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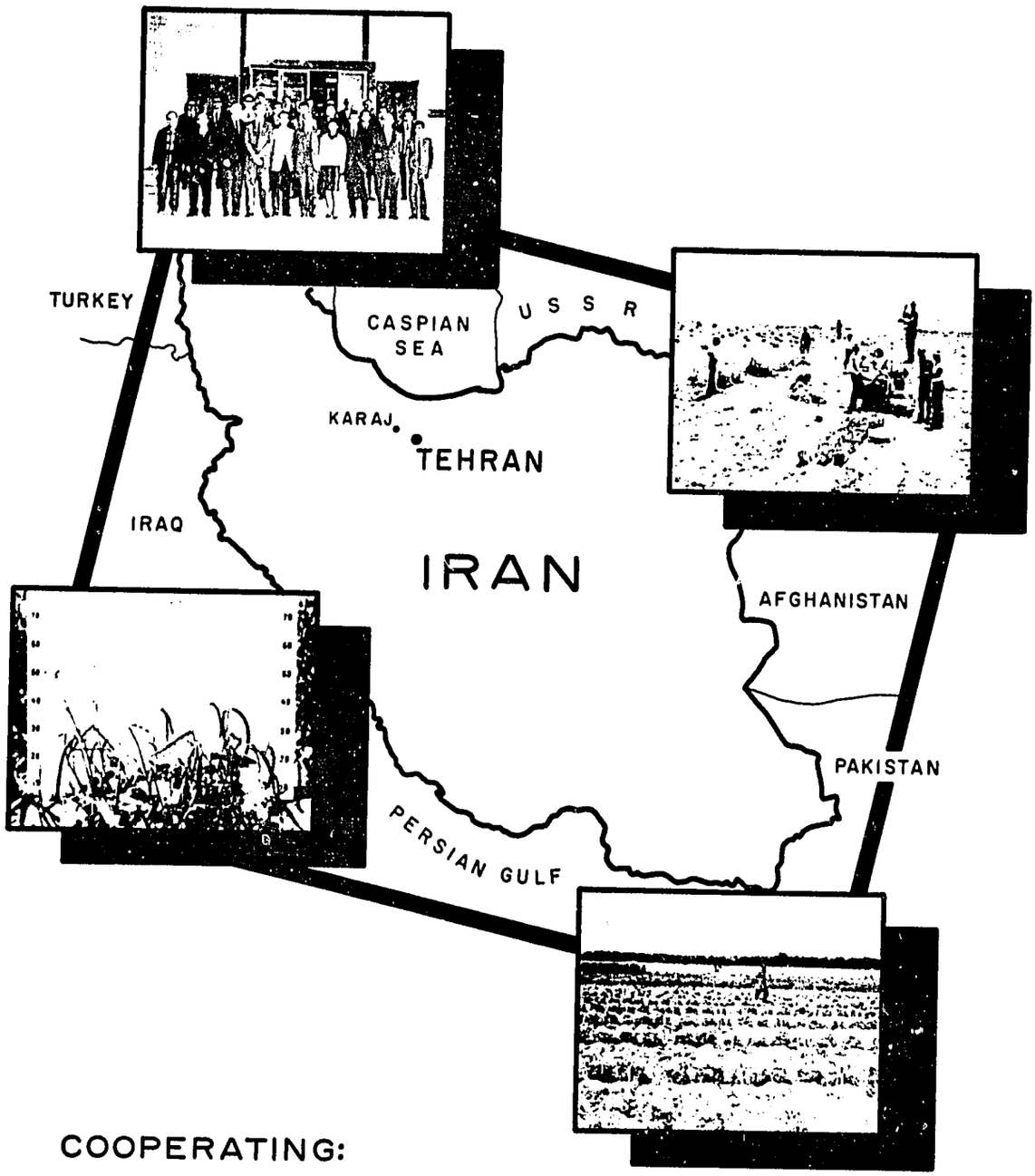
# PROGRESS REPORT

July - Dec. 1965

REGIONAL PULSE IMPROVEMENT PROJECT

US. DEPARTMENT OF AGRICULTURE, ARS

US. AGENCY FOR INTERNATIONAL DEVELOPMENT




COOPERATING:

- KARAJ AGRICULTURAL COLLEGE
- MINISTRY OF AGRICULTURE, IRAN
- PLAN ORGANIZATION, IRAN.

# PROGRESS REPORT

## No. 3

## July 1 - December 31, 1965

## REGIONAL PULSE IMPROVEMENT PROJECT

U.S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE,

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT,

KARAJ AGRICULTURAL COLLEGE, KARAJ, IRAN,

GOVERNMENT OF IRAN, MINISTRY OF AGRICULTURE,

GOVERNMENT OF IRAN, PLAN ORGANIZATION.

P. H. van Schaik

Agronomist-in-Charge

Copies of this report have been filed with:

1. U. S. Department of Agriculture, Agricultural Research Service, Crops Research Division, Vegetables and Ornamentals Research Branch, Beltsville, Maryland. (Also for distribution to other Divisions)

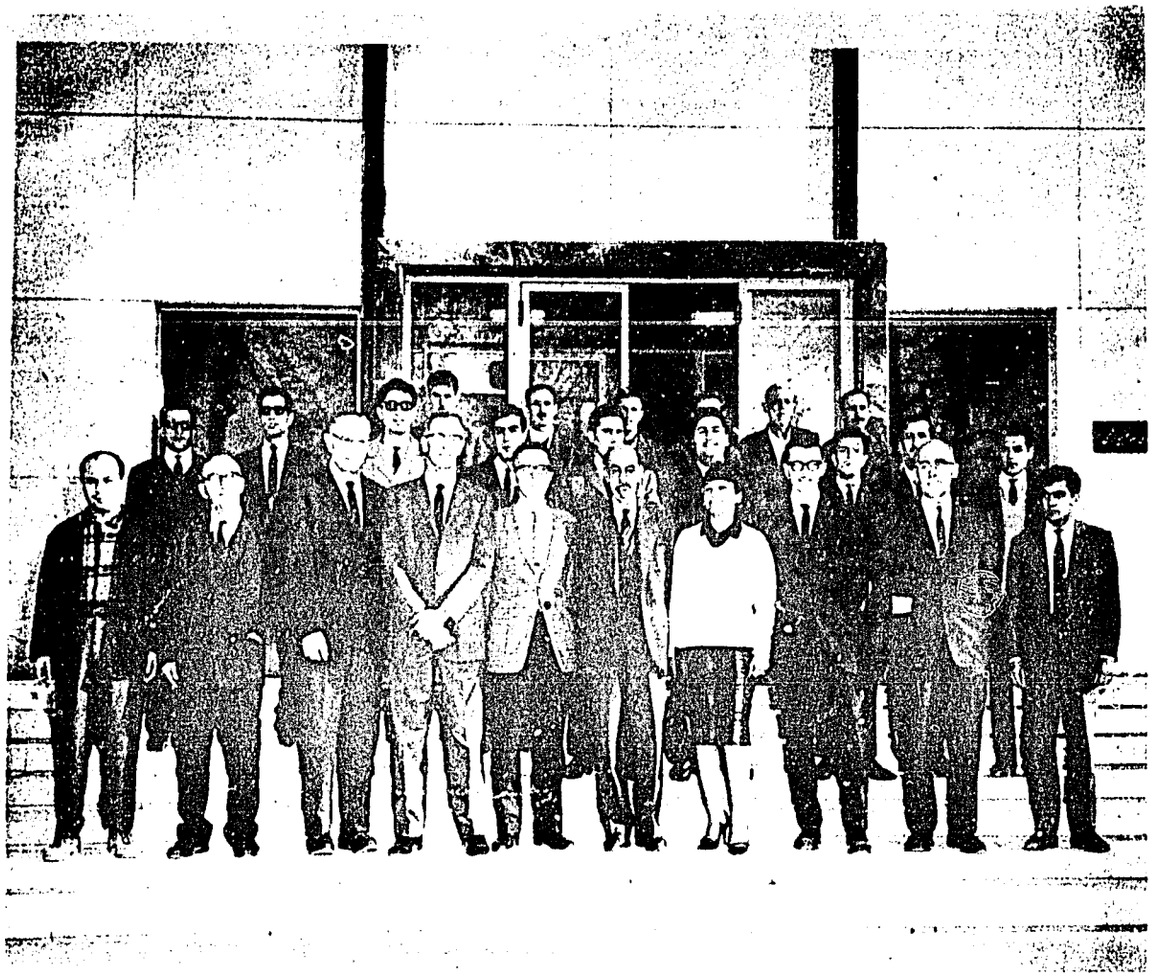
2. U. S. Agency for International Development, Washington, D. C., Dr. David White, Office of Technical Cooperation and Research, and Mr. O. L. Mimms, Chief, NESA, Agriculture Branch. (Also for distribution to other Missions in the NESA Region.)

3. U. S. Agency for International Development, Tehran, Iran, Mr. James B. Davis, Chief, Agriculture Division.

4. Plan Organization, Government of Iran, Tehran, Iran.

5. Ministry of Agriculture, Tehran, Iran.

6. Karaj Agricultural College, Karaj, Iran.



Left to Right:

Front Row: Eng. Saadati, Farm Supervisor; Eng. Afshar, Gov. Relations Adv.; Dr. Horner, Soils Scientist; Mr. Lansing, Admin. Officer; Dr. van Schaik, Project Leader and Plant Breeder; Prof. Schaybani, Karaj Hortic. Dept; Miss Azad, Steneographer Dr. Kaiser, Plant Pathologist; Mr. Gibson, Entomologist; Eng. Sarrafi, Plant Breeding Technician.

Second Row: Mr. Mansouryar, Driver; Mr. Simaloui, Driver; Eng. Mansouri, Soil Technician: Eng. Khosroshahin, Plant Breeding Technician; Eng. Jafari, Plant Breeding Technician; Eng. Ellini, Plant Breeding Technician; Eng. Kamaly, Entomology Technician; Eng. Danesh, Plant Pathology Technician.

Third Row: Mr. Ahmady, Laborer; Mr. Shirzadeh, Laborer; Mr. Hashemi, Laborer; Mr. Kheyrkhah, Laborer; Mr. Allahvaran, Laborer; Mr. Shirzadeh, Laborer.

Missing: Mrs. Mahvi, Administrative Assistant; Mr. Hadighi, Driver; Mr. Samani, Driver.

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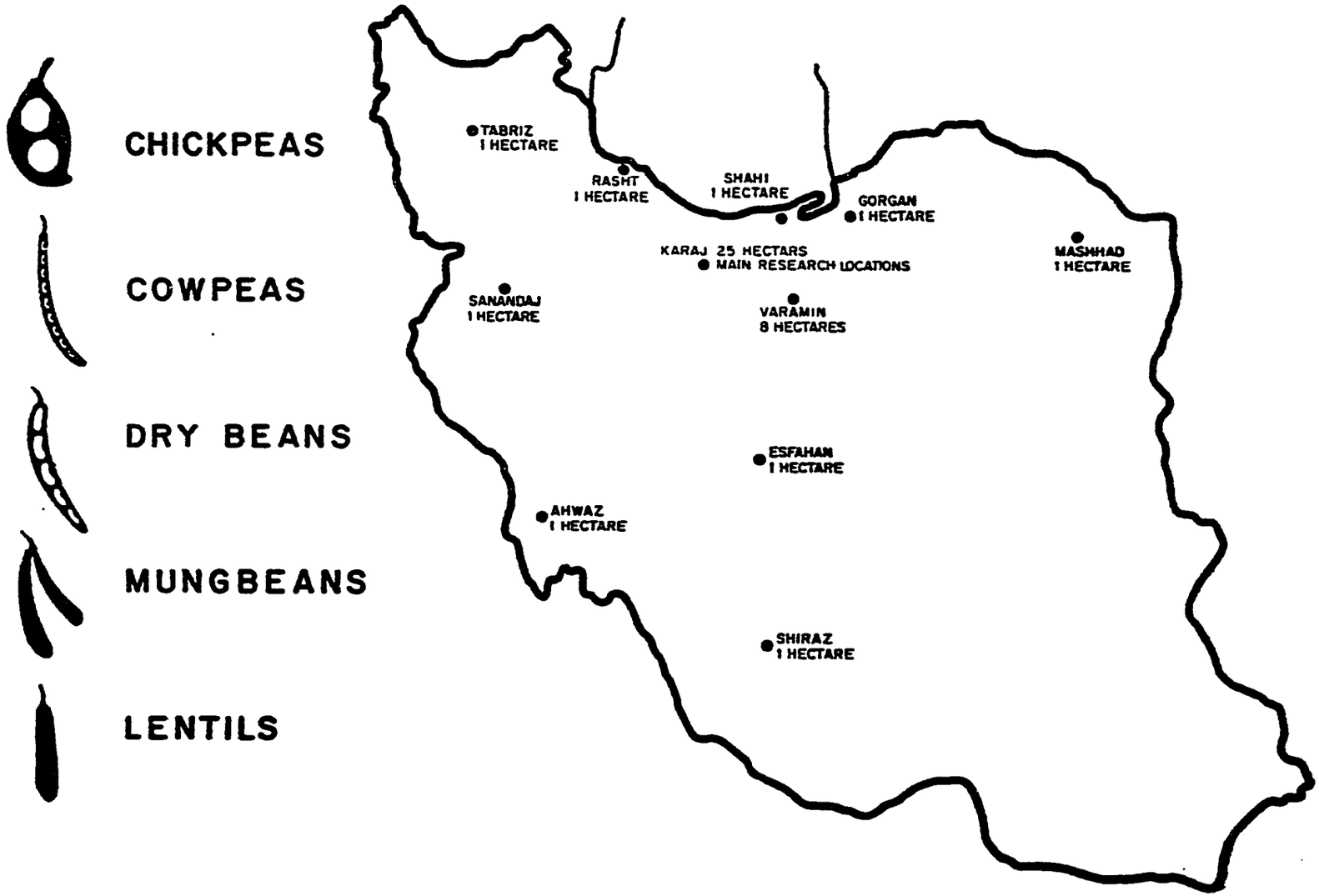
FIG. I — MAP OF IRAN. SHOWING 1965 PLANTING LOCATIONS. USDA, ARS/USAID, REGIONAL PULSE IMPROVEMENT PROJECT



## INTRODUCTION

This report covers the period July through December, 1965, and follows Progress Report No. 2, January through June, 1965.

