ Sweepings were not made on this date.
5/ Only 250 sweeps were made in the chickpea insecticide plots.

During the entire sweeping period from 19 January to 9 April, 1968, inclusive, a total of 50,500 sweeps were made in the five plantings placed under observation. A total of 272 adult bruchids of various species was swept from these crops during the stated period. This probably does not seem very impressive for the number of sweeps made. However, it is felt some very interesting trends and facts were discovered, and that the sweeping program was definitely worth while.

7. Examinations of the blooms of pigeon peas at various locations throughout India where this pulse crop is grown, have shown that a black chrip, Taeniothrips migricornis Schmutz, heavily infests these blooms. Some exploratory work with insecticides was done at Hyderabad, India in December, 1967, by spraying the plants, and particularly the blossoms, to see if any control or population reduction in the blossoms could be effected, and if any control would be reflected in yield differences. The materials used were Diazinon, Dieldrin, Dimecron, Dipterex (Trichlorfon) and Metasystox. Results were inconclusive, and it is planned to do additional work on this insect next season, to resolve its status as a pest and possible control.

8. Some exploratory work with Bromodan, a relatively new chlorinated hydrocarbon insecticide, produced by Hoechst Chemical Company of West Germany, used as a protectant for mature, stored pulse seeds against bruchid attack, has been initiated. This material has shown considerable promise when used as a 5% dust at the rate of 2 grams of the dust per kilogram of seed, and shaken into, and thoroughly mixed with the seed. The material is relatively inexpensive; comparatively safe, so far as hazard to human health is concerned, and has a long residual life. If it continues to prove as effective as preliminary experiments indicate, it is possible the combination of a judicious spray program in the field, and the use of Bromodan as a protectant for mature, stored seed could go a long way toward solving the very important bruchid problem in this part of the world.

Incident and corollary to this work with Bromodan against bruchids, some life history and a biological work with the important economic species of bruchids is being undertaken, to determine, if possible, the most effective methods of using the Bromodan against them.

'Kharif 1968

1. Objective - To determine the comparative effectiveness of four different systemic insecticides, applied as soil treatments at planting time, in granular formulations at four different rates each, for control of flea beetles, and possibly other noxious insects,attacking cowpeas, mungbeans and urd beans.

The common Galerucid beetle of pulse crops was earlier named as Monolepta nigrobilineata Motsch but some confusion has arisen in the identification because of its resemblance to Madurasia obscurella Jacoby determined by the U. S. Department of Agriculture. It is an important pest of kharif pulses such as cowpea (Vigna sinensis), mungbean (Phaseolus aureus), urd (Phaseolus mungo), pigeon pea (Cajanus cajan) and soya bean (Glycine max). The adults feed on the leaf lamina and make holes. The infestation continues throughout the entire crop season. During 1967, granular systemic insecticides were tried to control this pest. The same experiment was repeated on a larger scale during Kharif 1968.

Granular formulations of Tenik, Thimet, Solverex and Disyston insecticides were applied each in four doses, i.e., 2 kg, 1.5 kg, 1.0 kg., and 0.5 kg. per hectare. The application was done just before sowing. The insecticide was applied in the soil just before planting. The plan of the experiment was a complete randomized design. Each treatment had four replications and each plot had four 6.5 meter long rows. The sowing was done during the first week of July. The crops used were cowpea, mung and urd. In cowpea the dose of 2 kg/hectare of Solverex was not applied because of the shortage of insecticide. The variety of cowpea was Rashmi, of mung improved T-2 and of Urd, T-65. Observations were recorded six weeks after sowing. Two randomly selected plants were observed from each row (8 plants per plot). From the top, holes in third, fourth and fifth leaves of each plant were counted in case of mung and urd. In case of cowpea, holes in third, fourth and fifth leaves were counted from the lower side of the plants, as there was profuse branching in the upper portion of the plants at the time of observation.

When the plants were about half grown a remarkable growth response became evident in all three crops, and they soon literally "grew away from" the untreated check plots of the same crops. The plants in the treated plots generally grew taller, more lush, and had a heavier pod set than the untreated checks. There was a growth differential correlated with increased application rates, shown rather clearly by mungbeans and cowpeas, but rather completely masked in the urd beans. What would probably have been rather clear-cut differences in yield, between treatment rates, and between all treatments and the untreated checks, was also masked by a heavy nematode infestation in the field, which caused a wide-spread but spotty death of plants of all three crops before maturity. The results are shown in Table 129.

Table 129. Control of Galerucid beetle in pulses by granular insecticides, New Delhi, Kharif, 1968.

