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9. ABSTRACT
A summary of accomplishments in 1966 includes: For Iran: Work was done mainly on five pulse crops-- lentils, chickpeas, beans, cowpeas, and mungbeans. Approximately 9,300 germ plasm strains were screened in observation nurseries, and 475 promising strains were tested for yielding ability in replicated yield trials. Seeds of superior varieties of beans, chickpeas, cowpeas, and mungbeans have been increased. Investigations into cultural practices such as planting dates, plant spacing, fertilizer, and irrigation show that a potential exists for improved yields. A disease complex of broadbeans causing severe damage to the crop in some years was identified and methods of control investigated. Major insect pests of pulse crops have been determined and control methods explored. Chemosterilant work on certain insect pests has been started. For India: Germ plasm collections of chickpeas, mungbeans, urd beans, pigeon peas, cowpeas, and Lathyrus were grown, and the complete collections of chickpeas and cowpeas from the Iran project were transferred to India. All-India coordinated varietal trials were started for pigeon peas, mungbeans, urd beans, and chickpeas. Investigations were started into the neurotoxic factor causing lameness and paralysis in people eating Lathyrus sativus. Entomological activities were limited to observation and collection, but preliminary work got underway in identifying the various diseases.

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REGIONAL PULSE IMPROVEMENT PROJECT
U.S. DEPARTMENT OF AGRICULTURE, ARS
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

PROGRESS REPORT

Cooperating

INDIA

INDIAN COUNCIL FOR AGRICULTURAL RESEARCH
INDIAN AGRICULTURAL RESEARCH INSTITUTE
DEP'T AGRICULTURE, COOPERATING STATES

A.I.D.
Reference Center
Room 1656 NS

IRAN

PLAN ORGANIZATION
KARAJ AGRICULTURAL COLLEGE
MINISTRY OF AGRICULTURE

PAHLAVI UNIVERSITY, SHIRAZ

PROGRESS REPORT NUMBER 4

January 1 - December 31, 1966

REGIONAL PULSE IMPROVEMENT PROJECT

U. S. Department of Agriculture, Agricultural Research Service

U. S. Agency for International Development

Cooperating

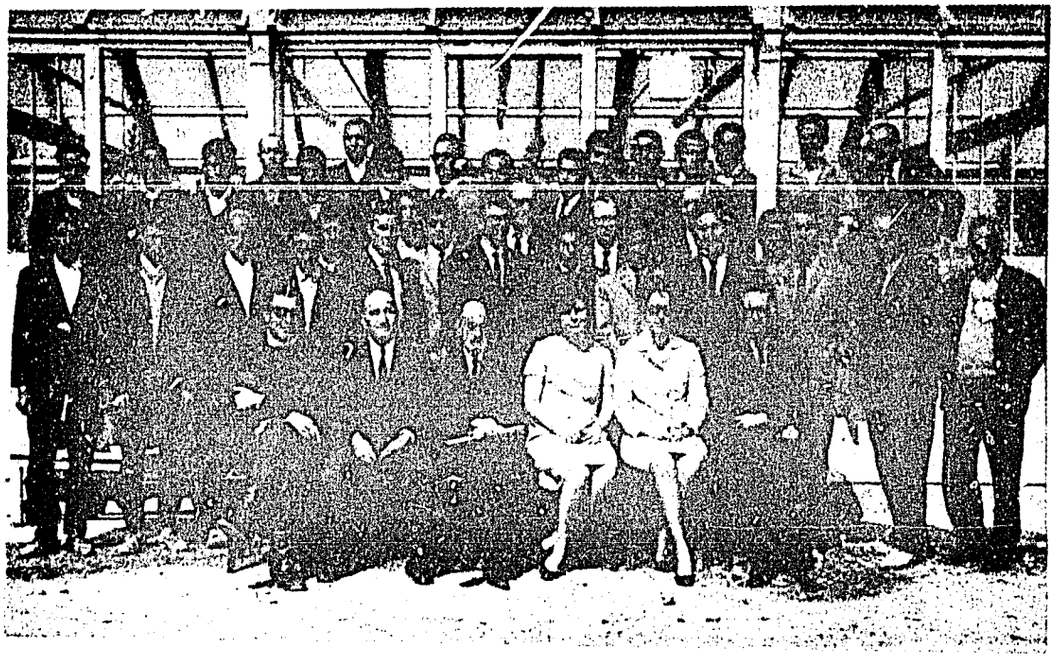
Iran

Plan Organization
Karaj Agricultural College
Ministry of Agriculture
Pahlavi University

India

Indian Council of Agricultural Research
Indian Agricultural Research Institute

Dr. Peter H. van Schaik
Regional Coordinator



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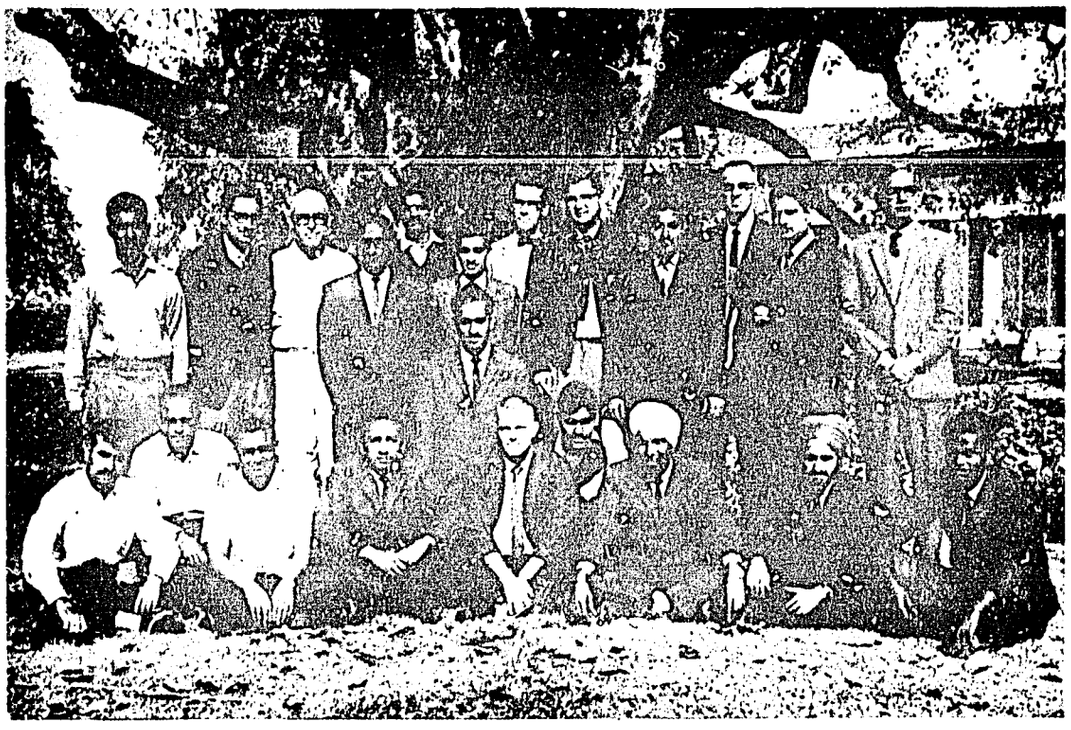

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SUMMARY

Iran

The Project completed its second full season in Iran in 1966. During that year the American staff was completed and major facilities contributed by the Government of Iran became available for use.

Major emphasis of the work has been on five pulse crops--lentils, chickpeas, beans, cowpeas and mungbeans. Work has included screening of local and exotic germplasm for adaptation, testing of promising strains for yielding ability, plant type, disease resistance and other characters at several places throughout Iran.

- Approximately 9,300 germplasm strains were screened in observation nurseries.

- Some 475 promising strains were tested for yielding ability in replicated yield trials.

- Seed of superior varieties of beans, chickpeas, cowpeas and mungbeans has been increased, and after further testing in 1967 recommendations will be made to the Iranian Ministry of Agriculture for release and distribution.

- Investigations on cultural practices such as planting date, plant spacings, fertilizer and irrigation practices show that a considerable potential exists for improved yields. However, it will be more difficult to change the traditional methods of farming than to have improved varieties accepted.

- A disease complex of broadbeans causing severe damage to the crop in some years was identified and methods of control investigated.

- Major insect pests of pulse crops have been determined, and control methods investigated. Preliminary work indicates that a safe, easy-to-use and economical method of control for bruchus stored grain weevils may be available. Bruchus weevils cause extensive damage, estimated as high as 40% loss, in all countries of the region.

- Chemosterilant work on certain insect pests has been started.

- A technical workshop was held in Karaj in August, 1966. See introduction.

- Seed of several pulse crops was sent to various countries for testing.

- Proposals were submitted to the Government of Iran for increased host government participation in pulse crop improvement work in Iran during the Fourth 5-Year Plan beginning March 21, 1968. These proposals include additional support to the Regional Pulse Improvement Project, as well as establishment of a Pulse Crop Division in the Seed and Plant Improvement Institute of the Ministry of Agriculture. The Government of Iran is asked to increase its contribution from 8,732,000 Rials ($116,426) during 1964-1967 to 70,000,000 Rials ($933,333) during 1968-1973.

India

The Project in India started its operations in December, 1965. During 1966 the American staff was completed except for the biochemist. Indian senior counterparts were not appointed until late 1966. Other appointments under the Indian Coordinated Pulse Crop Scheme still have to be made. Hopefully, construction of the laboratory building at IARI, Delhi will start in 1967, and regional centers and substations established and staffed.

- Work in 1966 consisted primarily of establishing germplasm, determining problem areas, becoming acquainted with people and places, and establishing simple facilities.

- Germplasm collections of chickpeas, mungbeans, urd beans, pigeon peas, cowpeas and *Lathyrus* were grown at Delhi, Coimbatore and Pant Nagar. A total of about 10,000 strains were screened. The complete collections of chickpeas and cowpeas from the Iran project were transferred to India.

- All-India coordinated varietal trials were started for pigeon peas, mungbeans, urd beans and chickpeas. These trials consisted of the major varieties developed and released by individual States, and allowed an exchange of material, which had not been done before.

- Investigations were started into the neurotoxic factor causing lameness and paralysis in people eating khesari (Lathyrus sativus).

- No results were obtained from the soil and crop management phase, as the work was only started with the rabi (fall-planted) crop of 1966.

- Entomological activities were limited to observation and collection, as the entomologist only arrived late in the year.

- Preliminary work got underway in identifying the various diseases. Several, causing serious losses, have been isolated and measures of control, including possible genetic resistance, are being investigated.

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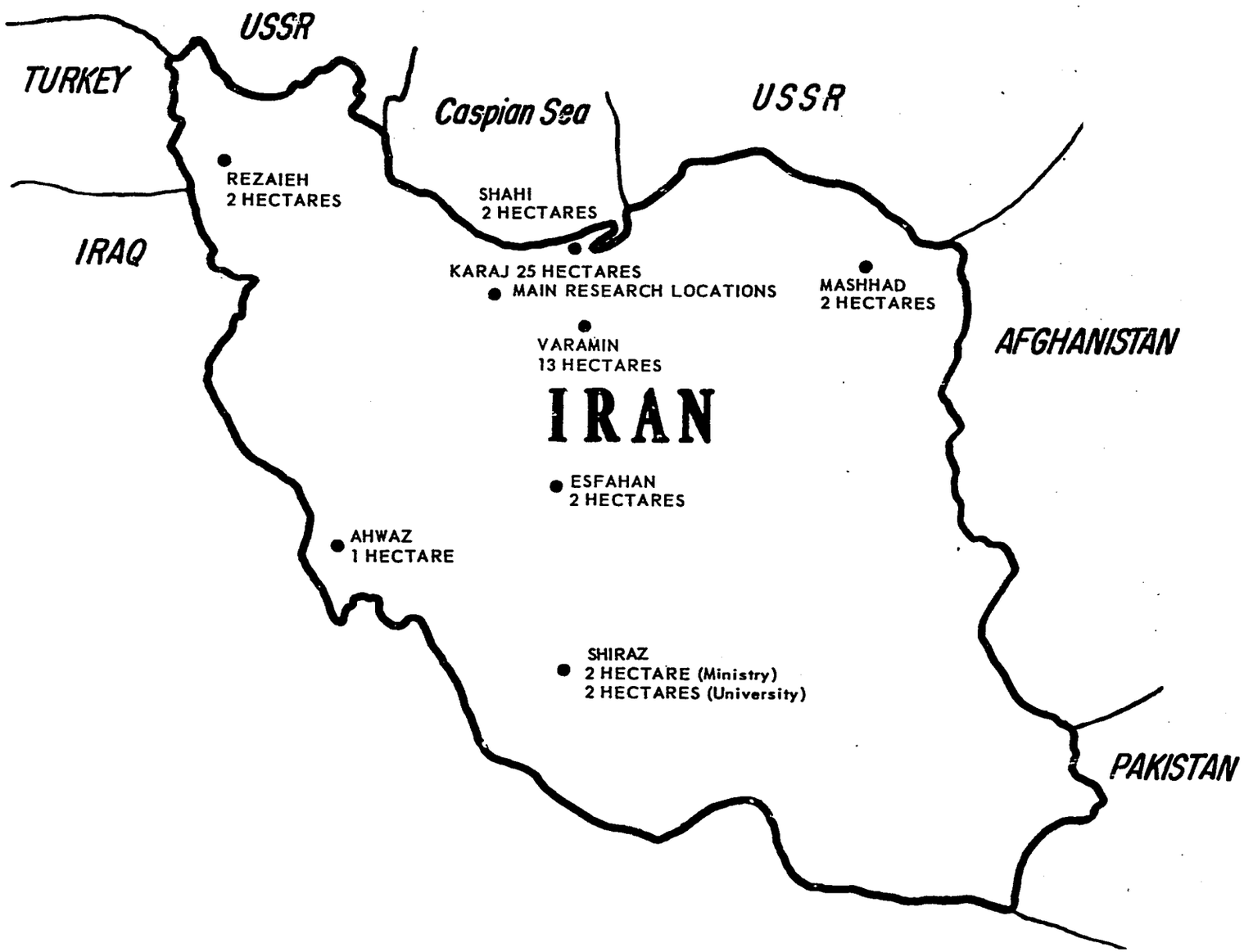
FIGURE 1

RESEARCH LOCATIONS, REGIONAL PULSE IMPROVEMENT PROJECT, IRAN, 1966



INTRODUCTION

This report covers the period January through December, 1966. Except for interim reports as requested by host government agencies, comprehensive progress reports will be issued annually.

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 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, with the arrival at post of the Regional Coordinator. The positions of entomologist, soils-agronomist, plant pathologist, and plant breeder were filled between then and early 1966.

In India, the Memorandum of Understanding was not signed until April, 1965. To counterpart the Pulse Improvement Project, 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. This project provides for a total budget of 3,500,800 rupees for the years 1965-66 to 1970-71, of which 443,000 rupees are provided for construction of facilities; the remainder for personnel at 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.

RESEARCH PROGRAMS 1966

Iran

Locations and Work Conducted (see map)

1. Karaj, College of Agriculture

   Land Used: 13 hectares

   Crops:
   - lentil (*Lens esculenta*)
   - chickpea (*Cicer arietinum*)
   - dry bean (*Phaseolus vulgaris*)
   - mungbean (*Phaseolus aureus*)
   - cowpea (*Vigna sinensis*)

   Program:
   - Varietal trials
   - Germplasm introduction and evaluation
   - Disease identification and control
   - Insecticide evaluations
   - Fertilizer trials
   - Plant spacing trials
   - Irrigation tests

2. Ministry of Agriculture, Seed and Plant Improvement Institute. Stations at Varamin, Rezaieh, Mashad, Esfahan and Shiraz.

   Land Used: 13 hectares at Varamin, 2 hectares each at other stations. Total of 21 hectares.

   Crops: Lentil, chickpea, dry bean, mungbean, cowpea.

   Program: Varietal trials.

3. Shiraz, the Pahlavi University, College of Agriculture.

   Land Used: About 2 hectares.

   Crops: Chickpea, dry bean.

   Program:
   - Germplasm evaluation
   - Varietal trials
   - Fertilizer-irrigation study.

4. Dezful, Khuzestan Water and Power Authority, Dezful Irrigation Project.

Land Used: 2 hectares

Crops: Chickpea, mungbean, cowpea, broadbean.

Program: Varietal trials
Disease studies

5. Food and Nutrition Institute, Tehran.

Analyses for cooking ability, total protein content and palatability.

6. Pest Control Institute, Tehran.

Cooperative work to study nematodes in mungbeans.

India

Locations and Work Conducted (see map)

A. Kharif (July Planting)

1. Delhi, Indian Agricultural Research Institute (IARI).

Crops:	pigeon pea	(arhar, tur, red gram)	(*Cajanus cajan*)
	mungbean	(green gram)	(*Phaseolus aureus*)
	urd bean	(black gram)	(*Phaseolus mungo*)
	cowpea		(*Vigna sinensis*)

Program: Germplasm introduction and evaluation
Varietal trials

2. Pantnagar, Uttar Pradesh Agricultural University (UPAU).

Crops: Mungbean, urd bean, cowpea.

Program: Germplasm observation nurseries
Varietal trials.

3. Coimbatore, IARI Regional Center and Agricultural College.

Crops: Pigeon pea, mungbean.

Program: Germplasm observation nurseries
Varietal trials

4. Research Stations (27) throughout India.

Crops: Pigeon pea, mungbean, urd bean, cowpea.

Program: Coordinated varietal trials of presently recommended varieties contributed by each state.

B. Rabi (November Planting)

1. Delhi, IARI

Crops: chickpea (gram, bengal gram) (*Cicer arietinum*)
vetch (khesari) (*Lathyrus sativus*)

Program: Germplasm introduction and evaluation
Varietal trials
Disease investigations
Insect control trials
Crop management studies

2. Pantnagar, UPAU

Crops: Chickpea, lentil, vetch.

Program: Germplasm observation nurseries
Varietal trials
Insect control trials
Crop management studies

3. Coimbatore, IARI

Crops: Chickpea

Program: Germplasm observation nurseries
Varietal trials

4. Research Stations (27) throughout India.

Crops: Chickpea, pea, lentil, lathyrus.

Program: Coordinated varietal trials of presently recommended varieties contributed by each state.

GERMPLASM COLLECTION

Collections are being established in both Iran and India. Germplasm is collected from a wide variety of sources, including U.S. Department of Agriculture, F.A.O., and individual countries. Collection trips have been and are continuing to be made in Iran, India, and other countries.

A uniform system has been developed for cataloguing this material. The germplasm is grown at Karaj, Iran and New Delhi, India and other locations in India. Detailed data are taken.

PL-480 project proposals have been submitted for collecting, classifying, and cataloguing these collections. These proposals, if approved, will provide finances to collect, assemble, and maintain a world collection of the major pulse crops.

SPECIAL ACTIVITIES

Conferences

A technical workshop was held in Karaj, Iran, August 8-12, 1966. Participants, in addition to Project personnel from Iran and India, were delegates from Government of Iran, Ministry of Agriculture, Karaj Agricultural College, other Iranian institutions, F.A.O., and participants from Turkey and Afghanistan.

A total of 44 people participated. A report of this conference was prepared and distributed.

Seed Distribution

As a result of requests, seed of various pulse crops was sent to the following:

Dr. Richard Bradfield, the Rockefeller Foundation, International Rice Research Institute, Manila, the Philippines.

12 strains of mungbeans
28 strains of chickpeas
10 strains of urd beans
14 strains of pigeon peas
3 strains of cowpeas.

Mr. E. T. Bailey, Dryland Farming Project, F.A.O., P. O. Box 565, Amman, Jordan.

152 strains of lentils
113 strains of chickpeas

Dr. Kenneth Evans, Plant Breeder, speaking to RPIP, Technical Workshop, Karaj, August, 1966.

Dr. Glenn Horner, Soil Scientist, demonstrating soil moisture probe at RPIP Workshop, Karaj, Iran, August 1966.

A field session during RPIP Workshop, Karaj, Iran, August 1966.

Dr. J. R. Schaeffer, Crops Research and Introduction Center, F.A.O., P. K. 25, Izmir, Turkey.

12 strains of broadbeans

Dr. L. L. Inman, Ahwaz Agricultural College (c/o Near East Foundation), Ahwaz, Iran.

50 strains of chickpeas
25 strains of lentils
25 strains of mungbeans
25 strains of cowpeas
25 strains of white beans
25 strains of pinto beans
34 strains of broadbeans

Mr. Don Schmidt, School of Agriculture, Akure, Nigeria.

18 strains of pigeon peas
54 strains of cowpeas
10 strains of mungbeans
10 strains of urd beans
25 strains of chickpeas

Cooperative Uniform Varietal Tests

As a result of discussions held during the workshop in Tehran and a subsequent questionnaire sent to several countries of the region, cooperative uniform varietal tests are being initiated with chickpeas, beans and lentils.

Each test will consist of a number of varieties or strains contributed by the various countries as their representative types. The tests are grown at one or more locations in each country and in all cases will be handled as uniformly as possible. Data will be sent to and processed by the Regional Pulse Improvement Project in Tehran.

Travel

Travel to other countries of the region included:

A two-week trip in June of 1966 by four members of the Iran team to Turkey, U.A.R., Jordan and Lebanon, to become acquainted with personnel and facilities in these countries and explore possible areas of cooperative work.

A trip in September of 1966 by Dr. W. J. Kaiser, Pathologist, and Dr. K. H. Evans, Plant Breeder, to Turkey to study disease conditions in pulse crops.

Travel within Iran and India included several trips by Project personnel for the purpose of making seed collections, to maintain contact with the various institutions in the countries, and to inspect and discuss cooperative research. Attendance of Dr. W. J. Kaiser, Pathologist, Iran, at the International Symposium on Plant Pathology in New Delhi, India, December 26-31, 1966.

§ § § § § §

VARIETAL IMPROVEMENT

Kenneth H. Evans - Plant Breeder
Counterparts: Jamshid Jaffari,
Mehdi Khosroshahin, Ali Ellini,
M. Taghavi-Bayat, Mohammad Moadab,
and Ahmad Sarrafi (Karaj College).

During 1966 varietal improvement work consisted of (1) evaluation of indigenous and exotic germplasm, (2) preliminary trials for yield and other characteristics of strains screened in 1964, and (3) testing of promising material in Advanced Yield Tests. This work was carried on at the locations outlined in the introduction of this report.

As in 1965, work was concentrated on the following crops: chickpeas (*Cicer arietinum*), cowpeas (*Vigna sinensis*), beans (*Phaseolus vulgaris*), mungbeans (*Phaseolus aureus*), and lentils (*Lens esculenta*).

The following sections deal with work conducted on the individual crops. Data reported in Tables 1 through 27 are from work supervised by Project personnel. Appendices V through IX contain limited data obtained from tests conducted by the Ministry of Agriculture at several stations in Iran.

Analyses for protein content, cookability, and palatability are being conducted under a cooperative agreement with the Food and Nutrition Research Institute in Tehran. As only the data for chickpeas are complete, only these are reported.

Chickpeas (*Cicer arietinum*)

Chickpeas are grown widely in the Middle East and are of considerable importance as a source of protein in the human diet. Since final use of black and white chickpeas differ, and plant type is somewhat different, the nursery and yield trials were divided into black and white types on the basis of seed and plant characteristics. The nurseries and yield trials were planted in five-meter rows with 50 centimeters' (20-inch) spacing between rows. The nursery plots were single row, while the yield trials were planted in four-row plots.

I. Observation Nurseries

With a large and varied area in which chickpeas are grown, and with limited knowledge of the problems that may be encountered, it seemed advisable to get further data on the observational nursery material. The entire nursery plus new accessions totaling 2,852 strains were grown again at Karaj under supervision of Project personnel. Selected lines representing the different populations were grown on the Pahlavi University farm at Shiraz under the supervision of Dr. Mansour Niknejad, head of the Plant Breeding and Genetics Department.

As in 1965, detailed notes on emergence, plant vigor, flower color, maturity, seed size, seed color, and disease resistance were taken.

II. Yield Trials

Preliminary yield trials of 49 varieties of white chickpeas (Table 1) and 25 varieties of black chickpeas (Table 2) were planted at Karaj. The strains were selected from the 1965 Observation Nursery on the basis of vigor, disease resistance, maturity, seed size, and yield, with some consideration for representing different populations.

The Advanced Yield Trials of chickpeas contained 25 strains and were planted at three locations--Karaj, Varamin and Shiraz.

The white chickpea Advanced Yield Trials (Tables 3, 4 and 5) had one strain (No. 331 from Cyprus) which performed well at Varamin and Shiraz again this year, but dropped rank at Karaj. Strain number 347 ranked first and second at Karaj and Shiraz, but was not planted at Varamin. Three other strains ranked in the top ten at all locations.

Comparing the nutritional data, it is of interest that the crop grown in Varamin is higher in protein and that seed takes less time to cook than that from Karaj or Shiraz. Palatability ratings are approximately the same from all locations. Whether a relationship exists between climatic conditions during the growing season--Varamin being several degrees warmer--and protein and cookability is not known.

In the black chickpea Advanced Yield Trials (Tables 6, 7 and 8) only one strain (416) ranked in the top ten at all locations. The three strains common to the 1965 and 1966 tests did not rank consistently over locations or years.

Nutritional data again show higher protein at Varamin. Cooking time was the same at all locations and about one-half of that required to cook white chickpeas. This may be because black chickpeas are dehulled before cooking. Absorption of water through the seed coat may take the greatest part of the required cooking time. Removing the seed coat apparently does not lower the percentage of protein.

The Iranian Ministry of Agriculture conducted yield tests of local varieties which are presented in the Appendix (Appendix V). Comparison of yield levels of these local types with improved strains included in Project trials shows that considerable improvement can be made.

Legend for Table 1

(1) Strain numbers refer to numbers assigned in 1965 Observation Nursery.

(2) Source numbers refer to Iranian Ministry of Agriculture. Numbers assigned to populations or collections; 6-digit numbers are P. I. numbers from Crops Research Division, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of Iran or country of origin. PKPS means "Progeny of Karaj Population Selection," and refers to plant selections made in a local Karaj population in 1963.

(4) LPu = light purple; W = white.

(5) Rated 1 to 9: 1 = vigorous plants and good stand; 9 = weak plants and uneven emergence.

(6) Planting date March 26, 1966.

(7) First mature pod indicates first pod ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Rated 1 to 9: 1 = no disease symptoms; 9 = severe symptoms. Disease symptoms included yellowing and wilting.

(10) Seeds per pod vary. Indicated here is range.

(11) W = white; Cr = cream; Br = brown; L = light; D = dark.

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

(13) Yield in grams per plot. Plots 2 bordered rows, 50 cm. apart, 5 meters long.
LSD .05 = 357. CV = 19%.
Conversion factor grams per plot to kilograms per hectare = 2.

TABLE 1. Agronomic Data, Chickpeas (white), Preliminary Yield Test, RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand & Vigor	(6) Days from Planting to 1st Flower	(7) Days from Planting to 1st Mat.Pod	(8) Days from Planting to Compl. Mat.	(9) Disease Rating 6/7	6/21	6/29	(10) Seeds P-Pod	(11) Seed Color	(12) Seed Size	(13) Yield
1796	162	I-Shahpour	LPu	4	64	106	134	3	4	4	1-2	Cr	23.4	2352
868	182	I-Shiraz	W	3	68	108	133	2	3	3	1-2	W	15.5	2293
1415	111	I-Varamin	LPu	3	59	101	129	3	4	4	1-2	LBr	18.1	2148
1591	161	I-Momaghan	LPu	3	60	106	137	3	4	3	1-2	Cr	22.8	2124
1649	152	I-Karaj	LPu	3	58	102	124	3	4	5	1-2	LBr	22.5	2112
1388	111	I-Varamin	LPu	3	60	103	129	2	4	3	1-2	Cr	26.9	1962
1376	111	I-Varamin	LPu	3	59	105	129	3	3	3	1-2	LBr	30.9	1954
646	106	I-Fars	W	3	68	102	132	4	4	4	1-2	W	18.0	1951
2013	217	I-Torbat-Heidarieh	Pu	3	66	108	138	2	2	2	1-2	LBr	14.3	1947
620	106	I-Fars	W	2	63	103	128	2	3	4	1-2	W	15.9	1931
931	182	I-Shiraz	W	3	66	105	137	3	3	4	1-2	W	20.2	1929
1602	161	I-Momaghan	LPu	3	60	102	121	4	4	5	1-3	Cr	23.5	1919
617	106	I-Fars	W	4	69	106	132	2	4	4	1-2	W	18.8	1843
976	230	I-Nishabour	W	3	57	102	130	2	3	5	1-3	W	18.7	1841
613	106	I-Fars	W	3	68	105	127	2	3	4	1-2	W	19.1	1831
1588	161	I-Momaghan	LPu	3	68	102	135	3	4	5	1	Cr	30.2	1769
795	230	I-Nishabour	W	3	57	102	129	3	4	5	1-3	W	18.4	1754
380	241	I-Ghuchan	W	3	59	104	129	3	4	5	1-2	W	19.1	1750
813	230	Nishabour-I	W	3	57	102	130	2	4	5	1-2	W	18.8	1726
1406	111	I-Varamin	LPu	5	60	102	126	4	4	4	1-2	Cr	31.2	1717
614	106	I-Fars	W	3	61	103	128	3	4	5	1-2	W	18.6	1713
825	230	I-Nishabour	W	3	66	102	124	2	3	4	1-3	W	16.4	1702
1779	153	I-Karaj	LPu	3	68	105	131	3	3	3	1-2	Cr	25.1	1647
1225	169	I-Ardabil	LPu	4	68	105	127	4	4	3	1-2	Cr	24.3	1623
797	230	I-Nishabour	W	3	60	104	127	3	3	4	1-2	LBr	17.7	1613
2014	217	I-Torbat-Heidarieh	W	2	63	103	130	2	3	4	1-3	W	18.9	1574
440	241	I-Ghuchan	W	3	57	101	125	3	3	5	1-2	W	20.7	1573
524	241	I-Ghuchan	W	3	59	101	131	2	4	6	1-2	W	20.2	1571
1389	111	I-Varamin	LPu	3	60	102	130	2	4	4	1-2	Cr	25.8	1565
794	230	I-Nishabour	LPu	3	67	102	124	2	3	5	1-3	DCr	15.7	1556
618	106	I-Fars	W	3	62	104	131	3	4	5	1-2	W	19.8	1539
822	230	I-Nishabour	W	3	66	103	120	2	4	5	1-2	W	18.9	1500
645	106	I-Fars	W	4	67	103	131	3	4	4	1-2	W	19.5	1500
433	241	I-Ghuchan	W	3	58	101	120	2	4	5	1-2	W	17.6	1440
1122	169	I-Ardabil	W	3	59	103	133	4	4	5	1-2	Cr	26.1	1437
823	230	I-Nishabour	W	3	62	101	118	3	4	5	1-2	W	17.9	1427
437	241	I-Ghuchan	W	3	56	102	123	3	4	4	1-2	W	20.3	1420
1398	111	I-Varamin	W	3	61	101	133	3	5	5	1-2	W	22.8	1410
935	182	I-Shiraz	W	3	68	103	132	2	3	3	1-2	W	19.6	1363
975	230	I-Nishabour	W	3	59	103	125	2	4	5	1-2	W	19.0	1361
809	230	I-Nishabour	W	3	61	102	125	3	4	5	1-2	W	20.2	1318
432	241	I-Ghuchan	W	3	56	105	130	3	3	4	1-2	W	21.0	1293
446	241	I-Ghuchan	W	5	56	103	125	3	4	4	1-2	W	21.7	1280
86	84	PKPS	W	4	59	102	122	4	5	5	1-2	LBr	29.8	1276
1517	168	I-Momaghan	W	4	59	104	129	4	5	5	1-2	W	22.9	1132
88	86	PKPS	W	4	59	101	124	4	5	6	1-2	W	30.4	1123
1176	169	I-Ardabil	LPu	3	63	100	123	3	4	6	1-2	Cr	20.3	1058
1396	111	I-Varamin	LPu	5	66	102	128	4	6	5	1-2	W	22.1	928
1156	169	I-Ardabil	W	3	58	102	127	3	4	6	1-2	W	31.6	926

Legend for Table 2

(1) Strain numbers refer to numbers assigned in 1965 Observation Nursery.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collections; 6-digit numbers are P.I. numbers from Crops Research Division, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of Iran or country of origin.

(4) Flower color for all strains is purple.

(5) Rated 1 to 9: 1 = vigorous plants, good stand; 9 = weak plants, uneven emergence.

(6) Planting date March 27, 1966.

(7) First mature pod indicates first pod ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Rated 1 to 9: 1 = no disease symptoms; 9 = severe symptoms. Disease symptoms included yellowing and wilting.

(10) Seeds per pod vary. Indicated here is range.

(11) Bk = black; Br = brown, L = light.

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

(13) Yield in grams per plot. Plots 2 bordered rows, 50 cm. apart, 5 meters long (5 M^2).
LSD .05 = 343. CV = 21%.
Conversion factor grams per plot to kilograms per hectare = 2.

TABLE 2. Agronomic Data, Chickpeas (black), Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand & Vigor	(6) Days to First Flower	(7) Days to First Mat.Pod	(8) Days to Full Maturity	(9) Disease Rating 6/7	(9) Disease Rating 6/21	(10) Seeds P-Pod	(11) Seed Color	(12) Seed Size	(13) Yield
2864	174	I-Ahar	Pu	3	56	94	120	2	3	1-2	Bk	12.5	1184
2428	172	I-Ardabil	Pu	3	54	93	118	3	3	1-2	LBr	13.8	1172
3034	154	I-Gharyegole	Pu	3	55	93	117	3	3	2	Bk	11.9	1159
2829	174	I-Ahar	Pu	3	56	92	122	3	3	1-2	Bk	12.8	1111
2861	174	I-Ahar	Pu	5	56	94	120	4	4	1-2	Bk	10.5	1098
2194	221	I-Esfahan	Pu	4	57	95	118	4	4	1-2	Bk	12.3	1082
2794	174	I-Ahar	Pu	3	55	92	116	4	4	1-2	Bk	12.8	1072
2862	174	I-Ahar	Pu	4	56	95	122	4	4	1-2	Bk	10.4	1061
2269	221	I-Esfahan	Pu	4	56	93	116	3	4	1-2	Bk	20.1	1024
284	327-1	I-Ghazvin	Pu	4	55	92	115	3	3	1-2	Bk	11.7	1016
276	326	I-Esfahan 221	Pu	3	55	92	115	3	3	1-2	Bk	13.2	996
2192	221	I-Esfahan	Pu	4	56	93	118	3	3	1-2	Bk	12.2	957
2231	221	I-Esfahan	Pu	3	56	91	113	4	3	1-2	Bk	12.7	949
2254	221	I-Esfahan	Pu	4	56	92	116	4	4	1-2	Bk	13.6	944
291	129	I-Esfahan	Pu	4	55	90	116	3	4	1-2	Bk	12.9	942
2247	221	I-Esfahan	Pu	4	56	90	115	3	3	1-2	Bk	20.1	916
2842	174	I-Ahar	Pu	4	55	91	113	3	4	2	Bk	13.8	916
2858	174	I-Ahar	Pu	3	54	90	112	4	4	1-2	Bk	13.5	916
268	222771	Iran	Pu	4	54	91	113	3	4	1-2	Bk	9.9	892
287	315-1	I-Karaj 47	Pu	4	57	92	115	3	4	1-2	Bk	12.4	878
2255	221	I-Esfahan	Pu	4	56	93	118	3	4	2	Bk	12.1	875
2246	221	I-Esfahan	Pu	4	56	91	115	4	4	1-2	Bk	13.8	869
275	325	I-Kermanshah 193	Pu	4	55	91	111	4	5	1-2	Bk	10.6	739
2727	175	I-Gharyegole	Pu	4	54	89	112	4	4	1-2	Bk	10.2	702
269	222772	Iran	Pu	5	53	86	113	4	5	1-2	Bk	11.8	552

Legend for Table 3

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. Those with "M" after number are Iranian Ministry of Agriculture strain numbers.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collections; 6-digit numbers are P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of origin, country. or area in Iran. PKPS means "Progeny of Karaj Population Selection," and refers to plant selections made in a local Karaj population in 1963.

(4) Pu = purple; W = white; L = light.

(5) Rated 1 to 9: 1 = complete stand, vigorous plants; 5 = uneven emergence, weak plants.

(6) Planting date March 17, 1966.

(7) First mature pod indicates first pod to reach full maturity, ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. Disease rating was for disease symptoms in general. Diseases present are discussed in Pathology section.

(10) Seeds per pod vary. Range is indicated here.

(11) W = white; Cr = cream; Br = brown; L = light; D = dark.

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

(13) Yield in grams per plot. Plots 2 rows, 50 cm. apart, 5 meters long (5 M^2).
LSD .05 = 259. CV = 15%.
Conversion factor, grams per plot to kilograms per hectare = 2.

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

(15) Cooking time (in hours) determined by boiling 50-gram sample in 500 ml. of water, 2 grams NaCl added, and checking regularly for hardness.

(16) Palatability, maximum rating 30.
- Appearance, maximum rating - 9.
  - Color uniformity - 3, 2, 0.
  - Size uniformity - 3, 2, 0.
  - Cooking uniformity - 3, 2, 0.
- Smell - 6, 4, or 0.
- Taste - 15, 10, or 0.

TABLE 3. Agronomic & Nutritional Data, Chickpeas (white), Advanced Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand & Vigor	(6) Days to First Flower	(7) Days to First Mat.Pod	(8) Days to Full Maturity	(9) Disease Rating 6/7	6/21	6/30	(10) Seeds P-Pod	(11) Seed Color	(12) Seed Size	(13) Yield	(14) Protein	(15) Cooking Time	(16) Palata-bility
347M	-	I-Karaj	LPu	3	59	103	135	3	3	3	1-2	Y	26.5	1958	21.4	7:45	15
323M	169	I-Ardabil	PW	3	61	102	130	4	3	4	1-2	Cr	26.7	1822	21.6	5:08	23
329M	170	I-Ardabil	LPu	3	58	102	133	2	3	4	1-2	Cr	28.0	1821	20.4	3:00	11
313M	161	I-Moghan	LPu	3	60	104	133	3	3	3	1-2	Y	23.8	1744	23.5	3:30	19
322M	169	I-Ardabil	LPu	3	62	103	131	3	2	2	1-2	Cr	22.8	1683	21.2	6:30	6
336M	170	I-Ardabil	LPu	3	59	104	131	3	3	4	1-2	Cr	28.8	1678	22.4	6:45	23
301M	111	I-Esfahan	LPu	3	59	101	131	3	4	4	1-2	Cr	29.1	1652	21.5	5:23	20
331M	170	I-Ardabil	LPu	3	60	104	134	3	3	3	1-2	Y	24.6	1633	22.6	5:23	17
309	230	I-Nishabour	W	4	58	101	131	3	4	4	1-3	W	19.0	1623	20.6	2:30	23
335M	170	I-Ardabil	LPu	2	61	102	130	3	3	3	1-2	YCr	26.5	1620	23.2	5:45	19
312M	153	I-Karaj	W	3	58	100	130	3	4	5	1-2	W	20.7	1570	21.0	3:45	29
302M	129	I-Moghan	LPu	3	58	100	132	3	4	5	1-2	Cr	30.2	1544	19.4	3:08	20
340M	170	I-Ardabil	LPu	3	60	104	132	3	4	4	1-2	Cr	28.3	1531	21.6	7:15	17
332	217	I-Torbat-Heydarieh	W	4	60	101	132	4	4	3	1-2	W	23.3	1485	23.0	5:00	20
331	32	Cyprus	LPuW	4	59	101	131	3	4	4	1-2	Cr	30.5	1482	19.7	4:00	18
329	37	I-Karaj	LPuW	3	60	101	132	3	5	5	1-2	Cr	22.9	1470	21.8	8:00	19
339M	170	I-Ardabil	W	3	60	100	132	3	4	4	1-2	W	21.3	1420	22.7	8:30	14
310	241	I-Ghuchan	W	4	56	101	131	4	5	5	1-2	W	18.1	1404	21.7	4:45	29
80	-	PSKP	LPu	3	58	101	133	3	4	5	1-2	Cr	31.1	1364	21.7	2:45	8
317M	162	I-Shahpour	W	3	59	101	131	3	4	5	1-2	W	25.9	1356	20.2	7:15	18
34	-	PKPS	W	4	57	99	128	4	5	6	1-2	W	26.3	1352	19.0	7:30	22
3	-	PKPS	W	4	57	100	130	4	5	6	1-2	W	29.1	1208	20.3	8:15	15
328M	170	I-Ardabil	PuW	4	59	102	132	4	4	5	1-2	Cr	30.7	1183	21.0	5:45	16
18	-	PKPS	W	5	57	101	132	4	5	5	1	W	31.6	1144	22.4	4:08	20
225	249982	Iran	W	4	62	100	129	4	5	6	1-2	W	34.2	935	18.9	6:15	19

Legend for Table 4

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. Those with "M" after number are Iranian Ministry of Agriculture strain numbers.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collections; 6-digit numbers are P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of origin, country or area in Iran. PKPS means "Progeny of Karaj Population Selection," and refers to plant selections made in a local Karaj population in 1963.

(4) Pu = purple; W = white; L = light.

(5) Rated 1 to 9: 1 = complete stand, vigorous plants; 5 = uneven emergence, weak plants.

(6) Planting date, March 17, 1966.

(7) First mature pod indicates first pod to reach full maturity, ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. Disease rating was for disease symptoms in general. Diseases present are discussed in Pathology section.

(10) Seeds per pod vary. Indicated here is range.

(11) W = white; Cr = cream; Br = brown; L = light; D = dark.

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

(13) Yield grams per plot. Plots 4 rows, 50 cm. apart, 10 meters long (20 M^2).
LSD .05 = 688. CV = 23%.
Conversion factor, grams per plot to kilograms per hectare = .5.

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

15) Cooking time (in hours) determined by boiling 50-gram sample in 500 ml. of water, 2 grams NaCl added and checking regularly for hardness.

16) Palatability, maximum rating - 30.
    Appearance, maximum - 9.
        Color uniformity - 3, 2, 0.
        Size uniformity - 3, 2, 0.
        Cooking uniformity - 3, 2, 0.
    Smell - 6, 4, or 0.
    Taste - 15, 10, or 0.