Since writing of the last progress report, staff additions have included Mr. Walter E. Lansing, Administrative Officer; Dr. Walter J. Kaiser, Plant Pathologist; and Mrs. Lillian S. Mahvi, Administrative Assistant.

Mr. Lansing joined the Project after almost 35 years of previous service with USDA. He was at the U. S. Salinity Laboratory in Riverside, California since its inception in 1938, most of the time as Administrative Officer. He is at post in Tehran with his wife.

Dr. Kaiser was employed by the United Fruit Company as a bahana pathologist in Honduras for two years before joining USDA to serve with this Project. With him in Tehran is his wife.

Mrs. Mahvi has lived in Tehran for several years, and served as Administrative Assistant and Secretary to the Utah State University contract team, and as executive secretary in the Pan-American Oil Company. She is married and has two daughters.

Dr. Kenneth Evans, Plant Breeder-Geneticist is expected

to arrive about March 1st.

No technical Iranian staff has been added. In supporting functions, Eng. Jaffar Afshar has joined the Project. Eng. Afshar has many years of experience as liaison officer between US AID and Government of Iran authorities. With reduction in US AID activities in Iran, we were able to obtain his full-time services.

Construction still is not underway on the greenhouse-headhouse, financed by the Government of Iran. It is hoped that the last of the approval formalities can be taken care of and construction started soon, so that the facilities will be available by the fall of 1966.

Although, according to the terms of the Memorandum of Understanding, Karaj Agricultural College was to provide all required laboratory and office space, it has become quite evident that it does not have sufficient facilities available for the multiple activities of a project such as this. Basic office and laboratories can be provided, but the facilities available for seed processing, seed storage, and other activities of breeding and research programs in at least five crops are wholly inadequate. To correct this, a request has been made to the Plan Organization for funds to construct a laboratory building on the Karaj College campus for Project use.

Funds have also been requested from Plan Organization to

employ four more Iranian engineers in addition to the four presently employed.

As considerable time is spent by Project personnel in travel between Tehran and Karaj (about 30 miles), a request has been made for funds to construct sufficient houses to accommodate all American personnel at Karaj.

All these requests are presently being studied and considered by the appropriate authorities.

As the 1965 crop season was the first for most Project personnel, much of the research carried on was by necessity of a preliminary nature. In varietal improvement where preliminary screening had been done in 1964, more advanced testing was done in 1965 in the form of replicated yield trials at several locations in Iran. The crops tested, locations, and number of varieties were as follows:

| | Location | | | |
|---|---|---|---|---|
| Crop | Karaj | Varamin | Shiraz | Dezful |
| Chickpeas | 25 | 26 | 14 | 14 |
| Cowpeas | 45 | 44 | 39 | 42 |
| Beans | 35 | 35 | 25 | 29 |
| Mungbeans | 40 | 35 | 30 | 33 |

As indicated in Progress Report No. 2, observation nurseries were planted at Karaj for evaluation and screening of germplasm obtained from as many sources as possible.

These included:

| | |
|---|---|
| Chickpeas | 3,154 strains |
| Cowpeas | 875 strains |
| Beans | 1,793 strains |
| Mungbeans | 950 strains |
| Lentils | 1,311 strains |
| Broadbeans | 33 strains |

Entomological research consisted primarily of survey of insects harmful or potentially harmful to the pulse crops, and of preliminary trials of several insecticides.

Soils and agronomic work consisted of preliminary trials with rhizobial inoculants and fertilizer trials, particularly with phosphorous.

No specific plant pathological research was carried on because no U. S. pathologist was at post. However, the Iranian junior pathologist surveyed the crops in the experimental fields at Karaj for disease symptoms, took considerable notes and plant samples for laboratory studies.

No work was carried on in any country of the region outside of Iran. Seed for planting in observation nurseries was obtained from Pakistan, Turkey, and U.A.R. Contacts will be made with these countries for suggestions for possible work in 1966.

## RESEARCH PROGRAM, 1965 CROP SEASON

### VARIETAL IMPROVEMENT

P. H. van Schaik
Agronomist-in-Charge
and Plant Breeder

During the 1965 crop season, varietal improvement research consisted of replicated yield trials and nurseries for observation and screening at several locations within Iran (Figure 1). Some of this was under the direct supervision of Project personnel; for instance, all plantings at Karaj and some at Varamin, while other trials were carried on entirely under the supervision of the Iran Ministry of Agriculture, Seed Improvement Institute.

In addition, yield trials were conducted at Shiraz in cooperation with the Agricultural faculty of Pahlavi University, and at Dezful (Khuzistan province) in cooperation with the Khuzistan Development Service.

No hybridization or actual breeding programs were started because available germplasm must be surveyed first and information on characteristics of this material obtained. Often, locally available types or introduced varieties provide the source for rapid development of improved varieties, while the development of new varieties by formal breeding procedures is usually more time-consuming. The variety obtained in this way seldom is superior in all desirable characteristics which

usually must be combined from several types through breeding programs. Therefore, the use of such a variety is most often only a stop-gap or short-term measure to satisfy an early demand for improvement.

Work in 1965 was concentrated on six crops: chickpeas (*Cicer arietinum*), cowpeas (*Vigna sinensis*), beans (*Phaseolus vulgaris*), mungbeans (*Phaseolus aureus*), lentils (*Lens esculenta*), and broadbeans (*Vicia faba*).

Replicated yield evaluation tests were planted at Karaj, Varamin, Shiraz, and Dezful. At Varamin, there were two yield tests in each crop--one planned and under the complete supervision of Project personnel; the other under the control of Ministry personnel. For the 1966 season, the two programs will be coordinated into one series of tests, handled cooperatively by Ministry and Project personnel.

Single row (non-replicated) observation and screening nurseries were planted in Karaj, Varamin, Isfahan, Shiraz, Ahwaz, Sanandaj, Resht, Gorgan, Sari and Meshed (for locations, see Figure 1). At Karaj, this nursery was made up of introductions from U. S. Department of Agriculture sources, the Food and Agriculture Organization of the United Nations, and from Pakistan, Turkey, and U. A. R. It also contained germplasm obtained from the Iranian Ministry of Agriculture. This nursery was conducted completely by Project personnel.

At all other locations, the single row nurseries were part of the Ministry of Agriculture pulse crop program and conducted by the Ministry Seed Improvement Institute, although financial support was given by the Regional Pulse Improvement Project under the terms of its Cooperative Agreement with the Ministry. These nurseries contained only local germplasm. There was little communication and exchange of ideas between Ministry and Project personnel in 1965 in connection with the work at these locations. A greater rapport has been established, and for 1966, it is hoped that the work can be better coordinated.

Karaj is the location of the Agricultural College of the University of Tehran, and technical headquarters of the Regional Pulse Improvement Project. It is located about 45 kilometers west of Tehran at the base of the Alborz mountain range, at a north latitude of about 36 degrees, and east longitude of about 51 degrees. Altitude is about 4,000 feet above sea level. Average annual precipitation is around 250 millimeters in the form of rain in late fall and early spring, and snow between December and February. The summer weather is characteristically hot and dry, with no appreciable precipitation between May and October. Karaj has a frost-free season of about seven months. The soil types and characteristics are discussed in the section on soils and

crop management research of this report. Pulse crops are grown under irrigation during the summer months. Lentils and chickpeas are sometimes planted in the fall, but mostly in early spring (March). Cowpeas, dry beans, and mungbeans are planted somewhat later (late April and May).

Varamin is the location of the main station of the Ministry of Agriculture's Seed Improvement Institute. It is located about 45 kilometers southeast of Tehran at the northern fringe of the Great Desert (Kavir Lut), latitude about 36 degrees, longitude about 51 degrees. The altitude is about 3,000 feet above sea level, approximately 1,000 feet lower than Karaj. Average annual precipitation is less than 200 millimeters, with about the same distribution as in Karaj. In general, the temperature in summer is about 3 to 4° C. higher than Karaj, and the frost-free season is somewhat longer. The soils in the Varamin region are heavier and there is a greater salt problem than in Karaj. All crops are grown under irrigation, and customary planting dates are about the same or slightly earlier than in Karaj.

Pahlavi University is located in Shiraz. Cooperative yield trials were conducted there with the College of Agriculture. A separate Cooperative Agreement is being drawn up to extend cooperative research in all disciplines represented in the Pulse Improvement Project. Shiraz is located about

900 kilometers south of Tehran, at 29 degrees latitude and 52 degrees longitude, and has an altitude of about 5,200 feet above sea level. It is in the sub-humid region with an average rainfall of about 300 millimeters. It has a more even climate, less extreme in heat in summer, and milder in winter.

The Pahlavi University experimental farm is in Bajgah, some 25 kilometers north of Shiraz. Its altitude is about 250 meters (about 800 feet) higher than Shiraz. This altitude, in addition to location characteristics as a result of two mountain ranges in between which the Bajgah valley lies, make this location rather different and atypical of most of the region. Often, groundfrosts occur later in spring and earlier in the fall, and strong, dessicating winds often occur during the summer months. The Ministry of Agriculture research station is also located in Bajgah.

Dezful is in Khuzistan province, where irrigated agriculture is being developed with the construction of large dams on the Dez and Karoun rivers. The area is being developed with technical assistance and under guidance of the Khuzistan Development Service. A pilot research farm is located in Dezful about 80 miles north of Ahwaz. Cooperative yield evaluation trials were conducted in Dezful. It is located at 31 degrees north latitude, and 49 degrees east longitude at an elevation of about 70 feet above sea level. The area is characterized

by long, hot, dry summers (mean maximum temperature in August is about 120°F.) and no frost or a very rare frost in winter. Average annual rainfall is about 200 millimeters, with usually no precipitation occurring between May and September.

Following is a section dealing with trials conducted in Iran under the supervision of Regional Pulse Improvement Project personnel. Although trials in the different crops were conducted also by the Ministry of Agriculture, no results have been made available.

CHICKPEAS (*Cicer arietinum*)

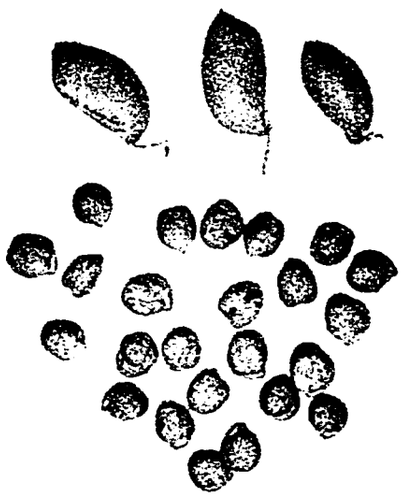
Chickpeas are of considerable importance in all countries of the Near East-South Asia area. There are three main types, based on characteristics and end use of the seed (Figure 2). The rather angular and pointed shape of chickpea seed was the source of the species designation arietinum, which means "similar to a ram's head".

The first class of chickpeas is large-seeded (about 25-35 grams per 100 seeds). The seed is white to cream colored, and it is used almost exclusively for cooking as a vegetable and with rice.

The second type has a smaller seed (15-25 grams per 100 seeds), which is also from white to cream in color. It is used primarily for roasting and eating out of hand, as Americans eat popcorn. The most common chickpea type grown in Pakistan and India has this seed size, but is usually darker in color.

The third type is a very small-seeded type (8-12 grams per 100 seeds). The seed has a reddish-brown or black seed coat which is normally removed. The yellow-green split seed is then used as a vegetable. In Iran, the black-seeded varieties of this type are normally used. The reddish-brown type, which is very common in Pakistan and India, is only used to a limited extent in the eastern sections of Iran.