Insecticide	Dose Kg/Hectare	Average number of holes per three leaves		
		Cowpea	Mungbean	Urd bean
Disyston	2.0	69.2	48.5	38.2
Disyston	1.5	74.2	53.7	40.0
Disyston	1.0	68.4	67.0	53.0
Disyston	0.5	73.6	116.0	62.5
Solverex	2.0	----	52.4	56.5
Solverex	1.5	67.0	64.5	52.0
Solverex	1.0	70.6	65.2	63.2
Solverex	0.5	81.9	87.9	71.7
Temik	2.0	65.4	72.5	73.4
Temik	1.5	78.9	97.0	80.0
Temik	1.0	68.5	109.0	102.0
Temik	0.5	84.6	133.7	102.5
Thimet	2.0	57.2	52.7	36.2
Thimet	1.5	72.3	114.7	35.7
Thimet	1.0	72.7	107.0	45.7
Thimet	0.5	89.8	108.2	85.5
Control	---	76.3	204.2	221.0

In each group of insecticidal treatments, the highest dose of 2 kg/hectare proved most effective. In mungbeans, the average number of holes (52.7) in the treatment of Thimet at 2 kg/hectare was considerably lower than that of the control (204.2). All four doses of Solverex resulted in reduction in the number of holes over the control. In urd, Disyston gave the best results and next to follow in order were Thimet, Solverex and Temik. In cowpeas, the treatment of Thimet at 2 kg/hectare was responsible for the lowest number of holes.

All other cowpea plantings received a single foliar protective spray of DDT and Endosulfan (0.75 pound of DDT + 0.50 pound of actual Endosulfan per acre), about 20 July 1968, for flea beetle control. This combination proved very effective, and gave necessary protection to the plants for a surprisingly long time, considering the frequent monsoon rains that followed its application.

2. Objective - To test the comparative value of single applications of several different insecticides, applied as foliar sprays to cowpeas and mungbeans for control of bruchids in the field, and to determine any possible residual effect on the harvested, mature, stored seed.

Replicated plots of both mungbeans and cowpeas each received single foliar applications of five different insecticides for bruchid control; the mungbeans in

September and the cowpeas in October. The sprays used on the mungbeans included DDT, Diazinon, Lindane, Malathion, and Endosulfan. The seed was examined immediately after harvest for bruchid incidence. The insecticides applied to the cowpea plots were DDT, Diazinon, Lindane, Endosulfan, and DDT + Endosulfan.

When the cowpea seed and mungbean seed from these trials was harvested, the seed from each treatment of each crop was weighed into three equal lots; one lot from each treatment was kept bagged as an untreated storage check; one fumigated with methyl bromide and one treated with Bromodan at 2 grams of 50% material per kilogram of seed.

The mungbean seed has been examined twice since storage and the results are shown in Table 130.

The cowpea seed has also been examined twice since storage and the results are shown in Table 131.

An examination of Tables 130 and 131 shows that a definite host preference is exhibited in these two pulse crops by the two infesting species of bruchids. While not a complete host specificity, it is obvious that cowpea seed is a better host for Callosobruchus maculatus than mungbeans, and that C. chinensis builds up to higher population levels in mungbeans than in cowpeas, wherever the species have been separated and identified, when counted. Generally speaking, C. chinensis appears to be the more abundant species in India. The magnitude of the bruchid populations in the treated lots of seed, where Bromodan was used, were disappointing, particularly in the mungbeans on 18 December, 1968. The comparatively high incidence was due primarily to C. chinensis. The fumigation with methyl bromide proved surprisingly effective in suppressing the succeeding generations and holding them to low minimums.

It appears from these results that, contrary to the belief of some, the methyl bromide may have an ovicidal effect.

3. Objective. (a) to conduct some life history with bruchids to determine its biotic potential, and (b) to determine dosage rates of the chlorinated hydrocarbon insecticide, Bromodan, necessary for effective bruchid control, and to determine the residual effectiveness of this material over a period of six months.

(a) Rearing work with bruchids of the species Callosobruchus chinensis, under an optimum constant temperature of 30 degrees Centigrade, has established that an initial infestation of 50 pairs of adults in mature mungbean seed can be responsible, in the course of approximately two months (two generations), for from 30,000 to 50,000 adults and virtual destruction of the seed.

(b) An experiment was carried out to determine the residual effectiveness of Bromodan for bruchid control against the species Callosobruchus chinensis infesting

Table 130. Incidence of two species of bruchids in mature mungbean seed after harvest and storage showing both field and storage treatments, December 1968 - January 1969, New Delhi, India.