TABLE 4. Agronomic & Nutritional Data, Chickpeas (white), Advanced Yield Test. RPIP, Varamin, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand & Vigor	(6) Days to First Flower	(7) Days to First Mat. Pod	(8) Days to Full Maturity	(9) Disease Rating 5/31	(9) Disease Rating 6/7	(10) Seeds P-Pod	(11) Seed Color	(12) Seed Size	(13) Yield	(14) Protein	(15) Cooking Time	(16) Palatability
302M	129	I-Moghan	Pu	2	59	90	101	2	3	1-2	Cr	25.6	3187	23.9	2:08	22
331M	170	I-Ardabil	W	2	61	93	104	2	2	1-2	Y	20.7	2800	24.9	3:08	22
328M	170	I-Ardabil	Pu	2	60	91	101	2	4	1	Cr	25.8	2756	24.7	1:45	14
339M	170	I-Ardabil	W	2	60	91	100	2	3	1	W	20.6	2734	26.8	2:15	21
80	-	PKPS	Pu	2	59	91	103	2	3	1-2	Cr	30.7	2724	27.1	3:15	15
329M	170	I-Ardabil	Pu	2	60	90	101	3	3	1-2	Cr	23.5	2694	23.5	2:23	20
331	32	Cyprus	Pu	3	59	91	100	2	4	1-2	Cr	21.7	2686	22.8	2:15	15
322M	169	I-Ardabil	Pu	1	62	90	101	2	3	1-2	YBr	20.5	2602	25.0	2:30	17
301M	111	I-Esfahan	Pu	2	59	88	98	2	3	1-2	W	22.5	2530	24.5	2:15	16
317M	162	I-Shahpour	W	2	58	91	102	3	3	1-2	W	23.6	2529	26.8	2:38	16
335M	170	I-Ardabil	Pu	2	62	94	104	2	2	1-2	W	23.6	2397	24.4	2:15	21
313M	161	I-Moghan	Pu	2	62	93	103	2	2	1	Y	17.3	2367	25.4	1:53	17
34	-	PKPS	W	3	59	87	98	3	4	1-2	W	23.0	2360	22.9	2:45	24
310	241	I-Ghuchan	W	4	55	89	98	2	5	1-2	W	15.7	2349	25.5	2:08	22
316M	162	I-Shahpour	W	2	59	93	102	2	2	1-2	Y	20.4	2277	23.0	3:30	18
312M	153	I-Karaj	W	3	59	90	101	2	4	1-3	W	20.4	2276	27.2	2:38	20
336M	170	I-Ardabil	Pu	2	60	93	102	2	3	1	Cr	24.0	2242	26.6	2:23	16
309	230	I-Nishabour	W	3	56	87	98	3	5	1-2	W	15.7	2235	25.5	3:53	18
323M	169	I-Ardabil	Pu	3	61	93	104	2	3	1-2	Cr	23.8	2203	27.4	1:38	17
3	-	PKPS	W	4	57	90	103	3	4	1-2	W	26.6	2153	24.3	2:45	19
225	249982	Iran	W	4	64	93	100	4	5	1-2	W	29.8	2130	23.2	1:45	22
303M	153	I-Karaj	W	2	62	90	102	2	3	1-2	W	19.7	2031	28.3	3:00	21
329	37	I-Karaj	WPu	3	60	90	101	3	4	1-2	Cr	23.0	1896	23.8	4:00	17
18	-	PKPS	W	4	58	91	101	3	5	1	W	23.5	1668	24.4	2:53	20
332	217	I-Torbat-Heydarieh	W	4	57	90	100	3	5	1-2	W	16.9	1507	26.1	2:45	20

Legend for Table 5

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. Numbers with "M" after them are Iranian Ministry of Agriculture strain numbers.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collections; 6-digit numbers are P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of origin, country or area of Iran.

(4) Pu = purple; W = white; WPu = mixed, L = light, D = dark.

(5) Rated 1 to 10: 10 = complete stand; 1 = very poor stand.

(6) Rated 1 to 5: 5 = vigorous plants; 1 = weak plants.

(7) Rated 1 to 5: 1 = erect; 5 = spreading.

(8) Measured (in centimeters) as average height of plants in the plot.

(9) Average width of plants in row (cm.).

(10) Average number of pods on six random branches.

(11) Counted at harvest time.

(12) Days from planting to appearance of first bloom.

(13) Complete maturity indicates whole plot ready for harvest.

(14) Number of seeds in 25 random pods.

(15) Weight of 10 randomly selected seeds.

(16) W = white; Cr = cream; Br = brown; Gr = green; L = light; D = dark.

(17) Sh = wrinkled; S = smooth.

(18) Yield in grams per plot. Plot size, 13.5 M^2.
LSD .05 = 658 CV = 22%.
Conversion factor grams per plot to kilograms per hectare = .74.

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

(20) Cooking time (in hours) determined by boiling 50-gram sample in 500 ml. of water, 2 grams NaCl added and checking regularly for hardness.

(21) Palatability, maximum rating - 30.
- Appearance, maximum - 9.
  - Color uniformity - 3, 2, 0.
  - Size uniformity - 3, 2, 0.
  - Cooking uniformity - 3, 2, 0.
- Smell - 6, 4, or 0.
- Taste - 15, 10, or 0.

TABLE 5. Agronomic and Nutritional Data, Chickpeas (white), Advanced Yield Test. RPIP, Pahlavi University, Shiraz, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand	(6) Vigor	(7) Plant Type	(8) Plant Ht.	(9) Plant Width	(10) Pods /Br.	(11) Plants /Plot	(12) Days to First Flower	(13) Days to Full Maturity	(14) Seeds /25 Pods	(15) 100 Seed Wt.	(16) Seed Color	(17) Seed Shape	(18) Yield	(19) Protein	(20) Cooking Time	(21) Palata-bility
301M	111	I-Esfahan	LPu	9	3	4	37	62	8	206	51	113	35	2.6	Cr	Sh	3694	21.0	2:30	16
347M	-	I-Karaj	LPu	10	4	3	38	62	7	207	54	117	28	2.6	W	Sh	3131	23.8	3:15	17
323M	169	I-Ardabil	LPu	9	4	3	36	59	7	225	57	120	33	2.3	Cr	Sh	3089	23.4	3:00	15
302M	129	I-Moghan	LPu	9	3	4	36	59	8	172	49	119	30	2.8	Cr	Sh	3039	20.0	3:30	15
329M	170	I-Ardabil	LPu	10	4	4	35	59	8	234	56	120	31	2.6	GrCr	Sh	2943	20.5	4:00	20
313M	161	I-Moghan	LPu	9	5	3	38	62	7	230	57	118	28	2.3	GrCr	Sh	2788	23.7	2:08	16
331	32	Cyprus	LPu	8	3	4	35	63	7	160	50	119	30	2.5	Cr	Sh	2781	21.3	2:38	19
335M	170	I-Ardabil	LPu	9	5	4	39	64	7	257	55	118	28	2.4	W	Sh	2717	23.9	3:30	16
328M	170	I-Ardabil	WPu	9	3	3	36	63	7	186	51	120	28	2.7	W	Sh	2619	22.9	2:15	18
322M	169	I-Ardabil	LPu	10	5	5	39	62	7	276	50	118	30	2.2	Cr	Sh	2545	23.2	2:38	19
329M	37	I-Karaj	LPu	9	3	3	35	58	6	221	46	115	33	2.4	LCr	Sh	2542	22.9	2:08	18
310	241	I-Ghuchan	W	8	3	1	27	55	10	198	42	111	37	1.8	W	Sh	2520	22.1	2:45	23
331M	170	I-Ardabil	LPu	9	4	3	36	60	6	186	55	113	32	2.3	LCr	Sh	2493	24.3	3:08	21
340M	170	I-Ardabil	LPu	9	4	3	37	61	7	187	54	113	30	2.8	W	Sh	2443	22.0	3:30	15
80	-	PKPS	LPu	9	4	4	38	58	6	232	50	119	32	2.6	DCr	Sh	2415	21.0	3:38	17
317M	162	I-Shahpour	W	9	4	3	36	60	7	177	49	120	29	2.4	LCr	Sh	2390	22.9	4:00	23
336M	170	I-Ardabil	LPu	9	4	4	39	62	6	229	56	120	30	2.7	W	Sh	2372	22.6	2:38	13
339M	170	I-Ardabil	W	8	3	3	34	55	7	207	46	113	33	2.2	Cr	S	2279	23.0	2:15	18
309	230	I-Nishabour	W	9	2	2	30	51	8	190	43	113	39	1.9	W	Sh	2185	21.4	2:38	21
312M	153	I-Karaj	W	8	3	3	34	56	6	183	49	113	41	2.2	LBr	S	2166	21.3	2:15	22
332	217	I-Torbat Heydarieh	W	7	3	3	33	57	7	120	51	123	32	2.2	W	Sh	2073	23.6	3:00	22
3	-	PKPS	W	8	3	3	33	54	7	110	47	116	28	2.9	LBr	S	2072	23.0	3:30	19
34	-	PKPS	W	8	3	3	31	53	6	125	46	113	30	2.6	CrGr	S	1860	21.3	2:38	25
225	249982	Iran	W	7	3	3	28	57	7	84	33	117	33	3.0	Cr	Sh	1600	21.3	1:38	23
18	-	PKPS	W	6	3	2	27	50	6	84	43	115	26	2.5	LCr	S	1114	22.9	2:15	26

TABLE 6. Agronomic Data, Chickpeas. RPIP/KWPA, Dezful, Iran, 1965/66.

Strain Number	Source Number	Source	Days to Emergence	Days to First Flower	Days to Podding	Yield(gm) per Plot	Kg. per Ha.
231	251514	Iran	9	96	113	1550	1722
237	268376	Afghanistan	9	92	114	1868	2075
302	-	I-Ghazvin	9	97	116	1512	1680
303	-	I-Azarshahr	9	98	117	1605	1783
305	-	I-Ardabil	9	93	112	1834	2038
306	-	I-Kermanshah	9	97	116	1809	2010
307	-	I-Ghazvin	9	96	114	1706	1895
309	230	I-Nishabour	9	102	116	1974	2193
310	241	I-Ghuchan	9	95	113	1891	2101
329	37	I-Karaj	9	99	116	1844	2049
331	32	Cyprus	9	99	115	1745	1939
332	217	I-Torbat-Heydarieh	9	100	115	1791	1990
337	-	Unknown	9	100	116	1565	1739
Check	-	I-Karaj local	9	95	115	1890	2100

Legend for Table 7

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. Numbers with "M" after them are Iranian Ministry of Agriculture strain numbers.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collections; 6-digit numbers are P.I. numbers from New Crops Research Branch, CRD, ARS, U.S.Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of origin in Iran.

(4) Pu = purple.

(5) Rated 1 to 9: 1 = full stand, vigorous plants; 9 = thin stand, weak plants.

(6) Planting date March 27, 1966.

(7) First mature pod indicates first pod to reach full maturity, ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. Rating for general disease symptoms. Diseases present discussed in Pathology section.

(10) Seeds per pod vary. Indicated here is range.

(11) Br = brown; Bk = black; L = light.

(12) Average weight in grams of 100 seeds.

(13) Yield in grams per plot. Plots 2 rows, 50 cm. apart, 5 meters long (5 M^2).
LSD .05 = 274. CV = 15%.
Conversion factor, grams per plot to kilograms per hectare = 2.

(14) Protein percentage based on total solids, determined by Kjeldahl method. As black chickpeas are consumed with hulls removed, determinations made on hulless seed. Each figure is average of two samples, two determinations per sample.

(15) Cooking time in hours, 50 grams of seed (dehulled) boiled with two grams of NaCl and checked regularly for hardness.

(16) Palatability, maximum rating - 30.
- Appearance, maximum - 9.
  - Color uniformity - 3, 2, 0.
  - Size uniformity - 3, 2, 0.
  - Cooking uniformity - 3, 2, 0.
- Smell - 6, 4, or 0.
- Taste - 15, 10, or 0.

TABLE 7. Agronomic and Nutritional Data, Chickpeas (black), Advanced Yield Test, RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand & Vigor	(6) Days to First Flower	(7) Days to First Mat.Pod	(8) Days to Full Maturity	(9) Disease Rating 6/7	6/21	6/31	(10) Seeds P-Pod	(11) Seed Color	(12) Seed Size	(13) Yield	(14) Protein	(15) Cooking Time	(16) Palatability
416M	175	I-Gharyehgole	Pu	4	58	101	132	3	3	3	1-2	LBr	14.0	1854	23.4	1:23	21
434M	154	I-Karaj	Pu	4	56	100	132	3	4	4	1-3	Bk	11.2	1762	25.5	0:45	21
303	-	I-Azarshahr	Pu	3	57	100	133	3	3	3	1-3	Bk	10.5	1733	26.2	1:00	17
425M	154	I-Karaj	Pu	3	56	99	133	3	4	4	1-2	Bk	10.3	1710	25.8	1:00	17
419M	175	I-Gharyehgole	Pu	4	58	100	131	3	4	3	1-2	LBr	13.7	1705	23.8	1:15	20
424M	154	I-Karaj	Pu	2	57	99	131	3	4	4	1-2	Bk	11.7	1640	24.7	1:15	19
448M	164	I-Moghan	Pu	3	57	100	131	3	3	4	1-2	Bk	10.5	1626	25.3	0:53	18
305	-	I-Ardabil	Pu	3	57	100	133	2	3	4	1-2	Bk	12.0	1622	25.2	0:53	19
415M	175	I-Gharyehgole	Pu	4	57	100	130	3	4	4	1-2	LBr	14.4	1606	24.0	1:30	15
426M	154	I-Karaj	Pu	3	55	100	133	2	3	3	1-2	Bk	11.4	1592	25.9	1:15	16
401M	175	I-Gharyehgole	Pu	4	58	102	128	3	4	3	1-2	LBr	11.7	1592	23.3	1:38	21
231	251514	Iran	Pu	3	57	100	130	2	3	3	2	Bk	12.6	1586	24.9	0:45	18
440M	154	I-Karaj	Pu	3	57	101	131	2	4	4	1-2	Bk	11.1	1577	25.6	0:45	18
412M	175	I-Gharyehgole	Pu	4	57	100	128	3	4	4	1-2	LBr	13.5	1575	22.1	1:30	18
438M	154	I-Karaj	Pu	2	57	100	131	2	3	4	1-3	Bk	11.3	1573	26.6	0:38	22
450M	164	I-Moghan	Pu	4	56	100	133	3	4	4	1-2	Bk	10.4	1551	26.6	0:45	19
449M	164	I-Moghan	Pu	3	55	99	130	2	4	4	1-2	Bk	10.5	1517	25.6	0:45	18
439M	154	I-Karaj	Pu	4	56	100	132	3	4	4	1-2	Bk	9.8	1461	26.8	0:45	19
417M	175	I-Gharyehgole	Pu	4	58	100	126	3	4	4	1-2	LBr	13.1	1454	23.2	1:30	18
307	-	I-Ghazvin	Pu	3	58	99	130	2	3	4	1-3	Bk	12.4	1431	25.5	1:00	15
404M	175	I-Gharyehgole	Pu	4	58	99	128	3	4	4	1-2	LBr	12.5	1394	24.7	0:45	15
428M	154	I-Karaj	Pu	3	57	99	128	2	3	4	1-2	Bk	11.8	1382	26.4	0:38	18
410M	175	I-Gharyehgole	Pu	4	58	100	131	3	4	4	1-2	LBr	14.2	1378	24.8	1:38	17
411M	175	I-Gharyehgole	Pu	4	57	99	129	3	4	4	1-2	LBr	12.1	1366	22.6	1:45	14
427M	154	I-Karaj	Pu	4	54	98	128	3	4	5	1-2	Bk	10.6	1222	25.5	0:45	17

Legend for Table 8

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. Numbers with "M" after them are Iranian Ministry of Agriculture strain numbers.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collectinns; 6-digit numbers are P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland 20705, U.S.A.

(3) Source indicates region of origin in Iran.

(4) Pu = purple.

(5) Rated 1 to 9: 1 = full stand, vigorous plants; 9 = thin stand, weak plants.

(6) Planting date March 27, 1966.

(7) First mature pod indicates first pod to reach full maturity, ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. Rating for general disease symptoms. Diseases present discussed in Pathology section.

(10) Seeds per pod vary. Indicated here is range.

(11) Br = brown; Bk = black; L = light.

(12) Average weight of 100 seeds in grams.

(13) Yield in grams per plot. Plots 4 rows, 50 cm. apart, 10 meters long (20 M^2).
LSD .05 = 518. CV = 22%.
Conversion factor, grams per plot to kilograms per hectare = .5.

(14) Protein percentage based on total solids, determined by Kjeldahl method. As black chickpeas are consumed with hulls removed, determinations made on hulless seed. Each figure is average of two samples, two determinations per sample.

(15) Cooking time in hours, 50 grams of seed (dehulled) boiled with two grams of NaCl and checked regularly for hardness.

(16) Palatability, maximum rating - 30.
Appearance, maximum - 9.
Color uniformity - 3, 2, 0.
Size uniformity - 3, 2, 0.
Cooking uniformity - 3, 2, 0.
Smell - 6, 4, or 0.
Taste - 15. 10. or 0.

TABLE 8. Agronomic and Nutritional Data, Chickpeas (black), Advanced Yield Test, RPIP, Varamin, Iran, 1966.

Strain Number	Source Number	Source	Flower Color	Stand & Vigor	Days to First Flower	Days to First Mat. Pod	Days to Full Maturity	Disease Rating 5/31	Disease Rating 6/7	Seeds P-Pod	Seed Color	Seed Size	Yield	Protein	Cooking Time	Palatability
415M	175	I-Gharyehgole	Pu	3	59	88	99	2	3	1-2	LBr	14.6	2600	27.9	1:00	23
424M	154	I-Karaj	Pu	2	57	85	96	2	4	1-2	Bk	12.8	2310	28.9	1:08	19
231	251514	Iran	Pu	2	58	85	95	2	3	1-2	Bk	12.5	2030	31.0	1:15	21
412M	175	I-Gharyehgole	Pu	3	58	88	99	3	4	1-2	LBr	14.8	2100	28.4	1:00	25
416M	175	I-Gharyehgole	Pu	3	58	85	94	2	4	1-2	LBr	14.7	2100	27.8	1:00	19
440M	154	I-Karaj	Pu	3	56	85	95	2	4	1-2	Bk	11.1	2090	29.3	0:53	21
438M	154	I-Karaj	Pu	3	53	83	93	2	4	1-2	Bk	10.9	2090	28.1	0:53	19
401M	175	I-Gharyehgole	Pu	2	60	86	96	2	3	1-2	LBr	13.4	2070	28.7	1:00	17
417M	175	I-Gharyehgole	Pu	3	60	86	96	2	4	1-2	LBr	13.0	2030	27.7	1:00	22
307	-	I-Ghazvin	Pu	2	57	84	95	2	3	1-2	Bk	12.3	2030	30.0	1:38	19
419M	175	I-Gharyehgole	Pu	2	59	85	95	2	3	1-2	LBr	14.0	2000	29.0	0:53	21
411M	175	I-Gharyehgole	Pu	3	57	85	97	2	3	1-2	LBr	16.1	1900	28.8	1:00	20
426M	154	I-Karaj	Pu	2	54	82	91	2	4	1-2	Bk	11.4	1850	30.1	0:53	24
428M	154	I-Karaj	Pu	2	55	83	92	2	3	1-2	Bk	12.4	1840	29.9	0:53	21
404M	175	I-Gharyehgole	Pu	3	60	85	95	2	3	1-2	LBr	14.0	1840	28.9	1:15	20
305	-	I-Ardabil	Pu	2	56	84	94	2	4	1-2	Bk	13.2	1760	29.6	1:08	20
450M	164	I-Moghan	Pu	3	56	83	94	2	4	1-2	Bk	10.3	1730	29.4	0:45	21
434M	154	I-Karaj	Pu	3	55	84	93	2	4	1-2	Bk	10.3	1720	29.2	0:53	24
410M	175	I-Gharyehgole	Pu	3	60	85	97	2	4	1-2	LBr	14.5	1700	29.4	1:00	25
448M	164	I-Moghan	Pu	3	57	85	95	2	4	2	Bk	8.2	1680	29.4	0:53	20
439M	154	I-Karaj	Pu	3	57	84	94	2	4	1-2	Bk	9.9	1630	28.1	0:45	21
427M	154	I-Karaj	Pu	3	52	82	90	3	5	1-2	Bk	9.9		27.1	1:00	20
449M	164	I-Moghan	Pu	3	55	83	93	2	4	1-2	Bk	10.4	1540	29.5	0:53	20
303	-	I-Azarshahr	Pu	3	54	84	96	2	4	1-2	Bk	10.5	1460	29.2	1:00	20
425M	154	I-Karaj	Pu	3	54	84	95	3	4	1-2	Bk	10.0	1400	29.3	0:53	17

Legend for Table 9

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. Numbers with "M" after them are Iranian Ministry of Agriculture strain numbers.

(2) Source numbers refer to Iranian Ministry of Agriculture numbers assigned to populations or collections; 6-digit numbers are P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A.

(3) Source indicates region of origin in Iran.

(4) Pu = purple.

(5) Rated 1 to 10; 10 = complete stand; 1 = very poor stand.

(6) Rated 1 to 5: 1 = weak plants; 5 = vigorous plants.

(7) Rated 1 to 5: 1 = erect; 5 = spreading.

(8) Measured (in cm.) as average height of plants in plot.

(9) Average width of plants in row.

(10) Days from planting to appearance of first bloom.

(11) Complete maturity indicates whole plot ready for harvest.

(12) Number of seeds in 25 random pods.

(13) Weight of 10 randomly selected seeds.

(14) Bk = black; Br = brown; Cr = cream; Gr = green; D = dark.

(15) Sh = wrinkled; S = smooth.

(16) Yield in grams per plot. Plots 13.5 M^2.
LSD = 860. CV = 13%.
Conversion factor, grams per plot to kilograms per hectare = .74.

(17) Protein percentage based on total solids, determined by Kjeldahl method. As black chickpeas are consumed with hulls removed, determinations made on hulless seed. Each figure is average of two samples, two determinations per sample.

(18) Cooking time in hours, 50 grams of seed (dehulled) boiled with two grams of NaCl and checked regularly for hardness.

(19) Palatability, maximum rating - 30.
- Appearance, maximum - 9.
  - Color uniformity - 3, 2, 0.
  - Size uniformity - 3, 2, 0.
  - Cooking uniformity - 3, 2, 0.
- Smell - 6, 4, or 0.
- Taste - 15, 10, or 0.

TABLE 9. Agronomic and Nutritional Data, Chickpeas (black), Advanced Yield Test. RPIP/Pahlavi University, Shiraz, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Flower Color	(5) Stand	(6) Vigor	(7) Plant Type	(8) Plant Ht.	(9) Plant Width	(10) Days to First Flower	(11) Days to Full Maturity	(12) Seeds /25 Pods	(13) Seed Wt.	(14) Seed Color	(15) Seed Shape	(16) Yield	(17) Protein	(18) Cooking Time	(19) Palata-bility
438M	154	I-Karaj	Pu	9	4	3	34	61	40	129	46	1.0	Bk	Sh	6298	28.5	0:45	22
439M	154	I-Karaj	Pu	10	5	4	32	60	47	129	42	1.0	Bk	S	6226	27.4	0:53	18
434M	154	I-Karaj	Pu	10	5	4	32	48	43	129	43	1.0	Bk	S	6179	30.5	0:53	18
419M	175	I-Gharyehgole	Pu	10	5	4	37	62	44	127	34	1.2	DBr	Sh	6162	26.2	0:53	25
412M	175	I-Gharyehgole	Pu	10	5	4	31	60	43	129	40	1.3	DBr	Sh	6130	27.2	0:53	21
450M	164	I-Moghan	Pu	10	5	4	25	65	43	130	44	1.0	Bk	S	6079	27.6	0:45	18
426M	154	I-Karaj	Pu	10	5	3	39	64	41	129	46	1.0	Bk	Sh	5989	27.6	0:45	21
416M	175	I-Gharyehgole	Pu	10	5	4	34	61	43	128	37	1.2	Bk	Sh	5919	24.4	1:00	22
411M	175	I-Gharyehgole	Pu	10	5	4	32	62	48	126	40	1.2	DCr	Sh	5907	26.5	0:38	14
401M	175	I-Gharyehgole	Pu	10	5	4	34	62	48	127	42	1.2	GrCr	Sh	5901	26.9	1:00	14
410M	175	I-Gharyehgole	Pu	10	5	4	35	64	40	127	37	1.5	GrBr	Sh	5880	26.0	1:00	18
424M	154	I-Karaj	Pu	9	4	4	38	67	43	129	45	1.0	Bk	Sh	5875	27.4	1:00	18
417M	175	I-Gharyehgole	Pu	9	4	4	35	65	48	127	38	1.2	GrBr	Sh	5716	25.9	0:45	17
425M	154	I-Karaj	Pu	10	4	4	28	63	43	128	42	1.0	Bk	S	5708	27.5	0:53	19
427M	154	I-Karaj	Pu	10	4	4	30	63	40	129	46	1.0	Bk	Sh	5692	26.2	1:00	6
305	-	I-Ardabil	Pu	9	4	3	39	60	43	129	44	1.2	Bk	Sh	5591	26.3	0:38	21
428M	154	I-Karaj	Pu	10	5	3	37	65	42	130	47	1.0	Bk	Sh	5541	27.0	0:45	14
415	175	I-Gharyehgole	Pu	10	5	4	37	55	48	130	38	1.2	GrBr	Sh	5497	27.4	0:53	16
307	-	I-Ghazvin	Pu	9	4	3	39	60	43	128	44	1.2	Bk	Sh	5488	26.9	0:45	16
404M	175	I-Gharyehgole	Pu	10	4	4	35	66	51	127	35	1.1	GrBr	Sh	5469	25.3	0:53	19
449M	164	I-Moghan	Pu	10	4	3	29	61	42	128	41	1.0	Bk	S	5464	27.9	0:45	14
440M	154	I-Karaj	Pu	10	5	3	36	62	42	129	46	1.1	Bk	Sh	5454	26.8	0:45	16
231	251514	Iran	Pu	8	4	4	40	60	43	129	45	1.2	Bk	Sh	5372	27.2	0:45	14
303	-	I-Azarshahr	Pu	10	4	4	31	58	43	126	42	1.1	Bk	Sh	4872	27.7	0:45	10
448M	164	I-Moghan	Pu	9	4	3	38	62	43	129	43	1.0	Bk	Sh	4756	25.2	0:45	15

Chickpea varietal trial, Pahlavi University, Shiraz, Iran. L. to R.: P. H. van Schaik, Project Leader; K. E. Gibson, Entomologist; M. Niknejad, Plant Breeder, Shiraz; B. Mansouri, Soils Technician; G. M. Horner, Soil Scientist; and K. H. Evans, Plant Breeder.

Close-up of chickpea plant, Shiraz, Iran, 1966.

Bean varietal trial, Pahlavi University, Shiraz, Iran. L. to R.: A. Sarrafi, Plant Breeder; P. H. van Schaik, Project Leader; and M. Niknejad, Plant Breeder, Shiraz.

Lentils (*Lens esculenta*).

Lentils are extensively grown in all Middle Eastern countries, being planted in the fall or early spring. In Turkey, varieties with reddish seed color are sole like split peas, with the seed coat removed. This type commands a higher price than other types.

I. Observation Nurseries

There were 1,241 single row, non-replicated plots of lentils planted in the Observation Nursery at Karaj. Detailed notes on flowering, emergence, maturity, and disease were taken. These samples were screened for possible use as varieties in selection and breeding programs. Most of the nursery was severely damaged by root rot. In many cases, root rot was so severe that other characters could not be clearly evaluated. One Esfahan population of several lines was very resistant to root rot. The resistant lines have small seeds not commonly found in the markets, and probably are less acceptable than the large-seeded types. A detailed report of the Observation Nursery will be presented in a germplasm observation report to be published later.

II. Yield Trials

A Preliminary Yield Trial of material mostly selected from the 1965 Introduction Nursery was conducted at Karaj College by Project personnel (Table 10). Because of severe disease epidemic in 1965, most of the material selected for this Preliminary Yield Trial was fairly root rot-resistant. This disease epidemic limited the number of populations.

The Cooperative Yield Trials (Tables 11 and 12) were planted with seed furnished by the Ministry of Agriculture. These strains do not represent pure varieties, but are most likely mixtures of populations. The results indicate most of the material to be tolerant or resistant to root rot.

The climate at Varamin is warmer, and the plants grew larger and matured earlier than at Karaj. There were few or no root rot symptoms at Varamin, but yields were still only about half of those at Karaj, on an equal area basis. Although there were no statistically significant differences in yields at Varamin, six of the top ten varieties were common to both locations.

Local yield tests were conducted by the Iranian Ministry of Agriculture. Results of these tests are presented in Appendix VI.

Legend for Table 10

(1) Strain numbers refer to entry numbers assigned in 1965 Observation Nursery.

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

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

(4) Rated 1 to 9: 1 = free from disease symptoms; 9 = severe symptoms. Disease is a root rot (See Pathology Section).

(5) B = blotched; Br = brown; G = green; O = orange; Y = yellow; L = light.

(6) Date of planting March 10, 1966.

(7) First mature pod indicates when first pod was ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Seed size indicates average weight (grams) of 100 seeds.

(10) Yield in grams per plot. Plot size: Center row of 3-row plot, 50 cm. between rows, and 5 meters long ($2\frac{1}{2}$ M^2).
LSD .05 = 69 grams.
Conversion factor, grams per plot to kilograms per hectare = 4.

TABLE 10. Agronomic Data, Lentils, Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source	(3) Vigor	(4) Disease Rating 5/25	6/6	6/18	(5) Seed Color	(6) Days from Planting to 1st Flower	(7) Days from Planting to 1st Mat. Pod	(8) Days from Planting to Compl. Mat.	(9) Seed Size	(10) Yield
992	I-Esfahan	2	1	1	2	O	78	103	126	2.4	262
195	I-Shushtar	3	2	2	3	Br	73	103	127	2.8	252
996	I-Esfahan	3	1	2	3	Br	75	102	126	2.9	236
59	I-Esfahan	4	2	2	4	Br	77	103	126	3.4	231
1017	I-Esfahan	3	2	2	3	Br	77	99	126	2.9	227
993	I-Esfahan	3	2	1	3	Br	77	103	125	3.3	224
194	I-Shushtar	3	2	2	3	Br	76	103	127	2.9	214
252	I-Bandarfars	3	1	2	3	LG	80	104	125	2.1	204
264	I-Bandarfars	4	2	2	3	GB	88	114	126	2.4	203
262	I-Bandarfars	4	3	3	3	LG	76	102	126	2.6	191
239	I-Bandarfars	4	2	2	3	LG	80	104	127	2.5	185
1000	I-Esfahan	3	2	1	3	Br	76	103	126	2.2	183
150	Afghanistan	4	1	2	4	OB	71	103	126	2.2	165
229	I-Bandarfars	4	2	2	2	LO	77	104	126	2.3	164
253	I-Bandarfars	3	1	2	3	LG	74	101	126	2.9	161
267	I-Bandarfars	5	4	4	4	LG	77	102	126	2.6	157
240	I-Bandarfars	3	2	2	4	LG	79	103	126	3.0	135
231	I-Bandarfars	4	2	2	4	LG	71	97	126	2.6	134
227	I-Bandarfars	3	1	2	3	LG	77	103	126	2.4	119
238	I-Bandarfars	4	4	3	3	LO	77	103	125	2.1	119
296	I-Esfahan	3	2	3	5	LG	76	103	123	3.1	115
268	I-Bandarfars	4	2	2	4	LG	78	103	126	2.5	99
241	I-Bandarfars	4	1	2	4	LG	80	106	126	2.7	97
237	I-Bandarfars	5	3	3	4	LG	78	103	125	2.5	93
591	I-Azarbijan	5	4	5	5	LG	71	103	126	2.1	50
522	I-Azarbijan	5	5	6	7	GY	71	103	124	4.8	49
888	I-Torbat	5	4	4	5	LG	70	102	126	4.1	48
815	I-Nishapour	5	2	3	5	O	80	103	128	2.4	47
975	I-Daregaz	7	4	5	5	O	81	108	128	2.3	43
663	I-Asgharabad	5	2	5	7	LOB	68	101	124	3.3	39
737	I-Nishapour	4	4	4	5	B	74	101	125	2.1	35
757	I-Nishapour	5	4	4	4	LBr	79	104	126	2.3	29
754	I-Nishapour	5	4	5	6	O	80	103	123	2.2	26
563	I-Nishapour	5	5	6	7	GY	74	101	125	3.3	24
817	I-Nishapour	4	3	3	3	O	76	103	128	2.0	21
554	I-Asgharabad	4	4	5	6	LG	75	103	126	4.0	20
811	I-Nishapour	5	4	6	6	O	79	103	125	2.3	12
51	USA	5	7	7	8	LO	76	103	124	4.4	8
60	I-Tabriz	5	7	7	8	GYB	76	103	124	4.4	6
84	I-Ghazvin	4	5	7	8	L	71	103	122	3.6	4

Legend for Table 11

(1) Strain numbers refer to entry numbers assigned in 1966.

(2) Source numbers refer to collection numbers assigned by the Ministry of Agriculture.

(3) Source indicates origin of seed, either country or section of Iran (I).

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

(5) Rated 1 to 9: 1 = free from disease symptoms; 9 = severe disease symptoms. Disease is a root rot (See Plant Pathology Section).

(6) Date of planting March 10, 1966.

(7) First mature pod indicates when first pod was ready for harvest.

(8) Complete maturity indicates whole plot ready for harvest.

(9) Indicates average weight (grams) of 100 seeds.

(10) Yield in grams per plot. Plot size: 4 rows, 50 cm. apart, 5 meters long (10 M^2).
LSD = 176. CV = 20%.
Conversion factor, grams per plot to kilograms per hectare = 1.

TABLE 11. Agronomic Data, Lentils, Cooperative Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Vigor	(5) Disease Rating 5/25	6/5	6/18	(6) Days from Planting to 1st Flower	(7) Days from Planting to 1st Mat. Pod	(8) Days from Planting to Compl. Mat.	(9) Seed Size	(10) Yield
4	101	I-Fars	3	2	2	3	76	102	128	2.5	1021
21	107	I-Esfahan	3	2	2	3	75	101	130	2.7	1000
19	101	I-Fars	2	2	2	3	78	102	129	3.0	987
14	144	Chile	3	2	2	3	77	102	129	2.5	978
24	101	I-Fars	2	2	2	3	76	103	129	2.7	962
22	101	I-Fars	3	2	2	3	70	102	129	2.7	962
1	101	I-Fars	2	2	2	2	77	102	128	2.7	937
11	101	I-Fars	2	2	2	3	76	103	129	2.5	902
20	101	I-Fars	3	2	2	3	77	102	130	2.6	883
15	107	I-Esfahan	2	2	2	3	75	103	129	2.6	862
13	101	I-Fars	3	2	2	3	77	102	129	2.5	853
16	101	I-Fars	3	2	2	3	77	102	129	2.4	851
25	101	I-Fars	2	2	2	3	73	102	129	2.6	845
8	107	I-Esfahan	3	2	2	3	77	103	128	2.5	844
12	101	I-Fars	3	2	2	3	75	101	128	2.5	841
9	101	I-Fars	3	2	2	3	76	102	129	2.4	817
23	101	I-Fars	3	3	2	3	78	101	128	2.4	779
3	107	I-Esfahan	2	2	2	3	77	103	129	2.5	764
10	101	I-Fars	2	2	2	3	78	102	129	2.4	727
5	101	I-Fars	3	2	2	4	75	102	129	2.6	718
18	101	I-Fars	3	3	3	4	76	101	129	2.6	711
2	117	I-Shushtar	4	5	6	6	71	99	128	2.6	322
17	117	I-Shushtar	4	6	7	7	72	99	127	2.7	268
6	166	I-Arasbaran	4	4	7	7	70	100	127	3.2	100
7	107	I-Esfahan	5	7	7	8	70	97	127	2.7	92

Legend for Table 12

(1) Strain numbers refer to entry numbers assigned in 1966.

(2) Source numbers refer to collection numbers assigned by the Iranian Ministry of Agriculture.

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

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

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

(6) Rated 1 to 9: 1 = free from disease symptoms; 9 = severe disease symptoms. Disease symptoms are root rot, which is discussed under Pathology section.

(7) Date of planting March 24, 1966.

(8) First mature pod indicates when first pod ready for harvest.

(9) Complete maturity indicates whole plot ready for harvest.

(10) Indicates average weight (grams) of 100 seeds.

(11) Yield in grams per plot. Plot size: 4 rows, 50 cm. apart, 10 meters long (20 M^2).
Differences not significant at .05 level. CV = 42%.
Conversion factor, grams per plot to kilograms per hectare = .5.

TABLE 12. Agronomic Data, Lentils, Cooperative Yield Test. RPIP, Varamin, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Vigor	(5) Stand	(6) Disease Rating 5/28	(6) Disease Rating 6/4	(7) Days from Planting to 1st Flower	(8) Days from Planting to 1st Mat.Pod	(9) Days from Planting to Compl. Mat.	(10) Seed Size	(11) Yield
15	107	I-Esfahan	1	2	1	1	56	82	104	2.8	962
4	101	I-Fars	2	3	1	1	56	84	105	2.7	948
8	107	I-Esfahan	2	3	1	1	57	81	104	2.8	911
11	101	I-Fars	3	3	1	1	56	84	104	2.8	866
14	144	Chile	3	2	1	1	56	84	105	2.9	838
21	107	I-Esfahan	2	3	1	1	55	81	104	3.0	791
20	101	I-Fars	3	2	1	1	55	82	104	2.8	769
5	101	I-Fars	2	3	1	2	55	83	104	2.9	757
25	101	I-Fars	2	2	1	1	56	83	107	2.8	755
9	101	I-Fars	3	3	1	1	55	81	105	2.8	741
18	101	I-Fars	4	5	1	2	55	82	104	2.9	734
24	101	I-Fars	2	3	1	1	55	83	104	3.2	710
17	117	I-Shushtar	2	3	1	1	56	73	103	3.0	696
6	166	I-Arasbaran	3	3	1	1	57	79	105	3.3	678
2	117	I-Shushtar	3	3	1	2	55	72	103	2.9	647
3	107	I-Esfahan	2	2	1	1	56	83	10.	2.9	646
7	107	I-Esfahan	3	4	1	1	56	80	105	3.1	627
10	101	I-Fars	2	3	1	2	56	79	104	2.2	626
1	101	I-Fars	3	4	1	1	57	84	104	2.9	591
12	101	I-Fars	3	4	1	1	56	81	103	2.7	579
23	101	I-Fars	2	2	1	1	57	82	105	2.7	538
19	101	I-Fars	2	2	1	1	55	83	105	2.9	502
22	101	I-Fars	3	3	1	1	56	82	104	2.9	482
13	101	I-Fars	3	3	1	1	55	81	105	2.8	446
16	101	I-Fars	4	4	1	2	56	83	103	2.7	380

Cowpeas (*Vigna sinensis*)

Cowpeas differ widely in plant type, making evaluation of strains for yield and other characteristics more difficult than in other crops. They range in plant type from prostrate to erect, with variation in plant size also. At present we are concentrating on the more erect plant types, since they seem to be more efficient seed producers per unit area.

The cowpea nursery and yield trials were grown in five-meter rows, with a meter between rows. Nursery plots were a single row, and yield plots four rows.

I. Observation Nursery

The observation nursery was planted at Karaj. There were 891 accessions, which included all of the 1965 observation nursery and new accessions. As in other crops, a check variety (Blackeye No. 7) was planted every tenth plot for comparative purposes and as a measure of error. Few of the accessions had good disease resistance, plant type and seed type.

II. Preliminary Yield Trial

A preliminary yield trial of 49 strains was planted in three replications at Karaj. As in the observation nursery, many of the strains were lacking in disease resistance (mostly viruses), seed type or plant type, and therefore were not suitable for consideration as varieties, but may offer good breeding material.

III. Advanced Yield Trials

Advanced yield trials were planted at Karaj and Varamin. Several strains obtained from New Crops Research Branch (Crops Research Division, Agricultural Research Service, USDA, Beltsville, Maryland) ranked high in yield trials. Blackeye No. 7 (Strain 195) ranked in the top ten strains in all tests to date. Other strains that continue to look promising are 175, 232 and 50. In addition to ranking high in most tests, some of these have a potential for higher yield in narrower row spacing. The more erect types did not fully utilize the meter space between rows.

Several strains of cowpeas were increased in agronomic and entomological experiments, as well as some small seed increase plots. The strains that were increased in limited quantities are Numbers 50, 195, 215, 214, 149, 194, 175, 210, 302, 53, Early Ramshorn, and a local Iranian variety from the Mashad area (Northeastern Iran).

Legend for Table 13

(1) Strain number refers to number assigned in 1964 Introduction Nursery.

(2) Six-digit numbers refer to P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A. Three-digit numbers refer to Iranian Ministry of Agriculture strain numbers.

(3) Source indicates variety name or country of origin.

(4) Rated 1 to 9: 1 = complete stand; 9 = uneven emergence.

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

(6) Plant type: P = prostrate; E = erect; SE = semi-erect; B = bush type; PB = Prostrate-bush type.

(7) Days from planting (May 20, 1966) to appearance of first flower.

(8) Days from planting until first pod in plot mature and ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. General disease rating;for diseases present see Pathology section.

(10) Pu = purple; W = white; PW = mixed.

(11) Pod shape: S = straight; C = curved.

(12) L = light; D = dark; Pu = purple; P = pink; Cr = cream; W = white; Y = yellow.

(13) L = large; M = medium; S = small.

(14) Seeds per pod is average number from five pods per replication.

(15) 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.

(16) & (17) Seed and eye color: Cr = cream; Pu = purple; P = pink; M = milky; Bk = black; Br = brown; G = green; Gr = grey; Y = yellow; R = red; W = white; SP = spotted; D = dark; L = light.

(18) Rated 1 to 9: 1 = no loss of seed from shattering in field; 9 = very severe shattering.

(19) Yield in grams per plot, 2 rows, 5 meters long, 1 meter apart (10 M^2).
LSD .05 = 695. Coefficient of variation = 27%.
Grams per plot equals kilograms per hectare.