There is very little difference in vegetative character-



istics of these three types. In general, plants of the large seeded types are somewhat larger. There are indications that there is greater resistance to such diseases as Peronospora (mildew) and Fusarium (wilt) in the smaller colored seeded types.

The following chickpea trials were conducted in 1965:

I. Yield Tests - Replicated yield evaluation tests were planted at Karaj, Varamin, Shiraz, and Dezful. Tables 1 to 3 show the results. Each table is preceded by a legend explanation sheet. The test at Dezful was not planted until the fall of 1965, and so no data are available as yet. All tests were planted with hand planters in dry soil on raised beds and irrigated after planting. At Karaj, rows were 36 inches apart, while at Varamin and Shiraz, row width was half a meter, or 20 inches. The row width at Karaj was for convenience in taking notes and to keep plants in adjoining rows from growing together. Wherever crops are cultivated in rows, the half-meter row width is customary. Broadcast planting and irrigation in karts are still the common practice.

Fertilizer applications at Karaj included 200 kilograms per hectare of superphosphate as a broadcast pre-planting application, and an undetermined amount of ammonium phosphate dribbled in the row by hand in June. At Varamin, 100 kilograms of urea and 150 kilograms of superphosphate were applied on

Legend for Table 1

(1) Strain numbers refer to numbers assigned in 1964 introduction nursery. V-ch and K-ch are local populations from Varamin and Karaj, respectively, included for comparative purposes.

(2) Numbers in parentheses refer to Iran Ministry of Agriculture numbers; 6-digit numbers are P. I. numbers from New Crops Research Branch, U.S. Department of Agriculture, Beltsville, Md., U.S.A.

(3) Indicates variety name 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) Pu = Purple; W = White; WP = Mixed Colors.

(5) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(6) Planting date, April 1, 1965.

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

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

(9) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Disease symptoms not all identified. Major diseases suspected are Fusarium wilt and mosaic viruses.

(10) Bk = Black; Br = Brown; W = White; Cr = Cream; D = Dark; L = Light.

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

(12) L = Large, approximately 34 grams per 100 seeds.
M = Medium, approximately 27 grams per 100 seeds.
S = Small, approximately 20 grams per 100 seeds.
VS = Very small, approximately 9 grams per 100 seeds.

(13) Yield in grams per plot, 15 feet long, 36 inches between rows.
LSD, 5% = 164.7 grams
LSD, 1% = 218.8 grams
Coefficient of Variation = 29.9%.
Conversion factors:
Grams per plot to pounds per acre = 2.13.
Grams per plot to kilograms per hectare = 2.43.

TABLE 1

Agronomic Data, Regional Pulse Improvement Project
CHICKPEA Yield Test, Karaj, Iran, 1965.

| (1) Strain No. | (2) Source No. | (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 Com.Maturity | (9) Disease Rating 5/25 | 6/17 | 7/4 | 7/27 | (10) Seed Color | (11) Seeds P/Pod | (12) Seed Size | (13) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 331 | (32) | Cyprus | Pu | 1 | 55 | 85 | 124 | 1 | 2 | 2 | 3 | LBr | 1-2 | M | 747 |
| 329 | (37) | Karaj | Pu | 1 | 55 | 86 | 124 | 0 | 1 | 2 | 3 | LBr | 1-2 | M | 654 |
| 60 | | PKPS | Pu | 0 | 59 | 88 | 124 | 0 | 1 | 2 | 2 | LBr | 1-2 | L | 619 |
| 310 | (241) | Ghuchan | W | 1 | 53 | 87 | 120 | 1 | 1 | 2 | 3 | W | 1-3 | S | 569 |
| 332 | (217) | Torbat Heydari | W | 2 | 54 | 87 | 123 | 1 | 2 | 2 | 2 | W | 1-2 | M | 526 |
| 235 | 254869 | Spain | W | 1 | 57 | 86 | 119 | 0 | 1 | 2 | 3 | Cr | 1-2 | M | 497 |
| 307 | | Ghazvin | Pu | 2 | 54 | 85 | 119 | 1 | 1 | 3 | 2 | Bk | 1-3 | S | 467 |
| 3 | | PKPS | W | 1 | 56 | 87 | 123 | 1 | 1 | 3 | 3 | W | 1-2 | M | 452 |
| 225 | 249982 | Iran | W | 2 | 54 | 88 | 120 | 1 | 2 | 3 | 3 | W | 1-2 | L | 452 |
| 34 | | PKPS | W | 2 | 53 | 85 | 120 | 0 | 2 | 3 | 3 | W | 1-2 | M | 451 |
| 77 | | PKPS | W | 2 | 55 | 86 | 121 | 1 | 2 | 3 | 3 | W | 1-2 | M | 450 |
| 18 | | PKPS | W | 2 | 56 | 87 | 122 | 1 | 2 | 2 | 3 | W | 1 | M | 450 |
| 63 | | PKPS | W | 2 | 54 | 86 | 120 | 1 | 2 | 2 | 3 | Cr | 1-2 | S | 441 |
| 305 | | Ardabil | Pu | 2 | 57 | 85 | 115 | 0 | 1 | 2 | 2 | Bk | 2 | S | 431 |
| 306 | | Kermanshah | W | 2 | 53 | 86 | 119 | 1 | 2 | 3 | 3 | Cr | 1-2 | M | 428 |
| 231 | 251514 | Iran | Pu | 2 | 54 | 85 | 116 | 0 | 1 | 2 | 2 | Bk | 2 | VS | 418 |
| 309 | (230) | Nishapour | W | 2 | 53 | 85 | 119 | 1 | 2 | 3 | 3 | W | 1-2 | S | 411 |
| K-ch | | Karaj | W | 2 | 55 | 86 | 122 | 1 | 2 | 3 | 3 | W | 1-3 | L | 397 |
| 337 | | | W | 2 | 55 | 85 | 120 | 1 | 2 | 3 | 3 | Cr | 1-2 | M | 370 |
| 237 | 268376 | Afghanistan | W | 2 | 53 | 85 | 118 | 2 | 2 | 3 | 3 | W | 1-2 | S | 352 |
| 302 | | Ghazvin | W | 2 | 54 | 85 | 120 | 1 | 2 | 2 | 4 | W | 1-2 | M | 335 |
| 303 | | Azarshahr | Pu | 2 | 56 | 84 | 117 | 0 | 2 | 3 | 3 | Bk | 1-3 | VS | 328 |
| 93 | | PKPS | W | 2 | 59 | 86 | 117 | 0 | 2 | 3 | 2 | Cr | 1-2 | M | 292 |
| 13 | | PKPS | W | 2 | 57 | 85 | 120 | 1 | 2 | 3 | 3 | W | 1-2 | L | 278 |
| 96 | | PKPS | W | 2 | 57 | 83 | 117 | 1 | 2 | 4 | 4 | W | 1 | L | 172 |

Legend for Table 2

(1) Strain numbers refer to numbers assigned in 1964 introduction nursery. V-ch and K-ch are local populations from Varamin and Karaj, respectively, included for comparative purposes.

(2) Numbers in parentheses refer to Iran Ministry of Agriculture numbers; 6-digit numbers are P. I. numbers from New Crops Research Branch, U.S. Department of Agriculture, Beltsville, Md., U.S.A.

(3) Indicates variety name 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) Pu = Purple; W = White; WP = Mixed colors.

(5) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(6) Planting date, April 3, 1965. First Mature Pod indicates first pod to reach full maturity, ready for harvest.

(7) Complete Maturity indicates whole plot ready for harvest.

(8) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Disease symptoms not all identified. Major diseases suspected are Fusarium wilt and mosaic viruses.

(9) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Powdery mildew appeared late in season during maturation.

(10) Bk = Black; Br = Brown; W = White; Cr = Cream; D = Dark; L = Light.

(11) Seeds Per Pod vary. Indicated here is range.

(12) L = Large, approximately 34 grams per 100 seeds.
M = Medium, approximately 27 grams per 100 seeds.
S = Small, approximately 20 grams per 100 seeds.
VS = Very small, approximately 9 grams per 100 seeds.

(13) Yield in grams per plot, 15 feet long, 20 inches wide.
LSD, 5% = 107.9 grams
LSD, 1% = 143.3 grams
Conversion factors:
Grams per plot to pounds per acre = 3.83.
Grams per plot to kilograms per hectare = 4.37.

TABLE 2

Agronomic Data, Regional Pulse Improvement Project
CHICKPEA Yield Test, Varamin, Iran, 1965.

| (1) Strain No. | (2) Source No. | (3) Source | (4) Flower Color | (5) Stand & Vigor | (6) Days from Planting to 1st Mat.Pod | (7) Days from Planting to Com.Maturity | (8) Disease Rating General | (9) Disease Rating Powdery Mildew | (10) Seed Color | (11) Seeds P/Pod | (12) Seed Size | (13) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 305 | | Ardabil | Pu | 2 | 77 | 108 | 1 | 3 | Bk | 1-2 | VS | 570 |
| 331 | (32) | Cyprus | Pu | 1 | 74 | 107 | 1 | 2 | LBr | 1-2 | M | 548 |
| 307 | | Ghazvin | Pu | 1 | 76 | 107 | 1 | 3 | Bk | 2 | VS | 539 |
| 329 | (37) | Karaj | WP | 1 | 77 | 108 | 1 | 3 | LBr | 1-3 | M | 502 |
| 309 | | Nishapour | W | 1 | 76 | 107 | 1 | 2 | W | 1-2 | S | 494 |
| 231 | 251514 | Iran | Pu | 1 | 76 | 107 | 2 | 3 | Bk | 1-3 | VS | 478 |
| V-ch | | Varamin | WP | 1 | 77 | 107 | 1 | 2 | LBr | 1-2 | M | 477 |
| 3 | | PKPS | W | 1 | 75 | 106 | 2 | 3 | Cr | 1-2 | M | 458 |
| 80 | | PKPS | Pu | 2 | 78 | 107 | 1 | 2 | LBr | 1-2 | L | 450 |
| 34 | | PKPS | W | 1 | 75 | 106 | 2 | 3 | Cr | 1-2 | M | 442 |
| 303 | | Azarshahr | Pu | 2 | 78 | 105 | 2 | 3 | Bk | 1-3 | VS | 439 |
| 310 | (241) | Ghuchan | W | 2 | 75 | 107 | 3 | 3 | W | 1-3 | S | 435 |
| 1 | | PKPS | W | 1 | 75 | 106 | 2 | 3 | Cr | 1-2 | M | 433 |
| 225 | 249982 | Iran | W | 2 | 77 | 107 | 1 | 3 | W | 1-2 | L | 430 |
| 332 | (217) | Torbat Heydari | WP | 1 | 76 | 107 | 1 | 2 | LBr | 1-3 | M | 417 |
| K-ch | | Karaj | W | 2 | 75 | 107 | 2 | 3 | W | 1-2 | L | 414 |
| 237 | 268376 | Afghanistan | WP | 2 | 75 | 107 | 1 | 3 | LBr | 1-2 | M | 401 |
| 93 | | PKPS | W | 2 | 76 | 106 | 1 | 3 | Cr | 1-2 | M | 399 |
| 15 | | PKPS | W | 1 | 79 | 107 | 2 | 2 | Cr | 1-2 | M | 393 |
| 96 | | PKPS | W | 1 | 75 | 107 | 1 | 3 | W | 1-2 | L | 387 |
| 77 | | PKPS | W | 1 | 76 | 105 | 2 | 3 | Cr | 1-2 | M | 373 |
| 306 | | Kermanshah | W | 3 | 76 | 108 | 2 | 2 | W | 1-2 | M | 373 |
| 63 | | PKPS | W | 2 | 78 | 107 | 2 | 2 | Cr | 1 | S | 361 |
| 302 | | Ghazvin | W | 2 | 77 | 106 | 2 | 2 | W | 1-2 | M | 361 |
| 13 | | PKPS | W | 2 | 76 | 107 | 2 | 2 | W | 1-2 | L | 347 |
| 5 | | PKPS | W | 2 | 75 | 107 | 2 | 3 | W | 1 | M | 335 |

Legend for Table 3

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

(2) Numbers in parentheses refer to Iran Ministry of Agriculture numbers; 6-digit numbers are P. I. numbers from New Crops Research Branch, U. S. Department of Agriculture, Beltsville, Maryland, U. S. A.

(3) Indicates variety name or country of origin.

(4) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(5) Rating 0 to 5; 0 = Free from any symptoms; 5 = Severe symptoms. P = Powdery Mildew; M = Mosaic virus.

(6) Number of seeds per pod vary. Indicated here is range.

(7) Bk = Black; W = White.

(8) Yield in grams per plot, 15 feet long, 20 inches between rows.
LSD, 5% = 86.0 grams
LSD, 1% = 115.2 grams
Coefficient of Variation = 13.9%.