Field Treatment	Storage Treatment	Bruchid Incidence					
		C. maculatus		*C. chinensis*		Total	
		12/18/68	2/4/69	12/18/68	2/4/69	12/18/68	2/4/69
DDT - 1½ lb/ac.	Fumigation, methyl bromide	3	0	11	3	14	3
	Bromodan, 2 gms/kg.	0	8	52	4	52	12
	Untreated Check	8	20	58	708	66	728
Diazinon - ½ lb/ac.	Fumigation, methyl bromide	13	0	17	2	30	2
	Bromodan, 2 gms/kg.	2	4	60	3	62	7
	Untreated Check	16	37	69	563	85	599
Lindane - 1 lb/ac.	Fumigation, methyl bromide	3	0	17	1	20	1
	Bromodan, 2 gms/kg.	3	2	93	12	96	14
	Untreated Check	0	7	90	241	90	248
Malathion - 3/4 lb/ac.	Fumigation, methyl bromide	2	0	19	1	21	1
	Bromodan, 2 gms/kg.	4	0	72	5	76	5
	Untreated Check	0	5	79	301	79	306
Endosulfan - ½ lb/ac.	Fumigation, methyl bromide	4	0	8	1	12	1
	Bromodan, 2 gms/kg.	3	8	85	8	88	16
	Untreated Check	2	11	73	602	75	613
Untreated Check	Fumigation, methyl bromide	4	0	8	4	12	4
	Bromodan, 2 gms/kg.	7	25	79	18	86	43
	Untreated Check	19	18	79	589	98	607

Table 131. Incidence of two species of bruchids in mature cowpea seed after harvest and storage showing both field and storage treatments, December 1968 - February 1969, New Delhi, India.

Field Treatment	Storage Treatment	Bruchid Incidence					
		C. maculatus		C. chinensis		Total	
		1/16/69	3/12/69	1/16/69	3/12/69	1/16/69	3/12/69
DDT, 1 lb/ac.	Fumigation, methyl bromide	2	0	0	0	2	0
	Bromodan, 2gms/kg.	8	1	8	1	16	2
	Untreated Check	6	4	6	1	12	5
Diazinon, 1 lb/ac.	Fumigation, methyl bromide	7	0	1	0	8	0
	Bromodan, 2 gms/kg.	7	2	4	0	11	2
	Untreated Check	20	53	10	0	30	53
Lindane, 1 lb/ac.	Fumigation, methyl bromide	4	0	1	0	5	0
	Bromodan, 2 gms/kg.	12	2	13	0	25	2
	Untreated Check	14	3	10	0	24	3
Thiodan, 1 lb/ac.	Fumigation, methyl bromide	1	2	0	1	1	3
	Bromodan, 2 gms/kg.	15	2 1/	11	0 1/	26	2 1/
	Untreated Check	21		18		39	6037
DDT 1 lb + Thiodan, 1 lb/ac.	Fumigation, methyl bromide	3	2	2	0	5	2
	Bromodan, 2 gms/kg.	32	11 1/	16	1 1/	48	12 1/
	Untreated Check	41		25		66	2464
Untreated Check	Fumigation, methyl bromide	2	1	2	0	4	1
	Bromodan, 2 gms/kg.	5	2 1/	4	0 1/	9	2 1/
	Untreated Check	14		25		39	409

1/ Bruchids were numerous in these seed lots and many were dead inside the seed. These are calculated estimates and since many bruchids were dead, species determinations could not be made with accuracy.

mature mungbean seed. One hundred and twenty small cloth bags of 500 grams of mature mungbean seed each, were treated with Bromodan 50% wettable powder (dry treatment) on 6 June, 1968. Thirty bags were treated at 1/2 gram, 30 at 1 gram, 30 at 1 1/2 grams, and 30 at 2 grams of the 50% Bromodan per kilogram of seed. No further treatments were made to the seed during the six month course of the experiment. At monthly intervals, starting on 6 June, 1968 and through November, 100 adult bruchids were released into four replicate bags of each treatment rate and four replicates of untreated checks. Results show that as the dosage rate of Bromodan was increased from 0.5 gram to 2 grams per kilogram of seed, the time required to obtain 100% mortality was correspondingly reduced. There seemed to be no appreciable reduction in the effectiveness of the Bromodan in killing the bruchids during the period of the experiment. Increased effectiveness of increased dosage rates was shown in suppressing populations of succeeding generations of bruchids following the initial release.

4. Objective - To screen germplasm of cowpeas, mungbeans and urd beans for resistance or tolerance to insect attack.

The reaction of the germplasm of cowpea (Vigna sinensis), mungbean (Phaseolus aureus) and urd (Phaseolus mungo) to insect pests were studied. Screening was done in 132 lines of cowpea including 31 lines of previous year's selection, 104 of mung and 100 lines of urd.