TABLE 13. Agronomic Data, Cowpeas, Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Variety or Source	(4) Stand	(5) Vigor	(6) Plant Type	(7) Days to First Flower	(8) Days to First Mat.Pod	(9) Disease Rating 7/9	7/22	8/14	8/29	(10) Flower Color	(11) Pod Shape	(12) Pod Color	(13) Pod Size	(14) Seeds P-Pod	(15) Seed Size	(16) Seed Color	(17) Eye Color	(18) Shat-tering	(19) Yield
97	200867	Burma	2	2	BP	62	83	4	4	3	3	Pu	S	YW	VL	15	MS	SpBk	Br	5	2376
713	-	I-Nishabour	4	3	BP	65	87	5	4	5	5	Pu	C	YW	M	9	M	CrW	Br	4	2155
157	255781	Nigeria	3	2	SE	71	94	4	4	3	3	Pu	S	YCr	ML	14	MS	CrP	Br	4	2072
241	293508	Early Silver Crowder	2	3	B	59	82	3	4	3	2	Pu	S	YCr	L	12	MS	SpBk	Bk	6	2023
58	183363	India	3	2	SE	58	82	5	5	6	5	WP	C	YCr	M	10	ML	MW	Br	4	1953
12	151562	Dom.Republic	3	2	B	65	85	3	3	4	4	W	S	YCr	S	12	MS	CrW	LG	4	1933
247	293517	Holstein	3	2	SE	62	83	4	4	3	3	WP	S	YWBr	L	12	M	BkW	Bk	4	1916
70	186460	Nigeria	3	3	P	61	86	5	4	3	3	Pu	C	GB	ML	9	MS	SpBr	Br	5	1835
160	255784	Nigeria	2	1	SE	69	91	3	4	3	3	Pu	S	LP	M	13	MS	LCr	YBr	4	1833
18	152199	Paraguay	3	2	B	64	86	4	4	4	4	Pu	S	YW	L	14	M	SpBk	Br	4	1832
245	293514	Greit	3	1	B	68	90	3	3	3	3	Pu	S	YW	L	16	M	SpBk	Br	5	1821
246	293516	Hib-Canel	3	2	B	59	79	5	5	3	3	Pu	S	YP	L	11	M	GP	Br	2	1821
301	293571	Swanee	3	2	SE	68	88	4	4	3	3	Pu	S	YP	L	14	MS	GP	Br	4	1808
678	172	I-Karaj	3	2	BP	67	90	4	4	5	5	W	C	PuCr	M	9	M	CrW	Bk	4	1801
135	227827	Guatemala	3	2	BP	71	94	3	4	2	1	Pu	S	YPCr	VL	14	MS	CrP	Br	4	1800
304	293574	Texas Cream	3	3	BP	61	85	4	4	4	5	W	S	YCr	ML	12	MS	CrW	Br	4	1766
75	188704	Nigeria	2	1	SE	68	88	5	4	3	3	Pu	S	CrP	L	14	M	GP	Br	4	1763
244	293513	GiantRamshorn	4	2	SE	53	81	5	5	5	5	W	S	YCr	L	10	ML	MW	Bk	5	1762
4	177074	Brazil	3	2	SE	73	93	4	4	3	4	Pu	C	PuBr	L	16	MS	DR	Br	5	1749
133	227397	Iran	3	2	SE	56	87	4	5	5	5	Pu	S	YCr	ML	12	MS	CrP	G	4	1745
63	186360	Australia	2	1	B	69	90	4	4	3	3	Pu	S	LPu	ML	15	S	DP	Br	5	1711
8	147569	Columbia	4	2	BP	59	86	6	6	6	6	Pu	S	YW	ML	10	ML	CrW	Br	4	1703
233	293500	Dixie Lee	4	3	B	61	82	5	5	6	6	Pu	S	YBr	MS	9	MS	CrBr	Br	8	1701
300	293570	Speckled Purple Hull	2	2	B	61	83	3	4	3	3	Pu	S	DPu	L	12	M	SpBr	Br	4	1696
438	168	I-Esfahan	3	3	BP	69	93	5	6	6	6	WP	S	LP	MS	11	MS	SpBr	G	5	1615
567	175	I-Karaj	4	2	B	66	91	4	4	5	6	Pu	S	YW	ML	10	M	CrP	Br	6	1610
185	293448	Ala.Browneye	3	1	SE	67	88	4	4	3	3	Pu	S	YPu	ML	13	M	SpBr	YBr	4	1578
142	244571	Guatemala	2	1	SE	64	89	3	4	3	2	Pu	S	YP	L	16	M	SpBr	Br	5	1571
663	180	I-Shahi	3	4	B	65	83	4	4	6	6	Pu	S	YGr	S	11	S	CrBr	DG	7	1549
139	229734	Iran	3	1	SE	62	91	4	4	4	4	W	S	CrPBr	ML	11	M	CrW	Bk	5	1545
36	170861	Turkey	3	1	SE	60	87	4	4	3	3	Pu	S	YP	ML	14	M	CrP	Br	5	1515
280	293574	Purple Hull	5	2	BP	61	88	4	4	3	3	W	C	DPu	L	10	ML	CrW	Br	4	1512
213	293477	Cal.Blackeye	4	3	SE	52	78	5	4	5	5	W	S	CrBr	ML	8	L	MW	Bk	4	1466
216	0189-293481	-Chinpgra Inst.	2	2	BP	62	83	4	4	4	4	Pu	S	LP	VL	13	MS	Bk	W	4	1466
138	227831	Guatemala	4	1	BP	70	93	5	5	2	2	Pu	S	YP	L	13	M	CrP	Br	4	1464
62	185647	Africa	2	1	SE	63	88	4	4	4	3	Pu	S	YP	L	15	MS	CrP	Br	5	1456
45	175962	Turkey	4	2	SE	65	88	4	4	4	3	Pu	S	YP	M	11	ML	BrP	Br	2	1433
207	293471	Browning	3	2	BP	68	69	3	3	3	3	Pu	S	YP	M	14	M	DP	Br	2	1409
208	293472	Brown Sugar	4	2	BP	67	90	4	4	3	3	pu	S	YP	ML	13	ML	PBr	Br	2	1397
127	223023	Iran	3	1	E	67	94	5	5	5	5	Pu	S	YPCr	ML	12	MS	MCr	Br	5	1373
556	I75	I-Karaj	3	3	SE	64	88	6	7	7	7	Pu	S	YCr	MS	11	MS	DP	G	5	1368
528	176	I-Nishabour	3	2	B	67	90	5	5	7	7	Pu	S	YP	M	10	M	CrW	G	5	1349
31	166146	India	4	1	SE	66	89	3	4	3	3	Pu	S	YP	L	12	MS	GP	Br	4	1313
6	147561	Columbia	3	1	SE	75	91	4	4	4	5	Pu	C	PBr	L	16	MS	DR	Br	5	1195
65	186452	Nigeria	4	3	P	65	86	5	5	4	4	Pu	C	YPu	ML	11	MS	CrP	Br	4	1181
81	190191	Mexico	4	1	E	68	87	5	4	4	4	Pu	S	YPW	L	15	MS	LP	Br	5	1081
14	122194	Paraguay	4	1	B	66	88	3	4	4	4	Pu	S	YPCr	L	14	MS	CrW	Bk	6	1000
163	255789	Nigeria	4	3	B	66	93	5	4	4	3	Pu	S	DPu	ML	9	M	SpBk	Br	3	997
222	293489	Claybuff	4	2	B	67	89	6	5	5	6	Pu	C	YPu	ML	10	M	CrW	Br	3	858

Legend for Table 14

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery.

(2) Source numbers refer to P.I. numbers from New Crops Research Branch, CRD, ARS, USDA, Beltsville, Maryland, U.S.A. "C" numbers are strains obtained from Oklahoma State University.

(3) Source indicates variety name or country of origin.

(4) Rated 1 to 9: 1 = complete stand; 9 = uneven emergence.

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

(6) P = prostrate; E = erect; SE = semi-erect; B = bush type; PB = prostrate bush type.

(7) Days from planting (May 23, 1966) to appearance of first flower.

(8) Days from planting until first pod in plot mature and ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. General disease rating; for diseases present see Pathology section.

(10) Pu = purple; W = white; WP = mixed.

(11) S = straight; C = curved.

(12) L = light; D = dark; Pu = purple; P = pink; Cr = cream; W = white; Y = yellow; G = green.

(13) L = large; M = medium; S = small.

(14) Seeds per pod is average number from five pods per replication.

(15) 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.

(16) & (17) Seed and eye color: Cr = cream; P = pink; M = milky; Bk = black; Br = brown; Gr = green; Bl = blue; W = white; Y = yellow; R = red; Pu = purple; Sp = spotted; D = dark; L = light.

(18) Rated 1 to 9: 1 = no loss of seed from shattering in field; 9 = shattering loss severe.

(19) Yield in grams per plot, 2 rows, 5 meters long, 1 meter apart (10 M^2).
LSD, N.S.D. Coefficient of variation = 26%.
Grams per plot equals kilograms per hectare.

TABLE 14. Agronomic Data, Cowpeas, Advanced Yield Test, RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Variety or Source	(4) Stand	(5) Vigor	(6) Plant Type	(7) Days to First Flower	(8) Days to First Mat.Pod	(9) Disease Rating 7/9	7/22	8/14	8/28	(10) Flower Color	(11) Pod Shape	(12) Pod Color	(13) Pod Size	(14) Seeds P-Pod	(15) Seed Size	(16) Seed Color	(17) Eye Color	(18) Shat-tering	(19) Yield
50	179555	Turkey	3	2	SE	60	83	5	4	5	5	W	C	YW	ML	10	ML	CrW	PuBr	4	2054
175	271257	India	3	2	B	56	78	4	5	4	5	WPu	C	YBr	ML	9	M	CrP	Br	4	1883
53	181833	Lebanon	3	3	BP	59	78	5	4	3	3	Pu	C	YCr	VL	10	M	CrP	Br	4	1869
327	-	Unknown	4	2	SE	60	79	5	4	5	6	Pu	S	YBr	S	11	S	CrP	OBr	7	1853
177	271259	India	4	1	SE	65	86	4	4	2	2	Pu	S	YBr	L	13	ML	P	Br	3	1783
232	293499	USA-Davis Pea	3	2	SE	61	78	5	4	3	3	Pu	S	Pu	ML	11	M	P	Br	6	1774
249	293519	Inst. 0154	4	2	B	61	83	4	3	2	2	Pu	S	YCr	VL	13	M	SpBl	Br	5	1758
195	293459	USA-Cal.Blkeye-7/4		2	SE	52	78	5	5	5	4	W	S	PCr	L	9	L	M	Bk	5	1704
76	189230	Belgian Congo	3	2	SE	61	82	5	5	4	3	Pu	S	YPu	ML	13	M	Bk	W	5	1703
215	293480	USA-Calra	2	3	B	54	74	4	4	4	4	Pu	S	YBr	ML	10	ML	MW	Bk	5	1582
136	277829	Guatemala	6	2	BP	62	89	4	4	3	3	Pu	S	PCr	L	13	M	SpBl	Br	5	1544
206	293470	USA-BrneyeCream	3	2	B	72	99	4	3	3	3	WPu	S	PY	M	14	S	Cr	Br	5	1533
151	255765	Nigeria	2	3	B	54	75	4	4	4	4	WPu	S	PCr	M	9	ML	MW	Bk	5	1510
300	293570	USA-Speckled Purple Hull	3	2	B	64	84	4	3	3	3	Pu	S	YW	L	12	ML	SpBl	Br	4	1471
305	293575	USA-Tex.Cream-40/3		2	SE	60	81	5	4	4	4	W	S	YCr	M	11	M	MCr	Br	5	1465
325	C-642	USA-PrincessAnn	4	3	SE	52	76	5	4	5	4	W	S	YCr	L	9	ML	CrW	Bk	5	1459
301	293571	USA-Swanee	3	2	E	58	87	4	4	3	3	W	S	PCr	L	15	M	CrP	Br	5	1428
Kch	-	I-Karaj	3	1	SE	65	91	5	5	6	6	W	S	YBr	M	10	ML	CrW	Br	5	1308
54	182316	Turkey	3	1	E	67	88	4	4	3	3	Pu	S	YCr	L	14	MS	CrP	Br	5	1291
266	293536	USA-Monarch	3	2	B	54	82	5	4	4	4	W	C	PCr	ML	11	M	MW	Bk	5	1232
44	175959	Turkey	3	1	SE	66	86	5	4	3	3	Pu	S	YP	L	12	MS	CrP	Br	4	1218
41	173827	Turkey	3	1	E	65	86	4	4	3	3	Pu	C	PCr	L	14	M	CrP	Br	4	1184
210	293474	USA-Cabbage Pea	4	2	SE	59	83	5	4	4	3	W	C	YBr	ML	10	M	MCr	GBr	5	1131
308	293581	USA-Victor	3	1	SE	70	96	4	3	2	2	Pu	S	YW	ML	15	MS	SpG	Bk	5	1086
255	293525	USA-Jackson Purple Hull	3	2	B	62	81	5	4	4	4	W	S	DPu	ML	10	M	CrW	RBr	4	978

Legend for Table 15

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery.

(2) Source numbers refer to P.I. numbers from New Crops Research Branch, CRD, ARS, USDA, Beltsville, Maryland, U.S.A. "C" numbers are strains obtained from Oklahoma State University.

(3) Source indicates variety name or country of origin.

(4) Rated 1 to 9: 1 = complete stand; 9 = uneven emergence.

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

(6) P = prostrate; E = erect; SE = semi-erect; B = bush type; PB = prostrate bush type.

(7) Days from planting (May 23, 1966) to appearance of first flower.

(8) Days from planting until first pod in plot mature and ready for harvest.

(9) Rated 1 to 9: 1 = free from any disease symptoms; 9 = severe symptoms. General disease rating; for diseases present see Pathology section.

(10) Pu = purple; W = white; WPu = mixed.

(11) S = straight; C = curved.

(12) L = light; D = dark; Pu = purple; P = pink; Cr = cream; W = white; Y = yellow; G = green.

(13) L = large; M = medium; S = small.

(14) Seeds per pod is average number from five pods per replication.

(15) 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.

(16) & (17) Seed and eye color: Cr = cream; P = pink; M = milky; Bk = black; Br = brown; Gr = green; Bl = blue; W = white; Y = yellow; R = red; Pu = purple; Sp = spotted; D = dark; L = light.

(18) Rated 1 to 9: 1 = no loss of seed from shattering in field; 9 = shattering loss severe.

(19) Yield in grams per plot, 2 rows, 10 meters long, 1 meter apart (10 M^2). Yield from one row only.
LSD .05 = 964. Coefficient of variation = 35%.
Conversion factor, grams per plot to kilograms per hectare = .5.

TABLE 15. Agronomic Data, Cowpeas, Advanced Yield Test. RPIP, Varamin, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Variety or Source	(4) Stand	(5) Vigor	(6) Plant Type	(7) Days to First Flower	(8) Days to First Mat.Pod	(9) Disease Rating 6/15	7/1	7/29	(10) Flower Color	(11) Pod Shape	(12) Pod Color	(13) Pod Size	(14) Seeds P-Pod	(15) Seed Size	(16) Seed Color	(17) Eye Color	(18) Shat-tering	(19) Yield
232	293499	USA-Davis Pea	4	3	SE	60	88	4	5	5	P	S	YCr	M	12	ML	LP	Cr	6	3117
308	293581	USA-Victor	2	2	E	70	88	3	3	3	P	S	YCr	ML	9	MS	SpBr	Br	5	2868
210	293474	USA-CabbagePea	5	5	SE	61	88	4	4	4	W	C	YCr	M	9	MS	MCr	Y	5	2787
175	271257	India	2	2	BP	64	88	3	4	4	P	C	CrBr	ML	10	M	P	Br	4	2754
Kch	-	Iran	4	4	SE	81	97	5	6	6	P	S	BrY	L	11	ML	CrW	Br	5	2578
195	293459	USA-Blackeye-7	5	4	SE	56	83	5	5	5	W	S	YCr	L	9	ML	MW	Bk	5	2573
54	182316	Turkey	5	4	E	76	95	4	5	4	P	S	YP	ML	10	MS	CrP	YBr	5	2533
249	293519	Inst. 0154	4	4	B	68	91	4	4	3	P	S	PCr	ML	10	MS	SpBr	Br	5	2427
136	277829	Guatemala	4	4	SE	79	98	4	4	3	P	S	PuBr	ML	11	MS	SpBr	Br	5	2254
301	293571	USA-Swanee	4	3	E	84	95	4	5	4	P	S	PCr	ML	11	MS	CrP	Br	4	2176
44	175959	Turkey	3	3	E	79	98	4	4	4	P	S	YW	S	10	MS	CRP	Br	4	2146
166	255811	Nigeria	4	4	BP	61	87	4	5	4	P	C	CrP	M	10	MS	SpBr	Cr	5	2114
255	293525	USA-Jackson Purple Hull	5	5	BP	75	90	5	4	4	W	S	YCr	ML	11	MS	CrW	Br	4	2088
215	293480	USA-Calra	4	3	B	57	82	4	5	4	W	S	YCr	ML	10	M	MW	Bk	5	2071
50	179555	Turkey	5	4	BP	62	89	5	5	5	W	C	BrPu	ML	11	VL	CrW	Br	4	2041
53	181833	Lebanon	3	3	BP	62	86	3	4	5	W	C	BrPu	ML	11	MS	CrP	Br	4	2034
76	189230	Belgian Congo	3	3	E	70	90	4	5	5	P	S	YP	ML	10	M	Bk	LY	5	1916
177	271259	India	5	4	SE	76	94	5	5	4	P	S	YCr	ML	10	ML	RP	Br	3	1897
206	293470	USA-Browneye Cream	4	4	E	69	100	5	4	4	P	S	YCr	L	11	S	SpCr	Br	5	1887
305	293575	USA-Texas Cream-40	5	4	B	59	85	5	4	5	W	S	YCr	ML	10	MS	WCr	YBr	5	1883
327			3	3	E	65	88	4	4	4	P	S	CrBr	ML	8	MS	CrP	Br	7	1700
151	255765	Nigeria	4	4	B	57	83	5	4	4	W	S	YCr	L	10	M	MW	Bk	5	1699
325	C-642	Princess Ann	5	4	SE	56	83	5	5	5	W	S	PuBr	L	10	ML	CrW	Bk	5	1633
266	293536	USA-Monarch	4	3	SE	59	84	3	4	3	W	C	YBr	M	13	MS	MW	Bk	5	1591
300	293570	USA-Speckled Purple Hull	4	3	SE	75	92	4	5	6	P	S	PuBr	L	11	ML	SpBr	Br	4	1337

Beans (*Phaseolus vulgaris*)

Phaseolus beans, either in green form or as dry beans, are quite popular in Iran and Turkey. In the U.A.R., Lebanon, and Jordan broadbeans (*Vicia faba*) are more commonly grown and consumed.

White-seeded varieties are most commonly grown, but for special uses reds, pintos, and miscellaneous other colors can be found in the markets.

Work on bean improvement was primarily concentrated on the *Phaseolus vulgaris*, and consisted of germplasm screening in observation nurseries and testing of varieties in various phases of evaluation.

Broadbean work was limited to disease investigations, which are reported in the Pathology section of this report.

I. Observation Nursery

The 1965 observation nursery material was planted again at Karaj, in addition to new accessions. The new accessions included material colleted in the past year and 1,676 samples from the USDA bean collection. The more promising material from the 1965 nursery was also planted at Shiraz under the leadership of Dr. Mansour Niknejad, head of the Plant Breeding and Genetics Department, the Pahlavi University, and supported by an RPIP Cooperative Agreement.

There were 3,362 introductions planted at Karaj, and 657 introductions planted at Shiraz, with a check variety every ten rows. The check served as a basis of comparison, as well as a measure of error associated with the various characters measured.

The nursery was repeated over years and locations to get a better evaluation of the various accessions, since little was known about disease or environment effects. Two hundred of the more promising accessions have been chosen for further evaluations in yield trials.

II. Preliminary Yield Trials

There were 124 strains of beans tested in preliminary yield trials at Karaj. The strains were grouped in four trials on the basis of seed color (white, red, pinto and other colors). The agronomic data

are presented in Tables 16, 17, 18 and 19. The more promising strains from these tests will be included in the 1967 advanced yield trials.

The Ministry of Agriculture conducted local yield trials at Rezaieh, Mashad, Varamin, Esfahan and Shiraz. Results these trials are presented in Appendix VIII.

III. Advanced Yield Trials

White and red bean advanced yield trials were planted at Karaj and Varamin. The results are shown in Tables 20, 21, 23 and 24. A single yield trial of the better white, red and pinto strains was planted at Shiraz under the supervision of Dr. M. Niknejad of Pahlavi University (Table 22).

On the basis of average rank in 1965 and 1966 tests, several strains show promise as varieties. Four superior white bean strains in their average rank order are Strain 47 (Kermanshah), 37 (Lebanon-3), 15 (Esfahan) and 49 (Shiraz). Strains 47 and 37 were fairly consistent in all tests, while 15 and 49 ranked high in some tests but low in others. Strain 50, a local red bean, and two U. S. pinto varieties have high average rank also in the 1965 and 1966 tests.

Strains 49, 79, 47 and 50 were increased on the basis of one year's results. Some of these may be released as varieties if they perform well in the 1967 yield trials.

Legend for Table 16

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

(2) Indicates variety name or area of origin.

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

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

(5) Planting date May 23, 1966. Flower color of all varieties is white; plant type is viney; seed color is white.

(6) Indicates when first pod in plot reaches full maturity, ready for harvest.

(7) Indicates when whole plot is ready for harvest.

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

(9) First column: C = curved; S = straight.
Second column: F = flat; C = cylindrical.

(10) S = short; M = medium; L = long.

(11) Average of ten pods per replication.

(12) C = cylindrical; F = flat.

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

(14) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 523. Coefficient of variation = 14%.
Grams per plot equal kilograms per hectare.

TABLE 16. Agronomic Data, Beans (white), Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Accession Number	(2) Variety or Source	(3) Stand	(4) Vigor	(5) Days to First Flower	(6) Days to First Mat. Pod	(7) Days to Full Maturity	(8) Disease Rating 6/27	7/13	8/13	8/21	(9) Pod Shape	(10) Pod Length	(11) Seeds P-Pod	(12) Seed Shape	(13) Seed Size	(14) Yield
65-071-00505	I-Shiraz	3	1	38	64	88	2	2	2	2	CF	M	5	F	27.7	3158
65-085-00494	Lebanon	3	3	41	74	89	2	2	2	2	CC	M	6	C	18.2	2944
65-071-00513	I-Unknown	3	2	42	72	91	2	2	2	2	CC	M	6	F	19.6	2903
65-071-00525	I-Esfahan	4	3	39	69	88	2	3	4	3	CC	M	6	F	26.7	2831
65-071-00490	I-Unknown	4	2	43	67	84	2	4	3	2	CF	M	6	F	23.9	2810
65-071-00517	I-Ghuchan	2	1	40	64	81	2	1	1	1	CC	M	5	F	22.7	2777
65-071-00497	I-Ghuchan	2	2	44	72	94	3	5	4	4	CF	M	5	F	23.7	2743
65-071-00503	I-Karaj	2	1	40	64	79	2	2	2	2	CF	M	6	F	26.2	2711
65-071-00506	I-Esfahan	5	2	39	66	82	2	3	2	3	CC	S	5	F	26.1	2687
65-071-00516	I-Ghuchan	2	2	40	70	94	3	2	3	2	CF	M	5	F	19.1	2678
65-071-00514	I-Unknown	2	2	38	66	87	2	3	3	3	CC	M	5	F	20.6	2676
65-071-00515	I-Darehgaz	2	2	39	64	83	2	3	3	3	CC	S	5	F	27.7	2651
65-071-00523	I-Esfahan	2	2	40	64	82	2	1	2	2	CC	S	5	F	25.5	2600
65-071-00533	I-Unknown	2	1	38	66	83	2	2	2	2	CC	M	6	F	22.6	2567
65-071-00519	I-Unknown	3	2	38	65	83	1	2	2	2	CC	M	6	F	25.9	2545
65-071-00531	I-Kermanshah	2	1	39	65	83	2	2	2	2	CC	S	5	C	21.3	2484
65-071-00501	I-Esfahan	3	2	41	67	83	2	2	2	2	CC	S	5	F	19.9	2472
65-071-00532	I-Unknown	2	2	39	67	83	2	2	2	2	CC	M	6	F	25.9	2472
65-071-00511	I-Unknown	3	2	38	65	83	2	2	2	3	CC	M	6	F	25.3	2445
65-071-00488	I-Unknown	3	2	39	65	84	2	2	4	4	CF	M	5	F	27.7	2438
65-071-00508	I-Esfahan	3	2	39	63	83	1	1	2	2	CC	M	5	F	23.5	2437
65-071-00529	I-Kermanshah	3	2	39	65	84	2	2	2	3	CC	S	5	C	24.9	2435
65-071-00526	I-Ghuchan	2	1	39	65	83	2	2	2	2	CC	M	5	F	27.2	2406
65-071-00495	I-Unknown	2	2	43	67	87	2	2	2	2	CF	M	6	F	23.0	2322
65-071-00496	I-Esfahan	3	2	39	64	82	2	1	[illegible]	2	CC	M	4	F	25.6	2319
65-071-00524	I-Esfahan	2	2	39	63	81	2	3	3	3	CC	M	6	F	23.5	2306
65-085-00518	Lebanon	3	2	39	62	81	2	2	2	3	CF	M	5	C	24.8	2301
65-071-00528	I-Ghuchan	2	2	39	62	79	2	2	2	3	CF	M	6	F	24.4	2274
65-071-00509	I-Esfahan	3	2	39	62	80	3	3	3	3	CF	M	5	F	25.0	2267
65-071-00487	I-Unknown	2	2	42	71	90	2	3	3	2	CC	S	5	F	17.6	2253
65-071-00486	I-Ghuchan	3	2	39	64	83	2	2	3	3	CC	M	6	F	25.4	2233
65-071-00485	I-Esfahan	4	1	41	63	81	2	2	3	3	CF	M	6	C	24.4	2212
65-071-00502	I-Esfahan	4	2	39	64	82	2	2	2	2	CC	M	6	F	24.8	2189
65-071-00529	I-Esfahan	3	1	40	63	81	3	2	3	3	CC	M	6	F	23.9	2180
65-071-00522	I-Esfahan	3	2	40	66	85	2	3	3	3	CC	S	6	F	20.3	2177
65-071-00491	I-Esfahan	3	3	39	60	80	2	3	3	3	CC	M	6	C	23.3	2160
65-071-00512	I-Unknown	3	2	39	65	81	2	2	2	2	CC	S	5	F	24.0	2102
65-071-00520	I-Esfahan	2	2	39	65	87	2	3	3	3	CC	M	5	F	25.4	2097
65-071-00498	I-Unknown	3	2	39	66	87	2	2	3	2	CC	M	5	F	21.5	2051
65-071-00507	I-Esfahan	3	2	40	64	82	2	1	2	2	CC	S	5	F	22.2	2014
65-071-00527	I-Ghuchan	3	2	41	61	82	2	2	2	2	CF	M	5	F	23.0	2002
65-085-00493	Lebanon	4	3	39	61	81	2	2	3	3	CC	M	5	F	24.3	1978
65-071-00504	I-Ghuchan	4	2	39	63	85	2	1	1	1	CF	M	5	F	25.7	1975
65-085-00489	Lebanon	4	3	41	64	82	2	3	3	3	CC	M	6	F	23.6	1961
65-071-00500	I-Esfahan	3	3	39	63	84	2	3	3	3	CF	M	6	F	25.0	1912
65-071-00510	I-Unknown	3	2	41	67	86	2	2	3	3	CC	S	6	F	17.0	1904
65-071-00521	I-Esfahan	2	2	41	64	82	2	1	2	2	CC	M	6	F	24.0	1875
65-071-00499	I-Esfahan	4	3	39	64	82	3	3	4	3	CC	M	5	F	27.4	1705

Legend for Table 17

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

(2) Indicates variety name or area of origin.

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

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

(5) Planting date May 5, 1966. Flower color is white and plant type viney for all varieties.

(6) Indicates when first pod in plot reaches full maturity, ready for harvest.

(7) Indicates when whole plot is ready for harvest.

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

(9) First column: C = curved; S = straight.
Second column: F = flat; C = cylindrical.

(10) S = short, M = medium; L = long.

(11) Average of ten pods per replication.

(12) C = cylindrical; F = flat.

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

(14) R = red; DR = dark red.

(15) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 580. Coefficient of Variation = 15.7%.
Yield in grams per plot equals kilograms per hectare.

TABLE 17. Agronomic Data, Beans (red), Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Accession Number	(2) Variety or Source	(3) Stand	(4) Vigor	(5) Days to First Flower	(6) Days to First Mat.Pod	(7) Days to Full Maturity	(8) Disease Rating 6/27	7/13	8/13	8/21	(9) Pod Shape	(10) Pod Length	(11) Seeds P-Pod	(12) Seed Shape	(13) Seed Size	(14) Seed Color	(15) Yield
65-071-00566	I-Esfahan	2	1	40	70	87	1	1	1	1	CF	M	6	F	22.2	DR	3078
65-071-00536	I-Torbat-H.	2	2	42	72	83	2	2	2	2	CF	M	6	F	20.9	DR	2956
65-071-00565	I-Dasht-sar	2	2	48	77	100	4	6	4	3	CF	M	6	F	28.8	DR	2844
65-071-00551	I-Esfahan	2	2	41	70	88	3	3	4	4	CR	M	6	F	24.0	DR	2754
65-071-00539	I-Nishabour	2	2	45	80	102	2	2	2	2	CF	M	6	F	22.1	DR	2719
65-071-00557	I-Kermanshah	3	2	40	71	88	1	2	2	2	CF	M	6	F	26.1	DR	2717
65-071-00535	I-Torbat-H.	2	2	50	85	103	4	4	2	2	CC	M	6	C	24.6	R	2693
65-071-00534	I-Torbat-H.	3	2	42	70	89	4	2	2	2	CF	M	6	F	26.6	DR	2680
65-071-00563	I-Nishabour	3	2	48	78	99	3	2	3	2	CF	M	6	F	19.2	DR	2676
65-071-00569	I-Nishabour	3	1	50	85	104	4	4	2	2	CC	M	6	F	25.0	R	2634
65-071-00541	I-Esfahan	3	2	43	73	89	2	4	4	3	CF	M	6	F	25.7	DR	2602
65-071-00549	I-T.Heydarieh	3	2	41	71	85	2	2	2	2	CC	M	5	F	24.1	DR	2576
65-071-00580	I-Unknown	3	3	50	81	101	3	3	3	2	CC	M	5	F	27.7	R	2543
65-071-00550	I-Esfahan	2	2	41	67	85	3	2	2	2	CF	M	6	F	24.0	DR	2494
65-071-00573	I-Unknown	3	3	41	70	88	3	3	3	3	CF	M	6	F	23.4	DR	2485
65-071-00540	I-Dashat-sar	2	2	49	84	104	2	2	2	2	CF	M	6	F	25.1	R	2441
65-071-00558	I-Nishabour	3	3	47	78	96	3	3	3	3	CF	M	5	F	19.1	R	2413
65-071-00546	I-Dashat-sar	3	3	47	81	105	3	3	2	2	CC	M	6	F	24.3	R	2408
65-071-00560	I-Dashat-sar	3	2	50	84	102	3	3	2	2	CF	M	5	F	25.9	R	2402
65-071-00545	I-Dashat-sar	2	3	45	77	98	4	4	3	2	CF	M	5	F	17.0	R	2391
65-071-00574	I-Unknown	2	2	40	64	81	2	2	2	3	CF	M	6	F	29.7	R	2382
65-071-00544	I-Safar-Khaleh	4	3	47	85	103	4	3	2	2	CC	M	6	C	24.3	R	2370
65-071-00570	I-Kermanshah	3	2	40	63	81	2	2	2	2	CF	M	5	F	29.9	R	2350
65-071-00576	I-Ghuchan	3	3	40	74	95	7	8	7	6	CF	S	5	F	22.8	R	2347
65-071-00581	I-Dareh-gaz	2	2	49	83	104	2	3	2	2	CF	M	5	F	20.8	DR	2330
65-071-00552	I-Dareh-gaz	2	2	43	76	101	2	3	3	3	CF	M	5	F	18.7	R	2325
65-071-00555	I-Kermanshah	2	2	41	63	80	2	2	2	2	CF	M	6	F	28.6	R	2319
65-071-00572	I-Safar-ghaleh	4	3	49	79	102	3	2	2	1	CF	M	6	F	20.7	R	2283
65-071-00575	I-Esfahan	3	2	43	71	84	1	1	1	1	CF	M	5	F	28.4	DR	2282
65-071-00538	I-Dareh-gaz	2	2	47	85	104	4	4	3	3	CC	M	5	F	23.5	R	2277
65-071-00579	I-Esfahan	4	3	45	66	83	2	2	2	2	CF	S	5	F	24.5	DR	2248
65-071-00556	I-Esfahan	3	3	42	71	89	2	3	2	2	CC	S	5	F	20.4	DR	2211
65-071-00537	I-Nishabour	3	2	49	81	103	2	2	2	2	CF	M	5	F	20.3	R	2137
65-071-00578	I-Nishabour	3	2	49	87	104	3	5	2	1	CF	M	6	F	20.9	R	2123
65-071-00577	I-Ghuchan	2	1	39	62	82	3	2	2	2	CF	M	5	F	27.5	R	2103
65-071-00561	I-Dashat-sar	3	2	44	81	99	3	3	2	1	CF	M	5	F	20.5	R	2091
65-071-00542	I-Kermanshah	2	2	39	63	82	3	3	2	2	CF	M	6	F	28.0	R	2087
65-071-00553	I-Unknown	3	2	40	68	80	3	3	2	3	CF	M	5	F	29.5	R	2081
65-071-00568	I-Kermanshah	3	3	39	64	81	3	5	5	5	CC	S	5	F	28.4	R	2075
65-071-00543	I-Esfahan	4	3	43	72	91	3	5	5	5	CF	M	5	F	23.7	DR	2062
65-071-00547	I-Nishabour	3	2	47	81	102	3	3	2	2	CF	M	6	F	24.8	R	2058
65-071-00559	I-Kermanshah	3	2	40	62	81	3	3	2	2	CF	M	5	F	29.3	R	2058
65-071-00562	I-Dashat-sar	2	1	46	75	100	2	3	2	2	CF	S	6	F	19.7	R	2015
65-071-00554	I-Kermanshah	3	2	39	62	79	2	3	3	3	CF	M	5	F	29.1	R	1972
65-071-00564	I-Kermanshah	5	2	39	62	79	2	2	2	2	CF	M	6	F	27.8	R	1787
65-071-00571	I-Kermanshah	4	2	37	60	79	3	2	3	3	CF	M	6	F	28.1	R	1725
65-071-00567	I-Kermanshah	3	2	40	63	81	2	2	2	2	CF	M	6	F	28.2	R	1707
65-157-00071	Red Mexican-36	5	3	41	64	84	2	2	3	3	CF	M	5	F	27.5	R	1528
65-071-00548	I-Dareh-gaz	2	2	45	81	102	2	2	2	1	CF	M	6	F	15.9	DR	1448

Legend for Table 18

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

(2) Indicates variety name or area of origin.

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

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

(5) Pu = purple; LPu = light purple; W = white.

(6) Planting date May 23, 1966. Plant type is viney for all varieties.

(7) Indicates when first pod in plot reaches full maturity, ready for harvest.

(8) Indicates when whol plot is ready for harvest.

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

(10) First column: C = curved; S = straight.
Second column: F = flat; C = cylindrical.

(11) S = short; M = medium; L = long.

(12) Average of ten pods per replication.

(13) C = cylindrical; F = flat.

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

(15) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 480.
Grams per plot equals kilograms per hectare.

TABLE 18. Agronomic Data, Beans (pinto), Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Accession Number	(2) Variety or Source	(3) Stand	(4) Vigor	(5) Flower Color	(6) Days to First Flower	(7) Days to First Mat. Pod	(8) Days to Full Maturity	(9) Disease Rating 6/26	7/13	8/13	8/21	(10) Pod Shape	(11) Pod Length	(12) Seeds P-Pod	(13) Seed Shape	(14) Seed Size	(15) Yield
65-071-00445	I-Kermanshah	1	1	Pu	46	70	92	1	1	1	1	CC	M	6	F	28.8	3330
65-071-00455	I-Torbat-H.	1	1	Pu	42	70	93	1	1	1	1	CF	S	5	F	27.3	2923
65-071-00452	I-Ghuchan	1	1	Pu	47	75	98	5	6	5	5	CF	S	5	C	22.8	2787
65-071-00446	I-Esfahan	1	1	Pu	37	70	94	2	1	2	2	SC	L	5	F	45.2	2688
65-071-00449	I-Ghuchan	1	1	Pu	42	73	98	7	6	5	6	CF	S	5	F	29.1	2664
65-071-00447	I-Ghuchan	1	1	Pu	42	69	96	6	7	5	5	CF	S	5	F	23.7	2603
65-157-00072	USA-Pinto 111	1	1	W	33	60	76	1	1	2	2	CC	M	5	F	34.6	2602
65-071-00465	I-Ghuchan	1	2	Pu	42	71	98	6	7	5	5	CF	S	5	F	23.2	2468
65-157-00068	USA-Pinto 114	2	1	W	37	63	80	2	1	2	2	CF	M	4	C	35.8	2313
65-071-00448	I-Ghuchan	1	1	Pu	42	71	96	6	7	6	5	CR	S	4	F	21.4	2205
65-071-00464	I-Ghuchan	1	1	Pu	44	75	98	6	7	6	5	CF	S	5	F	23.6	2171
65-071-00458	I-Esfahan	2	1	LPu	38	68	92	2	1	2	2	CF	S	5	C	42.3	2167
65-071-00454	I-Esfahan	1	1	LPu	38	73	97	2	1	2	2	CC	S	5	C	41.4	1999
65-071-00457	I-Esfahan	3	1	LPu	41	70	95	1	1	2	2	CC	S	5	C	41.8	1984
65-071-00460	I-Kermanshah	2	1	LPu	46	85	102	2	1	1	1	CF	M	5	C	31.5	1694
65-071-00461	I-Kermanshah	2	1	LPu	45	84	103	2	1	1	2	CF	M	5	C	31.5	1634
65-071-00466	I-Kermanshah	3	2	LPu	45	82	101	2	1	2	2	CC	S	6	C	30.2	1629
65-071-00450	I-Kermanshah	2	1	LPu	49	89	102	2	1	1	2	CF	S	5	C	36.4	1399
65-071-00463	I-Abbasabad	3	1	LPu	42	77	100	2	2	2	2	CC	M	5	C	43.9	1326
65-071-00459	I-Kermanshah	2	1	LPu	44	86	103	2	1	3	2	CF	M	5	C	29.3	1300
65-071-00467	I-Kermanshah	2	2	LPu	47	83	102	2	1	2	2	CF	M	5	C	41.1	1297
65-071-00453	I-Kermanshah	2	1	LPu	44	83	102	2	1	2	3	CF	M	5	C	30.1	1247
65-071-00462	I-Kermanshah	4	2	LPu	50	88	101	2	1	2	2	SC	S	5	C	34.0	996
65-071-00451	I-Abbasabad	4	2	LPu	49	85	103	2	2	2	3	CC	M	4	C	42.2	897
65-071-00456	I-Abbasabad	4	2	LPu	49	85	102	2	3	2	3	SF	S	5	C	44.5	663

Legend for Table 19

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

(2) Indicates variety name or area of origin.

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

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

(5) Pu = purple; W = white; LPu = light purple.

(6) V = vine type; B = bush type.

(7) Planting date May 5. 1966.

(8) Indicates when first pod in plot reaches full maturity, ready for harvest.

(9) Indicates whole plot ready for harvest.

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

(11) First column: C = curved; S = straight.
Second column: C = cylindrical; F = flat.

(12) S = short; M = medium; L = long.

(13) Average of ten pods per replication.

(14) C = cylindrical; F = flat.

(15) W = white; Cr = cream; Y = yellow; Br = brown; Bk = black; P = pink; L = light; D = dark; M = mottled.

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

(17) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 652. Coefficient of Variation = 11.5%.
Grams per plot equals kilograms per hectare.

TABLE 19. Agronomic Data, Beans (miscellaneous colors), Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Accession Number	(2) Variety or Source	(3) Stand	(4) Vigor	(5) Flower Color	(6) Plant Type	(7) Days to First Flower	(8) Days to First Mat. Pod	(9) Days to Full Maturity	(10) Disease Rating 6/26	7/13	8/13	8/21	(11) Pod Shape	(12) Pod Length	(13) Seeds P-Pod	(14) Seed Shape	(15) Seed Color	(16) Seed Size	(17) Yield
65-071-00481	I-Ghuchan	1	1	W	V	45	76	99	6	5	4	3	CF	S	6	P	Br	18.7	3613
65-071-00474	I-Esfahan	2	1	Pu	V	42	74	96	2	4	3	3	CC	M	6	F	LG	26.2	3184
65-071-00470	I-Kermanshah	2	1	W	V	40	70	88	2	2	2	2	CC	M	5	F	Y	28.4	3139
65-071-00484	I-Ghuchan	2	2	Pu	V	44	76	99	5	6	5	4	CC	M	5	F	Bk	22.2	3122
65-071-00482	I-Ghuchan	1	2	Pu	V	42	75	100	6	6	5	4	CC	S	5	F	Bk	21.9	3118
65-071-00052	I-Min. 1396	1	1	LPu	B	38	70	88	1	1	1	1	SC	L	6	C	Cr	44.3	3063
65-157-00098	USA-Contender	1	1	LPu	B	38	72	97	1	1	2	2	SC	L	6	F	Cr	23.4	2939
65-071-00472	I-Dashatsar	2	2	Pu	V	42	70	97	2	4	4	4	CF	M	6	F	Cr	26.3	2904
65-032-00269	Chile-151-017	2	1	Pu	V	38	66	90	2	2	4	2	CF	M	5	F	Cr	39.4	2900
65-071-00476	I-Ghuchan	3	2	Pu	V	47	70	93	2	5	4	4	CC	M	6	F	LCr	25.9	2757
65-071-00471	I-Kermanshah	2	1	W	V	42	68	90	1	1	1	1	CF	M	6	F	DBr	23.8	2738
65-071-00475	I-Kermanshah	2	1	W	V	40	68	90	2	1	2	2	CF	M	6	F	Y	28.5	2713
65-071-00480	I-Esfahan	3	2	Pu	V	42	75	100	3	5	5	5	CC	M	6	F	LCr	26.3	2597
65-071-00469	I-Ghuchan	2	1	W	V	40	68	92	2	2	2	2	CC	M	6	F	Br	23.5	2549
65-071-00477	I-Esfahan	4	2	W	V	39	69	90	1	1	1	1	CC	M	5	F	Br	25.8	2490
65-071-00468	I-Esfahan	2	1	Pu	V	38	67	88	2	1	2	2	CC	M	6	F	Bk	24.3	2394
65-071-00039	I-Min. 236	4	1	LPu	B	38	74	88	1	1	2	1	SC	L	6	C	Br	30.7	2360
65-071-00478	I-Dashatsar	2	2	Pu	B	39	73	91	2	1	2	2	SC	M	5	C	Cr	24.5	2344
65-165-00296	Africa-146-787	1	2	Pu	V	49	83	97	4	5	5	5	SC	L	6	F	Bk	17.7	2290
65-071-00479	I-Esfahan	2	2	Pu	V	40	67	86	2	1	2	2	CC	S	5	F	Bk	28.9	2241
65-157-00005	USA-Resistant Tender Green	2	1	LPu	B	37	71	93	1	1	1	1	SC	L	7	C	Bk	31.3	2186
65-071-00473	I-Unknown	4	2	Pu	V	42	66	91	2	3	3	2	CF	M	6	F	P	24.8	2149
65-157-00017	USA-Metisse	3	2	W	B	40	72	94	2	3	3	2	SC	L	6	C	BkW	23.1	2062
65-071-00052	I-Min. 1365	2	1	LPu	B	36	71	86	1	1	1	1	SC	L	7	C	Br	30.9	1840
65-071-00483	I-Ghuchan	5	2	W	V	42	69	95	2	2	2	2	CC	S	6	F	Y	29.4	1301

Legend for Table 20

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery.

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

(3) Indicates variety name or area of origin.

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

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

(6) Planting date May 5, 1966. Flower color = white; Plant type = viney; Seed color = white for all strains.

(7) Indicates when first pod in plot mature and ready for harvest.

(8) Indicates when whole plot ready for harvest.

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

(10) First column: C = curved; S = straight.
Second column: C = cylindrical; F = flat.

(11) S = short; M = medium; L = long.

(12) Average of ten pods per replication.

(13) C = cylindrical; F = flat.

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

(15) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 340. Coefficient of Variation = 9.2%.
Yield in grams per plot equals kilograms per hectare.