Conversion factors:
Grams per plot to pounds per acre = 3.83.
Grams per plot to kilograms per hectare = 4.37.

TABLE 3

Agronomic Data, Regional Pulse Improvement Project
CHICKPEA Yield Test, Shiraz, Iran, 1965.

| (1) Strain Number | (2) Source Number | (3) Source | (4) Stand | (4) Vigor | (5) Disease Rating P (7/29) | (5) Disease Rating M | (6) Seeds/Pod | (7) Seed Color | (8) Yield |
|---|---|---|---|---|---|---|---|---|---|
| 329 | (37) | Karaj | 1 | 1 | 1 | 1 | 1-2 | W | 553 |
| 331 | (32) | Cyprus | 1 | 1 | 1 | 1 | 1-2 | W | 549 |
| 309 | (230) | Nishapour | 1 | 2 | 2 | 1 | 1-2 | W | 547 |
| 310 | (241) | Ghuchan | 1 | 1 | 2 | 1 | 1-2 | W | 522 |
| 231 | 251514 | Iran | 1 | 2 | 1 | 1 | 1-2 | Bk | 518 |
| 307 | | Ghazvin | 1 | 2 | 2 | 1 | 1-2 | Bk | 512 |
| 332 | (217) | Torbat Heydar-1 | | 1 | 2 | 1 | 1-2 | W | 504 |
| 237 | 268376 | Afghanistan | 1 | 1 | 2 | 1 | 1-2 | W | 492 |
| 302 | | Ghazvin | 1 | 1 | 3 | 1 | 1-2 | W | 478 |
| Check | | Karaj | 1 | 2 | 3 | 1 | 1-2 | W | 456 |
| 305 | | Ardabil | 1 | 2 | 1 | 0 | 1-2 | Bk | 452 |
| 303 | | Azarshahr | 1 | 2 | 1 | 1 | 1-2 | Bk | 435 |
| 337 | | Unknown | 1 | 2 | 4 | 1 | 1 | W | 413 |
| 306 | | Kermanshah | 1 | 3 | 3 | 1 | 1-2 | W | 394 |

June 1. During the four preceding years, this field had had an average of 300 kilograms of phosphate and 200 kilograms of nitrate fertilizer per hectare.

If yielding ability is of prime interest, it is of interest that at all three locations, several strains performed better than the Karaj and Varamin check varieties. Strains 307, 329, and 331 performed well at all locations.

Because of the different purposes for which the seed of the three main types is used, it is planned to conduct separate trails for each type in the future.

II. Observation Nurseries - The nursery at Karaj consisted of 3,154 single, non-replicated rows, 10 feet long. A listing of the material in this nursery was included in the appendix of Progress Report No. 2. Detailed notes have been taken on emergence, plant vigor, flowering data, flower color, fruiting period, pod size and shape, seed color and size, and disease susceptibility. Because of the bulk these data would add to this report, they will not be presented here. A separate summary is being compiled, which will be made available to interested parties.

The Ministry of Agriculture conducted separate nurseries of local types at Varamin and other locations in Iran, results of which have not been made available yet.

COWPEAS (*Vigna sinensis*)

Cowpeas are not grown as widely as chickpeas. They are grown in many areas of Iran in mixed culture or on the raised irrigation borders (bunds) around melons, cotton, or other crops. The only type encountered so far has been a small-seeded, black-eyed type. They are generally planted in late May or June, and are quite late in maturity. The Persian cowpea is called *lubia cheshm bolboli*, which means "beans with the eye of a nightingale". They are eaten cooked, mixed with rice, and in soup, often together with lentils and other vegetables.

The following trials with cowpeas were conducted in 1965:

I. Yield Tests - Replicated yield evaluation tests were planted at Karaj, Varamin, Shiraz, and Dezful. Tables 4 to 6 show the results.

Partly because of germination problems resulting in very poor stands, the results of the test at Shiraz were so variable and yields so low, that they were not considered indicative of the performance ability of the strains tested. These results are therefore not reported.

Procedures for soil preparation, fertilizer applications, planting methods, etc. at Karaj and Varamin were the same as for chickpeas. A row width of 36 inches, or one meter (40 inches), appears to be the minimum required in row culture particularly

Legend for Table 4

(1) Strain number refers to number assigned in 1964 introduction nursery. K-ch is local population from Karaj, included for comparative purposes.

(2) Source number refers to P. I. numbers from New Crops Research Branch, U.S.Department of Agriculture, Beltsville, Maryland, U.S.A. "C" numbers are strains obtained from Oklahoma State University.

(3) Indicates variety name or country of origin.

(4) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(5) P = Prostrate; E = Erect; SE = Semi-erect; B = Bush type; PB = Prostrate Bush type.

(6) Planting date, May 4, 1965.

(7) First pod stage is when first pod reaches full size, ready for green harvest.

(8) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Disease symptoms not all identified. Major diseases suspected are Fusarium root rot and mosaic viruses.

(9) P = Purple; W = White; WP = Mixed colors.

(10) S = Straight; C = Curved.

(11) L = Light; D = Dark; Pu = Purple; P = Pink; Cr = Cream; W = White; Y = Yellow.

(12) L = Large; S = Small; M = Medium.

(13) Average number from five pods per replication.

(14) L = Large, approximately 24 grams per 100 seeds.
M = Medium, approximately 15 grams per 100 seeds.
S = Small, approximately 8 grams per 100 seeds.

(15) Cr = Cream; Pu = Purple; P = Pink; M = Milky; Bk = Black; Br = Brown; G = Green; Sp = Spotted; Bl = Blue; W = White; Y = Yellow; R = Red.

(16) Bk = Black; Br = Brown; G = Green; Y = Yellow; R = Red; Pu = Purple; W = White; D = Dark; L = Light.

(17) Rating 1 to 5; 1 = Number loss of seed from shattering in field; 5 = Shattering loss severe.

(18) Yield in grams per plot, 15 feet long, 36 inches wide.
LSD, 5% = 269.6 grams
LSD, 1% = 355.8 grams
Coefficient of Variation = 29.5%.

Conversion factors:
Grams per plot to pounds per acre = 2.13.
Grams per plot to kilograms per hectare = 2.43.

Agronomic Data, Regional Pulse Improvement Project
COWPEA Yield Test, Karaj, Iran, 1965.

TABLE 4

| (1) Strain No. | (2) Source No. | (3) Variety or Source | (4) Stand & Vigor | (5) Plant Type | (6) Days from Planting to 1st Flower | (7) Days from Planting to 1st Mat.Pod | (8) Disease Rating 6/26 | 7/11 | 7/20 | 8/28 | (9) Flower Color | (10) Pod Shape | (11) Pod Color | (12) Pod Size | (13) Seeds P/Pod | (14) Seed Size | (15) Seed Color | (16) Eye Color | (17) Shat-tering | (18) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | 181833 | Lebanon | 3.4 | P | 65 | 80 | 2.9 | 2.6 | 2.0 | 2.5 | W | C | DY | M | 10 | M | CrP | Br | 2.0 | 1125 |
| 175 | 271257 | India | 3.0 | B | 61 | 82 | 2.8 | 2.1 | 1.5 | 1.5 | W | C | WY | M | 9 | M | CrP | Br | 2.0 | 1029 |
| 41 | 173827 | Turkey | 2.9 | E | 71 | 87 | 3.0 | 2.2 | 1.0 | 1.0 | P | S | P | ML | 14 | M | CrG | DY | 1.0 | 998 |
| 195 | 293459 | Blackeye #7 | 3.6 | B | 61 | 76 | 3.0 | 2.2 | 2.0 | 2.0 | W | S | YW | M | 9 | L | CrW | Bk | 1.8 | 991 |
| 44 | 175959 | Turkey | 3.0 | SE | 66 | 84 | 3.0 | 2.9 | 1.1 | 1.0 | P | S | P | L | 15 | M | CrP | Br | 0.8 | 984 |
| 177 | 271259 | India | 3.0 | E | 71 | 88 | 2.6 | 1.4 | 1.0 | 1.5 | P | S | CrP | L | 14 | ML | P | Br | 0.4 | 957 |
| 206 | 293470 | Brown Eye Cream | 3.5 | B | 72 | 93 | 3.0 | 2.0 | 1.2 | 1.0 | P | S | PY | M | 13 | S | CrG | Pu | 1.6 | 952 |
| 151 | 255765 | Nigeria | 3.7 | PB | 60 | 74 | 3.0 | 2.8 | 2.8 | 3.0 | W | S | PY | ML | 11 | ML | CrW | Bk | 1.6 | 952 |
| K-ch | | | 2.0 | SE | 71 | 87 | 2.6 | 1.9 | 2.0 | 2.0 | WP | S | Y | ML | 10 | ML | CrW | Bk | 2.0 | 930 |
| 301 | 293571 | Swanee | 3.0 | E | 71 | 82 | 3.0 | 2.0 | 1.0 | 1.0 | W | S | P | ML | 14 | M | CrP | LG | 1.0 | 926 |
| 50 | 179555 | Turkey | 2.8 | B | 64 | 76 | 2.6 | 2.6 | 2.0 | 2.0 | W | C | YW | ML | 10 | L | CrW | PuBr | 1.6 | 925 |
| 54 | 182316 | Turkey | 3.4 | SE | 72 | 87 | 2.9 | 2.4 | 1.0 | 1.0 | P | S | P | ML | 12 | M | CrP | Br | 1.4 | 895 |
| 249 | 293419 | Inst. #0154 | 3.0 | P | 64 | 76 | 3.0 | 2.1 | 1.4 | 1.1 | P | S | CrY | L | 13 | M | SpBl | Br | 1.8 | 886 |
| 266 | 293536 | Monarch | 3.7 | B | 64 | 78 | 3.1 | 2.2 | 1.4 | 2.0 | W | C | PY | M | 13 | M | CrW | Bk | 3.0 | 864 |
| 300 | 293570 | Speckled Purple Hill | 3.1 | B | 69 | 80 | 3.0 | 2.4 | 2.4 | 1.4 | P | S | Pu | ML | 13 | ML | SpBl | LG | 1.6 | 860 |
| 325 | C-642 | Princess Ann | 3.0 | B | 64 | 75 | 3.4 | 2.8 | 2.0 | 2.6 | W | S | DY | ML | 9 | L | CrW | Bk | 1.8 | 834 |
| 136 | 277829 | Guatemala | 3.0 | BP | 73 | 89 | 3.2 | 2.4 | 1.9 | 1.1 | P | S | YW | ML | 15 | M | SPBl | Br | 1.0 | 819 |
| 255 | 293525 | Jackson Purple Hill | 4.0 | BP | 67 | 82 | 3.6 | 3.0 | 2.2 | 1.3 | W | S | Pu | L | 12 | M | Cr | RBr | 1.8 | 818 |
| 327 | | | 3.1 | B | 70 | 77 | 3.1 | 2.8 | 2.0 | 2.8 | W | S | Y | MS | 11 | S | CrP | GBr | 2.6 | 809 |
| 308 | 293581 | Victor | 3.0 | SE | 72 | 89 | 2.9 | 1.2 | 1.0 | 1.1 | P | S | YW | M | 14 | M | SpG | Bk | 1.4 | 802 |
| 215 | 293480 | Calra | 3.1 | B | 61 | 75 | 3.0 | 3.0 | 2.1 | 3.0 | W | S | YP | ML | 10 | ML | MW | Bk | 1.8 | 787 |
| 305 | 293575 | Texas Cream-40 | 3.2 | B | 69 | 84 | 4.0 | 3.0 | 3.2 | 2.2 | W | S | Y | M | 11 | M | Cr | Br | 2.6 | 757 |
| 210 | 293474 | Cabbage Pea | 3.2 | B | 64 | 79 | 3.4 | 3.0 | 2.0 | 2.0 | W | C | CrY | M | 9 | M | CrW | GBr | 2.2 | 755 |
| 338 | | | 3.1 | B | 68 | 76 | 3.0 | 2.4 | 2.0 | 2.0 | W | S | Y | MS | 10 | S | CrP | GBr | 3.8 | 750 |
| 232 | 293499 | Davis Pea | 3.0 | B | 65 | 74 | 3.0 | 2.4 | 2.0 | 1.4 | P | S | Pu | ML | 13 | M | P | GBr | 1.8 | 741 |
| 76 | 139230 | Bel. Congo | 3.0 | SE | 67 | 80 | 2.9 | 2.1 | 1.2 | 1.0 | P | S | YP | M | 12 | M | Bk | Bk | 3.4 | 733 |
| 166 | 255811 | Nigeria | 3.4 | P | 65 | 79 | 3.0 | 3.4 | 3.1 | 3.3 | P | C | Pu | ML | 10 | M | SpBr | Br | 1.8 | 732 |
| 194 | 293458 | Blackeye | 3.2 | B | 59 | 75 | 3.9 | 2.6 | 2.4 | 2.1 | W | S | Y | M | 10 | L | CrW | Bk | 1.8 | 729 |
| 170 | 262179 | Portugal | 3.0 | B | 60 | 74 | 2.7 | 3.0 | 3.0 | 3.2 | W | S | WY | M | 10 | M | CrW | Bk | 2.6 | 727 |
| 189 | 293453 | Arlington | 3.9 | PB | 67 | 81 | 3.0 | 3.1 | 3.0 | 2.0 | W | C | CrY | M | 12 | S | Cr | Br | 2.4 | 693 |
| 302 | 293572 | Sumptuous | 3.0 | B | 77 | 86 | 3.0 | 2.8 | 2.0 | 2.2 | W | S | Y | ML | 12 | M | CrW | GBr | 1.6 | 687 |
| 163 | 255789 | Nigeria | 3.8 | B | 74 | 87 | 3.4 | 3.0 | 2.1 | 2.8 | P | S | Pu | M | 11 | ML | SpG | BkPu | 2.2 | 658 |
| 248 | 293518 | Honolulu | 3.0 | SE | 72 | 78 | 3.0 | 2.6 | 2.0 | 2.0 | WP | S | CrY | MS | 12 | MS | Bk | W | 4.0 | 654 |
| 149 | 253428 | Spain | 2.7 | B | 61 | 72 | 3.0 | 2.9 | 2.1 | 2.7 | W | S | CrY | ML | 9 | L | CrW | Bk | 2.8 | 632 |
| 214 | 293479 | California Hackeye #7 | 4.0 | B | 62 | 76 | 3.0 | 2.8 | 2.2 | 2.2 | W | C | YP | M | 9 | L | MW | Bk | 2.2 | 587 |
| 320 | C-312 | Texas Cream-#12 | 3.2 | B | 62 | 78 | 3.1 | 3.0 | 3.0 | 2.0 | W | C | CrW | M | 11 | M | CrW | GBr | 2.0 | 562 |
| 263 | 293533 | Long Pod Cream | 3.1 | B | 72 | 87 | 3.1 | 2.8 | 2.2 | 2.1 | W | S | CrWY | ML | 10 | ML | CrW | Br | 2.0 | 533 |
| 231 | 293498 | Cream White | 3.8 | SE | 63 | 74 | 3.2 | 3.0 | 2.4 | 2.0 | W | S | WY | ML | 8 | L | CrW | Br | 1.4 | 489 |
| 204 | 293468 | Brabham Victor | 3.0 | SE | 75 | 88 | 3.0 | 2.0 | 1.0 | 1.1 | P | S | CrYW | ML | 15 | M | SpBr GPu | Bk | 1.0 | 482 |
| 323 | C-620 | Topset | 4.5 | BP | 75 | 68 | 3.8 | 3.4 | 3.0 | 3.0 | W | S | PY | MS | 11 | MS | CrWP | GBr | 2.0 | 397 |
| 123 | 221731 | S. Africa | 4.0 | B | 75 | 85 | 3.4 | 3.6 | 3.9 | 3.8 | W | S | CrY | S | 9 | M | BrBk | RBr | 2.0 | 366 |
| 173 | 269667 | India | 3.9 | P | 62 | 75 | 3.6 | 2.9 | 3.0 | 2.8 | P | C | Y | MS | 9 | S | CrG | Br | 2.6 | 362 |
| 169 | 257463 | S. Africa | 3.6 | B | 61 | 73 | 3.6 | 3.6 | 3.4 | 3.4 | W | C | CrY | MS | 10 | M | RBr | Bk | 1.6 | 318 |
| 124 | 221732 | S. Africa | 4.0 | B | 61 | 74 | 3.4 | 3.6 | 3.7 | 3.8 | W | S | Y | MS | 10 | M | Br | GBr | 2.2 | 306 |
| 115 | 218123 | Pakistan | 3.7 | B | 58 | 73 | 2.3 | 3.9 | 3.8 | 4.0 | W | S | YBr | S | 10 | S | Cr | Br | 3.6 | 208 |