During the year, the attack of Galerucid beetles (flea beetles) was very severe, whereas the infestation of jassid (Empoasca kerri Prutti), leaf miner (Acrocercops sp.) and aphid (Aphis craccivora Kalt) was mild. In each line of 6.5 meter length, leaving border of 0.75 meter on both sides, five plants falling at 1st, 2nd, 3rd, 4th, and 5th meter were observed for these pests. Screening was carried out twice at four weekly intervals. For the Galerucid beetle total number of damaged or healthy leaves per plant were counted. On the basis of the damage to the third leaf in all the plants under observation, the attack was graded as slight, moderate, and heavy. For jassid (Empoasca) and leaf miner (Acrocercops), total pest population on the five plants in each line was recorded. Aphids were confined to only a few lines. Results are as follows:

Galerucid beetle: Cowpea - Out of the 31 lines of cowpeas of previous year's selection, four lines, namely P417-67, P1077-67, P647-67, and P1128-67 were graded in the slight category during both screenings. From the 101 varieties taken up this year, the lines included in the slight grade were P1129, P122, P118, P576, P523, P520, P209-68 in the first screening. During the second screening, the varieties coming under this grade were P245, P249, P220, P211, P150, P118, P108, P91, P579, P549, P548, P546, P237, 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 also the least percentage of damaged leaves. Two lines, i.e., P118 and P576 came in the slight grade during both the screenings. P576 (Accession No. 62-069-00576 was also found to be remarkably free of insects and diseases in other plantings.

Mungbean - Out of the 104 mung varieties, 54 lines in the first screening and 26 during the second screening were graded as slight. Out of these, 14 namely P22, P25, P27, P55, P344, P271, P326, P332, P331, P333, P336, P335, and P338 were common during both the observations.

Urd bean - In urd during the first screening, only two lines, i.e., P130 and P145 could be graded as slight. In the 2nd screening, 22 lines namely, P1-68, P23, P13, P20, P274, P205, P190, P198, P161, P195, 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. (Table 132)

The categories for each crop were:

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 above 15.

Out of the previous year's selection of 32 lines of cowpeas none could be graded under 1st and 2nd categories. In this year's introduction of 101 varieties, no line could come under the 1st category, i.e., nil population, but seven lines, namely P237, P245, P242, P204, P107, P576, and 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 urd, 45 lines came in the first grade, i.e., had no jassid attack. In the second grade mung and 26 and urd had 42 lines. In the 4th and 5th grade mung had 13 and 8 lines respectively, whereas, in the case of urd only one line could be graded in the 4th category and none in the 5th category. Moreover, the population range in mung was from 0-25 and in urd it was from 0-13.

Leaf Miner (Acrocercops sp.)

As shown in Table 133, except in two lines of cowpea, no severe attack occurred.

Aphid (Aphis craccivora K.)

The attack was confined to only few lines in all the crops.

Table 132. Germplasm evaluation for resistance to jassid (Empoasca spp.), New Delhi, Kharif, 1968.

Crop	Jassid population per plant					No. lines Screened	Population Range	Promising Lines
	Nil	Below 5	Between 5-10	Between 11-15	Above 15			
Cowpea (second screening)	0	0	3	5	23	31	5-68	None
Cowpea (first screening)	0	7	24	14	56	101	1-85	P237, P245, P204, P107, P576, P359
Mungbean	27	30	26	13	8	104	0-25	None
Urd	45	42	12	1	0	100	0-13	None

Table 133. Germplasm evzluation for resistance to leaf miner (Acrocercops spp.), New Delhi, Kharif, 1968.

Crop	Jassid population per plant					No. lines Screened	Population Range	Promising Lines
	Nil	Below 5	Between 5-10	Between 11-15	Above 15			
Cowpea (second screening)	1	12	15	3	0	31	0-13	None
Cowpea (first screening)	15	50	26	8	2	101	0-16	None
Mungbean	76	27	0	0	0	104	0-4	None
Urd	74	26	0	0	0	100	0-3	None

From the previous year's selection of cowpeas, only six lines, namely P1177-67, P701-67, P273-67, P321-67, P22-67, and P647-67 were found to be infested. Nine lines out of the varieties taken during this year were found to be infested and these include PI21, P355, P502, P498, P454, P427, P267, P256, and P250. All other lines were not severely attacked.

In mungbean the four infested lines were P103, P164, P42, and P353.

In urd bean only two lines, namely P32 and P279, were attacked.

The identifications of the P numbers referred to above under each pest are given in Table 134.