TABLE 20. Agronomic Data, Beans (white), Advanced Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Accession Number	(3) Variety or Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Days to First Mat. Pod	(8) Days to Full Maturity	(9) Disease Rating 6/25	7/9	8/13	8/20	(10) Pod Shape	(11) Pod Length	(12) Seeds P-Pod	(13) Seed Shape	(14) Seed Size	(15) Yield
49	65-071-00042	I-Shiraz	2	2	40	68	87	2	2	2	2	CF	M	6	F	28.0	3648
65	65-071-00054	I-Esfahan	2	2	40	68	90	2	1	1	1	CF	M	6	F	26.0	3528
	65-071-00416	I-Fars	2	1	40	68	86	2	2	2	2	CF	M	5	F	26.3	3510
	65-071-00418	I-Sarab	2	2	40	67	86	2	1	1	1	CF	M	5	F	28.6	3510
	65-071-00415	I-Fars	2	1	40	67	86	2	1	1	1	CF	M	6	F	26.2	3440
	65-071-00420	I-Esfahan	2	2	40	65	89	3	3	3	3	CF	M	6	F	26.9	3432
	65-071-00413	I-Esfahan	2	1	39	68	87	3	2	2	2	CF	M	5	F	27.6	3416
	65-071-00412	I-Esfahan	1	2	40	65	87	2	3	4	3	CF	M	5	F	28.7	3394
	65-071-00417	I-Fars	2	2	40	67	86	2	2	2	2	CF	M	6	F	25.7	3387
37	65-121-00583	Lebanon-3	2	1	40	66	86	2	2	2	2	CF	M	6	F	26.3	3383
	65-071-00423	I-Esfahan	2	2	40	68	89	2	2	2	2	CF	M	6	F	26.1	3351
79	65-071-00064	I-Bojnurd	2	2	40	67	89	2	2	2	1	CF	M	6	F	26.9	3327
47	65-071-00040	I-Kermanshah	2	2	39	64	86	2	2	2	2	CF	M	5	F	27.4	3326
	65-071-00414	I-Esfahan	2	2	40	65	84	2	2	2	2	CF	M	6	F	27.1	3325
	65-071-00419	I-Sarab	2	2	40	67	88	3	2	2	2	CF	M	6	F	36.7	3314
	65-071-00421	I-Esfahan	1	2	40	67	87	3	2	2	2	CF	M	6	F	26.6	3283
15	65-071-00014	I-Esfahan	2	2	40	68	87	2	2	2	2	CF	M	5	F	25.5	3271
61	65-071-00050	I-Karaj	2	2	40	69	88	2	2	3	2	CF	M	6	F	27.0	3137
Kch	65-071-00424	I-Karaj	3	2	40	68	93	2	2	2	1	CF	M	6	F	27.7	3133
	65-071-00422	I-Fars	2	2	40	71	87	3	3	2	2	CF	M	6	F	23.9	3080
	65-157-00073	Gt.Northern-31	2	1	40	64	83	3	2	3	3	CF	M	5	F	33.8	2950
	65-157-00069	Great N. 123	3	2	39	65	84	2	1	2	2	CF	M	5	F	31.5	2945
80	65-071-00065	I-Bojnurd	2	2	40	63	85	2	1	2	2	CF	M	5	F	29.8	2945
	65-157-00067	Great N. 1140	3	2	40	59	81	1	1	3	2	CF	M	5	F	30.8	2774
11	65-157-00010	Blue Lake	2	2	40	64	88	3	3	4	3	SC	L	5	F	25.5	2712

Legend for Table 21

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery.

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

(3) Indicates variety name or area of origin.

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

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

(6) Planting date: April 19, 1966. Flower color white; plant type viney; seed color white for all strains.

(7) Indicates when first pod in plot reaches maturity, ready for harvest.

(8) Indicates when whole plot ready for harvest.

(9) Rated 1 to 9: 1 = free from disease; 9 = severe symptoms. General disease rating indicated; specific diseases are discussed in Pathology section.

(10) First column: C = curved; S = straight.
Second column: C = cylindrical; F = flat.

(11) S = short; M = medium; L = long.

(12) Average of ten pods per replication.

(13) C = cylindrical; F = flat.

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

(15) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 1138. Coefficient of Variation = 28.4%.
Yield grams per plot equals kilograms per hectare.

TABLE 21. Agronomic Data, Beans (white), Advanced Yield Test. RPIP, Varamin, Iran, 1966.

(1) Strain Number	(2) Accession Number	(3) Variety of Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Days to First Mat.Pod	(8) Days to Full Maturity	(9) Disease Rating 5/31	7/5	7/20	(10) Pod Shape	(11) Pod Length	(12) Seeds P-Pod	(13) Seed Shape	(14) Seed Size	(15) Yield
	65-071-00586	I-Esfahan	2	1	45	75	98	1	2	2	CF	M	5	F	27.1	2273
	65-071-00421	I-Fars	2	2	44	74	92	1	2	1	CF	M	4	F	25.8	2078
	65-071-00414	I-Esfahan	2	1	46	73	92	1	2	2	CF	S	4	F	26.0	2028
	65-071-00417	I-Fars	2	1	44	75	92	2	3	3	CF	M	5	F	25.2	1953
	65-071-00420	I-Esfahan	2	2	43	74	94	2	2	2	CF	M	5	F	25.4	1764
	65-071-00413	I-Esfahan	2	2	46	73	94	1	2	2	CF	M	4	F	26.1	1742
	65-071-00412	I-Esfahan	2	2	45	76	96	2	3	3	CF	M	4	F	26.4	1741
	65-071-00416	I-Fars	2	2	44	71	89	2	2	2	CF	M	5	F	24.9	1725
37	65-121-00583	Lebanon-3	3	2	43	70	93	1	2	2	CF	M	4	F	24.5	1720
	65-071-00422	I-Fars	3	2	43	72	93	2	3	2	CF	M	4	F	21.1	1676
	65-071-00423	I-Esfahan	3	2	44	75	95	2	3	2	CF	M	5	F	25.3	1610
47	65-071-00040	I-Kermanshah	2	2	43	73	92	2	3	2	CF	M	5	F	25.6	1595
61	75-071-00050	I-Karaj	3	2	42	73	97	2	3	3	CF	M	5	F	26.4	1588
	65-071-00415	I-Fars	3	2	46	75	95	2	3	2	CF	M	5	F	25.4	1583
	65-071-00418	I-Sarab	3	2	44	73	91	1	2	2	CF	M	4	F	26.1	1552
79	65-071-00064	I-Bojnurd	2	1	43	73	94	2	2	2	CF	M	4	F	25.5	1540
	65-071-00587	I-Fars	2	2	46	80	94	1	2	2	CF	M	5	F	20.9	1501
15	65-071-00014	I-Esfahan	3	3	42	75	94	2	3	3	CF	M	5	F	25.6	1435
	65-157-00069	USA-Great Northern 123	3	3	42	65	92	2	2	2	CF	M	4	F	30.8	1405
	65-071-00419	I-Sarab	3	2	42	75	94	2	3	3	CF	S	5	F	24.5	1397
65	65-071-00054	I-Esfahan	3	2	43	76	96	1	2	2	CF	M	5	F	24.5	1375
KCh	65-071-00424	I-Karaj	3	2	42	77	100	2	2	2	CF	M	5	F	24.3	1273
49	65-071-00042	I-Shiraz	3	2	43	74	94	2	3	3	CF	M	5	F	25.8	1179
	65-157-00067	Great N. 1140	3	3	40	59	86	1	2	1	CF	M	5	F	28.1	1159
	65-157-00073	Great N. 31	3	3	42	74	93	3	3	3	CF	M	4	F	34.1	1030

Legend for Table 22

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. These numbers coincide with numbers reported in Progress Report No. 3 (1965).

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

(3) Indicates variety name or area of origin. Min. numbers are Iranian Ministry of Agriculture collection types.

(4) W = white; P = pink.

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

(6) Rated 1 to 5: 1 = vigorous plants; 5 = weak plants.

(7) V = vine type; B = bush type.

(8) Average height in centimeters.

(9) Average width in centimeters.

(10) Date of planting April 20, 1966.

(11) Indicates when whole plot mature, ready for harvest.

(12) Plants counted at harvest time.

(13) Average number of seeds per 25 pods.

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

(15) W = white; Cr = cream; Br = brown; Pu = purple; Bk = black; D = dark; L = light; M = mottled.

(16) C = cylindrical; F = flat.

(17) Yield in grams per plot, 12 meters long, 3 meters wide (36 M^2).
LSD .05 = 1151. Coefficient of Variation = 29%.
Conversion factor, grams per plot to kilograms per hectare = .28.

TABLE 22. Agronomic Data, Beans, Advanced Yield Test. RPIP, Shiraz, Iran, 1966.

(1) Strain Number	(2) Accession Number	(3) Variety or Source	(4) Flower Color	(5) Stand	(6) Vigor	(7) Plant Type	(8) Plant Ht.	(9) Plant Width	(10) Days to First Flower	(11) Days to Full Maturity	(12) Plants /Plot	(13) Seeds /25 Pods	(14) Seed Size	(15) Seed Color	(16) Seed Shape	(17) Yield
15	65-071-00414	I-Esfahan	W	1	2	V	30	37	51	114	223	97	25	W	F	6468
Kch	65-071-00424	I-Karaj	W	2	2	V	30	38	52	116	212	78	25	DW	F	6326
50	65-071-00582	I-Esfahan	W	1	2	V	30	37	52	112	277	89	24	DPu	F	6165
	65-157-00068	Pinto 114-USA	W	2	3	V	26	22	40	94	199	76	35	MCr	F	6161
49	65-071-00042	I-Shiraz	W	1	2	V	33	36	53	111	226	82	29	W	C	6036
61	65-071-00050	I-Karaj	W	2	2	V	31	36	54	119	204	85	25	W	C	5793
	65-157-00069	USA-Great Northern 123	W	2	2	V	28	34	49	113	174	104	31	W	F	5504
37	65-121-00583	Lebanon-3	W	2	2	V	30	37	52	111	202	102	24	W	F	5451
47	65-071-00040	I-Kermanshah	W	2	2	V	30	33	51	116	216	107	27	W	C	5446
79	65-071-00064	I-Bojnurd	W	1	2	V	32	34	53	112	227	98	27	W	C	5341
65	65-071-00054	I-Esfahan	W	2	2	V	30	40	53	113	214	92	25	W	F	4924
57	65-071-00047	I-Min. 394	W	3	2	B	34	33	52	121	134	85	34	DPu	C	4901
	65-157-00067	USA-Gt.N.1140	W	2	3	V	23	30	44	112	154	59	30	DW	F	4735
80	65-071-00065	I-Bojnurd	W	2	3	V	27	33	47	112	191	95	30	DW	F	4505
	65-157-00010	USA-Blue Lake	W	2	2	V	30	31	54	119	222	120	26	LG	F	4444
	65-071-00052	I-Min. 1396	W	3	3	B	31	34	52	120	143	105	31	MBr	C	4384
4	65-157-00004	USA-Wade	W	3	3	B	33	39	52	121	110	92	34	DPu	C	4346
	65-071-00051	I-Min. 1365	W	2	2	V	31	33	51	121	156	108	29	MBr	C	4315
71	65-071-00057	I-Min. 2394	W	3	3	B	32	31	52	121	118	105	34	BlPu	C	4308
	65-157-00072	USA-Pinto 111	W	2	3	V	27	26	43	94	179	82	36	MCr	F	4162
	65-071-00039	I-Min. 236	W	3	3	B	30	34	50	121	130	104	33	MBr	C	3974
5	65-157-00005	USA-Resistant Tender Green	P	2	2	B	41	35	47	120	181	75	33	MBl	C	3848
	65-157-00073	USA-Gt.N.31	W	2	2	V	31	35	59	118	157	75	36	DW	F	3750
	65-157-00017	USA-Metisse	W	2	3	B	33	26	51	120	235	109	20	BLW	C	3650
	65-157-00018	USA-Contender	P	3	3	B	28	38	47	121	140	88	37	CrW	C	3572

Legend for Table 23

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. These numbers allow comparison with data in 1965 Progress Report (No. 3).

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

(3) Indicates variety name or area of origin. Min. numbers are Iranian Ministry of Agriculture collection types.

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

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

(6) W = white; LPu = light purple.

(7) V = vine type; B = bush type.

(8) Planting date May 22, 1966.

(9) Indicates when first pod in plot mature and ready for harvest.

(10) Indicates when whole plot ready for harvest.

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

(12) First column: C = curved; S = straight.
Second column: C = cylindrical; F = flat.

(13) S = short; M = medium; L = long.

(14) Average of ten pods per replication.

(15) C = cylindrical; F = flat.

(16) R = red; Br = brown; Pu = purple; Bk = black; D = dark; M = mottled.

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

(18) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 386. Coefficient of Variation = 10.3%.
Yield in grams per plot equals kilograms per hectare.

TABLE 23. Agronomic Data, Beans (red), Advanced Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Accession Number	(3) Variety or Source	(4) Stand	(5) Vigor	(6) Flower Color	(7) Plant Type	(8) Days to First Flower	(9) Days to First Mat. Pod	(10) Days to Full Maturity	(11) Disease Rating 6/26	7/9	8/13	8/20	(12) Pod Shape	(13) Pod Lth.	(14) Seeds P-Pod	(15) Seed Shape	(16) Seed Color	(17) Seed Size	(18) Yield
	65-085-00440	Lebanon	1	2	W	V	41	68	93	2	2	3	3	CF	M	5	F	R	27.2	3733
50	65-071-00582	I-Esfahan	1	1	W	V	41	73	90	2	3	3	3	CR	M	5	F	DR	27.2	3513
	65-085-00434	Lebanon	1	1	W	V	41	72	90	2	2	2	2	CF	M	6	F	DR	27.4	3369
	65-085-00441	Lebanon	1	1	W	V	41	70	85	1	2	2	2	CC	M	6	F	RBr	26.6	3334
	65-071-00430	I-Unknown	1	1	W	V	41	68	86	1	1	2	2	CF	M	5	F	DBr	27.6	3328
	65-085-00436	Lebanon	1	1	W	V	41	71	89	2	4	4	4	CF	M	5	F	DR	26.3	3309
	65-071-00431	I-Unknown	1	1	W	V	41	70	92	2	1	2	1	CF	M	6	F	R	29.5	3307
	65-085-00444	Lebanon	1	1	W	V	41	72	[illegible]	2	3	3	2	CF	M	6	F	DR	28.4	3289
	65-085-00433	Lebanon	1	1	W	V	41	69		1	2	2	2	CF	M	6	F	R	28.5	3233
	65-085-00439	Lebanon	1	1	W	V	40	71	[illegible]	1	2	2	2	CF	M	5	F	DR	29.2	3223
70	65-085-00435	Lebanon	1	2	W	V	41	69	91	1	3	3	3	CF	M	6	F	DR	28.0	3205
	65-071-00432	I-Unknown	1	1	W	V	40	69	89	2	2	2	2	CC	M	5	F	DR	26.7	3183
	65-071-00426	I-Unknown	1	1	W	V	40	70	91	2	2	4	3	CF	M	6	F	DR	28.0	3139
	65-071-00425	I-Unknown	1	2	W	V	41	66	86	2	3	3	3	CF	M	5	F	R	28.2	3095
	65-071-00427	I-Unknown	1	1	W	V	41	68	87	2	2	2	2	CF	M	5	F	R	31.2	3091
	65-085-00442	Lebanon	1	2	W	V	41	73	91	3	5	4	4	CF	M	6	F	DR	25.9	3061
	65-071-00428	I-Unknown	1	2	W	V	41	68	89	3	5	4	4	CF	M	5	F	DR	24.8	2974
	65-085-00437	Lebanon	1	2	W	V	41	70	87	2	2	2	2	CF	M	5	F	DR	25.3	2969
	65-085-00443	Lebanon	1	1	W	V	40	67	84	2	2	3	3	CF	M	6	F	R	31.9	2910
5	65-157-00005	USA-Resistant Tender Green	1	1	LPu	B	39	72	94	1	1	1	1	SC	L	7	C	BrM	33.6	2907
	65-085-00438	Lebanon	1	2	W	V	40	67	87	2	2	3	3	CC	M	6	F	DBr	25.9	2905
57	65-071-00047	I-Min. 394	2	1	LPu	B	39	75	91	1	1	1	1	SC	L	6	C	DPu	36.5	2869
	65-071-00429	I-Unknown	1	2	W	V	39	67	85	2	2	2	2	CF	M	5	F	R	31.7	2803
4	65-157-00004	USA-Wade	2	1	LPu	B	39	73	92	1	1	1	1	SC	L	7	C	DPu	37.0	2795
71	65-071-00057	I-Min. 2394	2	1	LPu	B	39	75	92	1	1	1	1	SC	L	5	C	DPu	37.4	2563

Legend for Table 24

(1) Strain numbers refer to numbers assigned in 1964 Introduction Nursery. These numbers allow comparison with data reported in 1965 Progress Report (No. 3).

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

(3) Indicates variety name or area of origin. Min. numbers are Iranian Ministry of Agriculture collection types.

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

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

(6) W = white; LPu = light purple.

(7) V = vine type; B = bush type.

(8) Planting date April 19, 1966.

(9) Indicates when first pod in plot reaches maturity, ready for harvest.

(10) Indicates whole plot ready for harvest.

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

(12) First column: C = curved; S = straight.
Second column: C = cylindrical; F = flat.

(13) S = short; M = medium; L = long.

(14) Average of ten pods per replication.

(15) C = cylindrical; F = flat.

(16) R = red; Pu = purple, D = dark.

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

(18) Yield in grams per plot, 5 meters long, 2 meters wide (10 M^2).
LSD .05 = 942. Coefficient of variation = 22.3%.

TABLE 24. Agronomic Data, Beans (red), Advanced Yield Test. RPIP, Varamin, Iran, 1966.

(1) Strain Number	(2) Accession Number	(3) Variety or Source	(4) Stand	(5) Vigor	(6) Flower Color	(7) Plant Type	(8) Days to First Flower	(9) Days to First Mat. Pod	(10) Days to Full Maturity	(11) Disease Rating 6/7	7/5	7/18	(12) Pod Shape	(13) Pod Length	(14) Seeds P-Pod	(15) Seed Shape	(16) Seed Color	(17) Seed Size	(18) Yield
	65-071-00430	I-Unknown	1	1	W	V	38	61	81	1	1	1	CF	M	5	F	DR	25.1	2022
	65-085-00434	Lebanon	1	1	W	V	39	73	92	1	2	2	CR	M	5	F	DR	24.8	1947
	65-071-00432	I-Unknown	1	1	W	V	38	67	80	1	1	1	CF	M	5	F	DR	23.2	1918
	65-085-00438	Lebanon	2	1	W	V	37	71	90	2	2	2	CF	M	5	F	DR	24.4	1888
	65-085-00433	Lebanon	1	2	W	V	37	63	80	1	1	1	CF	M	5	F	R	26.0	1885
	65-085-00439	Lebanon	2	1	W	V	39	74	94	1	1	2	CF	M	5	F	DR	25.2	1803
	65-085-00437	Lebanon	2	2	W	V	37	67	89	1	2	2	CF	M	5	F	DR	25.0	1799
	65-071-00431	I-Unknown	1	1	W	V	39	73	90	1	1	2	CF	M	5	F	R	24.7	1793
	65-085-00435	Lebanon	1	1	W	V	38	69	85	1	1	2	CF	M	5	F	R	26.2	1792
	65-085-00441	Lebanon	2	1	W	V	37	65	84	1	2	2	CF	M	5	F	DR	22.6	1752
50	65-071-00582	I-Esfahan	1	1	W	V	37	69	81	1	2	3	CF	M	5	F	DR	22.8	1733
	65-071-00588	I-Unknown	1	1	W	V	37	61	89	1	2	2	CF	S	5	F	DR	21.2	1718
	65-071-00428	I-Unknown	1	1	W	V	37	65	84	3	3	4	CF	M	5	F	DR	20.8	1712
	65-085-00442	Lebanon	1	2	W	V	38	69	89	2	2	2	CF	M	5	F	DR	23.6	1695
	65-085-00440	Lebanon	1	2	W	V	39	73	87	1	1	1	CF	M	5	F	DR	23.4	1780
	65-071-00427	I-Unknown	1	1	W	V	37	63	82	1	1	2	CF	M	5	F	R	28.9	1624
	65-071-00426	I-Unknown	2	1	W	V	38	70	84	2	3	3	CF	M	5	F	DR	20.6	1591
	65-085-00436	Lebanon	1	1	W	V	37	69	85	3	3	3	CF	M	5	F	DR	23.8	1577
	65-071-00425	I-Unknown	2	1	W	V	37	72	90	3	3	3	CF	M	5	F	DR	21.4	1563
71	65-071-00057	I-Min. 2394	3	2	LPu	V	41	74	80	1	1	1	CC	L	5	C	DPu	33.9	1328
57	65-071-00047	I-Min. 394	3	2	LPu	V	38	75	80	1	2	2	CC	M	5	C	DPu	30.9	1147
4	65-157-00004	USA-Wade	3	2	LPu	V	39	74	92	1	2	2	CC	L	5	C	DPu	31.1	1086

Mungbeans (*Phaseolus aureus*)

Mungbeans are not as important in the Near and Middle East as they are in South Asia and the Far East. However, they are grown and can be found in most markets.

The following trials were conducted.

I. Observation Nurseries

The nursery was planted at Karaj. The 1965 nursery was repeated in its entirety and new accessions were added. The majority of the germplasm was severely affected by virus diseases, discussed in the Pathology section.

Single plant selections were made for progeny testing in 1967. Certain lines were selected in bulk for further evaluation in yield trials, or for use as parents in hybridization programs.

II. Preliminary Yield Trials

A preliminary yield test was conducted at Karaj (Table 25). This test contained the better strains from the 1965 Observation Nursery. Much of the material had mottled virus symptoms. Mites and mildew attacked late in the season and probably caused little damage, although symptoms were rather severe.

The Ministry of Agriculture also conducted local yield trials at Rezaieh, Mashad, Esfahan, Shiraz and Varamin. The composit results of these tests are presented in Appendix IX. The local yield test of Varamin was not harvested due to poor fruit set. The poor fruit set may be in part due to thick stands. The Varamin advanced yield trial was planted adjacent to the local yield test and treated similarly, with the exception of thinning. The advanced yield test produced an acceptable crop, while the local test did not.

III. Advanced Yield Trials

Advanced yield trials of mungbeans were planted at Karaj and Varamin. Results are shown in Tables 26 and 27. The Ministry of Agriculture chose ten varieties to be included in the test at Karaj, but did not include them in the Varamin test.

Considering two years data, Strain 3 (USDA Accession No. 31287, Beltsville) ranked in the top five varieties in every test, with the exception of Karaj in 1965. It was early maturing in Karaj and Dezful, but somewhat later at Varamin. The other strains which averaged high in rank were USDA Accession No. 31728 (Beltsville), 273487 (Korea), 183136 (India), 171435 (China), 31710 (Beltsville), and 180311 (India).

Seed of three strains was increased on the basis of 1965 results. These three strains were USDA Accession Numbers 31728, 164336 and 171435.

A study of nematodes and possible methods of control has been started in cooperation with the Plant Pest Control Research Institute in Tehran.

Legend for Table 25

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

(2) Source numbers refer to P.I. numbers from New Crops Research Branch, CRD, ARS, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A. Numb

(3) Indicates variety or area of origin.

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

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

(6) Planting date May 21, 1966.

(7) Indicates when first pod in plot reaches full maturity, ready for harvest.

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

(9) Rated 1 to 9: 1 = free from mildew; 9 = severe symptoms.

(10) Rated 1 to 9: 1 = free from mites; 9 = severe damage symptoms.

(11) DG = dark green; MG = medium green; LG = light green.

(12) Mature plant height in centimeters.

(13) B = bushy; SP = semi-prostrate; P = prostrate.

(14) DG = dark green; MG = medium green; LG = light green. All pods were rated as straight.

(15) Average of ten pods per replication.

(16) LG = light green; MG = medium green; DG = dark green.

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

(18) Yield in grams per plot, 5 meters long, 1 meter wide (5 M^2).
LSD .05 = 143. Coefficient of Variation = 60%.
Conversion factor, grams per plot to kilograms per hectare = 2.

TABLE 25. Agronomic Data, Mungbeans, Preliminary Yield Test. RPIP, Karaj, Iran, 1966.

(1) Accession Number	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Days to First Mat.Pod	(8) Disease Rating 8/3	8/7	8/30	9/14	(9) Mildew	(10) Mites	(11) Color of Leaves	(12) Plant Ht.	(13) Plant Type	(14) Pod Color	(15) Seeds P-Pod	(16) Seed Color	(17) Seed Size	(18) Yield
48-071-00282	215	I-Karaj	2	4	54	71	2	2	3	8	9	6	DG	28	B	DG	11	LG	4.7	594
48-071-00283	215	I-Karaj	1	3	57	75	3	3	2	3	6	6	G	40	B	DG	12	LG	4.4	593
48-071-00284	217	I-Nosratabad	2	3	60	84	4	5	6	7	8	6	LG	37	B	LG	12	G	2.7	590
48-071-00285	21[illegible]	I-Karaj	2	3	57	75	3	2	4	6	8	7	LG	38	SP	DG	12	LG	4.4	575
48-071-00286	215	I-Karaj	2	2	60	74	2	2	2	3	9	8	DG	25	P	DG	12	LG	4.7	572
48-071-00287	217	I-Nosratabad	2	4	60	81	3	3	4	7	8	7	LG	35	B	G	11	G	2.5	566
48-071-00288	215	I-Karaj	1	3	64	81	3	4	5	8	9	9	G	37	B	G	11	G	3.1	555
48-071-00289	215	I-Karaj	2	4	66	77	2	2	3	7	8	7	DG	30	P	DG	11	LG	4.3	554
48-076-00290	236298	Ivory Coast	1	3	60	83	3	3	4	5	7	6	G	37	B	LG	11	G	3.9	533
48-071-00291	217	I-Kermanshah	2	3	64	86	2	3	5	4	8	7	LG	28	B	LG	10	G	3.3	528
48-071-00292	215	I-Karaj	1	3	66	84	3	5	5	8	6	7	LG	43	B	G	11	G	2.8	519
48-071-00293	218	I-Zahidan	3	2	60	80	2	2	2	3	8	8	G	22	P	DG	11	LG	5.1	511
48-071-00294	427	I-Jiroft	2	4	68	84	2	3	3	7	8	8	G	35	B	G	11	G	2.8	502
48-071-00295	223	I-Esfahan	2	3	67	86	2	3	4	7	7	7	LG	38	B	LG	11	G	2.7	491
48-062-00296	227754	Guatemala	1	2	69	86	2	2	3	8	8	8	G	43	B	LG	12	G	2.9	477
48-071-00297	213	I-Mamaghan	1	3	66	86	4	4	5	7	8	7	G	43	B	LG	10	G	2.6	477
48-071-00298	222	I-Sari	2	4	69	86	4	4	6	7	7	7	G	38	B	G	10	G	2.4	476
48-071-00299	215	I-Karaj	1	4	68	86	3	4	4	7	9	7	G	40	B	LG	10	G	2.8	474
48-071-00300	215	I-Karaj	1	4	58	87	3	5	5	9	9	8	G	37	B	G	10	G	3.0	470
48-071-00301	215	I-Karaj	2	5	66	84	3	3	5	8	9	8	G	32	B	G	10	G	2.9	470
48-071-00302	214	I-Esfahan	2	5	61	81	3	4	5	8	8	8	G	32	B	G	11	G	2.9	464
48-071-00303	224	I-Daregaz	1	3	63	89	3	4	6	7	9	8	G	37	B	G	12	G	2.8	458
48-071-00304	221	I-Nishapour	1	3	64	86	4	4	5	7	7	7	G	43	B	G	11	G	2.9	456
48-071-00305	226	I-Karaj	1	3	59	84	3	4	5	7	5	6	LG	40	B	G	10	G	2.8	454
48-071-00306	213	I-Mamaghan	2	4	69	91	3	3	5	7	9	7	LG	33	B	LG	10	G	2.6	449
48-157-00307	31287	Beltsville-USA	2	4	69	85	3	4	6	7	8	7	LG	35	B	LG	11	G	2.7	449
48-069-00308	1[illegible]4644	India	2	3	58	85	4	5	6	8	8	8	G	37	B	LG	10	G	3.0	447
48-071-00309	36	I-Rezaieh	1	3	69	87	3	4	5	7	8	7	G	40	B	G	11	G	2.8	444
48-071-00310	102	I-Bojnurd	1	4	66	83	3	4	5	7	7	7	G	42	B	G	10	G	2.9	444
48-071-00311	217	I-Nosratabad	3	4	64	89	4	5	5	7	9	6	LG	37	B	G	10	G	2.2	437
48-069-00312	271495	India	2	4	71	91	3	3	5	5	9	8	LG	43	B	G	12	G	2.6	434
48-071-00313	217	I-Jiroft	2	4	62	81	3	4	6	8	8	8	LG	33	B	LG	11	G	2.8	432
48-071-00314	213	I-Mamaghan	1	3	71	90	3	4	5	8	6	7	LG	40	B	G	12	G	2.7	418
48-071-00315	222	I-Sari	1	4	66	88	3	3	5	7	8	7	G	40	B	G	10	G	2.9	417
48-002-00316	211067	Afghanistan	2	3	71	90	3	4	6	5	9	8	LG	42	B	G	11	G	2.8	416
48-023-00317	2[illegible]0840	Burma	1	4	68	84	4	3	5	8	8	7	G	42	B	G	10	G	2.9	415
48-071-00318	214	I-Esfahan	2	3	69	85	3	3	3	7	7	8	LG	43	B	LG	11	G	2.6	413
48-071-00319	226	I-Karaj	3	3	66	87	4	3	3	6	7	6	LG	43	B	LG	11	G	2.3	409
48-071-00320	214	I-Esfahan	2	4	61	86	3	5	6	8	8	7	G	35	B	LG	10	G	2.8	397
48-071-00321	221	I-Nishapour	2	4	69	83	3	4	5	7	8	8	LG	37	B	G	10	G	2.4	395
48-002-00322	220816	Afghanistan	2	4	71	93	3	4	6	6	9	8	LG	45	B	G	11	G	3.0	393
48-069-00323	271490	India	2	4	67	93	3	3	6	6	8	8	LG	43	B	LG	11	G	3.1	383
48-071-00325	249	I-Khaledabad	1	3	68	87	3	4	4	8	8	8	G	40	B	LG	10	G	2.9	378
48-071-00326	217	I-Kermanshah	2	3	68	84	4	5	7	6	9	8	G	37	B	LG	9	G	3.1	371
48-071-00327	213	I-Mamaghan	1	4	62	88	4	4	5	7	8	8	LG	38	B	DG	11	G	3.0	368
48-071-00328	226	I-Karaj	1	4	65	88	3	3	4	8	8	7	LG	47	B	G	11	G	2.7	330
48-071-00329	157	I-Chahbahar	1	4	63	90	3	4	5	6	8	6	LG	37	B	LG	12	G	2.5	303
48-071-00330	217	I-Kermanshah	2	3	69	87	3	5	6	4	8	8	G	42	B	G	10	G	2.8	194

Legend for Table 26

(1) Strain numbers refer to numbers assigned in the 1964 Introduction Nursery, USDA accessions and Iranian Ministry of Agriculture. These numbers coincide with those reported in Progress Report No. 3, 1965, except for Ministry of Agriculure numbers.

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

(3) Indicates variety name or area of origin.

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

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

(6) Planting date May 21, 1966.

(7) Indicates when first pod fully mature, ready for harvest.

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

(9) Rated 1 to 9: 1 = free from mildew; 9 = severe infection.

(10) Rated 1 to 9: 1 = free from mites; 9 = severe damage symptoms.

(11) LG = light green; G = medium green; DG = dark green.

(12) SE = semi-erect; B = bushy; P = prostrate.

(13) Mature plant height in centimeters.

(14) LG = light green; G = green (medium); DG = dark green.

(15) S = straight; MC = moderately curved.

(16) Average of ten pods per rpplication.

(17) S = short; M = medium; L = long.

(18) Average weight of 100 seeds.

(19) Yield in grams per plot, 5 meters long (2 rows), 1/2 meter between rows (5 M^2). LSD .05 = 175. Coefficient of Variation = 28%. Conversion factor, grams per plot to kilograms per hectare = 2.

TABLE 26. Agronomic Data, Mungbeans, Advanced Yield Test. RPIP, Karaj, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Days to First Mat.Pod	(8) Disease Rating 8/3	8/17	8/30	9/14	(9) Mildew	(10) Mites	(11) Color of Leaves	(12) Plant Type	(13) Plant Ht.	(14) Pod Color	(15) Pod Shape	(16) Seeds P-Pod	(17) Pod Size	(18) Seed Size	(19) Yield
3	31287	Beltsville	1	2	60	78	3	3	4	5	5	8	G	B	32	G	S	11	M	3.6	702
42	171435	China	2	2	57	72	2	2	3	5	4	8	G	SE	35	DG	S	11	L	4.0	692
185	273487	Korea	2	2	57	73	2	2	2	4	4	8	G	P	30	DG	S	12	L	4.2	670
	Min.156	I-Karaj	1	2	63	79	3	4	5	6	4	7	DG	B	43	LG	S	10	L	3.1	657
105	212908	India	2	2	59	76	3	3	3	4	4	7	G	P	34	G	S	11	L	4.5	636
63	180311	India	2	1	61	76	2	2	2	3	4	7	G	P	34	DG	S	12	L	4.5	634
24	Min167-1	I-Mamaghan	2	2	59	76	3	3	3	5	4	8	DG	P	35	DG	S	11	M	4.3	611
13	Min167-2	I-Mamaghan	2	2	59	76	3	3	4	5	4	8	G	B	35	G	S	11	L	4.3	595
15	Min167-3	I-Mamaghan	2	2	63	77	3	3	3	5	4	7	DG	B	38	LG	MC	10	M	3.4	582
84	201869	Iran	2	2	61	77	3	3	3	5	4	8	G	SE	37	DG	S	10	M	4.2	565
180	271492	India	2	2	61	78	3	3	3	4	4	7	G	B	40	LG	S	11	M	3.3	548
72	183136	India	2	2	59	79	3	2	3	4	4	7	G	P	37	DG	S	10	M	3.8	548
178	271490	India	2	2	61	79	3	3	3	5	4	8	G	B	36	DG	S	12	L	3.9	564
75	183458	India	2	2	59	74	3	3	3	4	3	7	G	SE	45	DG	S	11	M	3.7	540
22	Min.156	I-Karaj	2	2	61	79	3	3	3	5	4	8	G	P	39	DG	S	11	L	4.3	531
20	31728	Beltsville	2	2	61	75	3	3	4	5	5	8	G	B	43	DG	S	11	M	3.3	526
25	Min.167	I-Mamaghan	2	2	63	82	3	3	3	6	5	8	G	B	43	G	S	10	M	3.3	515
21	140043	Brazil	1	2	62	77	2	3	3	5	4	8	G	B	33	G	S	11	L	4.1	513
64	180313	India	2	2	63	77	2	2	3	5	4	8	G	P	33	LG	S	10	M	4.2	491
28	164336	India	2	2	58	76	3	3	3	4	4	7	G	P	38	G	S	11	L	4.1	473
21	Min167-4	I-Mamaghan	2	2	62	80	3	4	4	5	4	7	DG	B	41	G	S	10	M	3.7	461
2	Min-167-5	I-Mamaghan	2	2	68	87	3	4	5	7	5	8	DG	B	38	LG	S	10	M	3.1	458
5	Min-167-6	I-Mamaghan	2	2	64	81	3	5	5	6	4	7	G	B	39	LG	S	10	M	3.1	428
19	31710	Beltsville	2	2	64	79	3	4	5	6	5	8	DG	B	45	LG	S	11	M	3.3	427
1	Min.156	I-Karaj	2	3	70	90	3	5	6	7	5	7	LG	B	40	LG	S	10	M	2.6	386

Legend for Table 27

(1) Strain numbers refer to numbers assigned in the 1964 Introduction Nursery. These numbers coincide with those reported in Progress Report No. 3 (1965).

(2) Source numbers refer to P.I. numbers from New Crops Research Branch, CRD, ARS, USDA, Beltsville, Maryland, U.S.A.

(3) Indicates variety name or area of origin.

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

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

(6) Date of planting May 7, 1967.

(7) Indicates when first pod in plot mature, ready for harvest.

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

(9) LG = light green; G = medium green; DG = dark green.

(10) B = bushy; SP = semi-prostrate.

(11) Mature plant height in centimeters.

(12) LG = light green; G = medium green; DG = dark green. Pod shape all rated straight.

(13) S = short; M = medium; L = long.

(14) Average of ten pods per replication.

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

(16) Yield in grams per plot, 4 rows, 10 meters long, 1/2-meter apart (40 M^2).
LSD .05 = 1021. Coefficient of Variation = 25%.
Conversion factor, grams per plot to kilograms per hectare = .25.

TABLE 27. Agronomic Data, Mungbeans, Advanced Yield Test. RPIP, Varamin, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Days to First Mat. Pod	(8) Disease Rating 7/12	7/21	7/28	8/14	(9) Color of Leaves	(10) Plant Type	(11) Plant Ht.	(12) Pod Color	(13) Pod Length	(14) Seeds P-Pod	(15) Seed Size	(16) Yield
16	31569	Beltsville-USA	4	4	54	66	3	4	5	5	LG	B	44	DG	L	11	4.9	4773
19	31710	Beltsville	3	2	57	72	3	4	4	4	G	B	70	G	M	10	5.4	4347
20	31728	Beltsville	2	2	58	72	3	4	4	4	G	B	57	DG	M	10	6.0	4252
1	31080	Beltsville	3	3	55	67	3	4	5	5	G	B	43	G	M	10	5.0	4180
3	31287	Beltsville	2	2	57	72	2	4	4	4	DG	B	45	LG	M	10	4.9	4091
74	183407	India	2	3	58	71	2	3	4	4	G	B	63	DG	M	10	5.9	4085
178	271490	India	3	3	58	71	3	4	4	4	G	B	63	DG	L	11	5.9	3970
36	164475	India	3	2	58	71	2	4	4	4	G	B	56	DG	M	10	6.2	3586
28	164336	India	2	2	57	71	2	3	3	3	G	B	55	DG	M	10	6.0	3545
180	271492	India	3	3	57	72	3	3	5	5	LG	B	58	DG	L	12	5.5	3469
21	140043	Brazil	2	3	60	74	2	4	4	4	DG	B	60	DG	M	9	6.2	3451
82	201867	Iran	3	3	59	72	3	3	4	4	DG	B	53	MG	M	10	4.4	3399
61	179962	India	3	2	60	74	3	4	4	4	MG	B	62	G	M	11	5.2	3359
64	180313	India	3	3	60	75	3	3	3	3	LG	B	52	G	M	10	5.8	3221
75	183458	India	3	3	58	70	2	3	4	4	G	B	54	DG	L	9	5.7	3193
185	273487	Korea	3	3	56	71	3	4	4	4	G	B	56	DG	L	11	6.4	3151
179	271491	India	3	2	58	72	3	5	5	5	LG	B	50	G	L	11	5.6	2958
72	183136	India	2	2	57	72	2	2	3	3	LG	B	50	G	M	10	5.9	2679
42	171435	China	3	3	57	71	3	3	4	4	G	B	49	G	M	10	5.8	2621
63	180311	India	2	2	62	75	2	3	3	3	LG	SP	48	G	L	9	6.5	2610
104	212907	India	2	3	56	72	2	3	3	3	G	B	45	G	M	9	6.6	2563
84	201869	Iran	2	2	58	70	2	3	5	5	G	B	50	G	L	10	6.7	2390
107	213015	India	2	2	60	74	2	2	3	3	G	B	43	LG	M	10	6.5	2382
105	212908	India	2	2	59	75	2	2	2	2	LG	SP	47	G	M	10	5.6	1753
78	183936	India	3	2	56	72	2	2	3	3	G	B	62	G	M	10	3.8	1277

SOIL & CROP MANAGEMENT

Glenn M. Horner, Soil Scientist-
Agronomist
Counterpart: Massoud Mojtehedi

During the 1966 crop year, the soil and crop management program included studies concerning date of planting, plant population density, rhizobia inoculation, fertilization and irrigation. The work was done at Karaj, except for some fertilizer tests conducted on the Ministry Station at Varamin and on two nearby village farms.

Date of Planting

Five crops were planted at intervals of 15 to 18 days, using six replications. Lentils and chickpeas (local Ghazvin varieties) were planted on four dates, while dry beans (Pinto 111), cowpeas (Early Ramshorn), and mungbeans (Beltsville strain) were planted on six dates. However, the first two plantings (March 29 and April 16) of dry beans, cowpeas and mungbeans were abandoned because of damage from seed corn maggot and/or rotting of the seed.

Seed yields and other growth characteristics as influenced by date of planting are summarized in Table 27a. The lentils were damaged by disease (primarily root rot) and consequently had abnormally low yields. Plantings made after March 29 resulted in significantly lower yields.

The yield of chickpeas decreased for plantings made after April 16. There was a corresponding relationship between the number of pods per plant and the planting date. Except for fewer seeds per pod for the May 3 planting, there were no significant effects of planting dates on seeds per pod or on the seed weight.

Date of planting had no significant effect on seed yield of dry beans, although the results may have been affected by differences in disease occurrence. Plants of the first two planting dates lost all their leaves and stopped blooming in mid-July. Pods that had formed then matured. Root rot is suspected as the cause of the phenomenon. However, new topgrowth and roots appeared in early August, and before the end of the season a second set of pods was produced. This disease problem did not occur in the last two plantings. There was a tendency for seed size to diminish for the later planting dates.

TABLE 27a. Relation of date of planting to grain yield and some growth characteristics of several pulse crops. RPIP, Karaj, 1966.

Crop	Planting Date	Seed Yield Tons/Ha.	Pods Per Plant	Seeds Per Pod	Seed Weight gm/seed
Lentils	March 12	0.31a[1/]	-	-	-
	March 29	0.28a	-	-	-
	April 16	0.19b	-	-	-
	May 3	0.14b	-	-	-
Chickpeas	March 26	2.20ab	51.8a	0.99a	0.305a
	April 16	2.40a	56.9a	0.95a	0.296a
	May 3	2.07b	41.2b	0.83b	0.298a
	May 21	1.35c	20.7c	1.03a	0.291a
Dry Beans	May 3	1.87a	6.3a	2.9b	0.357ab
	May 18	1.99a	5.8a	3.2b	0.368a
	June 1	1.89a	6.3a	3.9a	0.335bc
	June 16	1.90a	7.2a	3.1b	0.316c
Cowpeas	May 3	2.70a	20.2a	5.7a	0.236b
	May 18	2.78a	12.5b	5.5a	0.261a
	June 1	2.22b	8.6c	5.7a	0.254a
	June 16	2.12b	10.2bc	6.2a	0.249ab
Mungbeans	May 3	1.71a	27.4a	7.5a	0.052c
	May 18	1.81a	24.7a	8.7a	0.053c
	June 1	1.83a	17.4b	8.4a	0.057b
	June 16	1.35b	18.9b	8.9a	0.064a

1/ Figures followed by the same letter are not significantly different at the 5% level.

Seed yields decreased for plantings made after May 18 for cowpeas, and after June 1 for mungbeans. For both crops, the number of pods per plant decreased as the planting date was delayed. The number of seeds per pod was not affected significantly. Mungbean seed size tended to increase with later planting dates.

Elapsed times between planting and maturity dates decreased as the planting date was delayed, except in the case of dry beans, where disease and regrowth occurred. For example, the time from planting to first maturity of chickpeas was 85 days for the March 26 planting, and 66 days for the May 21 planting. Times for first maturity of cowpeas were 90 and 70 days, respectively, for the May 3 and June 16 plantings.