Legend for Table 5

(1) Strain numbers refer to number assigned in 1964 introduction nursery.

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

(3) Indicates variety name or country of origin.

(4) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(5) P = Prostrate; E = Erect; SE = Semi-erect; B = Bush type; PB = Prostrate Bush type.

(6) Planting date, May 5, 1965.

(7) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Disease symptoms not all identified. Major diseases suspected are Fusarium root rot and mosaic viruses.

(8) P = Purple; W = White; WP = Mixed colors.

(9) S = Straight; C = Curved.

(10) L = Light; D = Dark; Pu = Purple; P = Pink; Cr = Cream; W = White; Y = Yellow; G = Green.

(11) L = Large; S = Small; M = Medium.

(12) Average number from five pods per replication.

(13) L = Large, approximately 24 grams per 100 seeds.
M = Medium, approximately 15 grams per 100 seeds.
S = Small, approximately 8 grams per 100 seeds.

(14) Cr = Cream; P = Pink; M = Milky; Bk = Black; Br = Brown; G = Green; Sp = Spotted; Bl = Blue; W = White; Y = Yellow; R = Red; Pu = Purple.

(15) Bk = Black; Br = Brown; G = Green; Y = Yellow; R = Red; Pu = Purple; W = White; D = Dark; L = Light.

(16) Rating 1 to 5; 1 = Number loss of seed from shattering in field; 5 = Shattering loss severe.

(17) Yield in grams per plot, 15 feet long, 20 inches wide.
LSD, 5% = 225.5 grams
LSD, 1% = 297.7 grams
Coefficient of Variation = 44.5%.
Conversion factors:
Grams per plot to pounds per acre = 3.83.
Grams per plot to kilograms per hectare = 4.37.

Agronomic Data, Regional Pulse Improvement Project
COWPEA Yield Test, Varamin, Iran, 1965

TABLE 5

| (1) Strain No. | (2) Source No. | (3) Variety or Source | (4) Stand | (4) Vigor | (5) Plant Type | (6) Days from Planting to 1st Flower | (7) Disease Rating 7/6 | (7) 7/17 | (7) 7/31 | (7) 8/30 | (8) Flower Color | (9) Pod Shape | (10) Pod Color | (11) Pod Size | (12) Seeds P/Pod | (13) Seed Size | (14) Seed Color | (15) Eye Color | (16) Shattering | (17) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 232 | 293499 | Davis Pea | 2.0 | 1.6 | SE | 75 | 1.6 | 1.6 | 1.8 | 1.0 | P | S | LPu | ML | 10 | ML | CrP | Br | 3.2 | 730 |
| 215 | 293480 | Calra | 2.6 | 2.4 | B | 75 | 2.0 | 1.6 | 1.2 | 1.4 | W | S | YP | ML | 11 | ML | MW | Bk | 3.6 | 641 |
| 248 | 293518 | Honolulu | 2.0 | 1.8 | SE | 74 | 2.4 | 1.8 | 1.8 | 1.6 | P | S | Y | MS | 10 | ML | Br | W | 4.6 | 578 |
| 305 | 293575 | Texas Cream-#40 | 3.8 | 2.8 | B | 75 | 2.6 | 2.2 | 1.2 | 2.0 | W | S | YP | ML | 9 | ML | CrP | Br | 2.8 | 569 |
| 175 | 271257 | India | 2.2 | 1.8 | B | 76 | 1.2 | 2.4 | 2.0 | 1.6 | P | S | WP | ML | 11 | M | CrP | Br | 2.2 | 565 |
| 338 | | | 1.2 | 0.4 | E | 78 | 1.0 | 0.6 | 1.5 | 1.5 | P | S | Y | MS | 12 | MS | CrP | Br | 3.8 | 553 |
| 195 | 293459 | Blackeye #7 | 2.2 | 2.4 | B | 75 | 2.0 | 1.6 | 1.4 | 1.6 | WP | S | CrP | ML | 9 | L | MW | Bk | 1.0 | 543 |
| 53 | 181833 | Lebanon | 2.2 | 2.4 | P | 74 | 2.4 | 3.0 | 2.6 | 2.8 | P | C | YP | ML | 10 | ML | GCr | Br | 2.0 | 533 |
| 300 | 293570 | Speckled Purple Hill | 2.2 | 1.8 | B | 74 | 1.8 | 1.6 | 1.2 | 1.2 | WP | S | CrP | L | 11 | L | PuBr SpCr | Br | 0.6 | 533 |
| 249 | 293419 | Inst. #0154 | 2.0 | 1.4 | B | 77 | 1.2 | 2.0 | 1.8 | 1.8 | P | S | WCr | L | 10 | ML | SpPBr | Bk | 1.0 | 521 |
| 327 | | | 1.4 | 0.8 | E | 78 | 1.0 | 0.6 | 1.6 | 1.6 | W | S | Y | MS | 11 | MS | CrP | Bk | 4.0 | 518 |
| 149 | 253428 | Spain | 3.6 | 2.5 | B | 75 | 1.8 | 1.8 | 1.8 | 1.8 | W | S | YP | M | 8 | L | MW | Bk | 2.2 | 489 |
| 320 | C-312 | Texas Cream-#12 | 3.8 | 2.6 | B | 77 | 2.6 | 2.2 | 1.8 | 2.0 | WP | S | YCr | M | 12 | ML | CrW | YBr | 1.2 | 475 |
| 169 | 257463 | S. Africa | 4.0 | 2.8 | B | 75 | 2.4 | 2.4 | 1.6 | 2.2 | W | S | YCr | M | 9 | M | RBr | Bk | 1.4 | 474 |
| 204 | 293468 | Brabham Victor | 1.4 | 0.6 | E | 94 | 1.2 | 0.2 | 0.8 | 0.8 | WP | S | YP | ML | 13 | M | GCr | Br | 1.0 | 462 |
| 194 | 293458 | Blackeye #5 | 3.4 | 2.2 | SE | 76 | 2.2 | 1.8 | 2.0 | 2.4 | W | S | WP | M | 7 | L | MW | Bk | 1.2 | 448 |
| 50 | 179555 | Turkey | 2.6 | 2.6 | P | 75 | 1.6 | 1.2 | 1.8 | 1.8 | WP | S | YP | ML | 10 | L | CrW | Br | 1.6 | 426 |
| 44 | 175959 | Turkey | 1.0 | 0.2 | E | 79 | 1.0 | 0.2 | 0.6 | 0.6 | WP | S | PW | ML | 13 | M | CrP | YBr | 0.6 | 424 |
| 170 | 262179 | Portugal | 4.0 | 3.0 | B | 75 | 2.2 | 1.4 | 1.4 | 1.6 | W | S | YP | ML | 9 | L | Cr | Bk | 2.6 | 405 |
| 301 | 293571 | Swanee | 0.6 | 0.2 | E | 79 | 1.2 | 0.6 | 0.8 | 1.2 | W | S | WP | L | 14 | M | Cr | Br | 0.6 | 394 |
| 76 | 189230 | Bel. Congo | 1.2 | 0.8 | E | 76 | 1.6 | 1.2 | 2.2 | 2.2 | WP | S | WP | M | 11 | ML | Bk | W | 1.4 | 386 |
| 151 | 255765 | Nigeria | 3.4 | 2.6 | BP | 74 | 2.0 | 1.4 | 1.2 | 1.6 | P | S | YP | L | 11 | L | MW | Bk | 2.4 | 383 |
| 115 | 218123 | Pakistan | 4.0 | 2.2 | SE | 74 | 2.2 | 2.0 | 2.6 | 2.8 | W | S | LBr | MS | 10 | S | Cr | Br | 3.3 | 377 |
| 210 | 293474 | Cabbage Pea | 3.6 | 2.4 | SE | 76 | 2.0 | 1.4 | 1.0 | 1.2 | W | S | CrP | ML | 10 | ML | Cr | YBr | 1.6 | 372 |
| 263 | 293533 | Long Pod Cream | 2.2 | 2.2 | SE | 79 | 2.2 | 1.4 | 1.8 | 1.6 | W | S | WP | ML | 10 | ML | CrP | Br | 2.0 | 367 |
| 54 | 182316 | Turkey | 1.2 | 1.8 | E | 78 | 1.4 | 1.0 | 1.2 | 1.0 | W | S | WP | L | 12 | ML | CrP | LBr | 1.6 | 364 |
| 124 | 221732 | S. Africa | 4.0 | 3.0 | B | 74 | 3.0 | 2.2 | 2.2 | 2.6 | WP | C | Y | S | 7 | ML | CrW | Bk | 1.6 | 357 |
| 41 | 173827 | Turkey | 1.5 | 0.4 | E | 79 | 0.8 | 0.8 | 1.0 | 0.8 | P | S | P | ML | 11 | ML | CrG | YBr | 0.4 | 350 |
| 123 | 221731 | S. Africa | 4.8 | 3.4 | B | 74 | 3.2 | 1.6 | 1.8 | 1.8 | P | S | Y | S | 8 | MS | RCr | Bk | 1.6 | 347 |
| 206 | 293470 | Brown Eye Cream | 4.2 | 3.2 | PB | 89 | 1.8 | 1.0 | 0.6 | 0.8 | P | S | YW | M | 12 | M | Cr | Br | 1.0 | 342 |
| 163 | 255789 | Nigeria | 2.2 | 2.0 | SE | 79 | 1.2 | 1.0 | 1.2 | 1.4 | WP | S | CrP | L | 11 | ML | SpBr | Bk | 1.8 | 338 |
| 214 | 293477 | California Hackeye | 4.4 | 3.2 | BP | 76 | 2.6 | 1.8 | 1.6 | 1.8 | WP | S | Y | ML | 9 | L | WCr | Bk | 1.8 | 335 |
| 166 | 255811 | Nigeria | 2.2 | 3.0 | P | 76 | 2.8 | 2.6 | 2.6 | 2.0 | P | S | YP | ML | 11 | ML | SpBr | Y | 2.0 | 333 |
| 325 | C-642 | Princess Ann | 4.8 | 3.0 | SE | 75 | 2.6 | 2.2 | 1.8 | 1.8 | W | S | CrBr | L | 8 | L | Cr | Br | 0.8 | 320 |
| 255 | 293525 | Jackson Purple Hill | 4.8 | 3.2 | P | 77 | 2.6 | 2.2 | 1.4 | 1.2 | W | S | PBr | L | 10 | ML | CrR | Bk | 0.5 | 320 |
| 189 | 293453 | Arlington | 4.6 | 3.2 | P | 77 | 2.4 | 1.6 | 1.0 | 1.0 | W | S | YP | MS | 11 | S | CrY | Br | 2.4 | 315 |
| 308 | 293581 | Victor | 0.2 | 0.2 | E | 98 | 0.6 | 0 | 0.6 | 0.8 | P | S | YP | M | 13 | M | SpPuBl | Bk | 2.4 | 309 |
| 136 | 227829 | Guatemala | 2.0 | 1.8 | E | 87 | 1.6 | 1.0 | 1.2 | 1.2 | WP | S | YP | ML | 13 | M | GY | Br | 0.8 | 299 |
| 231 | 293498 | Cream White | 3.8 | 3.0 | B | 76 | 2.0 | 1.6 | 1.4 | 1.6 | W | S | YP | M | 7 | L | CrW | Br | 1.6 | 289 |
| 266 | 293536 | Monarch | 3.6 | 2.8 | B | 75 | 2.4 | 1.6 | 1.4 | 1.6 | W | S | CrP | ML | 11 | M | CrP | Bk | 4.2 | 284 |
| 173 | 269667 | India | 4.2 | 3.2 | B | 74 | 2.5 | 2.5 | 2.0 | 1.9 | P | C | YBr | MS | 11 | M | CrW | Br | 2.2 | 263 |
| 177 | 271259 | India | 1.2 | 0.8 | E | 85 | 1.4 | 0.9 | 0.8 | 1.4 | W | S | P | L | 11 | M | R | YBr | 1.0 | 245 |
| 302 | 293572 | Sumptuous | 4.4 | 2.8 | P | 79 | 2.0 | 1.4 | 0.8 | 1.0 | WP | S | YW | ML | 10 | L | CrW | Br | 1.4 | 233 |
| 323 | C-620 | Topset | 5.0 | 3.4 | B | 81 | 2.6 | 1.8 | 1.6 | 1.4 | W | S | YW | M | 12 | MS | CrW | YGBr | 0.4 | 115 |