B. To evaluate the reported resistance to bruchids of a lentil variety from Iran.

A lentil, grown in the neighborhood of Hamadan, Iran, and which, reportedly, never has the seed infested or damaged by bruchids, has become of interest. Some of the mature lentil seed was obtained and used in laboratory tests to determine its possible resistance to bruchid attack in storage. The Accession number of this strain is 33-071-01184.

Four separate lots of the mature seed (5 grams in each lot) were put in plastic containers, and five male and five female adult Callosobruchus chinensis bruchids were released in each lot of seed on 25 November, 1968. On 10 March, 1969, 529 adults were recovered from these four replicate lots of seed. These represented the second succeeding generation following the initial infestation on 25 November, 1968.

Four more lots of the same weights of the same seed were similarly infested on 25 November, 1968, with five male and five female adult Callosobruchus maculatus bruchids, in each lot of seed. Some eggs were laid and some of the larvae which hatched were able to partially penetrate the seed. However, all larvae died before making successful penetration and no succeeding generations of adults of this species ever appeared. This is the heavily preponderant species in Iran. Apparently the bruchid C. chinensis (most predominant in northern India) can successfully complete its life history in this mature lentil seed, but C. maculatus cannot.

5. Objective - To apply and evaluate three foliar applications of nine different insecticides for (1) control of thrips, Taeniothrips nigricornis Schmutz, in the blooms of pigeon peas; and (2) control of the insect complex known as pod-borers, which bore through the pods and damage or destroy the developing seed.

Three applications of nine different insecticides were made to a planting of pigeon pea plots at Hyderabad, India on 10 and 24 October, and 9 November, 1968, for control of thrips infesting the blooms and also the pod-borer complex. The latter includes dipterous, lepidopterous and coleopterous insects. Samples of blooms were picked on 24 October, immediately following the second spray application, preserved in alcohol and the thrips later dissected from them. The lowest populations were found where Diazinon, Metasystox and DDT + Diazinon had been applied. The thrips populations were higher in the six other treatments and not significantly different from the check.

Table 134. Identification of germplasm lines evaluated for insect resistance, IARI New Delhi, Kharif, 1968.

Cowpea (Vigna sinensis)

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	10086	U.S.A.	P363	10252-2	U.S.A.
P576	PLL59	India	P374	10257	U.S.A.
P523	PLL6	India	P361	10251-3	U.S.A.
P520	PLL2	India	P267	10169	Nigeria
P209-68	10137-1	Guatemala	P261	10167-2	Nigeria
P417-67	10286	U.S.A.	P246	10160-3	Nigeria
P1077-67	EL826411	Mexico	P1177-67	Bulk sample	Andhra (Ind.)
P1101-67	IC3338	India	P701-67	IC2913	India
P667-67	IC2661	India	P273-67	10175-1	India
P1128-67	15251	Iran	P321-67	10119	U.S.A.
P237	10155-1	Nigeria	P22-67	10022	Paraguay
P245	10160-2	Nigeria	P647-67	IC2441	India
P249	10161	Nigeria	P107	10075-1	Nigeria
P220	10166	Madagascar	P359	10251-1	U.S.A.
P211	10138-1	Guatemala	P262	10158	Nigeria
P150	10142-3	Turkey	P121	PLA34	India
P118	10086	U.S.A.	P355	10267	U.S.A.
P206	10134-2	Iran	P502	10354	Senegal
P108	10075-2	Nigeria	P498	10350-2	Iran
P91	10067-1	Nigeria	P456	10316	U.S.A.
P579	PLL62	India	P427	10298-1	U.S.A.
P549	PLL31	India	P267	10169	Nigeria
P548	PLL30	India	P256	10168-2	Nigeria
P546	PLL29	India	P250	10162-1	Nigeria
P547	PLL29	India	P783	IC7461	India
P543	PLL25	India	P1126	Field Collection	India
P519	PLL1	India	P364	10252-2	U.S.A.

Mungbean (Phaseolus aureus)

P22	NP16-2	India	P332	Perambalu	India
P25	NP17-2	India	P333	MS9720/2	India
P55	Mung-9	Pakistan	P336	1535/1	India
P27	NP16	India	P335	MS9381	India
P344	MS9719	India	P338	1788/9	India
P271	152016	India	P103	15005	U.S.A.
P217	15148	Afghanistan	P164	15068	India
P326	MS9385	India	P42	NP33	India
P331	NA	India	P353	1788-3	India

Table 134 (Continued)

Urd bean (Phaseolus mungo)