Plant Population Density

The effect of spacing between rows and between plants within the row was studied for chickpeas (local Ghazvin variety), cowpeas (Early Ramshorn), and dry beans (Pinto 111). A split-plot design, with row spacing as main plots and plant spacing as sub-plots, was used in six replications. Row spacings were 50, 60 and 75 centimeters. Plant spacings within the rows were adjusted so that four plant densities ranging from 100,000 to 400,000 plants per hectare were obtained for each row spacing. The various plant spacings were obtained by high rates of seeding and then thinning to the desired spacing. Planting dates were May 10 for chickpeas, and May 19 for cowpeas and dry beans.

Occurrence of root rot in the dry beans in mid-July caused nearly all the leaves to drop, while pods already formed matured. However, regrowth in early August developed to approximately the same amount as the original growth and produced a second set of pods. Even so, the final yields of dry beans were subnormal. This disease condition probably minimized the effect of the treatments, especially the row spacings.

Plant growth characteristics as influenced by row and plant spacings are summarized in Tables 28, 29 and 30. Seed yields of each crop increased with an increase in plant density up to 300,000 plants per hectare. The slightly greater yields with 400,000 plants per hectare were not significant at the 5% level. A marked reduction in yield occurred at the 100,000 density.

An increase in the number of pods per plant with a decrease in plant density tended to neutralize the depressing effect of wide plant spacing on seed yield. At 100,000 plants per hectare, chickpeas and dry beans had twice as many, and cowpeas three times as many, pods per plant

TABLE 28. Influence of row and plant spacings on growth of chickpeas. RPIP, Karaj, 1966.

Spacing Between Rows (cm)	Plants per Hectare 100,000	200,000	300,000	400,000	Mean
	Grain Yield - Tons per Hectare				
50	2.01	2.74	3.24	3.20	2.80a 1/
60	1.93	2.73	2.79	3.04	2.62ab
75	1.84	2.62	2.79	2.98	2.56b
Mean	1.92c	2.69b	2.94a	3.07a	
	Pods per Plant				
50	98	68	45	56	68a
60	103	114	68	43	82a
75	115	69	51	62	74a
Mean	105a	84b	56b	54c	
	Seeds per Pod				
50	0.89	0.91	1.00	0.91	0.93a
60	0.93	0.91	0.97	0.98	0.95a
75	0.95	0.91	0.87	0.97	0.93a
Mean	0.93a	0.91a	0.95a	0.95a	
	Seed Weight - Grams/Seed				
50	0.329	0.336	0.349	0.346	0.340a
60	0.298	0.328	0.325	0.336	0.322a
75	0.309	0.352	0.364	0.363	0.342a
Mean	0.312b	0.332ab	0.346a	0.348a	

1/ Figures followed by the same letter are not significantly different at the 5% level.

TABLE 29. Influence of row and plant spacings on growth of cowpeas. RPIP, Karaj, 1966.

Spacing Between Rows (cm)	Plants per Hectare 100,000	200,000	300,000	400,000	Mean
	Grain Yield - Tons per Hectare				
50	3.39	3.75	3.81	3.62	3.64b 1/
60	3.78	4.00	4.12	4.36	4.06a
75	2.86	3.12	3.28	3.40	3.16c
Mean	3.34c	3.62b	3.73ab	3.79a	
	Straw Yield - Tons per Hectare				
50	3.47	3.90	4.15	4.20	3.93a
60	3.59	4.11	4.30	4.42	4.10a
75	2.91	3.24	3.64	3.80	3.40b
Mean	3.30c	3.75b	4.03a	4.14a	
	Straw-Grain Ratio				
50	1.03	1.04	1.10	1.16	1.08a
60	0.95	1.03	1.04	1.02	1.01a
75	1.02	1.05	1.11	1.12	1.07a
Mean	1.00c	1.04b	1.08a	1.10a	
	Pods per Plant				
50	22.3	13.1	10.1	6.9	13.1a
60	25.3	14.1	9.9	9.1	14.6a
75	21.5	12.3	8.6	7.0	12.4a
Mean	23.1a	13.2b	9.5c	7.7c	
	Seeds per Pod				
50	5.5	4.9	5.2	4.6	5.0b
60	5.7	5.7	5.4	5.3	5.5a
75	5.9	5.8	5.3	5.0	5.5a
Mean	5.7a	5.5ab	5.3bc	5.0c	
	Seed Weight - Grams per Seed				
50	0.246	0.250	0.242	0.233	0.243a
60	0.246	0.235	0.236	0.229	0.236b
75	0.241	0.233	0.232	0.227	0.233b
Mean	0.244a	0.239ab	0.237b	0.230c	

1/ Figures followed by the same letter are not significantly different at the 5% level.

TABLE 30. Influence of row and plant spacings on growth of dry beans. RPIP, Karaj, 1966.

Spacing Between Rows (cm)	Plants per Hectare 100,000	200,000	300,000	400,000	Mean
	Grain Yield - Tons per Hectare				
50	1.21	1.61	1.60	1.80	1.55a 1/
60	1.18	1.31	1.73	1.70	1.48a
75	0.84	1.03	1.10	1.24	1.05b
Mean	1.08c	1.31b	1.47a	1.58a	
	Pods per Plant				
50	11.7	7.9	5.5	5.5	7.7a
60	11.4	7.2	5.9	4.8	7.3a
75	9.1	6.7	4.2	4.2	6.0b
Mean	10.7a	7.3b	5.2c	4.9c	
	Seeds per Pod				
50	3.3	3.5	3.2	3.1	3.3a
60	3.5	3.3	3.2	3.1	3.3a
75	3.3	3.3	3.2	3.0	3.2a
Mean	3.4a	3.4a	3.2b	3.1b	
	Seed Weight - Grams per Seed				
50	.326	.340	.342	.349	.340a
60	.341	.342	.347	.338	.342a
75	.325	.337	.335	.330	.332b
Mean	.331b	.339a	.341a	.339a	

1/ Figures followed by the same letter are not significantly different at the 5% level.

as plants at the 400,000 density. For cowpeas and dry beans, an increase in the number of pods per plant was accompanied by a slight but significant increase in the number of seeds per pod.

The relationship between the number of pods per plant and the spacing between plants in the row for the different row spacings is shown graphically in Figure 2. Plant spacing in the row had a greater effect on pods per plant than row spacing, especially in the case of dry beans. The row spacing effect was more pronounced with chickpeas.

The effect of plant spacing on seed size (weight per seed) was not consistent among the crops. Seed size for chickpeas and dry beans increased with an increase in plant density, but the opposite effect occurred for cowpeas.

Straw yield (cowpeas, Table 29) increased with an increase in plant density more rapidly than seed yield. This is indicated by an increase in the straw-grain ratio from 1.00 for 100,000 plants per hectare to 1.10 for 400,000 plants.

Increasing the space between rows tended to reduce yields on a unit area basis for chickpeas and dry beans. However, for cowpeas the highest yield was obtained with the 60-centimeter row spacing. The effect of row spacing on seeds per pod and seed weight was relatively insignificant in comparison to the effect of spacing between plants in the row.

Yield based on a unit length of row generally increased with an increase in row spacing, as well as with a decrease in spacing between plants in the row (Table 31 and Figure 3). The highest yield per unit length of row occurred with close plant spacing in the row and wide row spacing. This effect was not as apparent with dry beans, possibly because of the disease problem encountered with this crop.

Differences in irrigation procedures for the different row spacings may have had an effect on the results. The soil became wet across the 50-centimeter beds in less time than for the wider beds. Irrigation was continued for a longer period on the wider beds in order to apply equal amounts of water per unit area. Whether or not equal amounts were applied was not determined.

TABLE 31. Influence of row and plant spacings on yield of chickpeas, cowpeas and dry beans. RPIP, Karaj, 1966.

Spacing Between Rows (cm)	Plants per Hectare 100,000	200,000	300,000	400,000	Mean
	Seed Yield - Grams per Meter				
Chickpeas					
50	101	137	162	160	140c 1/
60	116	164	167	182	157b
75	138	197	209	224	192a
Mean	118c	166b	179a	189a	
Cowpeas					
50	170	188	190	181	182b
60	227	240	247	262	244a
75	215	234	246	255	237a
Mean	204c	221b	228ab	233a	
Dry Beans					
50	61	80	80	90	78b
60	71	79	104	102	89a
75	63	77	83	93	79b
Mean	65c	79b	89a	95a	

1/ Figures followed by the same letter are not significantly different at the 5% level.

FIGURE 2

RELATIONSHIP BETWEEN PLANT SPACING IN THE ROW AND NUMBER OF PODS PER PLANT, RPIP, KARAJ IRAN, 1966

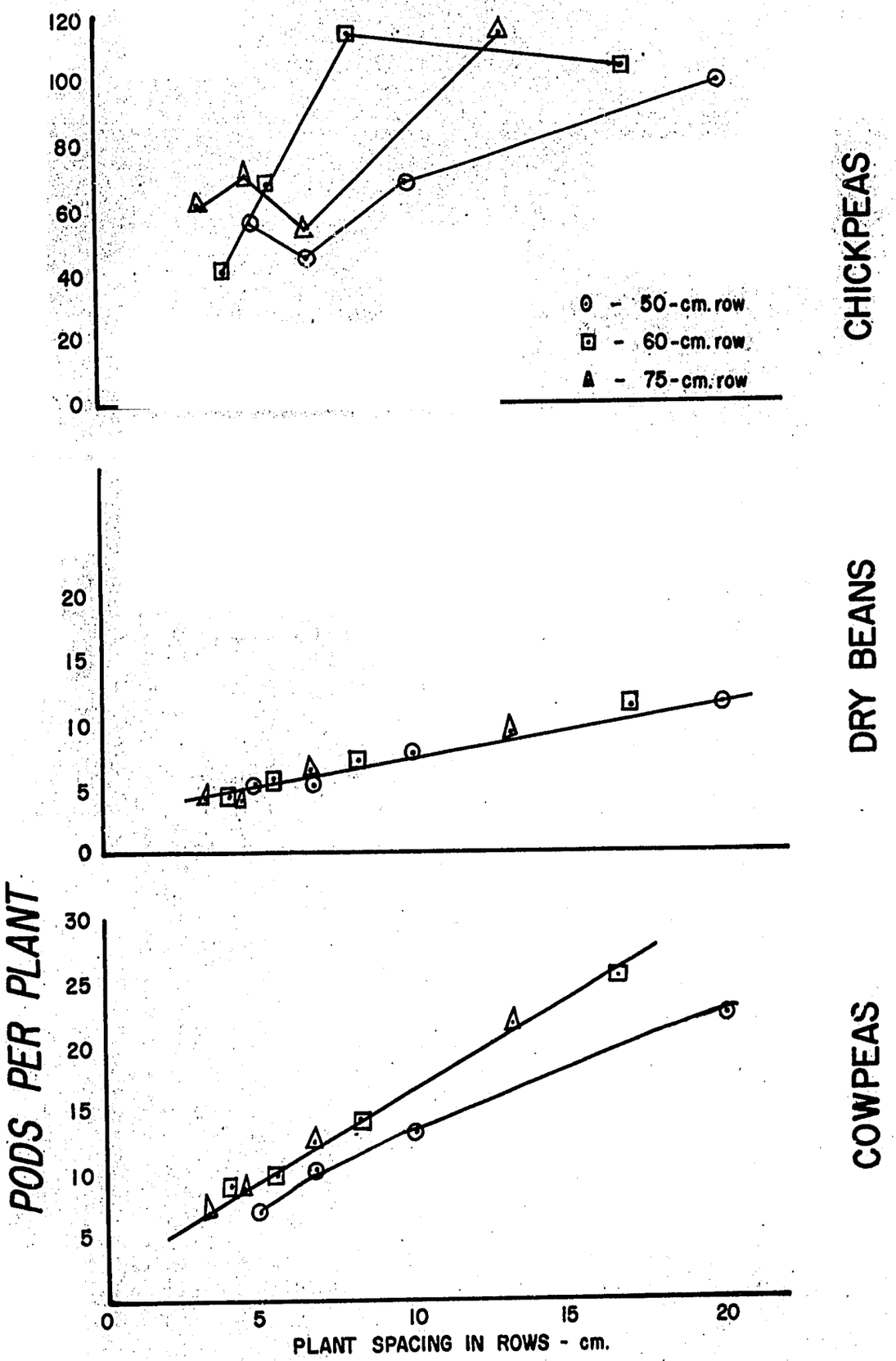
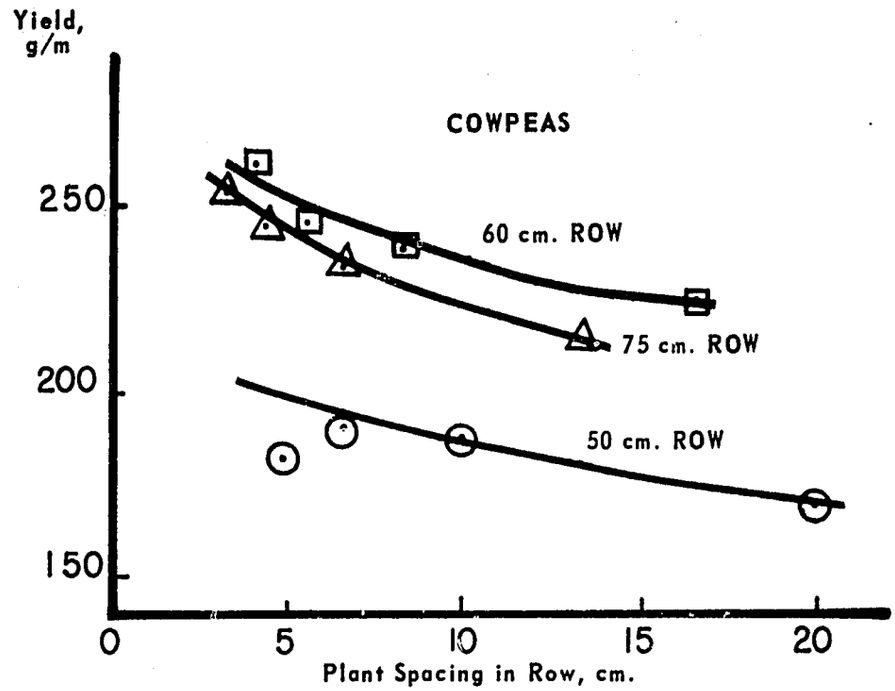
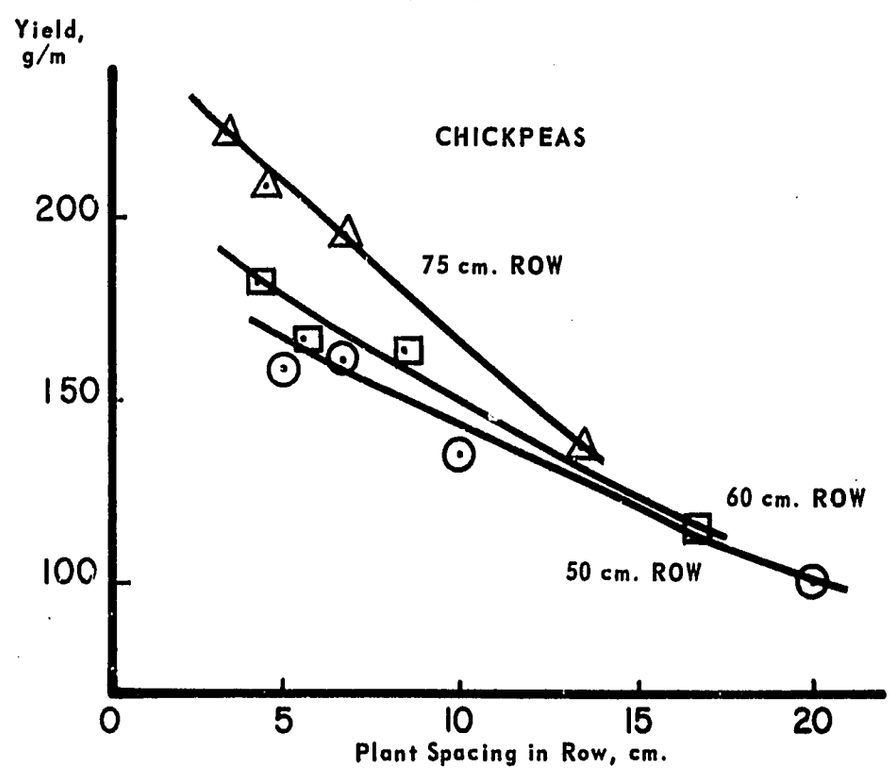


FIGURE 3

INFLUENCE OF ROW AND PLANT SPACING ON SEED YIELD IN GRAMS PER METER OF ROW





Rhizobium Inoculation

Several instances were observed at different locations of wide variations in the nodulation of pulse crops. Near Gorgan in the Caspien Sea area, no nodules were found on dry beans and chickpeas, while only a few occurred on cowpeas. At Mashad in Northeastern Iran, dry beans were very poorly nodulated and showed nitrogen starvation, chickpeas and mungbeans were fairly well nodulated, while cowpeas were very well nodulated. At Shiraz in Southern Iran, dry beans, cowpeas, and mungbeans were poorly nodulated, while chickpeas were heavily nodulated and showed vigorous growth. These observations show that specific rhizobial strains may be deficient in many soils and that consideration should be given to seed inoculation.

Rhizobium inoculation tests were conducted at Karaj in 1966 on chickpeas, cowpeas and dry beans. These tests were located on a different site than those of the previous year, when the effects of rhizobium inoculation were not significant. Results of the 1966 tests are given on Table 32.

Inoculation resulted in a marked increase in number and size of nodules on cowpeas and dry beans, but not on chickpeas. A darker green color was clearly visible in the inoculated cowpeas and dry beans until mid-season, then the color differences disappeared. The seed yield of dry beans was significantly increased at the 5% level by rhizobium inoculation, but the increase for cowpeas was not significant.

Fertilization

Studies were continued to determine the correlation between soil test values for phosphorus and the response of pulse crops to fertilization. Treatments included combinations of two rates of nitrogen (ammonium nitrate) and three rates of phosphorus (concentrated superphosphate). Each fertilizer main plot was split for two methods of application: (1) banded to the side and below the seed, and (2) broadcast and mixed in the surface 3 to 4 inches of the soil. Six replications were used.

Seed yields as influenced by nitrogen and phosphorus fertilization are summarized in Table 33. Phosphorus markedly increased yields of cowpeas and dry beans at Karaj. The higher rate of phosphorus (150 kilograms per hectare of P) did not produce a significant increase over that for 50 kilograms P. Nitrogen resulted in a significant increase in the yield of dry beans at Karaj, and of mungbeans at Varamin.

TABLE 32. Relation of rhizobia inoculation to nodulation and grain yield of chickpeas, cowpeas, and dry beans. RPIP, Karaj, 1966.

Crop	Rhizobia Treatment	Nodules per Plant 1/ Over 2mm	Under 2mm	% Red	Weight (gm)	Yield Tons/Hectare
Chickpeas	Not Inoculated	16	6	58	12.3	2.83a 2/
	Inoculated	13	8	48	16.2	277.a
Cowpeas	Not Inoculated	9	3	81	1.9	3.60a
	Inoculated	22	7	72	3.5	3.81a
Dry Beans	Not Inoculated	2	1	62	-	1.46b
	Inoculated	10	4	76	-	1.64a

1/ Average of 30 plants. Nodules were segregated by size and examined for presence of red pigmentation.

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

Crop yields at the two private farms were low and not appreciably affected by fertilization. These results are believed to be associated with the prevailing irrigation practices. We were unable at times to secure adequate irrigation, and consequently the crops suffered from lack of soil moisture.

Crop response to phosphorus fertilization at Karaj and Varamin was associated with soil test values. Soluble phosphorus at Karaj was in low range (1.8 ppm P), while that at Varamin was in the medium range (9ppm P).

The method of application of fertilizer, banding as compared with mixing, had no appreciable effect on crop yields.

A study of irrigation frequency and fertilizer on chickpeas in Shiraz (Pahlavi University) under the leadership of Dr. Bahrani showed the following results.

TABLE 33. Influence of fertilization on yield (Tons/hectare) of pulse crops at different locations. RPIP, 1966.

Location and Crop	Method of Application	Fertilizer Applied 1/						Mean (Except N_oP_o)
		N_oP_o	N_1P_o	N_oP_1	N_oP_2	N_1P_1	N_1P_2	
Experimental Station-Karaj Cowpeas	Band	1.87	1.76	2.34	2.48	2.45	2.65	2.34a 2/
	Broadcast	1.76	1.94	2.33	2.53	2.42	2.70	2.39a
	Mean	1.82c	1.85c	2.34b	2.51ab	2.43ab	2.68a	
Experimental Station-Karaj Dry Beans	Band	1.60	1.54	1.77	1.98	2.42	2.61	2.06a
	Broadcast	1.35	1.58	1.92	1.98	2.22	2.51	2.04a
	Mean	1.48d	1.56cd	1.84bc	1.98b	2.32a	2.56a	
Assadi Farm Cowpeas	Band	1.23	0.98	1.18	1.33	0.88	1.10	1.09a
	Broadcast	1.23	1.30	1.21	1.20	1.39	1.53	1.33a
	Mean	1.23a	1.14a	1.20a	1.27a	1.14a	1.32a	
Manavari Farm Chickpeas	Band	0.77	0.89	0.92	1.02	1.12	0.96	0.98a
	Broadcast	0.87	1.02	1.00	0.77	1.35	1.10	1.05a
	Mean	0.82b	0.96b	0.96b	0.90b	1.23a	1.03ab	
Experimental Station-Varamin Mungbeans	Band	1.44b	1.82a	1.43b	1.53b	1.84a	1.79a	

1/ Fertilization Rates: 100 kg. N/ha. (N_1); 50 kg. P/ha. (P_1); and 150 kg. P/ha. (P_2).

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

Applications of nitrogen fertilizer resulted in greater yields only when frequent irrigation was applied (every seven days for a total of 49 centimeters of water in 12 irrigations). With less water, nitrogen applications were not effective. Application of phosphorus fertilizer had no effect on yield.

Decreasing the irrigations reduced the amount of disease occurrence and speeded up flowering, podset and maturity of the crop.

Detailed data were collected on vegetative growth, root development, pod set, disease incidence, maturity, etc. This work will be repeated and expanded in 1967 and results published.

TABLE 34. Yield of chickpeas as affected by irrigation and fertilization. RPIP/Pahlavi University, Shiraz, Iran, 1966.

Number of Irrigations	Fertilization 1/					
	N_o P_o	N_o P_1	N_o P_2	N_1 P_o	N_1 P_1	N_1 P_2
12 (7 days)	1852	2090	2072	1512	1525	1502
8 (10 days)	14	1165	1016	1092	1092	1155
6 (14 days)	599	501	650	733	678	710

1/ Rates: 60 kg. N/ha. (N_1); 45 kg. P/ha. (P_1); 90 kg. P/ha. (P_2).

Irrigation

Studies were initiated in 1966 to determine the effects of irrigating cowpeas at three soil moisture levels during three stages of plant growth. The soil moisture levels were (1) when two-thirds of the water available at field capacity remained, (2) when one-third remained, and (3) when plants started to wilt. Nine irrigation treatments comprising combinations of these soil moisture conditions and the pre-bloom, bloom and post-bloom growth stages were applied.

Each main plot consisted of six rows 20 meters long, and was divided into three sub-plots for seed yield determinations on the three middle rows. A one-meter section of row from each sub-plot was used for the other determinations. Three replications were used.

A black-eyed variety (designated No. 50) was seeded May 29, 1966 on pre-irrigated soil. Two post-planting blanket irrigations, June 2 and 10, were made to insure a uniform stand.

Irrigation dates were determined from periodic soil moisture determinations made with a neutron moisture gage. One access tube was placed in each main irrigation plot.

The average time interval between irrigations and the total number of irrigations are summarized on Table 35. The interval ranged from 4.4 days for the high soil moisture level during bloom to 15.5 days for the low moisture level during pre-bloom. For the entire season, the average intervals between irrigations were 5.6, 8.2, and 12.5 days, respectively, for the high, medium, and low soil moisture levels. The total number of irrigations ranged from seven for low soil moisture all season to 15 for the high level.

TABLE 35. Summary of number and frequency of irrigations. RPIP, Karaj, 1966.

Soil Moisture at Irrigation			Average Interval Between Irrigations, Days			
Pre Bloom	Bloom	Post Bloom	Pre Bloom	Bloom	Post Bloom	Total Irrigations
High	High	High	6.5	4.6	5.8	15
Medium	Medium	Medium	10.0	7.0	7.7	10
Low	Low	Low	15.5	11.0	11.0	7
High	Medium	Medium	6.5	7.3	7.7	12
Medium	High	Medium	10.0	4.4	7.0	12
Medium	Medium	High	10.0	7.0	5.8	11
Low	Medium	Medium	15.5	7.5	7.7	9
Medium	Low	Medium	1[illegible].7	10.7	7.0	9
Medium	Medium	Low	10.0	7.0	11.0	9

Seed and straw yields and seed size were affected by the irrigation treatments (Table 36 and Figure 4). In general, the effect of soil moisture levels on seed and straw yields was greater when applied during the bloom and post-bloom stages than during the pre-bloom stage. Maintaining

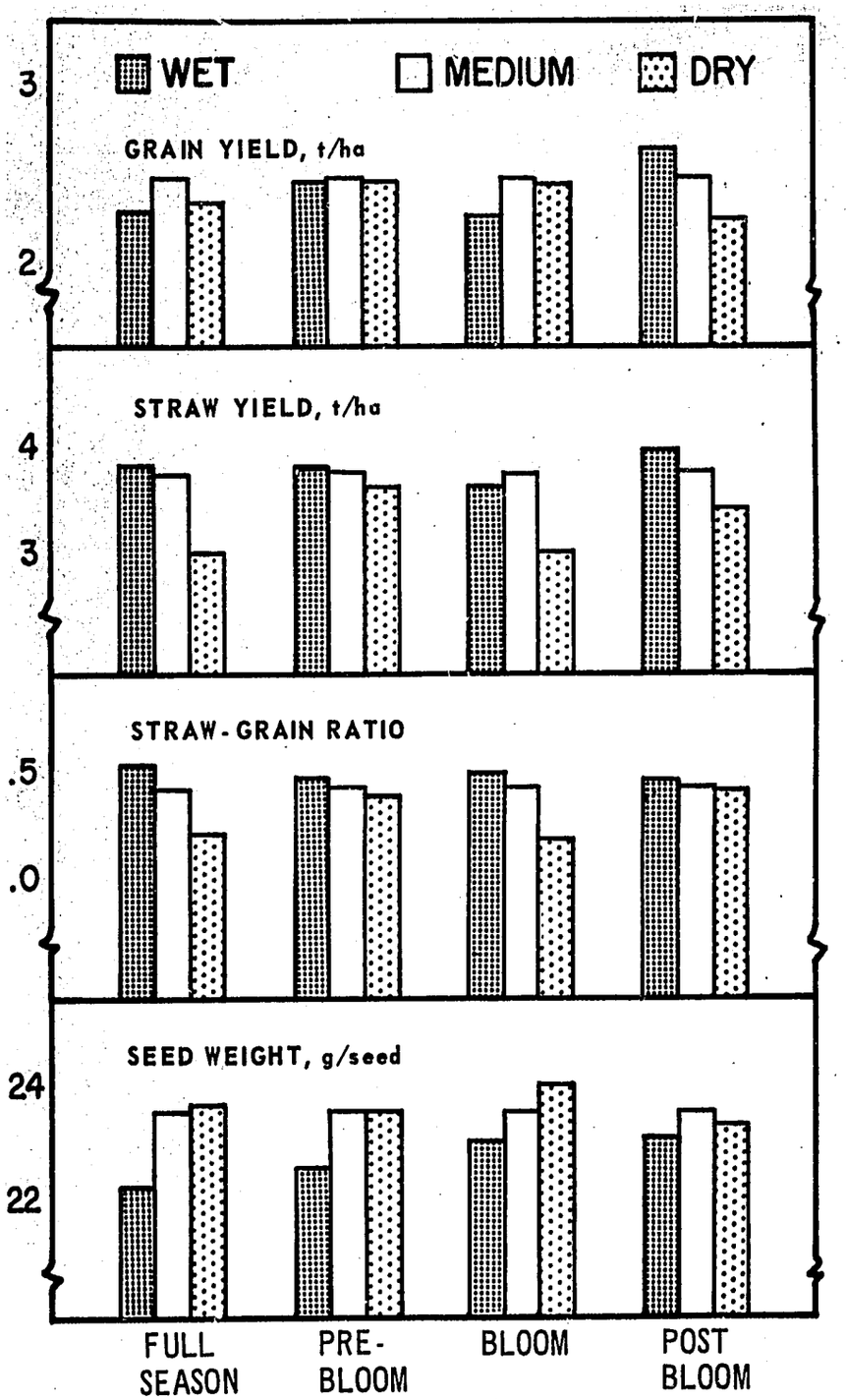
TABLE 36. Influence of irrigation on growth of cowpeas, RPIP, Karaj, 1966.

Irrigation[1/] Soil Moisture	Irrigation[1/] Time Applied	Grain Yield T/Ha.	Straw Yield T/Ha.	Straw Grain Ratio	Pods Per Plant	Seeds Per Pod	Seed Size gm/seed
High	All Season	2.43bc[2/]	4.14ab	1.69a	5.6a	6.8a	.206c
Medium	All Season	2.61ab	4.04ab	1.55ab	6.7a	6.8a	.227ab
Low	All Season	2.47bc	3.20c	1.29c	6.6a	6.1a	.228ab
High	Pre-Bloom	2.59abc	4.12ab	1.60ab	6.8a	6.2a	.212c
Low	Pre-Bloom	2.60ab	3.89ab	1.50b	6.4a	6.4a	.226ab
High	Bloom	2.42bc	3.91ab	1.62ab	6.1a	6.4a	.218bc
Low	Bloom	2.59abc	3.20c	1.25c	6.3a	6.3a	.234a
High	Post-Bloom	2.74a	4.29a	1.55ab	6.5a	6.2a	.218bc
Low	Post-Bloom	2.37c	3.68bc	1.52ab	6.7a	6.2a	.224ab

1/ Irrigated when soil moisture in the root zone was high (when two-thirds of the water available at field capacity remained), medium (when one-third of it remained), and low (when plants started to wilt). When irrigated at a high or low moisture level during one growth stage, irrigation was at the medium moisture level during the other growth stages.

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

INFLUENCE OF SOIL MOISTURE AT IRRIGATION ON GROWTH OF COWPEAS



high moisture during bloom or low moisture during post-bloom tended to reduce seed yields. The highest seed yield occurred with irrigation at medium soil moisture during the pre-bloom and bloom stages, and then at high moisture during post-bloom. The lowest seed yield resulted from irrigating at medium moisture until post-bloom and then at low moisture. Straw yields and straw-grain ratios were increased by high moisture and reduced by low moisture, particularly when applied at bloom stage or for the entire season.

The irrigation treatments had no significant effect on the number of pods per plant or the number of seeds per pod, but had a marked influence on seed size. Smaller seed resulted from maintaining high soil moisture.

Dates of first bloom and first mature pods were a few days earlier for the dry than for the wet treatments. However, there was no appreciable difference in date of maturity for the majority of pods.

No difference in disease occurrence was observed, although some plants developed more yellow leaves than others after mid-August. By early September, this yellowing was much less pronounced where low moisture had been maintained during pre-bloom and/or bloom than for the high moisture condition.

§ § § § § § §

ENTOMOLOGY

Shannon W. Wilson - Entomologist
Counterparts: Eng. Karim Kamali
Eng. G. Rassoulian

The appearance of the seed corn maggot, Hylemya cilicrura, on April 25, 1966 on dry beans, mungbeans, and cowpeas initiated the entomological activities at Karaj, Iran. They were lated observed on June 4, 1966 on chickpeas. Plantings of these crops were severely damaged and the infestations, which continued for over a month, necessitated replanting some of the plots up to three times. The third planting was seed-treated with Lindane at the rate of 2 ounces actual per 100 pounds of seed. Control was only fair, but acceptable plots were established.

In view of the problems created by the seed corn maggot, it is planned to have investigations initiated towards developing control methods for this insect.

Beet Armyworm (Spodoptera exigua)

When light infestations of the beet armyworm were first observed on cowpeas, a series of pesticides were applied at different rates of application on June 12, 1966 in an attempt to determine effective rates and materials for control of this insect. Forty rows of cowpeas (bulk planting, all one variety) were divided into thirds (lengthwise of the rows), and then into 4-row plots, making a total of 30 plots. These plots were foliar sprayed on June 12, 1966 for beet armyworm control.

On July 12, 1966 the foliage on the plants in these plots was rated as follows for beet armyworm feeding injury: 50 leaves per plot, or 200 per treatment were examined. The numerical rating was zero (0) for no damage, increasing to five (5), which represented very severe damage. Table 37 shows the treatments and the average damage rating of the foliage in each treatment.

No statistical analysis of the data from this experiment was made, since there were obviously no statistically significant differences in the foliar damage ratings between treatments, and between any of the treatments and the check. The damage ratings were all well below one, and damage from larval feeding of this insect in 1966 was extremely low compared to 1965.

At the same time the insecticide trials were conducted, a protective spray was applied to the cowpea plots of the other disciplines.

TABLE 37. Foliage damage to cowpeas following various insecticide treatments, RPIP, Karaj, Iran, 1966.

Treatment	Rate	Average Damage Rating of Foliage Resulting from Beet Armyworm Larval Feeding
DDT	1 kg/ha	.57%
DDT	2 kg/ha	.82%
DDT	½ kg/ha + Lindane, 150 gm/ha	.88%
DDT	1 kg/ha + Lindane, 300 gm/ha	.81%
Carbaryl	1 kg/ha	.65%
Carbaryl	2 kg/ha	.81%
Untreated Check		.75%

Cotton Bollworm (*Heliothis zea*)

At the appearance of cotton bollworm, a series of seven different treatments was applied to the entomology chickpea plots. Four insecticides were used, alone or in combination at different rates, to determine an effective control for this insect.

Between March 15 and 17, 1966, a planting of 52 field length rows of chickpeas was made and divided into 28 plots to be used for insecticide tests against the above two insects. Each plot was 35 meters long and four rows wide.

On May 28, six different sprays were applied to these plots for control of the beet armyworm, primarily a foliage feeder on pulse crops, and the *Heliothis* sp. which bores into the pods after they set on and completely destroys the developing seed. There were four replicate randomized plots of each of the six insecticide treatments and four untreated checks.

These plots were harvested approximately August 1, 1966, and 500 pods were examined from each plot to determine the number and per cent damaged by *Heliothis* sp. larvae. The only method of evaluating the effectiveness of the insecticides in controlling the beet armyworm on this crop was by comparing the seed weights of the different treatments (total in two middle rows of four replicate plots of each treatment). The results are shown in Table 38.

There was no significant difference in seed weights between the various treatments or between any of the treatments and the untreated check. The same applied to pod damage by *Heliothis* larvae. Mathematically the treatments generally showed slightly less pod damage by *Heliothis* larvae than the untreated check. There were some odd and unexplainable

discrepancies, however. The high rates of the DDT-Lindane combination and Carbaryl showed slightly more damage than the low rates (half the amount of toxicant). However, these differences are not statistically significant and should not be considered valid.

Infestations of any importance did not develop in the check plots, the chickpea plots of the other Project disciplines, or the adjacent area.

TABLE 38. A comparison of seed weights from six insecticide treatments and check sprayed for beet armyworm control, together with a comparison of the same treatments for controlling pod-boring *Heliothis* sp. larvae, RPIP, Karaj, Iran, 1966.

Treatment & Rate	Total Seed Weight (2 Rows, 4 Replicates)	%Pods Damaged by Heliothis Larvae - 2000 Pods Examined per Treatment
DDT - 1 kg/ha + Lindane, 300 gm/ha	14,649 grams	1.28
DDT - 2 kg/ha + Lindane, 600 gm/ha	16,467	1.78
DDT - ½ kg/ha + Toxaphene, 150 gm/ha	14,435	4.22
DDT - 1 kg/ha + Toxaphene, 300 gm/ha	14,912	2.07
Carbaryl - 1 kg/ha	13,953	0.74
Carbaryl - 2 kg/ha	14,934	1.44
Untreated Check	14,099	3.91
LDS - 5% Level	NSD	NSD

Aphids (*Acyrthosiphon sesbaniae*)

Aphids were observed in trace numbers soon after emergence of dry beans, cowpeas, chickpeas, and mungbeans. However, moderate populations were not observed until July 7 on experimental plots of chickpeas and cowpeas. The black bean aphid, *Aphis fabae*, was observed on cowpeas in trace numbers in early July, but never increased to any significant numbers.

The dry bean plots for entomological tests were planted on May 25 and 26, 1966. The plantings consisted of 72 field length rows of Great Northern 123, 48 rows of Columbia Pinto, and 16 rows of U.I. Pinto 111. All rows were 145 meters (471 feet) long. All rows were half a meter (20 inches) apart. All plots were irrigated on May 30.

Investigations involving aphids were conducted on dry beans and cowpeas. Dimethoate was applied to dry beans (U.I. Pinto 111) as a seed treatment at two rates: (1) 4 oz. actual/100 pounds of seed; and (2) 8 oz. actual/100 pounds of seed. The U.I. Pinto 111 beans were seed treated with Dimethoate

(a systemic insecticide) in an effort to see if aphids could be quickly and effectively controlled on the newly emerged plants, since infestation was thought to be largely responsible for virus transmission.

Population estimates were made 30 days after planting, but the extremely low populations (0.4 to 0.85 aphids/leaf) showed no significant difference in treatments.

Treatment & Rate	Average Number Aphids per Leaf (4 Replicate Plots)
Dimethoate - 4 oz/100 lb. seed	0.6
Dimethoate - 8 oz/100 lb. seed	0.4
Untreated Check	0.85

Yield data from the Pinto 111 plots, seed treated with two rates of Dimethoate, are shown in Table 39.

TABLE 39. Yield data of beans (Variety U.I. Pinto 111) treated for control of pea aphid (*Acyrthusiphon sesbaniae*), RPIP, Karaj, Iran, 1966.

Replication	Treatment 1 4 oz. Dimethoate	Treatment 2 8 oz. Dimethoate	Treatment 3 Check
1	4682 grams	6332 grams	6561 grams
2	7648	5186	5941
3	8744	5508	6177
4	3712	6296	8404
Total	24,786 grams	23,322 grams	27,083 grams

LSD at the 5% level = 697.4

The yield records indicate a difference between all treatments with the results favoring the check over the treated plots and the low rate of seed treatment over the high rate of seed treatment.

When aphid populations increased on cowpeas at Karaj, it was decided to make an experimental spraying with Diazinon for control of these aphids. The spray was applied at the rate of 600 grams of actual Diazinon per hectare to 28 plots, each four rows wide and approximately 140 feet long. On July 5, prior to spraying, 50 leaves were collected from foliage on plants at random in each plot and all the aphids counted on the collected leaves. The spray was applied on July 13 and post spray counts of aphids on 50 leaves per plot were made on July 17, four days after treatment.

The number of aphids per 50 leaves 8 days before spraying ranged from 32 to 747, with an average of 238. Four days after the spray application, the count was reduced to 0.1 aphid per 50 leaves for essentially 100% effective control.

A comparative test of foliar applications of six insecticide treatments, plus an untreated check, was made on Columbia Pinto Beans on June 19. Just before applying the sprays, 50 leaves were picked from each of the four replicate plots comprising each treatment and the aphids counted on each leaf. Six days after spraying, another set of 50 leaves was picked from each plot and the aphids counted again. The results are shown in Table 40.

TABLE 40. Aphid control on Columbia Pinto Beans with six different insecticide treatments, RPIP, Karaj, Iran, June, 1966.

Treatment and Rate	Aphids per 200 Leaves	
	Before Spraying	6 Days after Spraying
Diazinon - ½ kg/ha	194	0
Diazinon - 3/4 kg/ha	228	11
Malathion - 1 kg/ha	146	0
Malathion - 2 kg/ha	245	4
Dimethoate - ½ kg/ha	154	3
Dimethoate - 2 kg/ha	204	1
Untreated check	228	25

All materials and rates of application used appeared quite effective in reducing the aphid populations to low levels and the populations never built up again to their previous levels.

The seed weights at harvest for the seven treatments were statistically analyzed and there was no significant difference between the seed weights for the various treatments.

Jassids (*Epoasca* sp.)

While jassids were observed in trace numbers shortly after plant emergence in the dry beans plots and cowpeas in early June, it was not until August 3 that populations reached a moderate infestation, and then only on the dry beans. At this time, many of the Columbia Pinto Bean leaves had varying degrees of yellowish-white to yellow discoloration or blotches.

To determine an effective control measure, six insecticides were applied, each to four randomized and replicated plots, with four untreated check plots. Six days after application of the sprays (August 10), 25 sweeps were made in each plot with a standard insect net and the number of jassids so collected in each plot were killed and counted. On August 22, 18 days after spraying, similar sweeps were made in each plot and the jassids again counted. The insecticides used, application rates, and the effect on jassid populations are shown in Table 41.

TABLE 41. Number of jassids (*Epoasca sp.*) per 25 sweeps on dry beans (Variety Columbia Pinto) six and 18 days after treatment, RPIP, Karaj, Iran, 1966.

Treatment & Rate	Jassids per 25 Sweeps	
	6 Days After Treatment	18 Days After Treatment
Diazinon-½ kg/ha	19.0	30.7
Carbophenothion-1 kg/ha	8.0	58.7
Malithion-1 kg/ha	11.2	56.5
Ethion-½ kg/ha	8.2	44.5
Dimethoate-½ kg/ha	5.5	35.5
Sevin-½ kg/ha + Tedion-2 kg per ha.*	12.2	45.5
Check	72.0	46.2

*This combination was used at the rate of 2 kg. Carbaryl and ½ kg. Tetradifon (Tedion) per hectare. The Tetradifon was added to hold down the mite population which frequently builds up following the use of Carbaryl.

Obviously all these treatments were effective in reducing the jassid population level well below that of the untreated check plots as indicated by the counts of August 10. By August 22, populations had all increased almost to or above the level of the check. The reduction of the check population between August 10 and 22 was probably due to maturing of the beans and the plants were less attractive to the jassids as a source of food.

Seed yield was recorded and an analysis was made. There was no significant difference between treatments or between treatments and check.

A planting of a Great Northern line of beans was also heavily infested with this same jassid and showed evidence of feeding injury early in August.

On August 5, a spray was applied to six replicate plots for jassid control and also to depress the mite population. Six untreated check plots were also included in the experiment. The spray treatment applied to six plots was a combination of Trichlorfon (Dylox) and Erysit (a miticide). The application rate was two kilograms of Trichlorfon and 640 grams of Erysit (actual of each) in 75 gallons of spray per hectare. On August 10, and 22, five and 17 days after spraying, 25 sweeps with a standard insect net were made in each plot and the number of jassids counted. The results are shown below:

	Number of Jassids	
Treatment	5 Days after Treatment	17 Days after Treatment
Dylox + Erysit	69.1	114.8
Check	135.2	192.33

Seed weights from the sprayed and untreated check plots were determined at harvest time and there was no significant difference in yield between the treated and the check plots. The Trichlorfon-Erysit combination reduced the jassid population in these plots appreciably below the level in the check plots, although not as low as the materials used in the Columbia Pinto Bean plots discussed above. However, there was still a wide difference in population levels between the treated and untreated plots 17 days after spraying, indicating quite a good residual effect, although the populations in both the treated and check plots were well above the level of those in the Columbia Pinto Beans 18 days after spraying.