Legend for Table 6

(1) Strain number refers to number assigned in 1964 introduction nursery.

(2) Source number refers to P. I. numbers from New Crops Research Branch, U. S. Department of Agriculture, Beltsville, Maryland, U. S. A.

(3) Indicates variety name or country of origin.

(4) Planting Date, May 31, 1965.

(5) Yield in kilograms per hectare. Figures are the average of five replications.

Conversion factor:
Kilograms per hectare to pounds per acre = 0.88.

TABLE 6

Agronomic Data, Regional Pulse Improvement Project
COWPEA Yield Test, Dezful, Iran, 1965.

| (1) Strain No. | (2) Source No. | (3) Variety or Source | (4) Days from Planting to First Flower | (5) Yield |
|---|---|---|---|---|
| 195 | 293459 | Blackeye #7 | 55 | 3195 |
| 232 | 293499 | Davis Pea | 61 | 2845 |
| 263 | 293533 | Long Pod Cream | 58 | 2695 |
| 115 | 218123 | Pakistan | 55 | 2680 |
| 210 | 293474 | Cabbage Pea | 59 | 2670 |
| 302 | 293572 | Sumptuous | 57 | 2610 |
| 325 | C-642 | Princess Ann | 46 | 2530 |
| 214 | 293479 | California Hackeye #7 | 55 | 2295 |
| 305 | 293575 | Texas Cream - 40 | 52 | 2215 |
| 300 | 293570 | Speckled Purple Hill | 60 | 2165 |
| 151 | 255765 | Nigeria | 55 | 2130 |
| 189 | 293453 | Arlington | 58 | 2055 |
| 320 | C-312 | Texas Cream - 12 | 58 | 2010 |
| 123 | 221731 | South Africa | 54 | 1985 |
| 169 | 257463 | South Africa | 56 | 1925 |
| 194 | 293458 | Blackeye | 55 | 1920 |
| 50 | 179555 | Turkey | 58 | 1910 |
| 170 | 262179 | Portugal | 54 | 1870 |
| 215 | 293480 | Calra | 57 | 1855 |
| 177 | 271259 | India | 60 | 1840 |
| 255 | 293525 | Jackson Purple Hill | 55 | 1830 |
| 204 | 293468 | Brabham Victor | 72 | 1825 |
| 173 | 269667 | India | 49 | 1805 |
| 53 | 181833 | Lebanon | 51 | 1775 |
| 266 | 293536 | Monarch | 53 | 1745 |
| 166 | 255811 | Nigeria | 58 | 1700 |
| 308 | 293581 | Victor | 80 | 1695 |
| 175 | 271257 | India | 53 | 1635 |
| 206 | 293470 | Brown Eye Cream | 68 | 1580 |
| 327 | | | 57 | 1575 |
| 124 | 221732 | South Africa | 54 | 1525 |
| 301 | 293571 | Swanee | 65 | 1515 |
| 76 | 189230 | Belgian Congo | 55 | 1500 |
| 249 | 293419 | Inst. #0154 | 57 | 1475 |
| 136 | 277829 | Guatemala | 65 | 1455 |
| 41 | 173827 | Turkey | 61 | 1340 |
| 323 | C-620 | Topset | 60 | 1285 |
| 248 | 293518 | Honolulu | 56 | 1260 |
| 54 | 182316 | Turkey | 67 | 1205 |
| 44 | 175959 | Turkey | 66 | 1160 |
| 338 | | | 59 | 1090 |
| 231 | 293498 | Cream White | 56 | 930 |

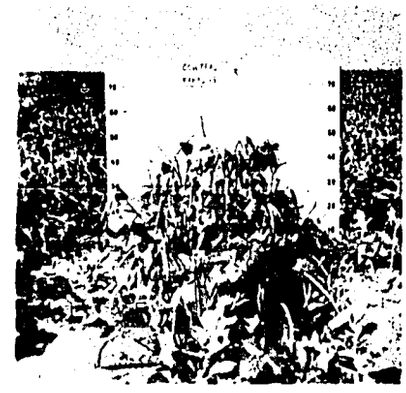
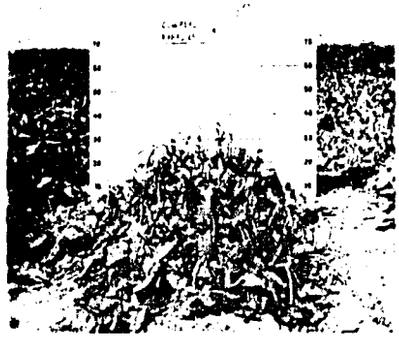
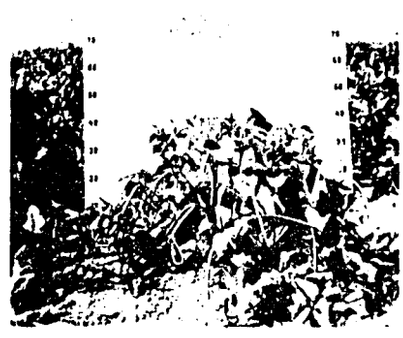
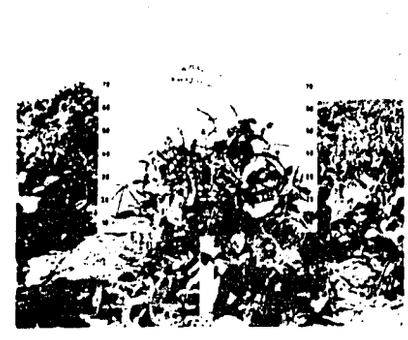
for testing purposes. When planted close together, the rows grow together, making the taking of notes and proper harvest methods very difficult. At Dezful, the cowpeas were planted in 40-inch rows, but with two rows planted on each bed. Considerable difficulty was encountered in germination and emergence of these tests at all locations. The reason for this is not known. All the seed for these tests was produced in 1964 in observation nurseries in Karaj except for the "Karaj check", which was seed bought in the local market at Karaj. It is of interest to note that the Karaj check had the highest stand and vigor rating in the Karaj yield test. At Karaj, crusting of the soil surface before seedling emergence created some problems. This was alleviated by repeated irrigations, and by mechanically breaking of the hard surface layers.

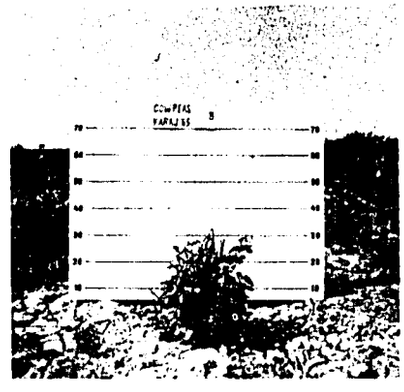
Figure 3 shows the variation in plant types among the strains tested in the yield tests. Because of the extended seed maturation period, the plots were hand-picked several times. The yields of each strain at each harvest date is shown in Figure 4. It indicates the potential for earlier maturity and shorter maturation period without a sacrifice in total yield.

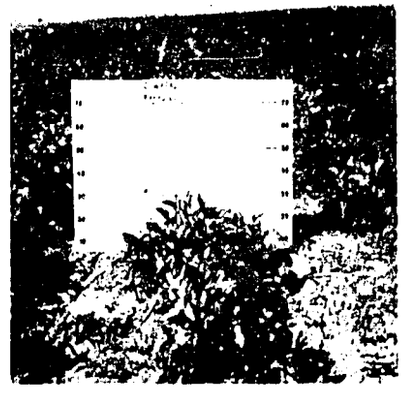
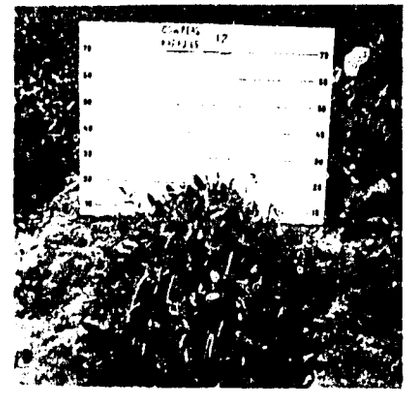
The data shown in Tables 4 to 6 indicate the wide range of agronomic characters occurring in this material. There was considerable divergence in yielding performance between the locations, part of which was undoubtedly due to stand problems.

Figure 3 - Plant types of 45 cowpea strains tested at Karaj, Iran, 1965.

Photographs taken August 11, 1965, 99 days after planting.