Line No.	Variety	Origin	Line No.	Variety	Origin
P145	T26	(Punjab) India	P160	38	(U.P.) India
P1-68	NP22	India	P154	41	(U.P.) India
P23	NP22	India	P153	39	(U.P.) India
P13	NP12	India	P141	19	(U.P.) India
P20	NP19	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	Bhadela 109	(U.P.) India	P241	6304	(Bihar)India
P190	T95	(U.P.) India	P234	6213-1	(U.P.) India
P161	51	(U.P.) India	P240	6303	(Bihar)India
P198	67-1	(U.P.) India	P239	6302	(Bihar)India
P192	97	(Bihar)India	P32	Kasarkoda	India
P195	100	(Bihar)India	P279	6408	(U.P.) India

On 4 December, 1968, pod samples were collected from all plots and examined for pod borer damage. 1,200 pods were examined from each of the 10 treatments. The percent of damaged pods ranged from a low of 0.4% in the DDT+Endosulfan treatment, to a high of 11.0% in the untreated check. Carbaryl+Endosulfan, DDT+Diazinon, Endosulfan alone, and DDT alone all showed less than 2% pod damage. Seed yields were the highest in the plots sprayed with DDT and with Metasystox, and the lowest where Carbaryl alone and Carbaryl+Endosulfan had been used. Carbaryl has shown obvious phytotoxicity in previous experiments on other pulse crops. This may or may not be evidence of an invisible, insidious phytotoxic effect on pigeon peas.

Miscellaneous entomological activities included operation of the insect black-light trap (nightly), sorting and care of the insect catches from the trap, and the maintenance of the project insect collection. They also include all the routine work incident to preparing and shipping insect specimens to specialists for identification, and cataloging this information as it became available. A list of the identification of insect material shipped to the U. S. National Museum in Washington, D. C. is given below. Identifications were made by taxonomist specialists of the Insect Identification and Parasite Introduction Research Branch of the Entomology Research Division, ARS, USDA. These specialists work at the U. S. National Museum. The following identifications have been made:

Order Homoptera

Family	Genus and Species	Host	Locality
Aphids	Aphis nerii Fonsc	Milkweed	New Delhi
	Aphis solanella Theob	solanaceae	Pant Nagar
	Aphis craccivora Koch	many	Widespread
	Hyadaphis pseudobrassicae Davis, also called, Lipaphis erysimi Ketb.	mustard	Ludhiana
	Myzus persicae Sulz.	mustard	Ludhiana
	Macrosiphum sp.	mustard	Ludhiana
	Acyrthosiphon pisum Harris	lentils	Pant Nagar
	Acyrthosiphon sesbaniae David	from light trap	New Delhi
	Rhopalosiphum maidis Fitch	from light trap	New Delhi
	Macrosiphum avenae F.	from light trap	New Delhi
	Schizaphis graminus Rond	from light trap	New Delhi
	Aphis sp.	from light trap	New Delhi
	Circulifer opacipennis Lethierry	sugarbeets	Shiraz, Iran
	Circulifer dubiosus Matsumura	sugarbeets	Shiraz, Iran
	Circulifer tenellus Baker	sugarbeets	Shiraz, Iran
	Circulifer sp.	sugarbeets	Shiraz, Iran
	Macrosteles laevis Ribant	sugarbeets	Shiraz, Iran
	Deltocephalinae sp.	sugarbeets	Shiraz, Iran
	Peragallia sinuata Mulsant & Ray	sugarbeets	Shiraz, Iran
	Empoasca parathes Pruthi	cowpeas	New Delhi
	Empoasca barathea Pruthi	pigeon peas	Hardoi, India
	Empoasca Kerri Pruthi	pigeon peas	Hardoi, India
	Empoasca Kerri, Variety motti Pruthi	pigeon peas	Hardoi, India
	Exitianus sp.		New Delhi
	Typhlocybinae		New Delhi
Delphacidae	Delphacodes sp.		New Delhi
Cixiidae	Cixiius sp.		New Delhi
Psyllidae	Psylla sp.		New Delhi
Thrips	Taeniothrips nigricornis Schmutz		Hyderabad Coimbatore
	Taeniothrips flavidulus Baghall		Pant Nagar
	Frankliniella sp. near or Formosae Monlton		Pant Nagar

Order Coleoptera

Bruchidae	Callosobruchus maculatus (f)	foodgrains	Widespread
	Callosobruchus chinensis (L)	foodgrains	Widespread
	Callosobruchus analis (f)	foodgrains	Widespread

Order Coleoptera (Continued)