Lentil Bruchid (*Callosubruchus analis*)

The entomology lentil plots were treated with two different insecticides at flowering time for bruchus control. DDT at the rate of $2\frac{1}{2}$ kilograms per hectare and Lindane at $\frac{1}{2}$ kilogram per hectare were applied on May 19. Four-row plots were used with only the two middle rows harvested for recorded data, and the outside rows used for buffer rows.

TABLE 42. Data of lentils treated with two insecticides for control of bruchus (*Bruchus analis*), RPIP, Karaj, Iran, 1966.

Treatment & Rate	No. of Seed Examined*	Per Cent of Damage	Seed Yield Per Treatment**
DDT - $2\frac{1}{2}$ kg/ha	2,193	0.045	2,103 gm.
Lindane - $\frac{1}{2}$ kg/ha	2,128	0.19	2,529
Untreated Check	2,153	0.22	1,340

LDS at the 1% level, 357.6.
*2,000 pods examined per treatment.
**Total yield for four replications.

The seed yields of the three treatments indicate a significant difference between the two insecticides and a difference between treated and untreated plots. The data on per cent damage show that these yield differences are not due to bruchus control. At the same time, there is not enough information available to determine why the differences between the seed weights occurred.

Mites (*Tetranychus bimaculatus complex*)

An infestation failed to build up in the entomology plots at the Karaj station, but a light infestation was controlled in the dry bean variety trials with applications of malithion, diazinon and dimethoate. After the dry beans were mature and just prior to harvest, very severe infestations built up on much of the dry bean plantings. However, no loss in yield was suffered due to the lateness of the infestation.

Bean Butterfly (*Lycaena baeticae*)

The appearance of a light infestation of bean butterfly in late July raised a question as to the possibility of this insect becoming a serious pest of cowpeas. A preliminary study of the life cycle in the Karaj area was conducted, along with an assessment of the damage to cowpeas by this insect.

Damage to the cowpeas consisted of flower blasting and pod boring which increased rapidly in later flowers and seed pods. On August 16, three plants were selected at random in each of 60 rows of cowpeas, and all flowers on these plants were checked for blasting. Results of the sampling were as follows:

TABLE 43. Damage to cowpea blossoms caused by bean butterfly (*Lycaena baeticae*), RPIP, Karaj, Iran, 1966.

No. of Plants Examined	No. of Blossoms	No. of Blossoms Destroyed	Per cent of Destroyed Blossoms
180	621	192	31%

In addition, three plants were selected at random from each of 50 rows to determine damage to the seed pods. Results are summarized in Table 44.

TABLE 44. Damage to seed pods of cowpeas caused by bean butterfly (*Lycaena baeticae*), RPIP, Karaj, Iran, 1966.

Total Plants	Total Pods	Total Damaged Pods	No. of Seeds in Damaged Pods	No. of Damaged Seeds	% Damage Pods	% Damage Seeds
150	3,244	277	1,925	348	8.5	18.0

The information presented in the preceeding tables is far from complete. The total number of blooms destroyed for the entire flowering season was not determined. However, based on the later flowering, blasting, and number of damaged seed, it would appear that the loss was high enough to warrant including this insect in future programs.

In view of the relatively large amount of damage the bean butterfly larvae were doing to cowpea blooms, some experimental controls were attempted.

On September 1, individual plants in the field were selected for these tests. Five plants comprised a plot and there were five randomized, replicated plots of each insecticide test. Six insecticides were used in the test and 150 plants were required.

Larval counts were made on the cowpea blooms on September 1, just prior to the application of the insecticides as sprays to the plants. On September 8, one week after spraying, the plants were again examined and the live larvae counted. The results of these tests are shown in Table 45 below.

TABLE 45. Insecticidal control of larvae of *Lycaena baetica* infesting cowpea blooms, RPIP, Karaj, Iran, September 1966.

Insecticide	Application Rate	Larval Count per 25 Plants: Pre-Treatment	Larval Count per 25 Plants: Post Treatment	Apparen Contro
DDT-Toxaphene*	1½ kg DDT/ha	28	0	100
Diazinon	½ kg/ha	25	0	100
Dimethoate	½ kg/ha	25	4	84
Dylox	1 kg/ha	20	4	80
Malathion	1 kg/ha	29	0	100

LSD at 5% level, 15.95%.
*This combination contained 300 grams of Toxaphene per 1 kilogram of DDT or 450 grams of Toxaphene per 1½ kilogram of DDT.

Although exploratory in nature, these tests show there is promise of effective insecticidal control of this insect while in or on the blooms. Probably timing will be of considerable importance here in order to control the larvae before they bore into and damage the blooms. DDT-Toxaphene, Diazinon, and Malathion were significantly more effective than either Dimethoate or Dylox (Trichlorfon) in these tests.

Stored Pulse Pests

Preliminary work has been initiated on Callosobruchus maculatus using a chlorinated hydrocarbon compound with the trade name of Bromodan. In tests on stored cowpeas, this insecticide has given 100% control at $1\frac{1}{2}$ and 1 kilogram actual per 1 metric ton of seed for a period of 60 days. At a level of $\frac{1}{2}$ kilogram per metric ton, 72% mortality was recorded. This particular insecticide has a very low mammalian toxicity which is of particular importance in the treatment of stored pulses. A separate report will be compiled upon completion of the evaluation of this pesticide.

§ § § § § § § §

Checking cowpea germplasm for insects and diseases. L. to R.: K. E. Gibson, Entomologist; A. Ellini, Plant Breeder; and P. H. van Schaik, Project Leader. Karaj, Iran, 1966.

Inoculating test plants with legume virus in greenhouse. Dariush Danesh, Pathologist; Karaj, Iran, 1966.

Spraying cowpeas for insect control. K. E. Gibson, S. W. Wilson and G. R. Rassoulian, RPIP Entomologists on right. Karaj, Iran, 1966.

PLANT PATHOLOGY

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

Plant diseases were found in all the pulse crops grown in Iran. Diseases were found to be a limiting factor in the cultivation of several pulse crops, particularly broadbeans and lentils. The plant diseases of utmost importance were caused by viruses and fungi (both foliar and soil-borne).

The 1966 pathological work consisted mainly of disease occurrence surveys and pathogen isolation and identification.

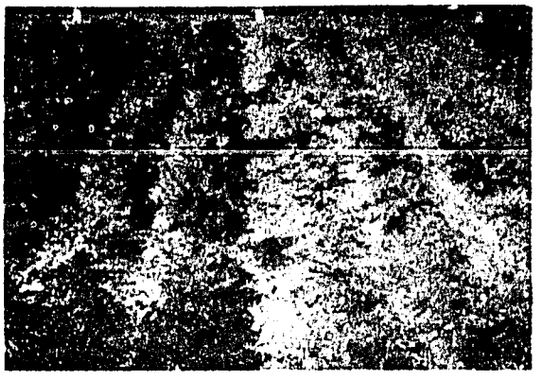
Virus diseases were widespread and of importance in beans, broadbeans, chickpeas, cowpeas and mungbeans. Viruses infecting pulse crops which have been identified are Alfalfa Mosaic (chickpea, cowpea and lentil), Bean Common Mosaic (bean), Bean Yellow Mosaic (broadbean, chickpea and lentil), and Cucumber Mosaic (broadbean). Several unknown viruses were found on bean, chickpea, cowpea and mungbean. Both insect and seed transmission were found to occur.

Root rot diseases were important in several areas of Iran on beans, chickpeas and lentils. Various soil-borne fungi, such as Rhizoctonia solani, Macrophomina phaseoli, Pythium sp., Phytophthora sp., and Fusarium spp., were isolated from roots of diseased plants. Most of these fungi are serious root rot pathogens of many crops, including legumes.

Foliar diseases caused by Botrytis and rust were of importance mainly in the wetter areas of Iran where they inflicted serious crop losses in broadbeans. A control program consisting of fungicidal spray treatments on the fall-treated broadbean crops in Southwestern Iran was initiated against foliar diseases caused by chocolate spot (Botrytis fabae) and rust (Uromyces fabae).

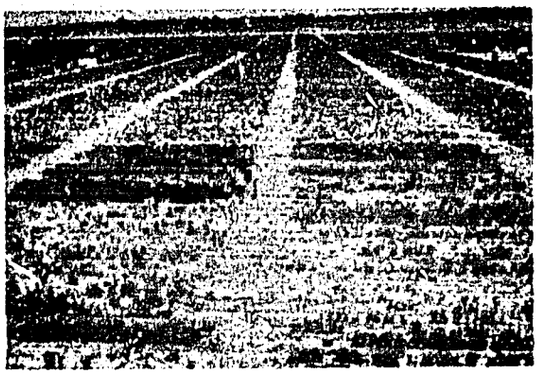
Beans (Phaseolus vulgaris)

Beans are an important pulse crop grown in Iran. Both dry and snap beans are cultivated throughout the country, although a larger acreage is planted to dry beans.



Chickpea root rot. Severe damage (right); apparently resistant variety (left). Rezaieh, Azarbaijan, Iran, 1966.

Chickpea virus. Each white stake is beside a virus infected plant. Karaj, Iran, 1966.



Lentil root rot. View of Karaj, Iran, nursery. Darker green areas are strains with apparent resistance. 1966.

Virus and root rot diseases were responsible for major crop losses in both dry and snap beans. Virus diseases were encountered wherever beans were grown, whereas root rot diseases were more restricted in distribution.

Bean Common Mosaic Virus (BCMV) was the most important virus disease of beans in Iran, where it was found in all the bean growing regions of the country.

Plants infected with BCMV are usually stunted and spindley, and the leaves may be mottled, cupped, blistered, twisted and misshapen (Figures 5 and 6). Pod production on infected plants is often sparse, and much of the seed produced is small and shriveled.

Virus infected bean plants with symptoms of BCMV were collected from several areas of Iran. In the greenhouse these were used to mechanically inoculate different test plants, including numerous bean varieties. Only certain bean varieties were infected by the virus. Symptoms very characteristic of BCMV were produced in inoculated bean varieties of Stringless Green Refugee and Bountiful. No infection occurred in many of the Great Northern U. I. bean lines and Pinto U. I. 111 bean. Inoculation tests in the greenhouse confirmed that BCMV was present in all the bean growing areas of Iran.

Bean Common Mosaic Virus is one of the few legume viruses which may be transmitted through a high percentage of the seed. Seed transmission of a virus, such as BCMV, is extremely important since it enables the virus to survive from one growing season to another and to be introduced into new areas previously free of the virus.

The importance of seed transmission of BCMV under Iranian conditions was investigated at Karaj using eight bean varieties which were grown at the location in 1965. One month after planting, a survey was made of the number of plants in each variety which had symptoms of BCMV or other viruses. Bean Common Mosaic Virus was seed-borne in over ten per cent of the seeds from two Iranian varieties (Table 46). Four U.S. bean varieties included in the test were resistant to several stains of BCMV which occur in the United States. During this test, symptoms of BCMV were not found in any of these four varieties indicating that the strains of BCMV occurring in the Karaj area may be similar to those occurring in the United States. However, an unknown virus was found in some of these varieties.

Virus diseases are also extremely important in other Middle Eastern countries. In September, 1966, a disease survey was made of the dry bean

FIGURE 5. Healthy bean plants next to a plant infected with Bean Common Mosaic Virus (right). The leaves of virus infected plants are mottled, deformed, twisted and blistered.

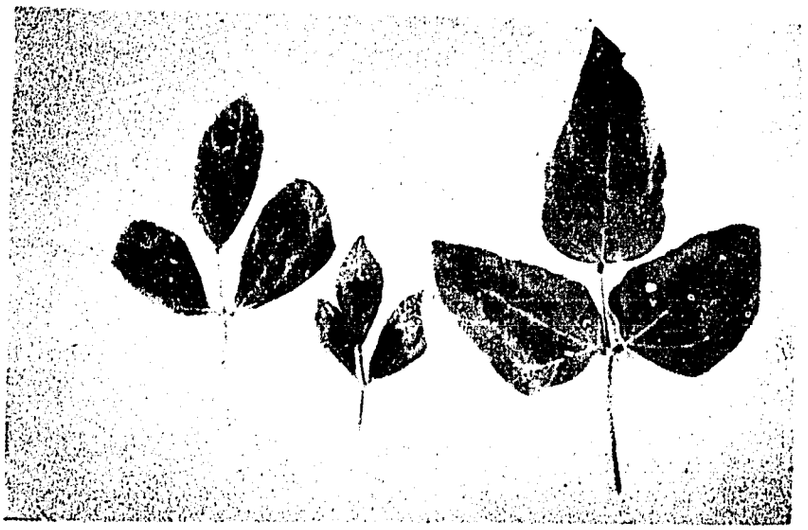


FIGURE 6. Bean leaves from plants infected with Bean Common Mosaic Virus. The leaves are mottled, deformed, twisted and blistered.

growing areas in Central and Western Turkey. Bean Common Mosaic Virus was found to be the most important plant disease of beans in Turkey, although diseases caused by rust and root rot were also encountered.

TABLE 46. Seed transmission of Bean Common Mosaic Virus (BCMV) in eight bean varieties. RPIP, Karaj, Iran, 1966. 1/

Selection Number	Country of Origin	Number of Plants	Number of Plants with Virus Symptoms	% Virus Infection
1	United States 2/	1145	6	0.5 3/
2	United States	594	7	1.2
3	United States	1064	19	1.8
4	United States	2516	67	2.7
5	Iran	970	29	3.0
6	United States	1617	160	9.3
7	Iran	3593	404	11.2
8	Iran	2509	364	14.5

1/ Seed was planted on May 26 and the virus survey taken on June 28, 1966.

2/ Varieties 1-4 are resistant to certain strains of BCMV in the United States.

3/ The virus symptoms observed on varieties 1-4 were not characteristic of BCMV, and BCMV could not be isolated from these plants in greenhouse inoculations.

Bean root rot was responsible for large crop losses in the Karaj area and at Dezful in Southwestern Iran. Root rot at Karaj became important after flowering. Infected plants were stunted and yellowish in color and tended to lose their leaves prematurely. Diseases plants often die before the crop has matured, resulting in poor crop yields and shriveled seeds. The root systems of diseased plants are sparse and contain few feeder rootlets. The roots are usually discolored, necrotic and rotted. Isolations from discolored roots on agar media yielded mainly Rhizoctonia solani, although several other potentially pathogenic soil-borne fungi were isolated, including Macrophomina phaseoli, Pythium sp. and Fusarium spp.

In Dezful bean root rot was serious on snap beans. The beans were planted in an area which received frequent irrigations. Infected plants turned yellow and died (Figure 7). Many plants were killed by the disease. A Pythium sp. was isolated most frequently from discolored roots, although Rhizoctonia solani and Macrophomina phaseoli were occasionally recovered. Some of the green pods which touched the soil were rotted and covered with a white mycelium. Pure cultures of Pythium were isolated from the serial mycelium and rotted pod tissue.

A small scale fumigation experiment with methyl bromide was conducted at Karaj for control of weeds and bean root rot. The fumigant (two pounds per 180 square feet) was injected beneath a polyethylene tarp which covered the plot. The maximum daytime temperature at the time of fumigation was 90°F. Tarps were removed after 48 hours and the plots planted after 14 days. In the fumigated plots, weed control was excellent, but bean plants were stunted and yellowish in color (Figure 8).

Nitrogen in the form of ammonium nitrate (150 kilograms per hectare) was applied to half of each fumigated plot; however, there was no response in plant growth. It appears that beans are extremely sensitive to the bromine which is left in the soil after fumigation with methyl bromide.

In one Great Northern U. I. bean variety included in the test, the yield from four non-fumigated plots was 11.4 kilograms, but from four fumigated plots only 1.4 kilogram. Since the incidence of root rot was very low in the area of the field where the fumigation test was located, no data was obtained on the effect of soil fumigation on the control of bean root rot.

Two leaf spot diseases of minor importance were found on snap beans in the Caspien Sea area during the wet, rainy season. The diseases were caused by angular leaf spot (Isariopsis griseola) and rust (Uromyces phaseoli var. typica). Under ideal weather conditions, both of these diseases could cause widespread damage to the bean crop in this area.

Broadbeans (Vicia faba)

Broadbeans are grown in many areas of the country, but are especially important in the North around the Caspien Sea and the South in Khuzestan. An epidemic of plant diseases in Khuzestan in the spring of 1966 reduced broadbean yields by over 50 per cent.

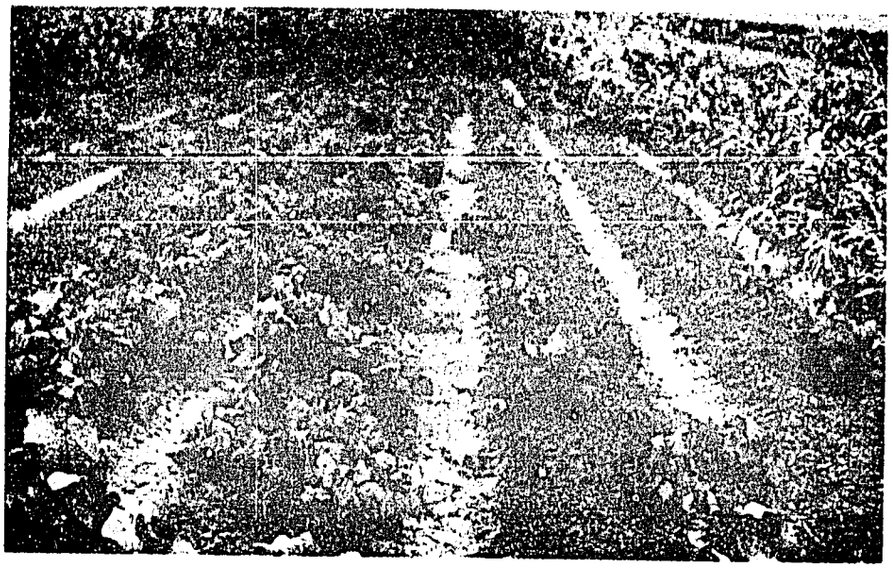


FIGURE 7. Snap beans infected with root rot. Many plants have been killed by the disease, while others (lighter colored) are showing initial symptoms of infection.

FIGURE 8. The effect of fumigation with methyl bromide on weed control and growth of beans. Fumigated plots are weed free, but the bean plants are stunted.

The diseases of major importance were identified as chocolate spot (Botrytis fabae), broadbean rust (Uromyces fabae) and virus (Bean Yellow Mosaic Virus). The disease responsible for most crop damage was caused by chocolate spot.

Before and during the disease epidemic, there were frequent rains with dews occurring most mornings. These weather conditions appear to have been very favorable for a disease epidemic of chocolate spot and rust to occur.

Under less favorable environmental conditions, Botrytis infection results in the formation of small reddish brown lesions on the leaves (non-aggressive stage). When weather conditions are very favorable for infection, as in the spring of 1966, the fungus causes extensive necrosis of leaf and stem tissue (aggressive stage) (Figures 9, 10), often resulting in death of the plant.

There is abundant sporulation of Botrytis within 24 hours when necrotic tissue is placed in a humid atmosphere. The Botrytis spores appear to be spread by moisture, in the form of rain and dew, and wind. Under ideal environmental conditions spread, infection and disease development proceed at a very rapid rate, often resulting in a disastrous disease epidemic as was witnessed in 1966.

Rust infection was confined mainly to the leaves, although pustules also formed on the stems and petioles of heavily infected plants. Only the uredial stage of the rust was found on infected broadbeans.

In the fall of 1966 a fungicide test was begun in Khuzestan to control chocolate spot and rust on broadbeans. Two fungicides, Botran and Maneb, are included in the test. Both fungicides will be applied at different time intervals, and the test will be terminated just before the crop is harvested in May, 1967.

Almost 100 per cent of the broadbeans grown in Khuzestan during 1966 were infected with Bean Yellow Mosaic Virus (BYMV). Broadbean plants infected with this virus are often lighter green in color than healthy plants, and the younger leaves are sometimes twisted and deformed. Mosaic symptoms, consisting of dark green areas of various sizes confined to interveinal areas (Figure 11) are very conspicuous, especially on the younger leaves.

In greenhouse studies the virus has been mechanically transmitted to several varieties of bean and broadbean, Chenopodium amaranticolor and pea. Serological studies were conducted with antiserum of BYMV. The virus infecting broadbeans in Khuzestan was identified as BYMV by the symptoms produced on test plants and confirmed by serology tests.

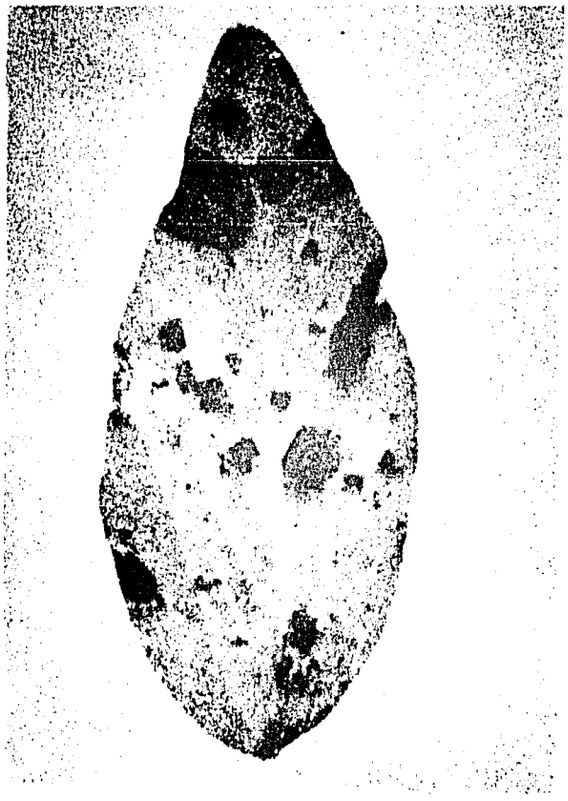


FIGURE 9. Many leaves on a broadbean plant infected with chocolate spot (Botrytis fabae) have been killed. The fungus causes extensive necrosis of both leaf and stem tissue.

FIGURE 10. A broadbean leaf with necrotic lesions caused by the chocolate spot fungus (Botrytis fabae).

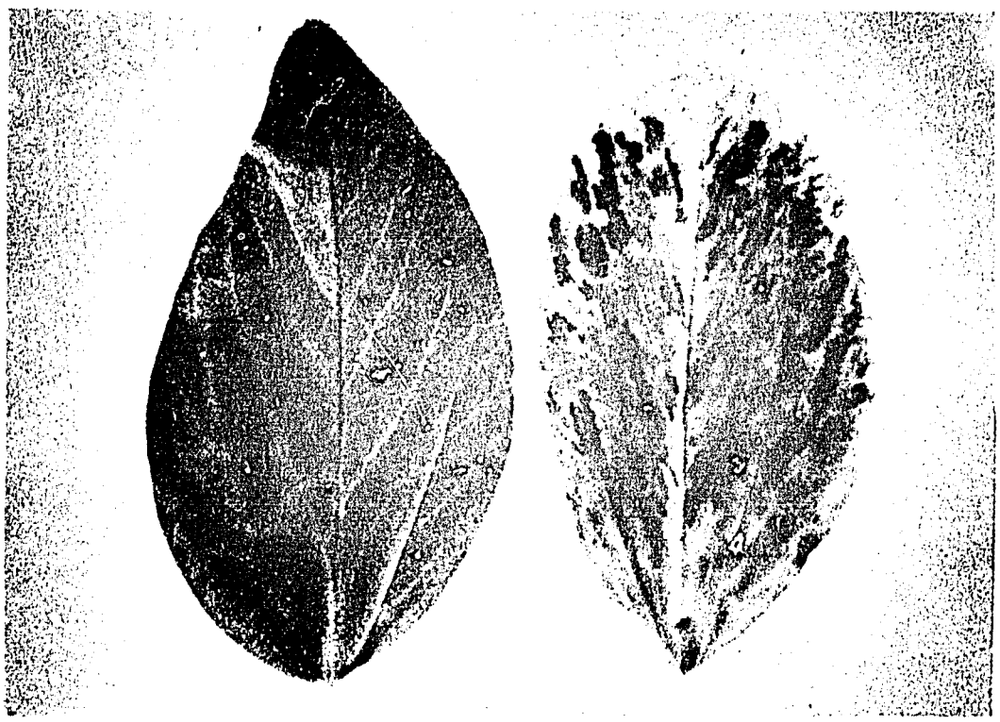


FIGURE 11. A healthy broadbean leaf (left) adjacent to one infected with Bean Yellow Mosaic Virus (right). Leaves from infected plants are a lighter green in color and the mosaic symptoms consist of dark green areas of various sizes, generally confined to interveinal areas.

In the field broadbeans are often heavily infested with the black bean aphid (Aphis fabae). Black bean sphids from BYMV infected broadbeans from the Khuzestan area transmitted the virus when transferred to healthy broadbeans maintained in insect-proof cages in the greenhouse. The green pea aphid (Acyrthosiphon pisum), which occasionally colonizes broadbeans, has also transmitted the virus to healthy broadbeans in greenhouse tests. The insect vector of major importance in the spread of BYMV in broadbeans is A. fabae.

Field observations of broadbean plants derived from seed of BYMV infected plants indicate that the virus is seed-borne, although the percentage transmission seems to vary with the broadbean variety, and in some instances transmission may be as low as 1-2 per cent.

Seed transmission would be a very important factor in the survival of the virus from one growing season to another, and in the initial introduction of the virus into an area where it can be moved to adjacent plants by insect vectors.

An unusual disease of potential importance was observed in fall planted broadbeans growing in Southwestern Iran. The disease appears to be caused by Aster Yellows Virus from symptoms observed on field infected broadbeans, cowpeas and mungbeans.

Infected plants are stunted and chlorotic, although the root system appears normal. There is an abnormal production of secondary shoots, but the leaves are small, cupped and leathery (Figure 12). Diseased plants are usually sterile, producing no pods.

Pockets of diseased plants were scattered through a large broadbean planting. Numerous green leafhoppers were found on healthy and diseased plants. It has not been possible to transmit the disease by mechanical inoculation to healthy test plants, including broadbeans. Transmission tests with leafhoppers from diseased broadbeans have yet to be completed.

Chickpeas (Cicer arietinum)

Diseases of major importance were caused by viruses and root rot fungi. These diseases were important throughout Iran.

Virus diseases were especially important in our Project field plots at Karaj, although they were also encountered in other chickpea growing areas. Shortly after the chickpeas were planted in early April, scattered plants were found which were stunted and yellow in

FIGURE 12. A broadbean plant infected with an unknown disease thought to be caused by Aster Yellows Virus. Infected plants are chlorotic, stunted and sterile, but produce numerous secondary stems. Leaves are small, cupped and leathery.

color (Figure 13). The roots of diseased plants appeared to be clean and healthy, although the phloem was generally discolored (Figure 14). Many diseased plants died before setting pods. Repeated isolations were made on agar media from roots and stems of diseased plants, but microorganisms were not recovered.

When plant sap from diseased chickpeas was rubbed on healthy greenhouse grown test plants of bean, broadbean and cowpea, necrotic local lesions developed on inoculated leaves, indicating that a virus was the cause. In later greenhouse inoculation tests, healthy chickpeas and lentils were killed by the virus. From the symptoms produced in test plants and results obtained in serological studies, this virus was identified as a strain of Alfalfa Mosaic Virus (AMV).

In a large chickpea planting at Karaj, approximately nine per cent of the plants were infected with AMV (Table 47).

TABLE 47. Surveys of a chickpea planting for virus (primarily Alfalfa Mosaic Virus). RPIP, Karaj, Iran, 1966. 1/

Virus Survey	Number of Plants	% Plants w/Pods	Total No. of Seeds	Seeds per Plant	Wt. seed from 144 plants (gm)	Wt. of 100 seed (gm)
1 2/	298	10.7	218	0.7	24.2	22.0 3/
2	132	45.5	358	2.7	68.7	21.0
3	261	74.3	2307	8.8	281.9	22.5
4 4/	144	75.7	1920	13.3	492.0	24.5
Healthy plants 5/	144	100	11,582	80.4	3,702.0	33.0

1/ The chickpeas were planted on May 10 and harvested on September 11-13, 1966. A total of 16,002 plants were surveyed.

2/ Virus surveys were taken on the following dates: (1) July 3 (early flowering); (2) July 16 (full flowering); (3) July 27 (end of flowering).

3/ Many of the seed from diseased plants were shriveled and small, and appeared to have dried up prematurely.

4/ Survey for unknown disease called Little Leaf taken on August 12, 1966.

5/ The data tabulated for healthy plants is a random sample of all healthy plants.

FIGURE 13. A healthy chickpea plant (left) with two plants infected with Alfalfa Mosaic Virus. Virus infected plants are chlorotic and stunted and generally fail to produce many pods.

FIGURE 14. The phloem of a chickpea plant infected with virus (right) is often discolored, but that of a healthy plant (left) is not discolored.

Three virus surveys were made through the planting and all virus infected plants were marked on each survey. The first survey was taken before flowering, the second after flowering, and the third when pods had set. Virus infection greatly reduced pod production and seed yields (Table 47), and resulted in a high mortality rate (Table 48).

TABLE 48. Effect of virus (mainly Alfalfa Mosaic Virus) on mortality of chickpeas. RPIP, Karaj, Iran, 1966. 1/

Virus Survey	Total No. Virus Infected Plants	Per cent Plants Infected with Virus	Number of Dead Plants	Per cent Mortality
1 2/	609	3.8	472	77.5
2	300	1.9	225	75.0
3	542	3.4	442	81.6
TOTAL	1,451	9.1	1,139	78.5
4 3/	808	5.0	0	0

1/ The chickpeas were planted on May 10 and harvested on September 11-13, 1966. A total of 16,002 plants was surveyed.

2/ Virus surveys were taken on the following dates: (1) July 3 (early flowering); (2) July 16 (full flowering); (3) July 27 (end of flowering).

3/ Survey for the unknown disease, called Little Leaf, was taken on August 12, 1966.

Chickpea fields with virus infected plants were generally located near an alfalfa field. Alfalfa Mosaic Virus has been isolated from alfalfa fields throughout Iran. Alfalfa fields are usually heavily infested with the green pea aphid. This aphid is known to be an efficient vector of AMV, although it still remains to be determined whether the aphid is a vector of AMV under Iranian conditions.

In the large chickpea field where the virus surveys were conducted, an unusual unknown disease, tentatively called Little Leaf, was frequently encountered. At harvest time, five per cent of the plants

exhibited Little Leaf symptoms (Table 48). The leaves of diseased plants were yellowish-green in color and greatly reduced in size. There was no phloem discoloration associated with diseased plants. Although there is generally little stunting associated with Little Leaf, infected plants usually produce few pods (Table 47, Survey 4). An unusual aspect of this disease is that few Little Leaf plants die prematurely, and most remain green for several weeks after adjacent healthy plants have dried up (Table 48, Figure 15).

Inoculations were made with sap from Little Leaf chickpeas to several test plants in the greenhouse. A virus resembling Bean Yellow Mosaic was isolated from some of these diseased plants. As yet we have not been able to reproduce Little Leaf symptoms in greenhouse inoculations, but these tests are still continuing.

The other important disease of chickpeas that was encountered in widely separated areas of the country was root rot. From the symptoms of root rot observed in the Shiraz, Rezaieh, and Karaj areas, it appears that the cause of each particular root rot disease may be different in each area.

Chickpea root rot occurring in the Karaj area was studied in greatest detail. Plants infected with root rot were usually stunted and yellow in color. The xylem tissue of diseased plants is often discolored, and the roots are necrotic, rotted and discolored (Figure 16). Few feeder rootlets are present on roots of infected plants. The mortality rate of diseased plants is high. Various fungi, such as *Rhizoctonia solani*, *Macrophomina phaseoli*, *Pythium* sp., *Phytophthora* sp. and *Fusarium* spp., have been isolated from roots of diseased plants. Many of these fungi are serious root rot pathogens of other crops.

Chickpea diseases of minor importance encountered during 1966 were *Ascochyta blight* (*A. rabiei*), rust and powdery mildew.

Cowpeas (*Vigna sinensis*)

The most important diseases of cowpea in Iran during 1966 were caused by viruses. Two viruses have been isolated from cowpea varietal trials at Karaj. The identity of one virus which infected 89 per cent of the lines in the varietal trial (Table 49) remains unknown, although it was tentatively called Cowpea Mosaic Virus. The other virus was identified as Alfalfa Mosaic Virus.

FIGURE 15. The diseased chickpea plant on the right with small leaves is infected with an unknown disease tentatively called Little Leaf. Although diseased plants are usually sterile, they are not stunted. Little Leaf plants remain green two to four weeks longer than adjacent healthy plants (left).

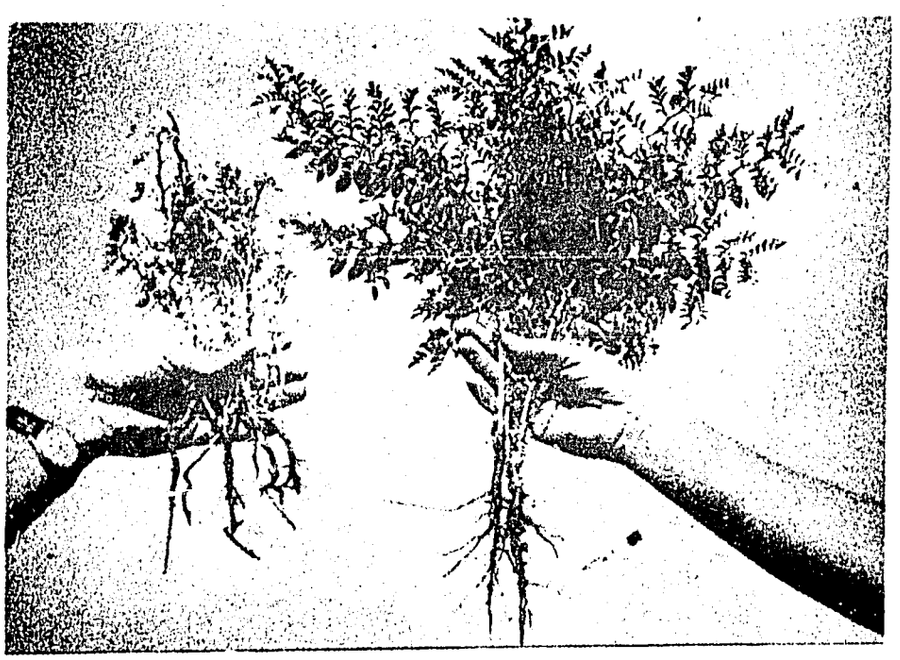


FIGURE 16. Healthy (right) and diseased (left) chickpea plants infected with root rot. Diseased plants are stunted, chlorotic and usually devoid of pods. The root system is necrotic, discolored and rotted.

Most plants infected with Cowpea Mosaic Virus were stunted and yellowish-green in color (Figure 17). The leaf symptoms consisted of mosaic, deformation and blistering (Figure 18). The pods from many infected plants were small and deformed.

In preliminary greenhouse inoculation studies, Cowpea Mosaic Virus produced systemic symptoms in several cowpea varieties similar to those observed on diseased cowpeas in the field. Local lesions formed on inoculated leaves of mungbean and Chenopodium amaranticolor.

Over nine per cent of the lines were 90 to 100 per cent infected with the virus (Table 49). Studies on seed transmission were conducted with seed from these heavily infected lines. Seed transmission was found to occur in many lines infected with Cowpea Mosaic Virus (Table 50, Figure 19).

TABLE 49. Survey of cowpea lines in the cowpea varietal trials for Cowpea Mosaic Virus. RPIP, Karaj, Iran, 1966. 1/

Cowpea Test	Number of Strains	Number and Per cent of Plants in Lines with Disease Rating of: 1 2/	2	3	4	5	6	7	8	9	10
Nursery	980	85	140	129	89	65	57	80	115	119	101
Per cent	-	8.7	14.3	13.2	9.1	6.6	5.8	8.2	11.7	12.1	10.3
Preliminary Yield Test	49	21	16	8	1	0	1	1	1	0	0
Per cent	-	42.9	32.7	16.4	2.0	0	2.0	2.0	2.0	0	0
Advanced Yield Test	25	8	10	4	2	1	0	0	0	0	0
Per cent	-	32.0	40.0	16.0	8.0	4.0	0	0	0	0	0
TOTAL	1054	114	116	141	92	66	58	81	116	119	101
Per cent	-	10.8	15.7	13.4	8.7	6.3	5.5	7.7	11.0	11.3	9.6

1/ The cowpeas were planted on May 15-20 and the survey conducted on August 24, 29, 1966.

2/ The disease ratings of 1-10 which indicate the per cent of plants in each line infected with Cowpea Mosaic Virus are: 1 = 0%; 2 = 1-10; 3 = 11-20; 4 = 21-30; 5 = 31-50; 6 = 51-60; 7 = 61-70; 8 = 71-80; 9 = 81-90; 10 = 91-100.

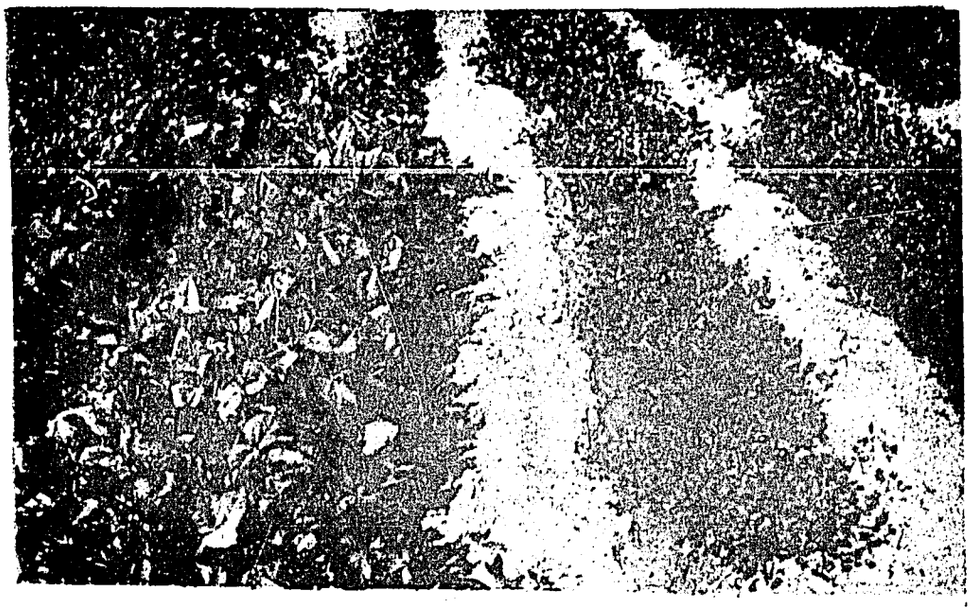


FIGURE 17. The stunted, lighter colored cowpea lines with twisted, crinkled leaves (right) are infected with Cowpea Mosaic Virus. Healthy lines (left) are more vigorous in growth and darker green in color.

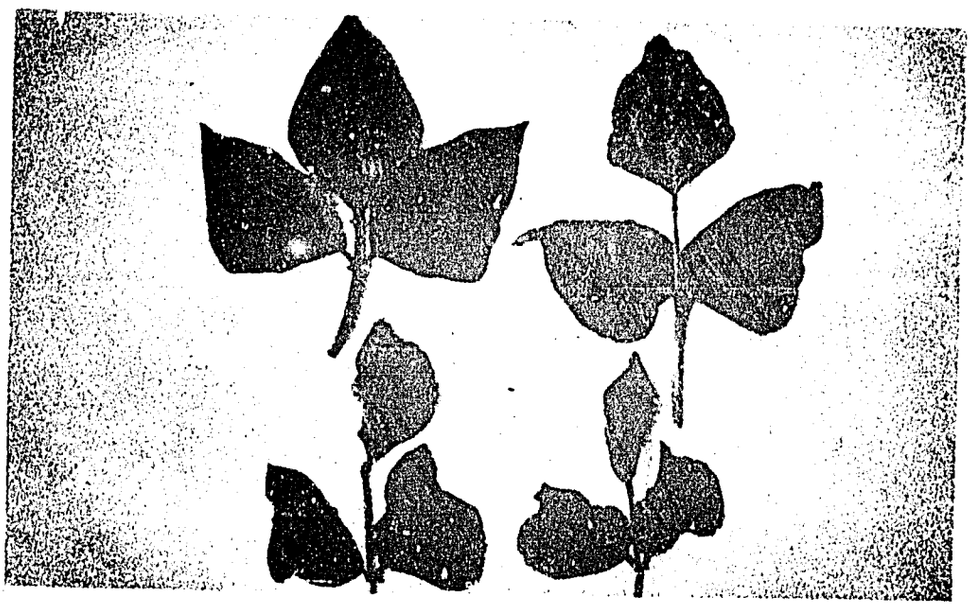


FIGURE 18. The leaves of cowpea plants infected with Cowpea Mosaic Virus are deformed, mottled, twisted and blistered. A healthy leaf appears in the upper left portion of the picture.

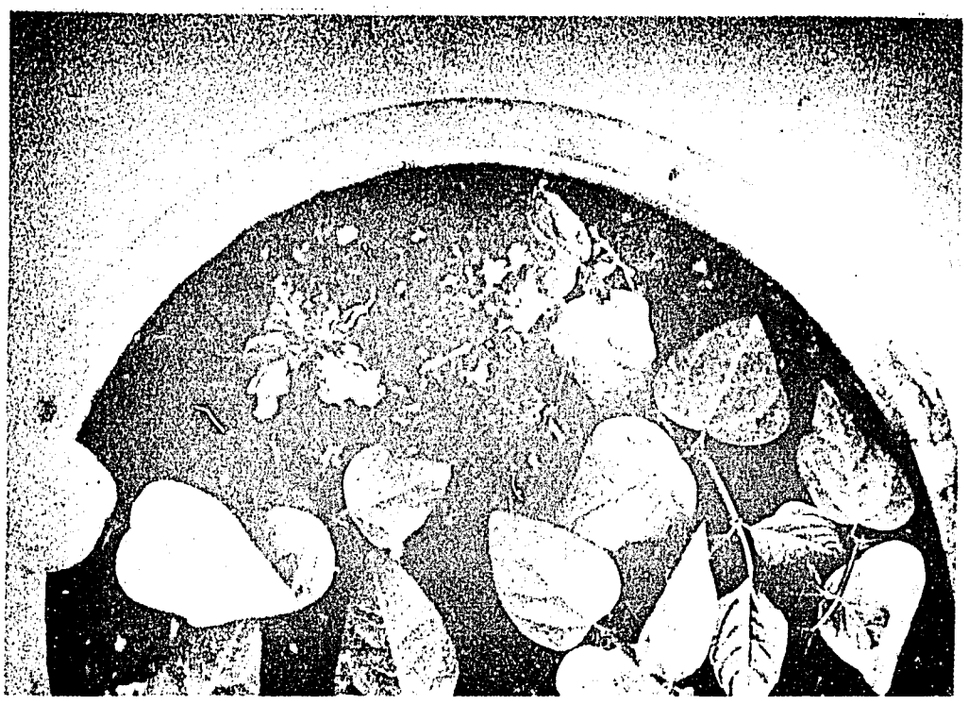


FIGURE 19. The two cowpea seedlings at the top of the picture with deformed, blistered leaves are from seed of plants infected with Cowpea Mosaic Virus. In some cowpea lines this virus was seed-borne in over 37 per cent of the seed.