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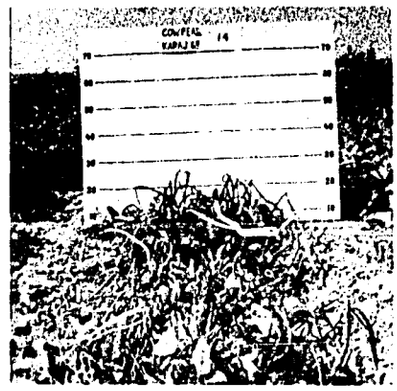
KARAJ 65
13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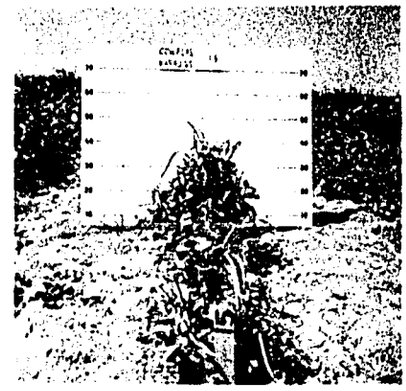

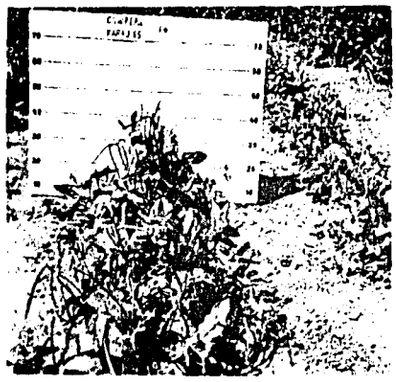

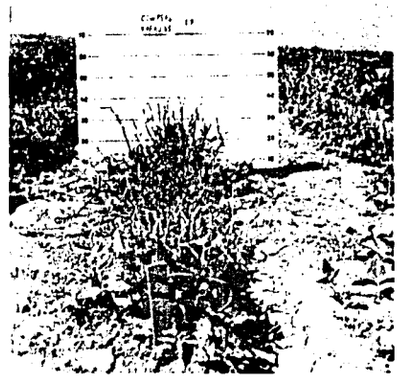

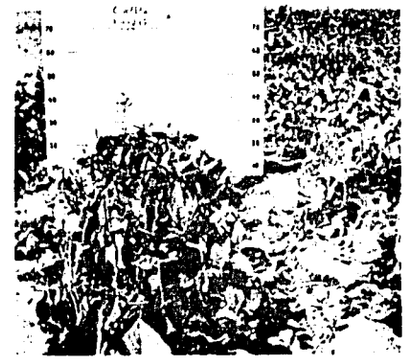

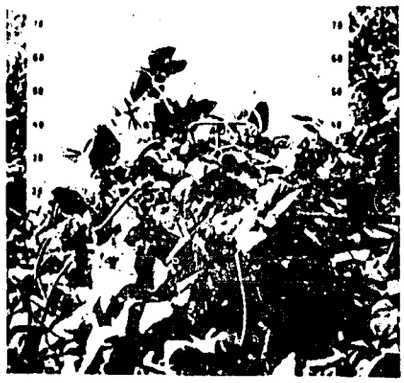

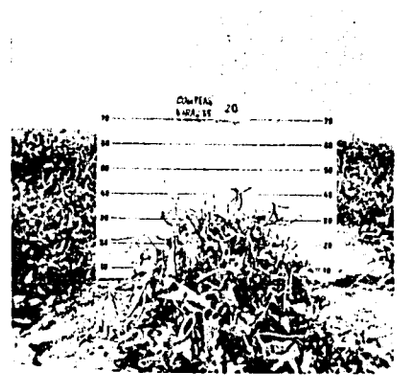
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KARAJ 65
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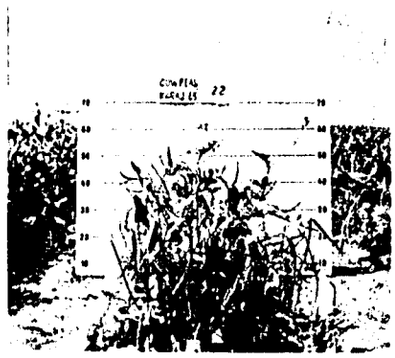
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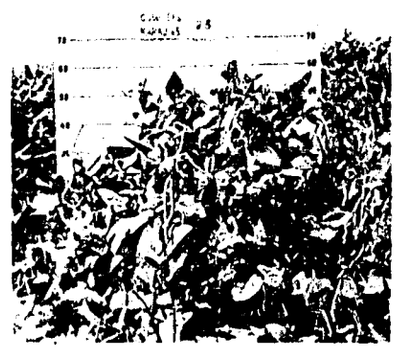

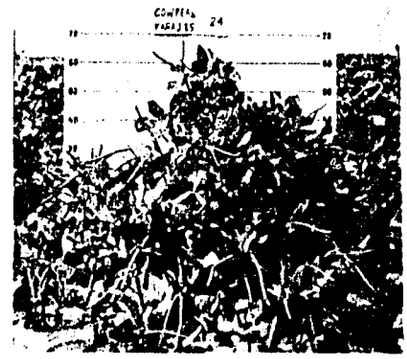
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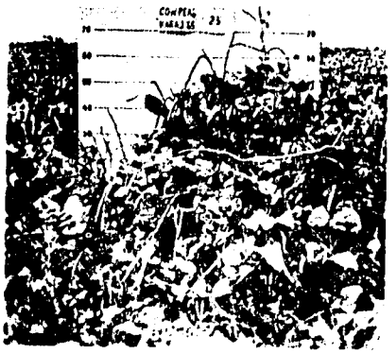
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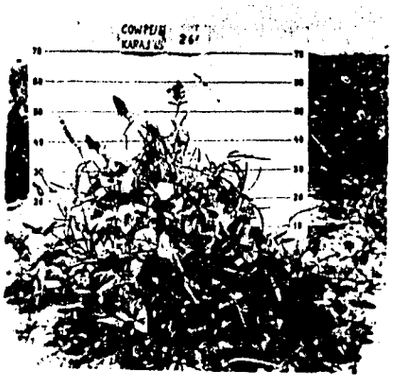
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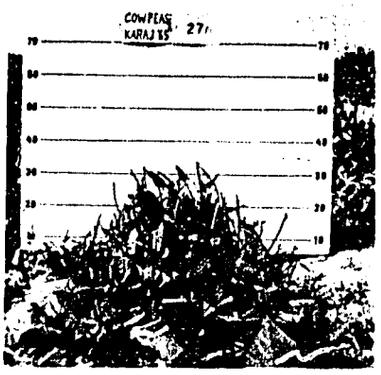
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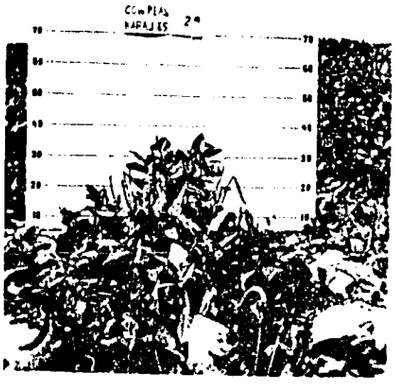
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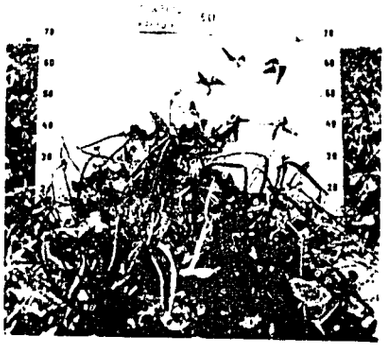

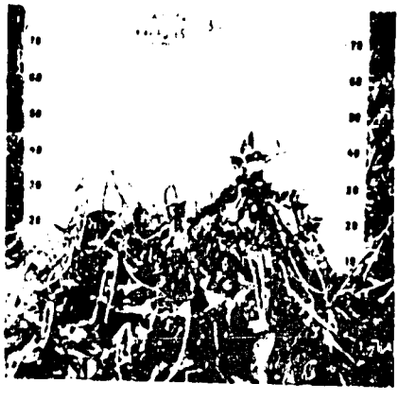

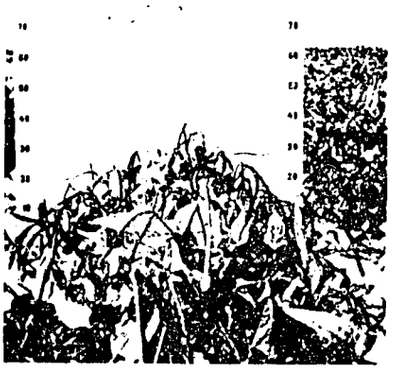

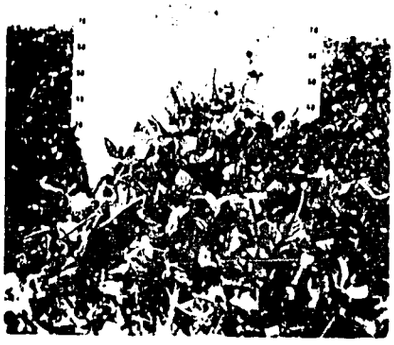

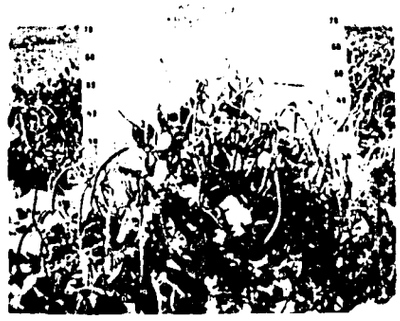

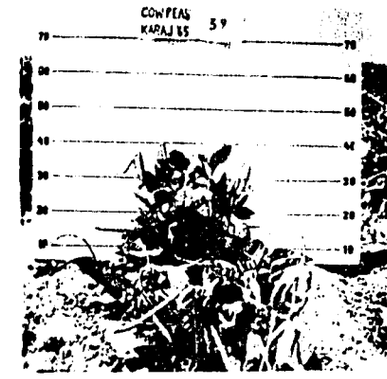
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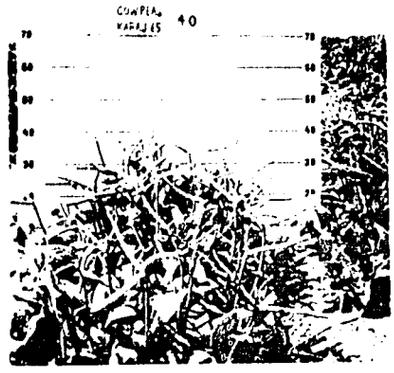
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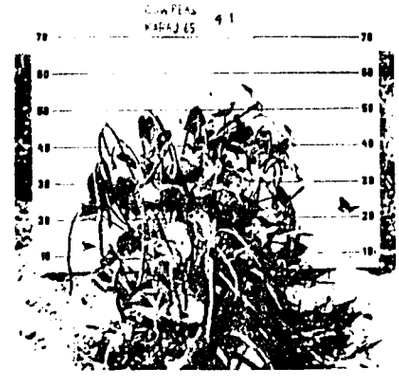
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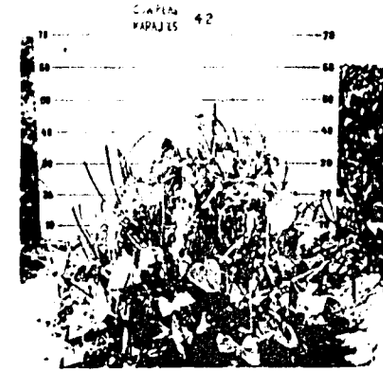
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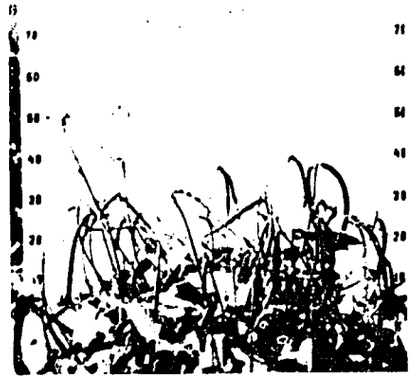