Family	Genus and Species	Host	Locality
Chrysomelidae	Madurasia obscurella Jac	pulses	No. India
	Longitarsus sp.	pulses	No. India
	Chaetocnema sp.	pulses	No. India
Anthicidae	Unknown	pigeon peas	Jabalpur
Tenebrionidae	Tribolium castaneum Herbs	nsect specimens	New Delhi
Dermestidae	Trogoderma granarium	wheat seed	New Delhi
Bostrichidae	Thyzopertha dominica (f)		New Delhi
Cucujidae (Silvanidae)	Oryzaephilus surinamensis (L)	insect specimens	New Delhi

Order Hymenoptera

	Euryscotolinx coimbatorensis Rohwer	leaf miner larva	New Delhi
Pteromalidae	Anisopteromalus calandrae How	bruchids	New Delhi
	Diarnus vagabundus Timb	bruchids	New Delhi
	Diarnus laticeps Ashmead	bruchids	New Delhi
Eulophidae	Ceranisus maculatus Watanson	thrips	Hyderabad

Order Lepidoptera

Gracilariidae		cowpeas & beans	New Delhi
			Coimbatore
Gelechiidae	Sitrotroga cerealella Olivier	millet seed	New Delhi
Noctuidae	Heliothis armigera Hbn.	reared - Bangalore, India	

Order Diptera

Agromyzidae	Phytomyza horticola Gourean (atricornis Meigen)	peas	New Delhi

Class Arachnidae (Mites)

	Tarsonemus sp.	jute plants	New Delhi

QUALITY

RPIP
O. A. Krober

The main emphasis of this phase of the work is (1) on screening germplasm collections to identify high-protein breeding material and (2) on analyzing for protein the variations tested in the multi-location varietal trials to determine protein content as affected by variety and location.

The physical facilities, equipment, and staff available are too limited to permit much research on protein and component amino acids.

The protein content was determined of all samples of pulse crops from the All India Coordinated Variety Trials which were suitable for chemical analysis. Some samples were obviously seed mixtures, others were so badly damaged by insects that they would not give satisfactory evaluation of the genetic material. Most seed lots coming in from trial locations were incomplete with samples from varieties entered in the trials missing.

Results of these analyses should enable the plant breeder to identify high protein lines. However, due to the condition of the seed and the many missing samples, statistical analysis of the data was not possible and no reliable, final conclusions could be drawn from them. However, the data did indicate that a range of protein content exists in the present Indian varieties but that none are outstanding in this respect.. (Tables 135, 136, 137, 138, and 139)

Four sets of samples from simazin trials (see Soils and Crop Management Section), were analyzed for protein content. One set each of green gram and cowpeas grown at Hyderabad and Delhi were analyzed. In general there was little evidence of any marked increase in protein content due to simazin treatment. However, a few cowpea samples were somewhat higher in protein than the check sample.

Several sets of samples were analyzed by the official Kjeldhal method using Cereal Laboratory equipment. Duplicate samples were analyzed with the Udy Analyzer for calibration of the Udy equipment. The analytical work has been greatly handicapped by the long delay in the delivery of essential equipment. Equipment which was requested in the summer of 1967 was not delivered until late in 1968. Much of the work has been done with equipment and facilities borrowed from the Cereal Laboratory at I.A.R.I.

We have developed and used methods for the determination of protein in pulse materials using (1) Macro Kjeldahl, (2) Micro-kjeldahl digestion and distillation

(3) Microkjeldahl digestion and calorimetric determination with Technicon Auto-Analyzer, and (4) Udy dye-binding method.

Since the Udy equipment was received without the necessary conversion tables it was necessary to calibrate the instrument by analyzing samples of each of the pulse crops by standard methods and then with the Udy equipment.

Germplasm collections are presently being screened for protein content.

Papers and Publications

Nutritional Quality in Pulses - paper presented at a Symposium on "The Nutritive Value of High Yielding Strains of Cereals and Pulses" sponsored by the Nutrition Society of India, October 1968.

Nutritional Quality of Pulses - Proceedings 2nd Annual Workshop Conference in Pulses, New Delhi, 1968.

Table 135. Protein content (%) of mungbean varieties, Coordinated Varietal Trials, India, Kharif, 1968.

Variety Name	Origin	Punjab	Madhya	Pradesh	W. Bengal
		Ludhiana	Gwalior	Powerkheda	Maldo
D45-6	Gujarat	26.6	27.5	30.6	26.6
B-1	W.Bengal	26.1	27.7	29.4	----
T 44	U. P.	26.0	27.1	----	----
T 51	U. P.	28.8	26.6	33.1	----
No. 305	Punjab	25.2	24.9	----	----
24-2	Punjab	25.2	25.7	25.7	----
24-3	Punjab	24.8	26.0	----	23.4
BR-2	Bihar	28.2	29.3	28.1	----
RS-4	Rajasthan	28.1	27.5	27.9	----
Hyb.45	M. P.	27.7	28.6	29.0	27.3
Kopargaon	Mahar	28.9	30.3	----	27.3
Jalgaon 781	Mohar	31.4	28.5	----	----
D2-15	Gujarat	28.5	27.8	28.3	28.1
Khargaon-1	M. P.	31.4	28.4	30.4	26.4
N.P. 23	IARI	26.8	24.9	27.4	26.7
No. 54	U.P.	26.4	26.7	----	----
T-2	U.P.	----	26.6	29.3	25.6
K-111	A.P.	----	----	26.4	30.8

Table 136. Protein content (%) of urd bean varieties, coordinated varietal trials, India, Kharif 1967 & 1968.