TABLE 50. Transmission studies of Cowpea Mosaic Virus and Alfalfa Mosaic Virus through cowpea seed and Mungbean Mosaic Virus through mungbean seed. RPIP, Karaj, Iran, 1966. 1/

Plant	Type of Virus Disease	Seed Planted	Seed Germinated	Number of Infected Plants	% Virus Transmission
Cowpea	Cowpea Mosaic	62	59	22	37.3
Cowpea	Cowpea Mosaic	100	100	29	29.0
Cowpea	Cowpea Mosaic	100	94	25	26.6
Cowpea	Cowpea Mosaic	100	96	8	8.3
Cowpea	None-Healthy 2/	100	97	0	0
Cowpea	Alfalfa Mosaic	30	30	0	0
Cowpea	Alfalfa Mosaic	30	30	0	0
Mungbean	Mungbean Mosaic	50	39	3	7.7
Mungbean	Mungbean Mosaic	100	96	2	2.1

1/ The seeds were collected from virus infected plants growing in the Karaj varietal trials and planted in pots of sterilized soil maintained in a greenhouse.

2/ Seed from an apparently healthy line, showing no virus symptoms.

Alfalfa Mosaic Virus was less common in the cowpea varietal trials than Cowpea Mosaic Virus. It occurred in 8.7 per cent of the strains (Table 51).

Infected plants were less stunted than plants infected with Cowpea Mosaic Virus. The most characteristic leaf symptoms were a conspicuous yellow mosaic associated with deformation, twisting and blistering.

The virus was mechanically transmitted to bean, broadbean, *Chenopodium amaranticolor*, cowpea, cucumber and tobacco. It formed local lesions on all test plants, except tobacco. The virus was identified as Alfalfa Mosaic Virus by host range and serological studies. In preliminary seed transmission tests, the virus does not appear to be seed-borne (Table 50).

TABLE 51. Survey of cowpea strains in the varietal trial for Alfalfa Mosaic Virus. RPIP, Karaj, Iran, 1966. 1/

Cowpea Test	Number of Strains in Test	Number of Strains Infected	Per cent Infection
Nursery	980	86	8.8
Preliminary Yield Test	49	3	6.1
Advanced Yield Test	25	3	12.0
TOTAL	1054	92	8.7

1/ Cowpeas were planted May 15-20 and the survey conducted on August 24-29, 1966.

An unusual disease of cowpeas was encountered in Southwestern Iran. This disease was not widespread in distribution, and from symptomatology it appears to be caused by Aster Yellows Virus. Diseased plants were located in an area where broadbeans and mungbeans exhibited similar disease symptoms. Infected cowpea plants produced no pods and remained very stunted. There was an excessive production of secondary shoots, but leaves were small, cupped, leathery, and a light green in color. The root system of infected plants seemed healthy. Little work has been done with this disease beyond attempting to transmit it mechanically to healthy test plants. All attempts to transmit the disease have failed.

In the more humid regions of the North around the Caspien Sea, two leaf spot diseases of minor importance were encountered. One disease was caused by a Cercospora sp. (possibly C. cruenta), and the other by rust.

In the drier areas around Karaj, root rot and powdery mildew were occasionally encountered. Powdery mildew was most prevalent when plants were nearing maturity.

Lentil (*Lens esculenta*)

A root rot disease caused devastating damage in the lentil varietal trials at Karaj in 1966. Lentil plantings observed in other locations, such as Varamin, Rezaieh and Ghazvin, had little or no root rot, even though the varieties were the same in many cases. Lentil root rot was also extremely important in Karaj the year before, although in 1966 the varietal trial was in a different part of the farm.

Infected plants were stunted and yellowish in color. Plants infected while young usually dried up and died before producing mature seed (Figure 20). Seeds from diseased plants were generally small and shriveled. The root systems of infected plants were poorly developed and lacked root hairs. Individual roots were discolored, necrotic and often rotted.

Entire plots of lentil strains were killed by root rot (Figure 21). Over 98 per cent of the lentils in the varietal trial were infected with root rot (Table 52). Of all strains and varieties tested, only 1.3 per cent did not exhibit symptoms of the disease (Table 52, Figure 21).

In an attempt to determine the cause of lentil root rot, numerous isolations were made on agar media from roots of diseased plants. Several pathogenic, soil-borne fungi were consistently recovered from discolored roots. The most commonly isolated fungi were *Rhizoconia solani*, *Pythium* sp., and *Fusarium* spp. With the advent of hot weather, *Macrophomina phaseoli*, a root rot pathogen which thrives under high temperatures, was also frequently isolated. These pathogenic fungi were seldom isolated from roots of healthy plants.

Inoculation of healthy lentils with these different fungi alone and in various combinations under controlled conditions has yet to be completed. In 1967 the effect of different cultural practices during the growing season on the severity of the disease, such as method and frequency of irrigation, will be investigated. Studies will also be conducted on the control of the disease in the field with various seed protectant and soil fungicides.

Two viruses were isolated from diseased lentils growing in the varietal trials at Karaj. The most frequently encountered virus disease was caused by Alfalfa Mosaic Virus. Bean Yellow Mosaic Virus was isolated only on a few occasions. Alfalfa Mosaic Virus caused leaves to be mottled, twisted and deformed (Figure 22). In greenhouse inoculations the virus had a similar host range as the AMV isolates from chickpea.

FIGURE 20. Lentil plants infected with root rot are stunted and yellow. Diseased plants often dry up before producing seed.

FIGURE 21. Entire strains of lentils in the Karaj varietal trial were killed by root rot (center). Some strains (left) appear to be tolerant or resistant to the disease.

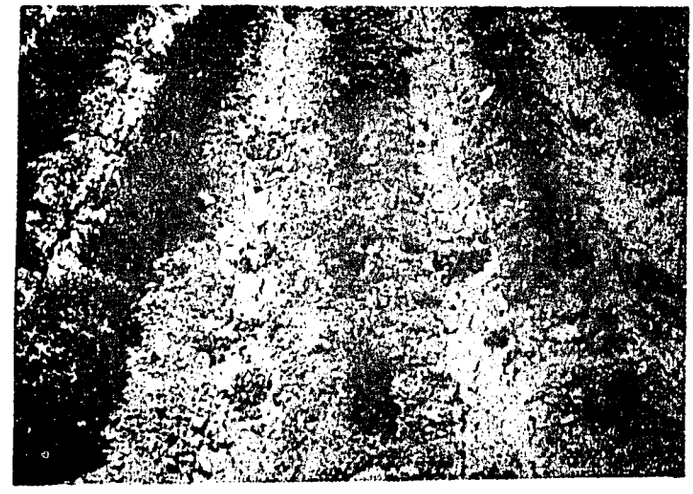


FIGURE 22. Lentil plants infected with Alfalfa Mosaic Virus (left) are stunted and the leaves are small, mottled and twisted when compared to a healthy plant (right).

TABLE 52. Survey of lentil lines in the varietal trial at Karaj for root rot. RPIP, Karaj, Iran, 1966. 1/

Lentil Test	Number of Strains	Number and Per cent of Plants with Lines with Disease Rating of: 1 2/	2	3	4	5	6	7	8	9
Nursery	1241	17	64	59	54	105	223	246	367	106
Per cent	-	1.4	5.2	4.8	4.4	8.5	17.9	19.7	29.6	8.5
Preliminary Yield Test	40	0	2	14	9	6	3	3	3	0
Per cent	-	0	5	35	22.5	15	7.5	7.5	7.5	0
Advanced Yield Test	25	0	1	18	2	0	1	2	1	0
Per cent	-	0	4	72	8	0	4	8	4	0
TOTAL	1306	17	67	91	65	111	227	251	371	106
Per cent	-	1.3	5.1	7.0	5.0	8.5	17.4	19.2	28.4	8.1

1/ The lentils were planted March 6-10 and the survey conducted June 15, 1966.

2/ The disease ratings of 1-9 indicate the per cent of plants in each line infected with root rot. 1 = 0%; 2 = 1-10; 3 = 11-20; 4 = 21-30; 5 = 31-50; 6 = 51-60; 7 = 61-70; 8 = 71-90; 9 = 91-100.

Mungbean (*Phaseolus aureus*)

A virus disease was found in different areas of Iran, and was especially important in the mungbean varietal trials at Karaj. A root rot and root knot nematode disease were more limited in distribution, being confined mainly to the Karaj-Varamin areas.

The identity of the mungbean virus is unknown, but tentatively it has been called Mungbean Mosaic Virus. Infected mungbean plants were sometimes stunted and leaves were mottled, deformed and blistered (Figure 23). The virus infected over 81 per cent of the varieties

FIGURE 23.
A mungbean leaf from a plant infected with Mungbean Mosaic Virus. The leaf is mottled, twisted and deformed.

FIGURE 24.
Several mungbean plants infected with root rot nematode. Many galls of various sizes form on the roots of infected plants.

in the Karaj varietal trials (Table 53). In preliminary tests, the virus was transmitted through a small percentage of the seed (Table 50).

TABLE 53. Survey of mungbean lines in the varietal trial at Karaj for Mungbean Mosaic Virus. RPIP, Karaj, Iran, 1966. 1/

Mungbean Test	Number of Strains	Number and Per cent of Plants in Strains with Disease Rating of: 1 2/	2	3	4	5	6	7	8	9	10
Nursery	1112	209	125	122	91	92	95	126	126	73	53
Per cent	-	18.8	11.2	11.0	8.2	8.3	8.5	11.3	11.3	6.6	4.8
Preliminary Yield Test	49	4	5	13	5	5	4	8	5	0	0
Per cent	-	8.2	10.2	26.5	10.2	10.2	8.2	16.3	10.2	0	0
Advanced Yield Test	25	10	6	5	2	2	0	0	0	0	0
Per cent	-	40.0	24.0	20.0	8.0	8.0	0	0	0	0	0
TOTAL	1186	223	136	140	98	99	99	134	131	73	53
Per cent	-	18.8	11.5	11.8	8.3	8.3	8.3	11.3	11.0	6.2	4.5

1/ Mungbeans were planted on May 15-20 and surveyed on August 27-29, 1966.

2/ The disease ratings of 1-10 indicate the per cent of plots in each line infected with Mungbean Mosaic Virus. 1 = 0%; 2 = 1-10; 3 = 11-20; 4 = 21-30; 5 = 31-50; 6 = 51-60; 7 = 61-70; 8 = 71-80; 9 = 81-90; 10 = 91-100.

In greenhouse inoculation studies the virus was mechanically transmitted to mungbeans, beans and Chenopodium amaranticolor. Bountiful bean was found to be a very useful test plant to use for indexing purposes. Inoculated Bountiful bean plants usually developed systemic mosaic symptoms in 7 to 9 days.

Another unknown disease occurred in about four per cent of the strains in the mungbean trials at Karaj. From symptoms this disease

appears to be caused by a virus, although it has not been possible to infect test plants in limited greenhouse inoculations. The disease is easily recognized by the conspicuous yellow mosaic symptoms on the leaves, which are also blistered and deformed.

Root rot was common in the Karaj area. Infected plants were usually stunted and yellowish-green in color. Premature defoliation, accompanied by wilting and final collapse and death of the plant, were often very good symptoms of the disease. The root system of a diseased plant is sparse and lacking in feeder rootlets. Roots are discolored and necrotic. Isolations on agar media from these roots yielded primarily Rhizoctonia solani, Macrophomina phaseoli, Pythium sp. and Fusarium spp.

In a large mungbean trial at Varamin, diseased plants were found scattered through the planting. These plants were a yellowish-green in color and many appeared to be wilting. An inspection of the roots of diseased plants showed that they were heavily infested with root-knot nematode (Meloidogyne sp.). On infected plants, the galls were round to oblong in shape and varied in size and number (Figure 24). Numerous small white female nematodes could be seen with a hand lens when a cross section was made of a gall.

A survey was made of the field to determine the distribution of the disease and the number of mungbean strains infected. It was found that the disease was spotty in occurrence, but that all strains were susceptible to the nematode. In plots heavily infested with root knot, the roots of several different weed plants were heavily galled.

In 1967 experiments are going to be conducted in the field and greenhouse on the biology and control of root knot nematode in pulse crops.

In one large mungbean planting at Dezful in Southwestern Iran, a few plants were found with symptoms similar to those caused by Aster Yellows Virus. Various vegetable crops, including cowpeas and broad-beans, growing in the Dezful area appear to be infected with this virus, although the virus has not yet been transferred to healthy plants, and typical disease symptoms produced.

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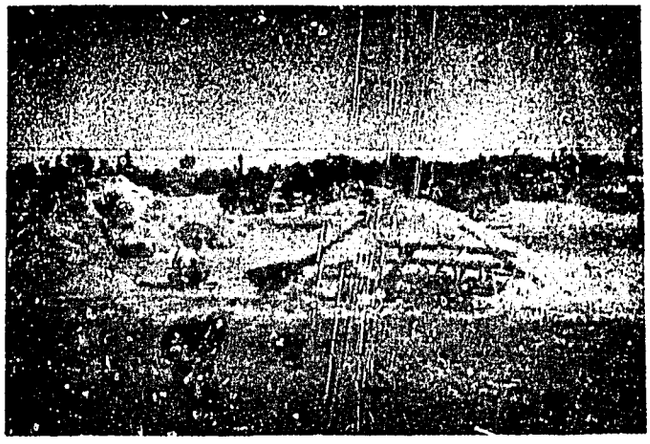
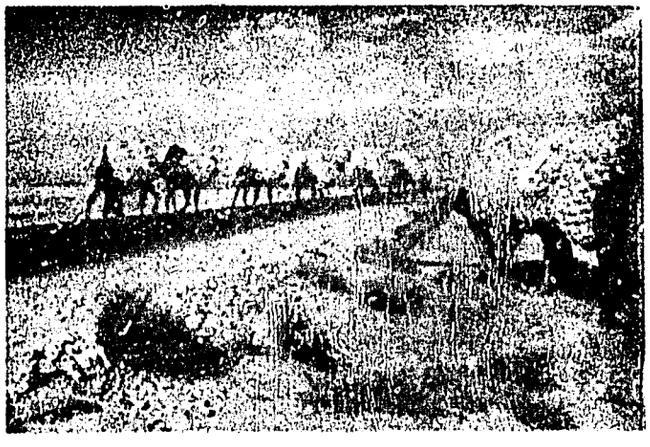
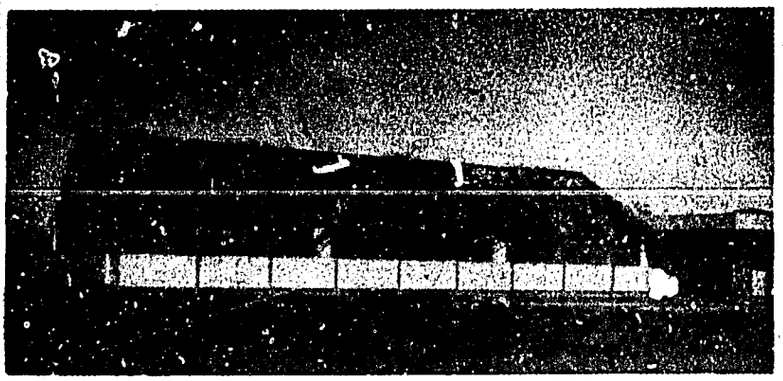


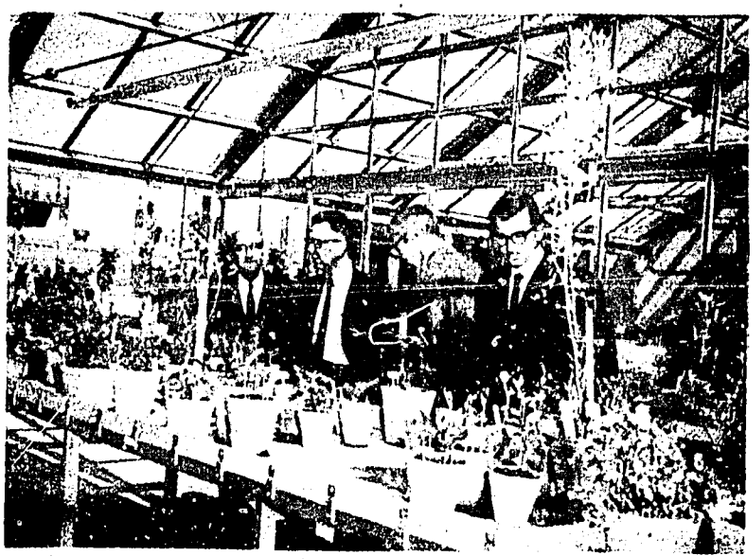
Wheat threshing, village threshing floor, Iran.

Boy with flock in southwestern Iran.



Camel train, Iran.





Greenhouse-laboratory, a government of Iran contribution to the Regional Pulse Improvement Project. Karaj, Iran, 1966.

Germplasm nursery of pigeon peas, New Delhi.

RPIP and all-India Coordinated Pulse Scheme Staff in field, New Delhi. L. to R.

J.L. Tiwari, Research Assistant, P.V. Rangarao, Entomologist, L.M. Jeswani, Plant Breeder, V.R. Gadwal, Plant Physiologist-Geneticist, Peter H. van Schaik, Regional Coordinator, S.P. Singh, Research Assistant, Floyd J. Williams, Plant Pathologist, Richard M. Matsuura, Plant Breeder.

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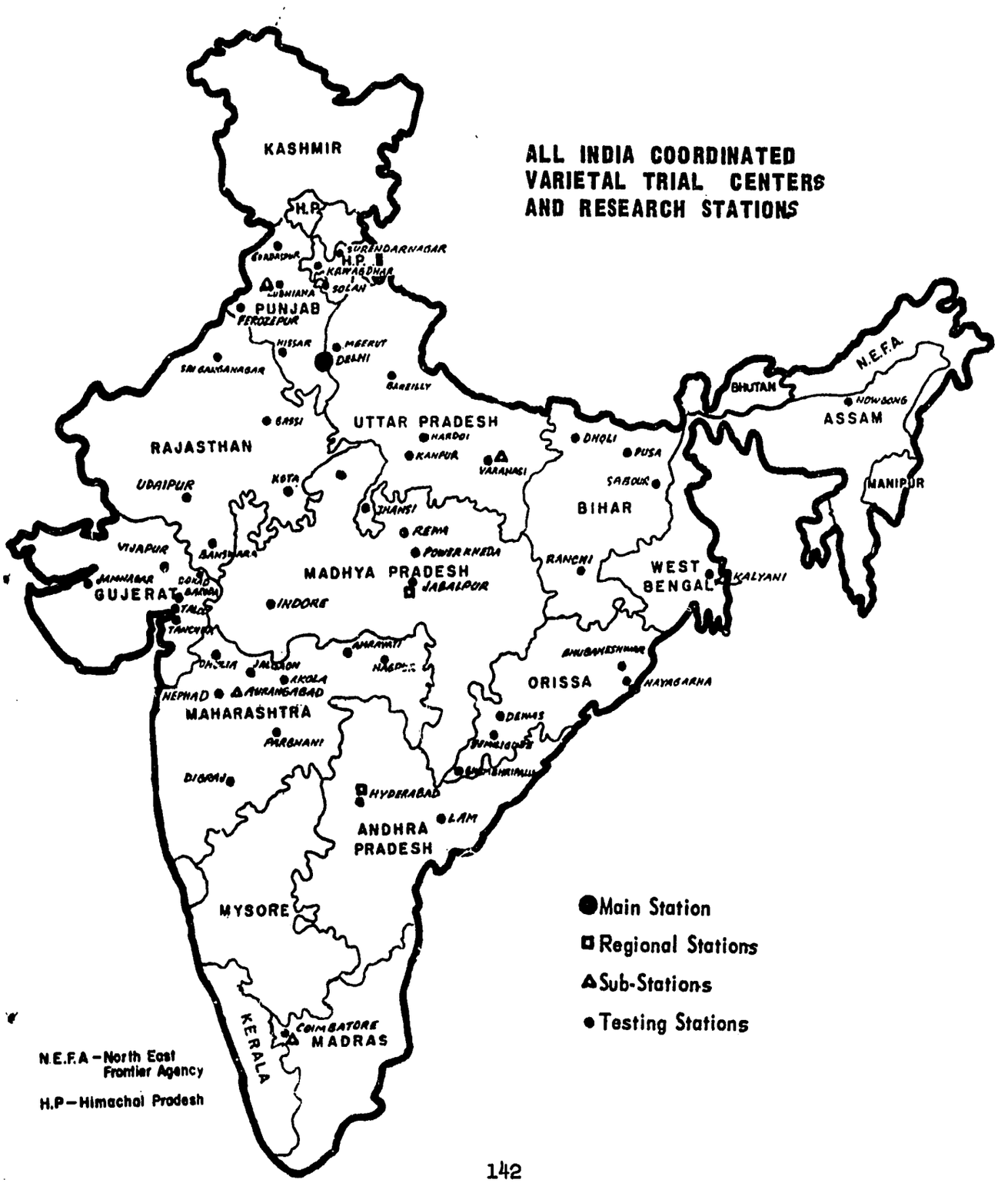
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Regional Stations
Sub-Stations
Testing Stations
N.E.F.A – North East Frontier Agency
H.P – Himachal Pradesh

VARIETAL IMPROVEMENT

R. M. Matsuura - Plant Breeder
Counterpart: L. M. Jeswani

The main emphasis of the work in 1966 was on collection and evaluation of germplasm and the organization of the all-India coordinated varietal trials.

Crops on which major emphasis is being placed are pigeon peas (*Cajanus cajan*) and chickpeas (*Cicer arietinum*) but work will also be conducted on mungbeans (*Phaseolus aureus*), urd beans (*Phaseolus mungo*), cowpeas (*Vigna sinensis*), lentils (*Lens esculenta*), and Lathyrus (*Lathyrus sativus*).

Germplasm Evaluation and Breeding Program

Table 54 shows the number of lines of the various crops brought together in 1966.

TABLE 54. Pulse crop germplasm, RPIP, India, 1966.

Crop	Number of Lines	
	Indigenous	Exotic
Pigeon Pea	2165	100
Chickpea	1699	4497
Mungbean	216	162
Urd Bean	92	
Cowpeas	397	706
Lentil	177	
Lathyrus	158	80
Peas	28	

Of the 4497 exotic lines of chickpeas, 3750 constitute the collection transferred from the Iran program. The collection of cowpeas in Iran was also transferred to India. In 1967, the Iran collections of mungbeans and dry beans will also be grown in India.

The pigeon pea and chickpea germplasm were planted in Delhi and Coimbatore (Madras). The mungbeans and urd beans were grown at Delhi only, while the cowpeas, lentils and lathyrus were also grown at Pantnagar in Uttar Pradesh.

This material is being evaluated for direct adaptation as varieties or for specific desirable characteristics which can be incorporated in new varieties through breeding. To this end, notes are taken on plant type, plant size, number of days to flowering, number of days to maturity, pod size, number of seeds per pod, seed size, seed color, disease resistance, and drought resistance.

In pigeon peas for instance, one of the major objectives is to develop varieties with reduced plant size and shorter required growing season. Present varieties are extremely tall growing, inefficient seed producers in relation to plant size, and occupy the land for nine months, or essentially two growing seasons (kharif, July-October and rabi, November-March). If the crop matured by about December 1, this would enable farmers to grow another crop of early wheat. The T-21 variety from Uttar Pradesh State, in addition to some germplasm strains, will be used for this purpose.

Lathyrus sativus, locally called khesari, is grown in many areas of India as a poor man's crop. When other crops fail because of drought or other unfavorable conditions, this crop will still produce a reasonable yield. For this reason, it is grown and consumed in spite of the fact that it contains a neurotoxin which may cause severe paralysis and incapacitation. Efforts by the Government of India to discourage the cultivation of khesari have not been successful primarily because farmers rely very heavily on it for subsistance and there is no suitable alternate crop available.

Some project activities are directed to screening the Lathyrus germplasm for possible strains with none or sufficiently reduced levels of the toxic factor. Dr. B. Baldev is working primarily on this problem. A literature review on the subject has been compiled. Through cooperative work with the Nutrition Research Laboratories, Indian Council of Medical Research in Hyderabad and the Department of Biochemistry, Indian Institute of Science, Bengalore, quick field tests for the neurotoxin and isolation procedures have been developed. A PL-480 project has been approved to assist in this work.

Coordinated Varietal Trials

Varieties of the major pulse crops developed by the Central as well as State research institutions were assembled and tested throughout India. The geographic locations of the testing stations are shown on the map of India (Figure 25). Yield data of the summer (kharif) crops, mungbeans (green gram), urd beans (black gram), and cowpeas are given in Tables 55, 56 and 57. Only a limited number of

test stations have reported data at the time of writing. The fall and winter (rabi) crops, pigeon peas, chickpeas, lentils, peas, and Lathyrus will not be harvested until March 1967.

In spite of difficulties, such as the problem to get all the cooperators to ship their seed in time to the central organizing location, failure to do so resulting in late planting and poor results, these coordinated trials appear to be quite successful. The willingness and desire to participate on the part of State institutions has been quite encouraging. The various states can thus evaluate varieties developed by other states. In many cases, performance of out-of-state varieties is better. For example, the pigeon pea variety T-21 from Uttar Pradesh matured so early in Andra Pradesh that it was planted again as a rabi crop in November.

Mungbeans (Table 55) - From the limited data available, it appears that the variety D-45-6 from Gujerat has a wide range of adaptation. Hybrid-45, No. 305 and RS-4 are medium maturing varieties which gave promising results at several locations. For early maturing types, Krishna-11, T-2, and T-44 performed well.

Urd Beans (Table 56) - The best yielding early maturing variety appears to be T-27. Punjab No. 1-1 and D-6-7 from Maharashtra also performed well at several locations. T-9 from Uttar Pradesh was extremely early maturing.

Cowpeas (Table 57) - Only four varieties were contributed, three of which from Madhya Pradesh State. More varieties will be included in subsequent tests. Of the four varieties, K-11 was the best performer at most locations.

TABLE 55. Yield (kilograms per hectare) and Rank of Mungbean Varieties in Coordinated Varietal Trials, India, 1966 1/

Variety	Origin	Pantnagar		Ludhiana		Hissar		Delhi		Kopergaon		Bassi		Dessa		Vijapur		Gwalior		Amaravati		Akola	
		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	Gujerat	1139.97	6	74.15	12	1550.04	3	561	12	278.8	8	727.73	5	657	3	624.5	8	252	3	229.71	7	297.00	2
D-45-6	"	1090.63	8	136.94	8	1779.07	1	665	7	410.0	4	869.09	1	798	1	908.23	1	252	3	328.51	4	359.00	1
B-1	W.Bengal	1061.48	9	113.02	11	440.73	12	494	13	349.5	5	468.58	12	77	12	426.08	11	96	10	229.71	7	118.00	12
T-44	U.P.	1296.19	4	205.71	4	730.76	10	1070	2	221.8	9	706.58	6	218	9	484.39	10	119	8	316.16	5	172.00	10
T-51	U.P.	1560.07	1	138.14	7	380.93	13	935	3	197.1	11	232.98	13	231	8	652.58	7	67	11	224.77	8	172.00	10
Krishna-11	M.P.	1136.98	7	26.91	14	478.40	11	624	9	279.9	7	827.21	2	191	10	712.01	6	109	9	414.96	2	230.00	8
Hybrid-45	M.P.	1374.69	3	154.28	6	1495.02	5	748	5	444.8	3	654.44	7	387	5	864.50	2	203	6	175.37	10	285.00	3
T-2	U.P.	1495.98	2	168.04	5	882.06	9	1289	1	25.6	14	633.50	8	360	7	786.01	3	57	12	244.53	6	136.00	11
No. 305	Punjab	729.58	13	314.55	2	1502.20	4	735	6	344.0	6	565.43	11	365	6	723.22	5	235	4	531.05	1	275.00	5
Jalgaon 781	Maha-rashtra	947.10	10	53.22	13	978.94	8	359	14	205.9	10	748.68	4	155	11	355.44	13	67	10	158.08	11	277.00	4
BR-2	Bihar	377.49	14	633.89	1	1243.86	7	776	4	68.1	13	225.13	14	-	-	226.49	14	304	2	44.46	13	113.00	13
R.S.4	Rajasthan	927.67	11	243.98	3	1710.30	2	619	10	463.8	2	801.03	3	726	2	763.59	4	336	1	167.96	9	272.00	6
R.S.5	"	823.76	12	117.20	10	1487.25	6	647	8	507.5	1	625.64	9	630	4	595.39	9	222	5	59.28	12	245.00	7
Kopergaon	Maha-rashtra	1263.30	5	128.57	9	231.42	14	603	11	162.2	12	581.14	10	155	11	408.14	12	138	7	370.50	3	229.00	9

1/ Not all locations reported.

TABLE 56. Yield (kilograms per hectare) and Rank of Urd Bean Varieties in Coordinated Varietal Trials, India, 1966 1/

Variety	Origin	Jamnagar		Jabalpur		Kopergaon		Indore		New Delhi		Akola		Ganga Nagar		Ludhiana	
		Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank
T.9	U.P.	62.5	8	98.6	8	272.2	6	144.5	4	504	6	242.5	8	520.0	5	373.7	5
T.27	U.P.	90.0	6	242.2	1	267.7	7	51.7	9	1167	1	412.5	5	320.0	9	575.2	2
T.65	U.P.	155.0	3	156.9	5	212.1	9	66.1	7	716	2	455.0	4	600.0	2	434.7	3
B. Gwalior 18	M.P.	-	-	55.6	10	474.1	1	40.3	10	320	7	-	-	-	-	-	-
No. 1-1	Punjab	87.5	7	240.4	2	251.8	8	87.3	5	706	3	317.5	7	548.0	4	799.5	1
D-6-7	Maharashtra	131.0	5	152.5	6	414.0	2	152.3	3	228	9	537.5	2	479.0	7	25.1	7
Sindh Kheda 1-1	Maharashtra	152.5	4	72.6	9	408.3	3	181.9	2	157	10	591.0	1	407.0	8	12.5	8
B.R. 61	Bihar	47.5	9	163.2	4	96.4	10	59.6	8	629	4	170.0	9	791.0	1	380.9	4
B.R.68	Bihar	170.0	2	177.6	3	282.4	5	68.3	6	506	5	367.5	6	575.0	3	245.1	6
No. 55	Maharashtra	202.5	1	150.6	7	391.3	4	280.2	1	235	8	487.5	3	492.0	6	8.4	9

1/ Not all locations reported.

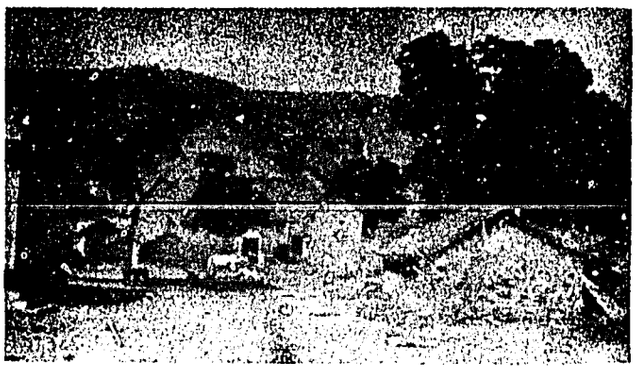
TABLE 57. Yield (Kilograms per hectare) and Rank of Cowpea Varieties in Coordinated Varietal Trials, India, 1966 1/

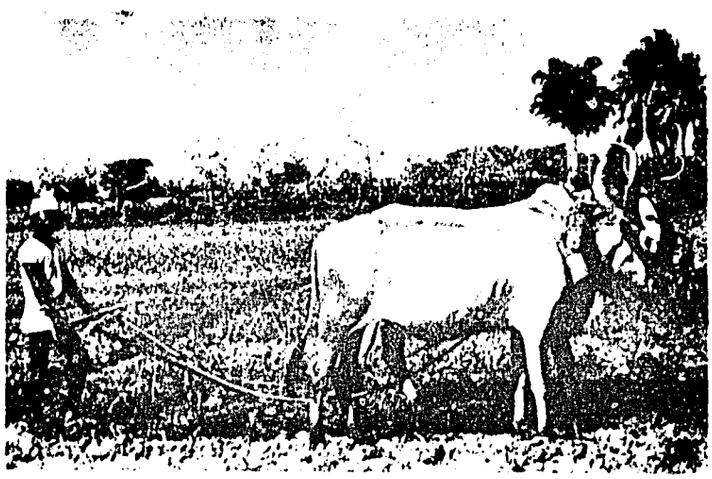
Variety	Origin	Jabalpur		New Delhi		Indore		Pantnagar		Kanpur		Coimbatore 2/		Baroda	
		Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank	Yield	Rank
K-11	M.P.	257.14	1	161.00	2	155.02	1	1536.40	1	0.51	4	0.371	3	1255.83	1
K-14	M.P.	161.46	3	240.00	1	144.12	2	1113.20	3	0.69	2	0.377	2	1240.88	2
K-313	M.P.	245.18	2	119.00	3	142.17	3	883.20	4	0.79	1	0.362	4	1061.47	3
T-2	U.P.	65.78	4	45.00	4	20.40	4	1499.60	2	0.55	3	1.562	1	1024.10	4

1/ Not all locations reported.

2/ Plot size not given.

Village scene,
Southern India.





Bullock farming,
India.

Mixed cropping, India.
Crops seed include
sorghum, sesamé, lablab
bean and ragi.

ENTOMOLOGY

Kenneth E. Gibson - Entomologist
Counterpart: P. V. Ranga Rao

The entomology report will cover the period from the Entomologist's transfer from Karaj, Iran to New Delhi, India (October 9, 1966 to December 31, 1966).

Activities involving the entomology discipline have been limited to observation and collection. Since the entomologist has not been present for an entire growing season, no investigations involving pesticide trials have been completed, and only a partial list of insects of economic importance to pulse crops has been prepared. The results of observations to date are as follows.

Lepidopterous pod-borers (*Heliothis species*)

Larvae have been noted on pigeon peas, where they appear after pod set. Damage due to this insect results from their boring through the pod and destroying the developing seed. Pod destruction as high as 90% has been observed in experimental plantings at Coimbatore, located in Southern India. Distribution of this insect appears to range at least from Delhi at a latitute of 29° North to Coimbatore, 11° North.

It is planned to conduct experimental applications of carbaryl on pigeon peas in the winter of 1966 in an effort to determine the effectiveness against these pod-borers.

Thrips (*species unknown*)

Thrips have been observed in the pigeon pea blooms. Occassionally infestations of 50 to 60 thrips have been noted in a single blossom, which regularly is no larger than a pea blossom. Damage is rather insidious, since it is sustained from the blasting of the bloom with a consequent failure to set on pods, and the damage is not readily noticeable. Observations indicate the range of this insect on pigeon peas is widespread. They have been noted from the North to the South of India.

Next season experimental pesticide trials will be initiated on this insect. Since the thrip spends most of the time within the bloom, making it difficult to reach with insecticides, it is planned to try a systemic (dimethoate) and perhaps a non-systemic (diazinon).

Bean butterfly (*Lycaena baeticae*)

The larvae of this insect have been observed feeding on the blossoms of pigeon peas. The adult apparently lays its eggs on the outer portion of the bloom, and when the larvae emerges it bores through the petals, where it blasts the bloom. Larvae then remain in the bloom until they are fully grown. If the larvae act similarly to the conduct of those observed on cowpeas in Karaj, Iran, there is a possibility that they may be responsible for some of the pod boring observed on pigeon peas in India. Large numbers of the adults have been observed in Coimbatore, but the complete distribution of the pest is not yet known.

Trials to determine effective control and importance of this insect are under consideration in planning the control work for the next season.

Coccinellid sp.

A coccinellid was noted on weeds and some pulse crop plantings in the Coimbatore area. The damage was similar to that resulting from the feeding of Mexican bean beetle (*Epilachna varivestis*) on bean foliage in the United States. In addition, the adults have from 10 to 24 spots on their backs, with the pattern set for 24 spots, and the individuals with fewer spots, most likely the result of an incomplete pattern from infancy or a wearing off in older specimens.

Jassids and Flea beetles

These insects have not been observed as serious pests on pulses because these crops were mature and approaching harvest when the entomologist arrived. However, both insects are reported to be serious pests of mungbeans, urd beans and cowpeas. In respect to this information, plans are being made to use bulk plantings of these crops for insecticide trials in 1967.

Bruchids

During November of 1966, bruchid populations built up to high enough numbers in the Project's stored mature seed to warrant fumigation, using methyl bromide to prevent severe seed loss. In addition, appreciable quantities of collected seed (representing germplasm from various parts of India and other countries) have come in to the Project infested with bruchids. While the entomologist has not been in India long enough to be familiar with the life cycle and biology of the particular bruchid species here, it is planned to initiate insecticide trials against this pest next season. Until more information is known about the various species of bruchids, a series of materials will be applied using Stateside timing. Most likely two applications of BHC and diazinon will be used.

Aphids

Aphids will be observed on both the rabi and kharif crops, although they are expected to be more of a problem on the rabi crops. The cool, dry weather during the rabi season is more conducive to aphid development than the high temperatures and humidity present during the kharif growing season.

In addition to the plots of rabi crops located at the Project experimental land at IARI in Delhi, plantings of the same crops at the Uttar Pradesh Agricultural University at Pant Nagar, 155 miles east of Delhi, have been obtained. Observations and exploratory insecticide trials are conducted against aphids, bruchids and borers in both locations. Protective sprays against noxious pests will also be made on the plantings of the other disciplines if needed.

When conducting pesticide trials and protective spray applications for the other disciplines' plots against pulse pests in India, consideration of materials mentioned in this report has been based upon availability, effectiveness, cost and toxicity.

A number of field trips were conducted for the purpose of observation and collection of pulse pests. These trips ranged from approximately 150 miles north of the Southern tip of India to 150 miles north and east of Delhi. The wide range of specimens accumulated during the collecting trips will be made into a working collection along with the material gathered through the use of a stationary UV light trap which has been operated in Delhi.

Preliminary observation has indicated that incorporation of entomological control practices into the culture of the pulse crops in India will be important in increasing the production and quality of these indispensable food crops.

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SOIL & CROP MANAGEMENT

Robert J. Davis - Soil Scientist-
Agronomist
Counterpart: S. L. Choudhury

This phase of the work was initiated in mid-August upon the arrival at post of Robert J. Davis. The final plantings of the Kharif season were just being completed at that time.

Laboratory Work

No laboratory work has been done to date. Laboratories are in the process of being equipped, and it is hoped that with the 1967 Kharif (summer) season microbiological work can be undertaken.

Nodulation Observations

The nodulation pattern was checked on all of Kharif (summer) and Rabi (fall) plantings. In addition, many plants were checked in various farmers' fields.

The Indian soils appear to contain a large population of Rhizobium effective on all crops except soybeans. Soybeans are consistently not nodulated, often even when inoculation has been applied. All pulse crops had the maximum number of nodules they could support, although generally these did not appear to be too efficient. The cowpeas had a large percentage of ineffective nodules. This was true even at Pant Nagar, where research plot land had been jungle until three years ago.

From these observations the following facts emerge:

(1) Indian soils contain a large rhizobial population.

(2) Many of the rhizobia infecting wild legumes can form nodules on our pulse crops.

(3) These nodules are often not the most efficient on the pulse crops.

(4) The above would explain the reports that, where tried, nitrogen fertilization increased yields.

(5) For inoculation to be effective, the strains used in the inoculum will have to compete effectively in the soil against a large number of diverse native organisms.

Fertility Spacing Experiments

In the Rabi season a fertilization spacing experiment on chickpeas was planted at Delhi and Pant Nagar. This experiment consisted of three spacings between rows (one foot, two feet and four feet), three plant spacings within rows (four and one-half inches, nine inches and 18 inches), and three levels of fertility (0; 25 pounds per acre of nitrogen, 50 pounds per acre of P_2O_5; and 50 pounds per acre of nitrogen, 100 pounds per acre of P_2O_5) in all combinations. A split-plot design was used with fertilizer treatments as main plots and spacings as sub-plots. Plot size, alley size, etc. were all the same used by the plant breeders in varietal trials. The middle spacing in both cases also represents the spacings used in these trials. All treatments were replicated four times. Fertilizer was broadcast and worked in before planting.

The Rabi plantings were late, so that the plants did not get a good start before winter set in. In addition, the block of land we were assigned at Delhi turned out to be too saline for chickpeas, which have a very low salt tolerance. As a result, no useful information can be collected from the Delhi plots.

The above work, plus inoculation studies, will be continued in the 1967-68 season and extended to the other pulse crops.

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PLANT PATHOLOGY

Floyd J. Williams - Pathologist
Counterpart: G. S. Grewal

Chickpeas (*Cicer arietinum*)

Plantings of Cicer in Punjab and Uttar Pradesh have been extensively damaged by wilt, sometimes causing nearly total loss of the crop. The cause of Cicer wilt has been attributed to both a "soil factor" and *Fusarium orthoceros* var. *ciceri*.

We isolated *Fusarium* sp. and *Operculella padwickii* from wilted Cicer, and proved pathogenicity of both. We screened the recommended varieties for resistance to each pathogen. We have erratic results with the Fusarium, but Operculella has consistently killed the plants. The erratic results after inoculation with Fusarium may result from temperature variations, since the test plants are kept in the office. Some of the varieties were killed more quickly than others by Operculella in our tests. This fungus was reported as causing wilt of Cicer about 20 years ago, but apparently no further work was done.

A phloem discoloration has been noticed in young Cicer plants having other symptoms usually associated with wilt. Some specimens were sent to Iran for virus indexing, since plants with similar symptoms there have contained Alfalfa Mosaic Virus, but the preliminary results were negative.

Since control of the wilt diseases of Cicer is probably limited to resistant varieties or soil management practices, an experiment to learn the effect of adding commonly available crop residues on wilt incidence has been established at Delhi. Residues included are wheat, maize, jowar, burseem and Cicer fodders.

Our line plantings of Cicer at Delhi have extensive root discoloration. We are attempting to learn the cause of this disease. The soil is known to be slightly saline, but the effect of salinity on Cicer is unknown.

Stands of Cicer are often poor in the farmers' fields. To learn the effectiveness of seed treatment in improving stands, we have started a replicated trial, including nine seed treatment chemicals.

Pigeon Peas (Cajanus cajan)

Several diseases affect Cajanus, but their severity is sporadic. No disease on Cajanus has caused as widespread damage as have the insects.

Fusarium wilt of Cajanus is recognized as a serious disease and resistant varieties have been developed. Races of the pathogen may exist, since pathologists have asserted that resistant varieties developed in one locality are susceptible when planted in another. I have seen sections of fields where the wilt incidence was high, but most plantings are free of the disease. We are collecting isolates of the pathogen from as many areas as possible to use in developing resistant varieties.

A sterility mosaic affects Cajanus (Figure 26) and has been severely damaging plantings in Uttar Pradesh. The causal virus is reportedly mite-transmitted, but one worker in Southern India was unable to obtain transmission with mites. He had indirect evidence of nematode transmission. Little work has been done on this disease, which is reported as becoming more serious each year.

Powdery mildew was serious on our Cajanus plantings at Coimbatore. In spite of dusting with sulphur, some defoliation occurred. I have not seen powdery mildew of Cajanus causing serious damage to the farmers' crops.

A yellows symptom occurred in our Delhi plantings of Cajanus (Figure 27), and I saw the same symptom in Uttar Pradesh. Whether this is a virus and if so, whether it is the same virus that causes yellow mosaic on Phaseolus vulgaris is not known. The incidence of the disease in Delhi was too low to learn of varietal resistance. The entire plantings were killed by frost before any transmission could be effected.

A few plants in our Delhi plantings of Cajanus wilted and died without the usual symptoms of Fusarium wilt. We isolated a non-sperulating Phycomycete from the diseased plants and were able to induce extensive canker formation at and above the inoculation site by inoculating the stem with mycelium. The cankers had not encircled the stems when the plants were killed by frost.

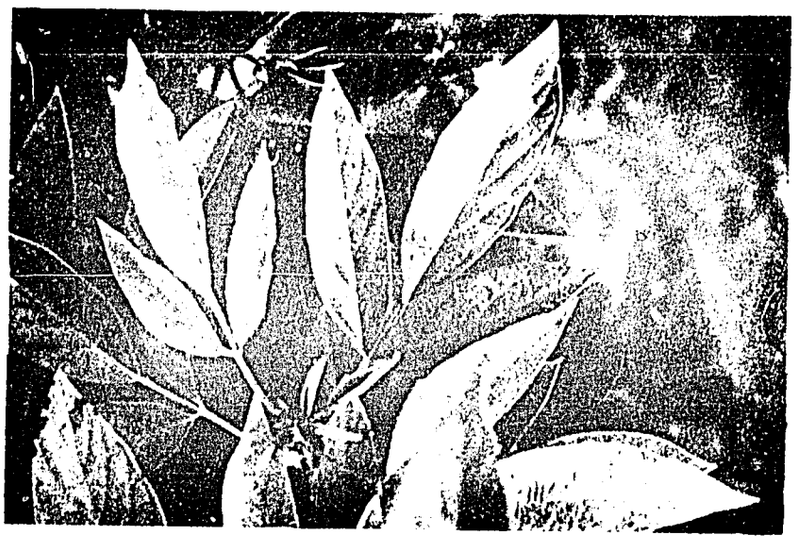
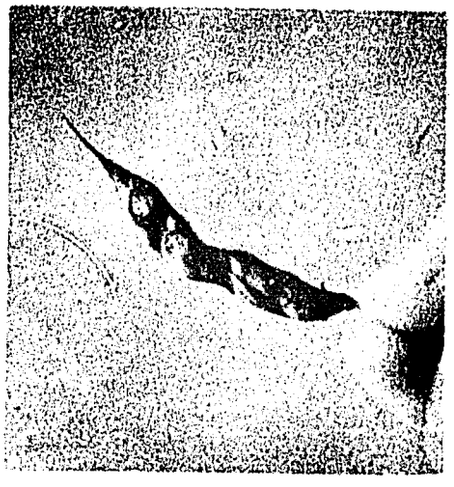


FIGURE 26. Sterility virus (leaf symptom) of Cajanus cajan.

FIGURE 27. Yellows symptoms of Cajanus cajan.

Phyllody of mungbean.



Pod borer damage
on pigeon pea.

Wilted pigeon pea
plant caused by as
yet unidentified
Phycomycete.

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

Variety trials of these two crops at Delhi were severely damaged by yellow mosaic (Figure 28), leaf crinkle (Figure 29), and bacterial blight. The yellow mosaic is reported to be caused by a virus, which is white fly vectored. The leaf crinkle is apparently a new disease. The symptoms are similar to those of sugar beet curly top on P. vulgaris; including severe stunting, lack of fruit production, leaf crinkling, cupping and rugosity. The plants are not killed. Preliminary attempts to transmit a virus mechanically have failed.

All three diseases have been seen in farmers' fields. Yellow mosaic and bacterial blight were serious on our plantings at Delhi, Kanpur and Pant Nagar. The disease ratings for yellow mosaic and bacterial blight at both locations were similar to those at Delhi, so only the Delhi Disease ratings are given in Table 58.

Yellow mosaic and leaf crinkle caused more extensive damage to P. mungo than to P. aureus. P. aureus var. B1 and BR-2 had only a trace of yellow mosaic and no leaf crinkle diseased plants were seen. P. mungo var. T-65 and 1-1 had only a trace of yellow mosaic, but both were severely damaged by the leaf crinkle disease.

Cross protection between yellow mosaic and leaf crinkle is not complete if it exists, because a few plants had obvious symptoms of both diseases.

More extensive testing will be done in 1967, but it seems probable that resistance to these important diseases can be combined.

Powdery mildew is frequently seen on P. aureus and P. mungo as the crop matures. The amount of damage is unknown.

A planting of P. mungo, heavily damaged by rust, was seen at Coimbatore. While most of the material was highly susceptible, the plants of one line had only a few small pustules. A few isolated plants were also found that were apparently quite resistant. The local pulse specialist was asked to save seed from the resistant material when it was mature.

TABLE 58. Disease ratings on *Phaseolus aureus* and *Phaseolus mungo* at Delhi, India, 1966.

Variety	Yield (kg/ha)	Yellow Mosaic Rating	Leaf Crinkle Rating	Bacterial Blight Rating
		Mungbean (*Phaseolus aureus*)		
D-2-15	561	moderate	none	moderate
D-45-6	665	severe	none	moderate
B-1	494	trace	none	severe
T-44	1070	moderate	none	severe
T-51	935	slight	none	severe
Krishna-11	624	slight	none	severe
Hybrid-45	748	slight	none	slight
T-2	1289	severe	none	severe
No. 305	735	slight	severe	slight
Jalagon 781	359	severe	moderate	moderate
BR-2	776	trace	none	slight
RS-4	619	severe	moderate	moderate
RS-5	647	moderate	trace	moderate
Kopergaon	603	severe	none	severe
		Urd bean (*Phaseolus mungo*)		
T-9	504	slight	trace	slight
T-27	1167	slight	moderate	moderate
T-65	716	trace	severe	severe
Gwalior 18	320	severe	trace	severe
No. 1-1	706	trace	severe	severe
D-6-7	228	severe	none	severe
Sindkheda 1-1	157	severe	none	severe
BR-61	629	moderate	none	slight
BR-68	506	slight	moderate	moderate
No. 55	235	severe	none	severe
N-212	55	severe	trace	severe
No. 1766	156	severe	none	severe

FIGURE 28. Relative resistance to yellow mosaic of Phaseolus mungo.

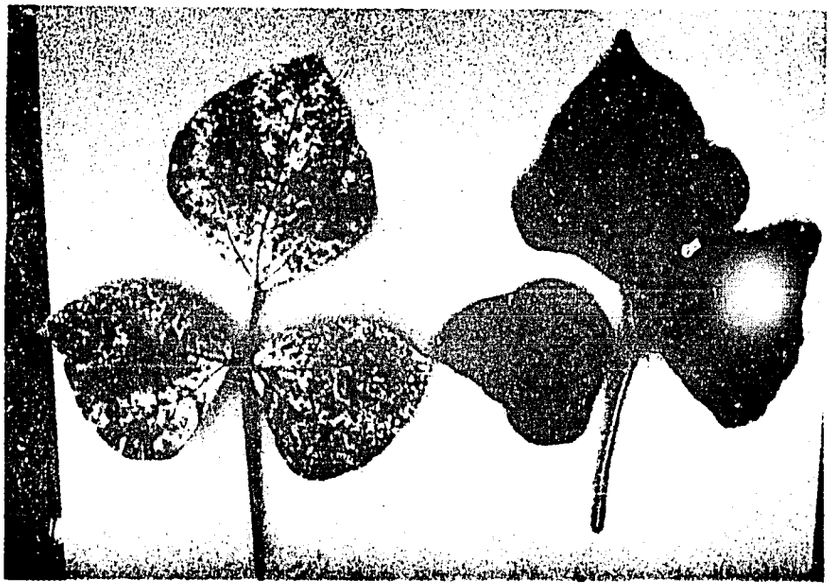


FIGURE 29. Yellow mosaic (left) and leaf crinkle (right) of Phaseolus mungo.

Peas (*Pisum sativum*)

Both rust and powdery mildew were severe on peas in a planting at Pant Nagar in 1966. Higher yielding, introduced varieties were more susceptible than the local varieties. Planting has been made at Delhi for control of these diseases by spraying if they occur. A pea variety trial to learn relative resistance has also been planted at Delhi.

Hyacinth bean (*Dolichos lablab*)

Bacterial blight has been the only serious disease seen on this crop. It is difficult to estimate the extent of damage due to disease because the foliage-eating insects are usually causing extensive damage Yellow mosaic has been seen on *Dolichos lablab* (Figure 30), but was not serious. This comparatively minor crop has not been included in our Delhi plantings.

Horse gram (*Dolichos biflcris*)

This crop is planted extensively in Southern India. It is used as fodder and eaten as a pulse. Every field seen by the writer has had a high incidence of yellow mosaic (Figure 31). Frequently 50 to 70 per cent of the plants are diseased. The diseased plants appear to grow well and no estimate of the extent of yield reduction has been possible.

Lentils (*Lens esculenta*)

Lentil plantings in the Punjab have been seen that were totally destroyed by lentil wilt. We have isolated a bacterium and will test varieties and germplasm lines for resistance as they become available.

Summary

Conclusions from the first year's work, which must be tentative, are:

(1) Resistance to yellow mosaic and leaf crinkle of *P. aureus* and *P. mungo* exists within varieties;

FIGURE 30. Yellow mosaic of Dolichos lablab.

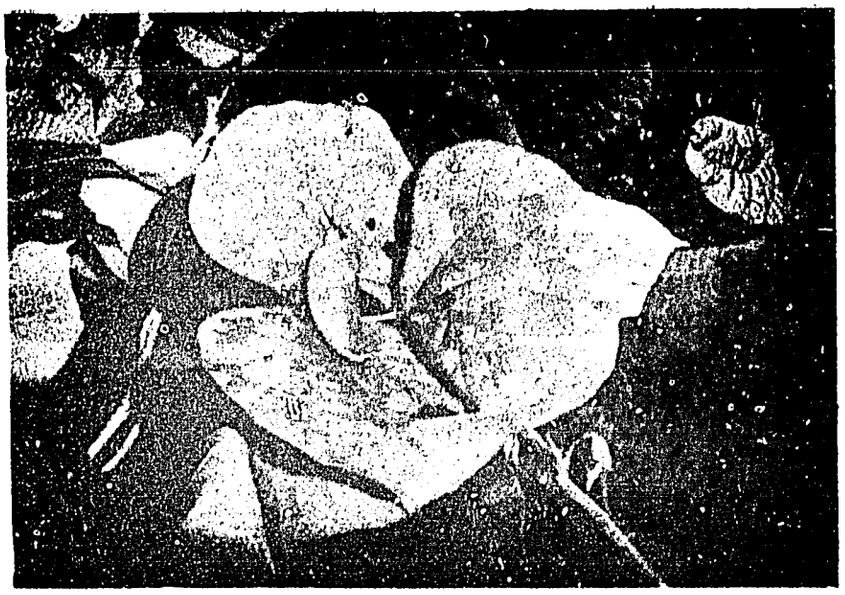


FIGURE 31. Yellow mosaic of Dolichos bifloris.

(2) Resistance to rust and powdery mildew probably exists in the indigenous varieties of Pisum sativum;

(3) There are probably strains of the Fusarium wilt of Cajanus cajan pathogen;

(4) Obtaining resistance to wilt of Cicer will be a demanding task, with more than one pathogen and possibly strains of both involved in the disease.

Resistance to the sterility virus of Cajanus cajan is unknown. Before the germplasm can be tested efficiently, techniques of transmission must be developed.

An insect-proof screenhouse and a greenhouse are essential for definitive work with many of the important pulst crop diseases, since they are caused by insect vectored viruses. No such facilities are yet available. No immediate possibility of a greenhouse is seen, but we expect to have a small screenhouse erected during 1967.

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APPENDIX I

STAFF

Iran

American

Name	Position	Arrival Date
Peter H. van Schaik	Regional Coordinator	August 21, 1964
Kenneth E. Gibson	Entomologist	January 11, 1965; Transferred to India October 8, 1966.
Glenn M. Horner	Soil Scientist	February 17, 1965
Lillian Mahvi (Mrs.)	Administrative Assistant	September 1, 1965
Walter E. Lansing	Administrative Officer	September 21, 1965; Transferred to India October 8, 1966.
Walter J. Kaiser	Plant Pathologist	November 22, 1965
Kenneth H. Evans	Plant Breeder-Geneticist	March 13, 1966
Shannon W. Wilson	Entomologist	June 10, 1966

Iranian

Jamshid Jaffari	Plant Breeder	January 21, 1965
Mehdi Khosroshahin	Plant Breeder	March 11, 1965
M. Ali Ellini	Plant Breeder	June 3, 1965
Dariush Danesh	Plant Pathologist	July 7, 1965
Karim Kamali	Entomologist	July 7, 1965
Mahmoud Okhovat	Plant Pathologist	June 22, 1966
Massoud Mojtehedi	Agronomist	June 25, 1966
Gholam-Reza Rassoulian	Entomologist	June 26, 1966
Mohammad Moadab	Agronomist	June 29, 1966
Manuchehr Taghavi-Bayat	Agronomist	July 16, 1966
Jaffar Afshar	Government Relations Adv.	October 10, 1965
Jerri Ellini (Mrs.)	Secretary	February 20, 1966

The first five of these personnel are employed by Plan Organization of the Government of Iran. The remainder are employed by Karaj Agricultural College under the terms of the Cooperative Agreement.

Other supporting staff as of January 1, 1967, consists of one storekeeper-technician, six drivers and 12 field laborers, also employed under the terms of the Cooperative Agreement.

India

American

Name	Position	Arrival Date
Richard M. Matsuura	Plant Breeder-Geneticist	December 1, 1965
Floyd J. Williams	Plant Pathologist	January 1, 1966
Robert J. Davis	Soil Scientist	August 20, 1966
Kenneth E. Gibson	Entomologist	October 8, 1966
Walter E. Lansing	Administrative Officer	October 8, 1966

Indian

L. M. Jeswani	Plant Breeder-Geneticist	Ad-hoc, December, 1965 Official, November, 1966
G. S. Grewal	Plant Pathologist	Ad-hoc, December, 1965 Official, January, 1967
S. L. Choudhury	Agronomist	Official, January, 1967
P. V. Ranga Rao	Entomologist	Ad-hoc, March, 1966 Not yet official.

R.K.Jayaprakash Narayan	Sr. Research Assistant	June 27, 1966
B. Baldev	Plant Physiologist-Geneticist	July 1, 1966
Venkat Rao Gadwal	Geneticist	July 13, 1966
Kantilal Shivabhai Amin	Research Assistant	October 12, 1966
J. L. Tiwari	Research Assistant	November 14, 1966
Girdhari Lal Kaul	Research Assistant	December 19, 1966
Nanak Singh Dang	Secretary	May 13, 1966
Ranjit Kumar Sharma	Administrative Asst.	December 1, 1966
Puran Chand Bector	Clerk-typist	January, 1967

Of these, the first four are counterparts appointed under the Government of India Coordinated Pulse Scheme. The remainder are employed under personal services contracts and paid from U. S. Project funds.

Other supporting staff includes four drivers employed from Project funds.

APPENDIX II

FINANCIAL

The United States' contributions to the Project for Fiscal Year 1966 (July 1, 1965-June 30, 1966) and for Fiscal Year 1967 (July 1, 1966-June 30, 1967) are shown below.

	F.Y. 1966		F.Y. 1967	
U.S.A.	$ 268,000.00		$ 320,000.00	
Iran	94,000.00	(Rls. 7,050,000)	166,000.00	(Rls. 12,450,000)
India	55,000.00	(Rs. 412,500)	134,700.00	(Rs. 1,010,250)
Total	$ 417,000.00		$ 720,700.00	

A new Cooperative Agreement was approved in 1966 with the Pahlavi University, College of Agriculture, in Shiraz, providing up to Rls. 600,000 for F.Y. 1967 for reimbursement of salaries and other expenses incurred in cooperative research. This is similar to the Cooperative Agreement with Karaj College and Ministry of Agriculture (Rials 4,000,000).

The Government of Iran, during Fiscal Years 1344 (March 21, 1965-March 20, 1966) and 1345 (March 21, 1966-March 20, 1967), contributed the following from Plan Organization development funds.

1344	Rials 1,171,000 ($15,613.33)
1345	Rials 6,191,000 ($82,546.67)

Of this, Rials 4,941,000 ($65,880.00) were for construction of a greenhouse-headhouse at Karaj Agricultural College. This, therefore, is a non-recurring expense. The remainder was for salaries, travel, etc. of counterpart staff.

The Government of India's contributions during Fiscal Years 1965 (April 1, 1965-March 31, 1966) and 1966 (April 1, 1966-March 31, 1967) were as follows.

1965	Rupees 4,391 ($922.11)
1966	Rupees 115,500 ($15,015.00)

APPENDIX III

FACILITIES

Iran

Construction of the greenhouse-headhouse, provided by the Plan Organization of the Government of Iran, was started in May of 1966. Considerable difficulties have been encountered to keep the contractor on the job and to have installations made according to specifications. Although the construction contract called for a completion date within six months, as of January 1, 1967 the facility had not been completed.

Three U. S. Army surplus quonset buildings were shipped into Iran. One was erected adjacent to the greenhouse and will be used for storage of equipment and chemical supplies. A second will be constructed near the same site and will house a Project photographic darkroom and additional work areas. The third will be erected on Karaj College farm and will be used for farm tools and equipment storage.

One wing of the old chemistry building on the Karaj College campus was turned over for Project use, and was remodeled to include work and seed storage space.

A pump and motor were installed on a deep well on the Karaj College farm and this well was activated to irrigate land primarily used for pulse crop research.

India

The Indian Agricultural Research Institute turned over for Project use four laboratories formerly occupied by the PIRRCOM unit. These laboratories will be used until the new research laboratory planned at IARI for the Coordinated Pulse Scheme is completed. Although inadequate for all Project operations, they will handle the plant breeding aspects and provide supplementary space for the other disciplines, who will also have space provided in their respective departments.

Finances have been approved and initial construction plans have been made for the laboratory provided for in the Memorandum of Understanding, and in the Project for the Intensification of Coordinated

Research by the Improvement of Pulses at the Indian Agricultural Research Institute. It is expected that construction could start early in 1967.

No decision has as yet been made on construction of the glasshouse. According to the terms of the Memorandum of Understanding, this was to be provided by the Indian Government. However, because of lack of experience, past difficulties encountered in glasshouse construction, and the serious delay in essential research caused by lack of greenhouse facilities, the possibility is being explored to have a prefabricated greenhouse shipped in from the United States. Because of budget limitations and other restrictions, it now appears that a locally constructed greenhouse will have to be provided.

As in Iran, three U. S. Army surplus quonset buildings were shipped to India. These have not been erected as yet.

APPENDIX IV

REPORTS AND PUBLICATIONS

Progress Reports 1, 2 and 3 were issued for the periods July-December 1964, January-July 1965, and July-December 1965, respectively.

The data of the 1965 Plant Introduction Observation Nurseries were compiled in a bound volume and distributed.

A report on the workshop held in Tehran in August of 1966 was prepared and distributed.

A Summary of Activities, 1966, was prepared at the request of the Government of Iran.

A manuscript entitled An Outbreak of Broadbean Diseases in Iran by Walter J. Kaiser, K. E. Mueller and Dariush Danesh has been submitted for publication in the U.S.D.A. Plant Disease Reporter.

Legend for Tables in Appendix V

(1) Numbers assigned by the Iranian Ministry of Agriculture.

(2) Area of origin.

(3) Population or collection numbers assigned by the Iranian Ministry of Agriculture.

(4) Average weight (grams) of 1,000 seeds.

(5) Yield in grams per plot.
N.S. = not statistically significant at .05 level.
Conversion factor, grams per plot to kilograms per hectare = .5.

APPENDIX V

Agronomic Data, Chickpea Yield Test, Iranian Ministry of Agriculture. Varamin, Iran, 1966, (white).

(1) Identification Number	(4) 1000 Seed Weight	(5) Yield (Grams/Plot)
635	255	3492
636	210	3492
632	255	3451
648	270	3411
650	250	3304
629	170	3208
633	170	3190
626	250	3136
647	160	3124
637	180	3109
634	195	3104
641	160	3040
640	150	3022
644	160	2922
645	225	2922
627	290	2900
646	285	2839
642	170	2773
628	260	2772
643	182	2670
638	180	2666
631	200	2657
649	380	2626
630	350	2010
639	190	1906

LSD .05 = 68.6.

Coefficient of Variation = 23%.

App. V - Esfahan, white chickpeas.

(1) Identification Number	(2) Source	(3) Source Number	(4) 1000 Seed Weight	(5) Yield Grams/Plot
1646	I-Karaj	152	303	3497
1597	I-Moghan	129	276	3342
1532	Cyprus	139	269	3197
1714	I-Shahpour	162	281	3040
1602	I-Fars	106	274	3021
1654	I-Karaj	153	299	2775
1683	I-Moghan	161	283	2532
1730	I-Moghan	168	280	2351
1552	I-Esfahan	111	262	2289
1723	I-Ardabil	163	300	2254

LSD .05 = N.S. Coefficient of Variation = 27%.
Conversion factor, grams per plot to kilograms per hectare = .5.

App. V - Rezaieh, white chickpeas.

(1) Identification Number	(2) Source	(4) 1000 Seed Weight	(5) Yield Grams Per Plot
1745	I-Ardabil	300	3010
1792	I-Karaj	190	2830
1719	I-Ardabil	260	2800
1563	I-Esfahan	270	2740
1621	I-Fars	170	2690
1535	Cyprus	340	2630
1687	I-Moghan	280	2610
1699	I-Shahpour	270	2570
1649	I-Karaj	340	2570
1642	I-Karaj	330	2560
1755	I-Ardabil	255	2550
1585	I-Esfahan	200	2450

LSD .05 = N.S. Coefficient of Variation = 18%.
Conversion factor, grams per plot to kilograms per hectare = .5.

App. V - Shiraz, white chickpeas.

(1) Identification Number	(2) Source	(3) Source Number	(4) 1000 Seed Weight	(5) Yield Grams/Plot
1708	I-Shahpour	162	310	7168
1564	I-Esfahan	111	300	7046
1728	I-Shiraz	182	195	6912
1756	I-Ardabil	170	275	6802
1690	I-Moghan	161	330	6650
1627	I-Karaj	152	330	6006
1648	I-Karaj	152	325	5798
1605	I-Fars	106	195	5754
1787	I-Karaj	-	355	5490
1740	I-Ardabil	169	415	3422
1724	I-Ardabil	163	195	5392
1554	I-Esfahan	111	230	5090
1732	I-Moghan	168	290	5054
1656	I-Karaj	153	295	4782
1533	Cyprus	139	395	4448

LSD .05 = 1611. Coefficient of Variation = 21%.

App. V - Esfahan, black chickpeas.

(1) Identification Number	(2) Source	(3) Source Number	(4) 1000 Seed Weight	(5) Yield Grams/Plot
2049	I-Ardabil	172	106	2729
1910	I-Karaj	154	106	2472
1980	I-Ardabil	173	131	2296
1833	I-Ardabil	175	135	1996
2089	I-Ardabil	174	110	1951
1955	I-Moghan	164	109	1808

LSD .05 = N.S. Coefficient of Variation = 22%.

App. V - Rezaieh, black chickpeas.

(1) Identification Number	(2) Source	(4) 1000 Seed Weight	(5) Yield (Gm/Plot)
1846	I-Gharyegole	140	2900
1914	I-Karaj	120	2680
2004	I-Ardabil	120	2450
2084	I-Ardabil	110	2450
1989	I-Ardabil	120	2370
1975	I-Mogham	110	2360
1906	I-Karaj	120	2340
1052	I-Ardabil	110	2330
2080	I-Ardabil	120	2310
1845	I-Gharyegole	140	2200
1976	I-Mogham	120	2200
1998	I-Ardabil	115	2160

LSD .05 = N.S. Coefficient of Variation = 22%.

App. V - Shiraz, black chickpeas.

(1) Identification Number	(2) Source	(3) Source Number	(4) 1000 Seed Weight	(5) Yield Grams/Plot
1853	I-Gharyegole	175	155	3918
2050	I-Ardabil	172	115	3848
1973	I-Moghan	164	140	3768
2130	I-Ardabil	174	125	3566
1912	I-Karaj	154	125	3540
1996	I-Ardabil	173	100	3138

LSD .05 = N.S. Coefficient of Variation = 24%.

App. V - Varamin, black chickpeas.

(1) Identification Number	(4) 1000 Seed Weight	(5) Yield (Grams/Plot)
741	140	2577
745	175	2357
736	145	2192
747	120	2034
739	140	2017
735	135	2008
749	115	2003
731	130	1962
737	140	1950
746	145	1938
730	140	1918
727	105	1818
734	110	1774
728	115	1773
726	125	1760
750	145	1755
743	130	1772
744	115	1668
742	135	1659
729	130	1568
740	140	1536
738	135	1530
733	128	1485
732	135	1469
748	132	1454

LSD .05 = 518. Coefficient of Variation = 22%.

Legend for Tables in Appendix VI

(1) Strain numbers are numbers assigned by the Iranian Ministry of Agriculture.

(2) Source numbers are numbers assigned to collections by the Ministry of Agriculture.

(3) Source indicates area of origin.

(4) Yield in grams per plot.
Conversion factor to kilograms per hectare = 0.1.

APPENDIX VI

Agronomic Data, Lentil Yield Test, Iranian Ministry of Agriculture, RPIP. Varamin, Iran, 1966.

(1) Strain Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
442M	101	I-Fars	6040
441M	101	I-Fars	5770
439M	144	Chile	5580
435M	101	I-Fars	5450
444M	101	I-Fars	5400
450M	107	I-Esfahan	5360
446M	101	I-Fars	5283
448M	101	I-Fars	5152
437M	101	I-Fars	5122
426M	107	I-Esfahan	5056
447M	101	I-Fars	4985
443M	107	I-Esfahan	4728
436M	107	I-Esfahan	4716
445M	101	I-Fars	4602
430M	101	I-Fars	4528
427M	101	I-Fars	4510
440M	107	I-Esfahan	4400
433M	101	I-Fars	4240
428M	101	I-Fars	4218
432M	107	I-Esfahan	4122
431M	101	I-Fars	4068
429M	101	I-Fars	3962
438M	-	Unknown	3840
449M	101	I-Fars	3826
434M	107	I-Esfahan	3538

Coefficient of Variation = 32%.
Yields not statistically different.

App. VI - Esfahan, lentils.

(1) Strain Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
404M	101	I-Fars	3059
406M	107	I-Esfahan	3058
408M	107	I-Esfahan	2822
402M	117	I-Shushtar	2746
405M	101	I-Fars	2689
403M	101	I-Fars	2626
409M	101	I-Fars	2494
410M	107	I-Esfahan	2365
401M	117	I-Shushtar	2243
407M	107	E-Esfahan	2119

LSD .05 = 519. Coefficient of Variation = 16%.

App. VI - Rezaieh, lentils.

(1) Strain Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
403-M	101	I-Fars	2150
401M	101	I-Fars	2130
407M	107	I-Esfahan	1940
409M	107	I-Esfahan	1740
410M	107	I-Esfahan	1670
404M	101	I-Fars	1650
402M	101	I-Fars	1640
408M	107	I-Esfahan	1640
406M	101	I-Fars	1630
405M	101	I-Fars	1540

LSD .05 = 345. Coefficient of Variation = 15%.

Legend for Tables in Appendix VII

(1) Numbers assigned by the Iranian Ministry of Agriculture.

(2) Population or collection numbers assigned by the Iranian Ministry of Agriculture.

(3) Area or country of origin.

(4) Yield in kilograms per plot.

APPENDIX VII

Agronomic Data, Cowpea Yield Test, Iranian Ministry of Agriculture, RPIP. Esfahan, Iran, 1966.

(1) Identification Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
304	102	I-Fars	2270
305	-	I-Esfahan	2140
308	150	I-Karaj	1680
303	102	I-Fars	1464
306	-	I-Esfahan	1390
302	118	Unknown	1206
309	157	Moghan	1190
310	157	I-Moghan	1100
301	118	Unknown	966
307	-	I-Karaj	820

LSD .05 = 493. Coefficient of Variation = 27%.

App. VII - Cowpeas, Rezaieh.

(1) Identification Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
308	150	I-Karaj	2045
303	102	I-Fars	1985
307	150	I-Karaj	1535
310	157	I-Moghan	1410
305	109	I-Esfahan	1295
302	118	Unknown	1250
309	157	I-Moghan	1176
311	180	I-Shiraz	1155
306	109	I-Esfahan	1140
304	102	I-Fars	1125
301	118	Unknown	490

LSD .05 = 338. Coefficient of Variation = 39%.

App. VII - Cowpeas, Mashad.

(1) Identification Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
318	418	Kashmar	5360
301	118	Unknown	4778
310	-	I-Darehgaz	4734
311	366	I-Varamin	4587
316	417	I-Bojnord	4524
309	226	I-Esfahan	4503
314	374	I-Varamin	4487
317	416	I-Bojnord	4483
306	180	I-Shiraz	4383
313	371	I-Varamin	4256
304	114	I-Behbahan	4222
302	109	I-Esfahan	4158
307	197	I-Kermanshah	4125
308	227	I-Nishabour	4106
312	367	I-Varamin	3958
305	150	I-Karaj	3601
303	115	I-Dezful	3451
315	248	I-Chahbahar	3094

LSD .05 = 1003. Coefficient of Variation = 18%.

App. VII - Cowpeas, Shiraz

(1) Identification Number	(2) Source Number	(3) Source	(4) Yield (Grams/Plot)
308	150	I-Karaj	1024
306	102	I-Fars	950
307	109	I-Esfahan	888
309	157	I-Moghan	882
301	366	I-Varamin	880
303	368	I-Varamin	680
302	367	I-Varamin	652
310	180	I-Shiraz	584
304	374	I-Varamin	554
305	118	Unknown	306

LSD .05 = 395. Coefficient of Variation = 41%.

Legend for Tables in Appendix VIII

(1) Numbers assigned by the Iranian Ministry of Agriculture.

(2) Population or collection numbers assigned by the Iranian Ministry of Agriculture.

(3) Area or country of origin.

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

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

(6) Days from planting to first flower.

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

(8) Average weight (grams) of 1000 seeds.

(9) Average plant height at maturity.

(10) Yield in kilograms per plot based on plots 20 square meters in size.
N.S. = Not statistically significant at .05 level.

APPENDIX VIII

Agronomic Data, Bean Yield Test (white), Iranian Ministry of Agriculture, RPIP. Esfahan, Iran, 1966.

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Disease Rating	(8) Seed Wt.	(9) Plant Ht.	(10) Yield
8	178	I-Shiraz	1	1	53	1	24.6	39	729
3	110	I-Esfahan	2	1	53	1	23.4	37	715
6	149	I-Karaj	1	2	54	2	22.4	38	705
7	158	I-Sarab	2	2	55	2	23.8	34	649
4	103	I-Fars	1	2	50	1	23.8	40	633
5	120	I-Unknown	1	1	49	1	22.9	40	633
2	140	Lebanon	3	3	52	3	24.9	34	477
1	121	Egypt	3	3	52	3	36.2	32	243

LSD .05 =608. Coefficient of Variation = 41%.

App. VIII - White beans, Mashad.

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(6) Days to First Flower	(8) 1000 Seed Wt.	(9) Plant Ht.	(10) Yield
8	158	I-Sarab	1	44	28.9	28	1451
5	103	I-Fars	1	43	28.7	31	1344
4	110	I-Esfahan	1	46	26.8	30	1333
6	120	I-Unknown	1	44	27.9	29	1254
2	131	I-Lebanon	1	43	30.2	24	1180
9	178	I-Shiraz	1	44	31.6	32	1161
7	149	I-Karaj	1	44	27.7	29	1095
3	140	Lebanon	1	47	31.2	24	764
1	121	Egypt	1	41	39.2	31	673

LSD .05 = 982. Coefficient of Variation =34%.

App. VIII - White beans, Rezaieh.

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Disease Rating	(8) Seed Wt.	(9) Plant Ht.	(10) Yield
15	178	I-Shiraz	1	1	61	1	28.0	34	1885
10	-	I-Unknown	1	1	60	1	30.0	31	1665
8	103	I-Fars	1	1	61	2.	29.0	37	1656
11	149	I-Karaj	1	1	59	1	28.0	36	1523
12	178	I-Shiraz	1	1	61	1	32.5	35	1503
7	103	I-Fars	1	1	59	1	29.0	33	1440
3	140	I-Moghan	2	2	59	6	31.0	30	1430
6	110	I-Esfahan	2	1	60	2	29.0	34	1415
9	-	I-Unknown	1	1	59	1	27.5	30	1415
13	158	I-Sarab	2	2	61	2	28.0	30	1400
14	158	I-Sarab	2	2	59	3	30.0	33	1395
5	110	I-Esfahan	2	1	58	1	28.5	34	1394
2	121	Egypt	3	3	55	5	48.5	35	1355
1	121	Egypt	4	3	56	5	47.5	25	1341
16	178	I-Shiraz	1	1	60	1	30.0	34	1340
4	140	I-Moghan	2	2	59	5	29.5	33	1086

LSD .05 = 850.6. Coefficient of Variation = 27%.

App. VIII - White beans, Shiraz.

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Disease Rating	(8) Seed Wt.	(9) Plant Ht.	(10) Yield
10	419	I-Bojnurd	2	1	72	2	31.0	50	4373
9	383	I-Varamin	1	2	72	1	31.0	45	4089
18	149	I-Karaj	3	3	72	2	32.0	45	3852
20	178	I-Shiraz	3	4	72	2	22.5	45	3802
15	110	I-Esfahan	3	2	72	2	33.0	50	3720
14	140	Lebanon	3	2	72	2	33.0	45	3705
5	149	I-Karaj	2	2	73	1	29.0	45	3645
16	103	I-Fars	3	3	72	2	32.5	35	3613
11	222	I-Esfahan	3	2	72	2	28.0	35	3318
17	120	I-Unknown	3	2	72	3	29.5	50	3239
3	120	I-Unknown	3	2	73	2	31.0	50	3226
6	178	I-Shiraz	2	2	74	2	31.0	47	3010
19	158	I-Sarab	3	3	72	3	29.0	50	3010
1	110	I-Esfahan	2	2	74	2	33.5	45	2973
7	196	I-Chamchal	4	2	73	2	34.0	40	2960
4	149	I-Karaj	3	2	75	2	32.0	35	2889
2	110	I-Esfahan	2	2	75	3	32.5	45	2819
8	247	I-Dashtsar	2	2	73	1	29.0	50	2755
12	121	Egypt	3	2	72	3	32.5	40	2607
13	131	Lebanon	4	2	72	3	33.0	50	2601

LSD .05 = 2019. Coefficient of Variation = 24%.

App. VIII - White beans, Varamin.

(1) Identification Number	(2) Source Number	(3) Source	(6) Days to First Flower	(8) Seed Wt.	(9) Plant Height	(10) Yield
32	103	I-Fars	42	30.5	38	1944
26	110	I-Esfahan	42	32.5	38	1889
45	103	I-Fars	42	33.0	42	1884
37	158	I-Sarab	42	31.0	41	1845
35	158	I-Sarab	42	33.0	44	1845
33	103	I-Fars	43	33.0	40	1822
50	158	I-Sarab	43	33.0	35	1813
48	149	I-Karaj	42	31.5	35	1768
38	149	I-Karaj	42	36.0	40	1758
29	149	I-Karaj	42	31.0	38	1751
36	120	I-Unknown	43	29.5	39	1705
30	149	I-Karaj	42	32.2	37	1701
46	178	I-Shiraz	42	32.5	41	1679
44	149	I-Karaj	43	30.0	35	1611
39	178	I-Shiraz	42	32.5	37	1600
28	178	I-Shiraz	42	32.0	38	1588
43	103	I-Fars	42	32.2	31	1566
34	149	I-Karaj	42	34.5	41	1514
41	110	I-Esfahan	43	30.5	44	1508
42	178	I-Shiraz	43	32.2	36	1497
40	178	I-Shiraz	43	32.0	41	1471
49	149	I-Karaj	43	33.5	35	1453
27	103	I-Fars	42	27.2	32	1325
31	149	I-Karaj	42	32.5	39	1296
47	120	I-Unknown	42	32.2	33	1240

LSD .05 = 1207. Coefficient of Variation = 29%.

App. VIII - Pinto beans, Varamin.

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Disease Rating 6/5	(7) Disease Rating 7/5	(8) Seed Wt.	(9) Plant Ht.	(10) Yield
119		USA-Pinto Columbia	1	1	34	1	2	32.5	31	729
108	79	I-Ardakan	2	1	36	4	4	35.0	35	610
110	79	I-Ardakan	3	3	36	2	4	26.0	34	530
114	79	I-Ardakan	1	2	42	1	3	27.0	32	468
101	159	I-Sarab	2	1	35	2	3	32.4	26	459
113	179	I-Ardakan	2	2	37	2	4	25.5	31	443
116	179	I-Ardakan	2	2	38	2	3	24.0	36	443
120	-	USA-Pinto 111-2		2	34	1	2	37.5	26	429
112	179	I-Ardakan	2	1	39	2	3	19.5	43	358
107	159	I-Sarab	2	1	37	1	3	36.8	45	353
102	159	I-Sarab	2	2	42	2	3	33.0	43	320
118	179	I-Ardakan	2	1	42	2	5	38.0	29	313
117	179	I-Ardakan	2	3	48	1	1	36.0	31	305
111	179	I-Ardakan	2	2	46	2	2	38.0	32	297
103	159	I-Sarab	2	2	46	1	2	37.0	39	266
109	179	I-Ardakan	1	2	36	2	3	22.8	42	262
115	179	I-Ardakan	2	2	49	2	4	34.0	36	251
106	159	I-Sarab	3	2	47	2	1	37.0	35	236
104	159	I-Sarab	2	2	47	1	3	30.0	42	167
105	159	I-Sarab	2	2	40	1	1	29.5	44	133

LSD .05 = 539. Coefficient of Variation = 58%.

App. VIII - Red beans, Esfahan

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Disease Rating	(8) Seed Wt.	(9) Plant Ht.	(10) Yield
203	132	Lebanon	2	1	56	1	26.0	42	715
202	119	I-Unknown	1	1	54	1	24.1	42	611
201	119	I-Unknown	1	2	53	1	23.5	40	545

LSD .05 = N.S. Coefficient of Variation = 27%.

App. VIII - Red beans, Shiraz.

(1) Ident. No.	(2) Source Number	(3) Source	(4) Stand	(5) Vigor	(6) Days to First Flower	(7) Disease Rating	(8) Seed Wt.	(9) Plant Ht.	(10) Yield
205	295	I-Kuh Sorkh	3	3	72	2	30.0	50	2847
201	216	I-Torbat-H.	2	3	72	2	34.0	34	2731
204	132	Lebanon	3	3	72	2	29.5	59	2668
206	206	I-Unknown	2	3	72	3	26.0	53	2668
202	119	I-Unknown	2	3	72	2	28.0	55	2619
203	119	I-Unknown	2	3	72	2	31.0	55	2613
207	151	I-Karaj	3	3	-	4	10.0	63	1267

LSD .05 = 1479. Coefficient of Variation = 24%.

App. VIII- Red beans, Varamin.

(1) Identification Number	(2) Source Number	(3) Source	(6) Days to First Flower	(8) Seed Weight	(9) Plant Height	(10) Yield
231	104	I-Fars	45	24.5	35	1405
248	132	Lebanon	46	32.8	42	1237
247	132	Lebanon	46	31.0	39	1227
230	119	I-Unknown	46	30.0	38	1154
227	132	Lebanon	44	24.0	35	1153
242	104	I-Fars	46	22.5	33	1100
245	132	Lebanon	45	27.5	42	1093
239	104	I-Fars	45	24.5	33	1080
249	132	Lebanon	45	26.0	46	1064
250	132	Lebanon	45	29.0	46	1037
244	119	I-Unknown	46	22.0	43	1002
243	104	I-Fars	46	20.0	48	929
299	104	I-Fars	45	28.0	34	915
246	132	Lebanon	45	25.5	41	834

LSD .05 = 600. Coefficient of Variation = 30%.

Legend for Tables In Appendix IX

(1) Numbers assigned by the Iranian Ministry of Agriculture.

(2) Population or collection numbers assigned by the Iranian Ministry of Agriculture.

(3) Area or country of origin.

(4) Average weight (grams) of 1000 seeds

(5) Yield in grams per plot.
N.S. = Not statistically significant at .05 level.
Conversion factor, grams per plot to kilograms per hectare = .5.

APPENDIX IX

Agronomic Data, Mungbean Yield Tests, Iranian Ministry of Agriculture, RPIP. Esfahan, Iran, 1966.

(1) Identification Number	(2) Source Number	(3) Source	(4) Seed Weight	(5) Yield
502	184	I-Shiraz	34	1215
508	161	I-Mamaghan	34	1202
503	116	I-Dezful	34	1137
506	156	I-Karaj	35	1135
505	156	I-Karaj	33	1024
507	161	I-Mamaghan	34	1013
510	184	I-Shiraz	34	1002
504	116	I-Dezful	35	918
502	112	I-Esfahan	29	917
501	112	I-Esfahan	31	822

LSD .05 = N.S. Coefficient of Variation = 28%.

App. IX - Mungbeans, Mashad.

(1) Identification Number	(2) Source Number	(3) Source	(5) Yield
507	405	I-Varamin	4918
509	428	I-Kashaman	4828
505	203	I-Jeroft	4508
508	427	I-Bojnord	4174
502	112	I-Esfahan	4168
506	398	I-Varamin	4149
504	236	I-Daregaz	4174
503	116	I-Dezful	3836
510	219	I-Faridan	3262
501	105	I-Fars	1566

LSD .05 = 874. Coefficient of Variation = 18%.

App. IX - Mungbeans, Rezaieh.

(1) Identification Number	(2) Source Number	(3) Source	(5) Yield
501	112	I-Esfahan	1700
508	156	I-Karaj	1590
503	112	I-Esfahan	1490
502	112	I-Esfahan	1490
510	156	I-Karaj	1430
504	116	I-Dezful	1410
506	116	I-Dezful	1400
509	156	I-Karaj	1390
507	156	I-Karaj	1260
505	116	I-Dezful	1260

LSD .05 = 499. Coefficient of Variation = 28%.

App. IX - Mungbeans, Shiraz.

(1) Identification Number	(2) Source Number	(3) Source	(5) Yield
506	223	I-Esfahan	2412
508	402	I-Varamin	2312
510	427	I-Bojnord	2142
504	156	I-Karaj	2072
507	397	I-Varamin	1964
503	116	I-Dezful	1938
501	112	I-Esfahan	1916
509	403	I-Varamin	1860
505	167	I-Mamaghan	1832
502	112	I-Esfahan	1784

LSD .05 = N.S. Coefficient of Variation = 17%.