Variety		Locations within States					
		Bihar		M. P.	Punjab		W. Bengal
Name	Origin	Dhoi	Kanki	Gwalior	Ludhiana	Berhampore	Maldo
BR 61	Bihar	26.2	23.4	26.6	29.5	----	----
BR 68	Bihar	26.8	23.5	28.3	----	----	----
D6-7	Mahar	25.2	26.6	28.1	26.2	27.1	----
Khargaon-3	M. P.	25.0	24.0	28.1	28.0	----	27.8
Mash 35-5	Punjab	24.3	23.3	26.6	26.0	----	28.2
Mash 4-13	Punjab	25.3	23.8	27.7	25.3	----	----
Sindkheda	Mahar	25.9	25.4	27.0	27.8	30.5	----
T 9	U. P.	27.3	22.3	26.2	----	21.6	26.3
T 27	U. P.	26.2	24.4	27.2	26.1	24.7	28.3
T 65	U. P.	26.4	22.6	26.9	----	23.7	28.4
No. 1-1	Punjab	25.6	23.0	27.5	25.5	26.1	28.3
No. 55	Mahar	23.8	25.4	27.4	----	27.7	----
No. 212	Madras	25.1	23.6	28.3	----	----	----
No. 1766	Madras	23.4	28.5	28.4	25.3	23.1	----
NP 6	IARI	----	----	27.8	----	----	----
Mash 48	Punjab	25.0	21.3	27.2	23.7	24.7	28.0

Table 137. Protein content (%) of pigeon pea varieties, coordinated varietal trials, India, kharif, 1968.

Variety		% Protein
Name	Origin	
B 7	Bengal	21.7
PT 301	Maharashtra	23.2
N-290-21	Maharashtra	26.3
N 148	Maharashtra	24.3
T-7	U. P.	24.7
T-17	U. P.	25.5
2-E	Bihar	24.5
GWL-3	M. P.	25.7
NPWR 15	IARI	24.8
7-S	Bihar	25.9
NP 69	IARI	24.0
S 103	IARI	23.0
C 11	Mahar	24.6
N 84	Mahar	26.1
S 101	IARI (?)	23.7

Table 138. Protein content (%) of cowpea varieties, coordinated varietal trials, India, kharif, 1968.

Variety		M. P.	Bihar	Punjab
Name	Origin	Gwalior	Kanke	Ludhiana
Ramshorn	U.S.A.	28.2	21.9	26.4
Meshed	Iran	29.1	23.2	27.5
No. 1		28.7	----	----
No. 3		29.5	----	----
No. 7		26.6	21.2	27.6
K 14	M. P.	29.5	23.3	28.0
No. 4		27.6	----	----
K 11	M. P.	28.8	24.6	30.5
K3B		29.3	24.8	----
NP 2	IARI	30.6	----	----
T 2	U. P.	----	22.0	24.9
RS 9	Rajasthan	----	24.1	28.0
5286-3	U. P.	----	27.1	28.0

Table 139. Protein content (%) of chickpea varieties, coordinated varietial trials, India, Rabi, 1968.

Variety		Gujarat	Bengal	A. P.
Name	Origin	Ahmedabad	Jamnajar	Lam
742-9	U. P.	28.3	----	17.7
Chaffa	Gujarat	27.1	----	16.9
ST 4	Bihar	----	----	20.3
BG 482	A. P.	27.0	----	18.9
T-2	U. P.	27.2	----	18.7
PB 7	Punjab	----	24.4	19.5
T-1	U. P.	29.0	----	20.1
Gwalior-2	M. P.	26.8	----	20.4
G62-404	M. P.	27.7	----	19.4
NP 58	IARI	----	----	23.9
736-1	U. P.	----	----	17.0
RS-10	Rajasthan	----	25.3	----
RS-11	Rajasthan	----	25.3	----
G 24	Punjab	----	25.7	----
C 235	Punjab	----	24.2	----
B 98	W. Bengal	----	26.0	----