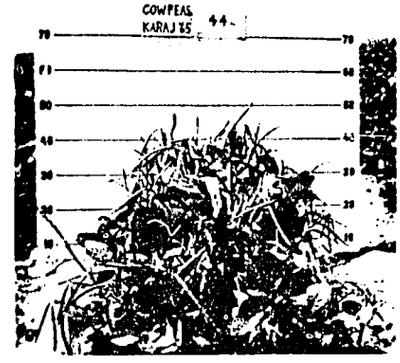
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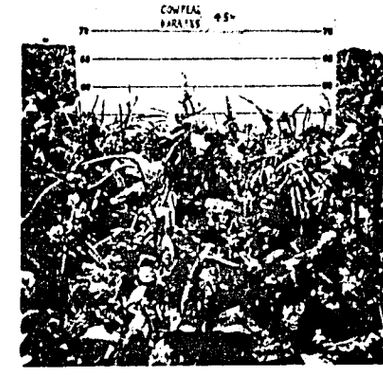
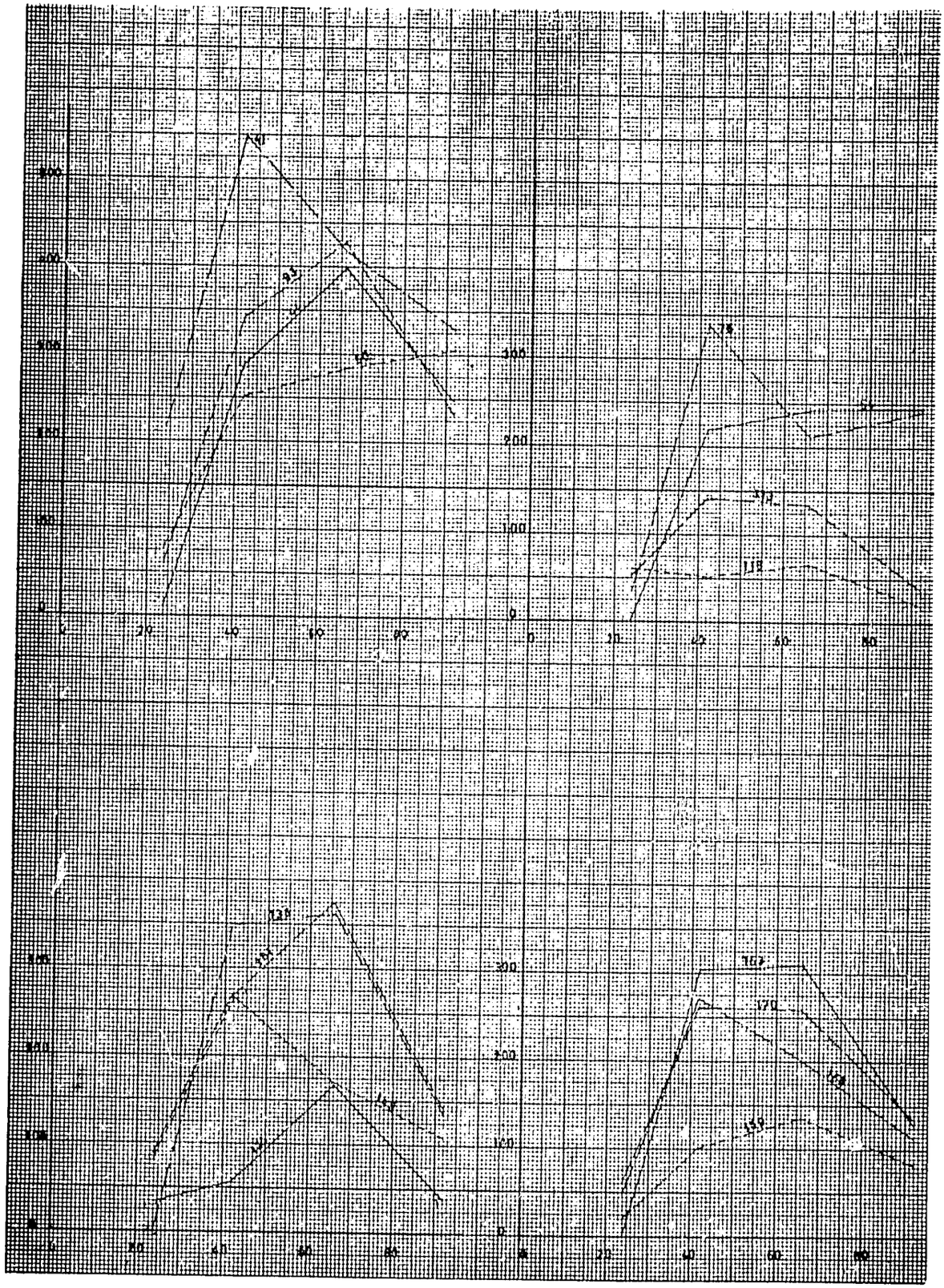
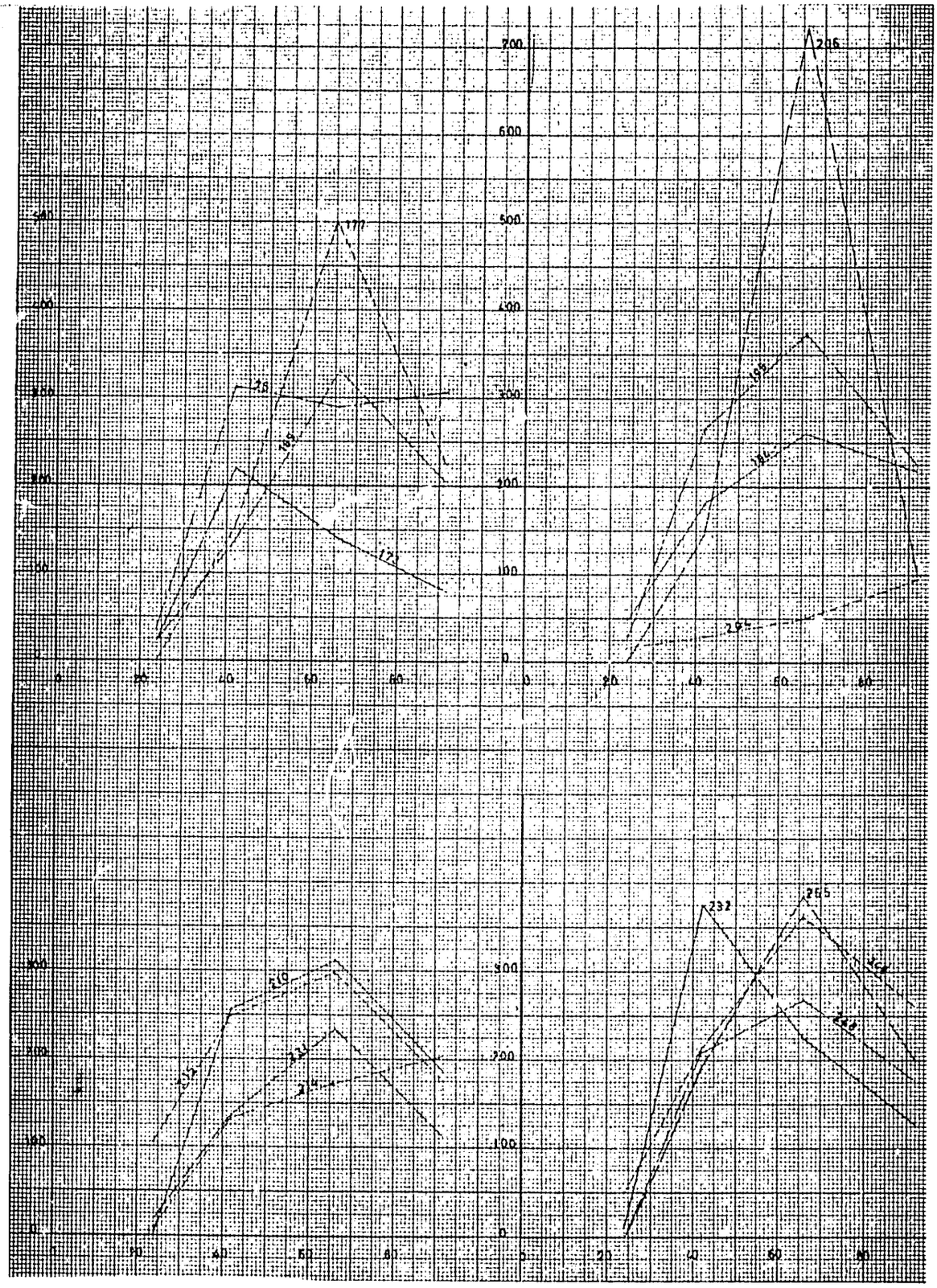
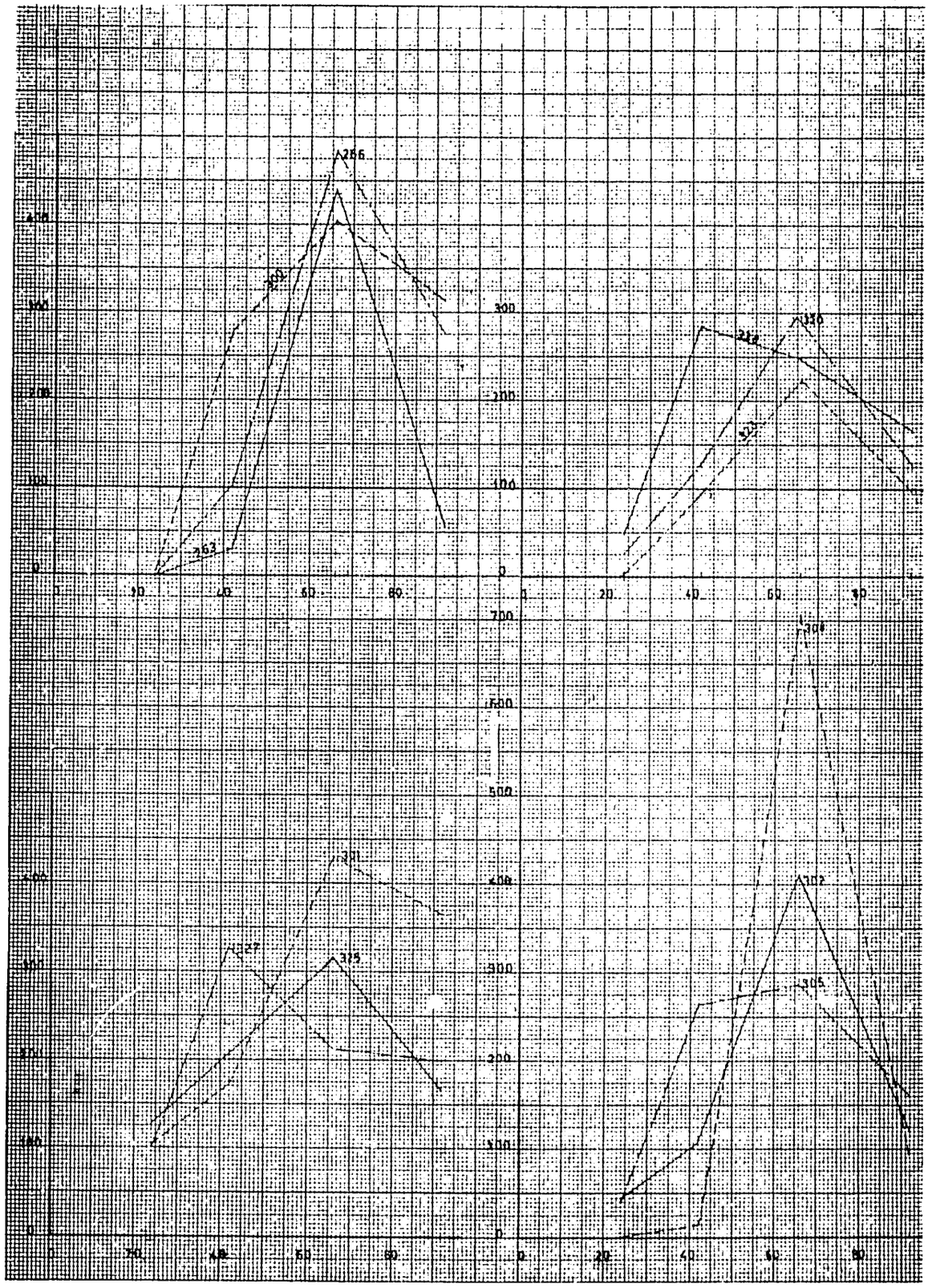

COWPEAS
45

Figure 4 - Yields of 45 strains of cowpeas at different harvest dates.

The ordinates indicate grams of seed per plot; the abscissas indicate harvest dates in days from July 1.




700
600
500
400
300
200
100
0
20
40
60
80
206
170
232
265


256
300
263
330
212
304
301
327
375
302
305

The high coefficients of variation reflect the many factors which contribute to the great variability occurring from uneven soil, land preparation, planting depth, irrigation and fertilizer applications to harvesting methods and seed loss. In spite of this, there appear to be several strains (Nos. 53, 175, 195, and 232) which performed well consistently.

II. Observation Nurseries - The nursery at Karaj consisted of 875 single, non-replicated rows, 10 feet long. A listing of the material in this nursery was included in the appendix of Progress Report No. 2.

As in chickpeas, detailed notes were taken which will be assembled in a separate summary, and made available to anyone interested in surveying a wide range of material.

In cowpeas, the Ministry of Agriculture also had separate nurseries of local types in Varamin and other locations.

BEANS (*Phaseolus vulgaris*)

Beans, both green, snap, or stringbeans, and dry beans, are of considerable importance in almost all countries of the Near and Middle East. In most instances, no varietal distinction is being made regarding final utilization. The same planting will most often be used for early season green harvest and later season dry seed harvest. They are grown under irrigation, as well as dry land conditions.

Both bush and vine types are found, and there are several seed types, primarily differing in seed color, each of which is used for a specific purpose, i.e. as a specific vegetable, or mixed with rice, or in soups. The white bean is the most common with cranberry, pinto, and other types being less important.

Most beans are planted in the spring (May and June), almost exclusively in broadcast culture.

The following bean trials were conducted in 1965:

I. Yield Tests - Replicated yield evaluation trials were planted in Karaj, Varamin, Shiraz and Dezful. Tables 7 and 8 show the results. These tests included both dry bean and green bean types. No green bean harvest was made, however.

At Karaj and Varamin, procedures were the same as for chickpeas and cowpeas. At Dezful, the bean test was planted, but a total loss of stand occurred after the second irrigation, when 9-10 millimhos of salts built up in the top 5 centimeters

Legend for Table 7

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

(2) Names followed by (I) indicate source location names within Iran for local types. Min. numbers are Iran Ministry of Agriculture collection types. American and other named varieties are indicated by name.

(3) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(4) V = Vining type; B = Bush type.

(5) Planting date, May 6, 1965.

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

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

(8) W = White; P = Purple; L = Light; D = Dark.

(9) Rating 0 to 5; 0 = Free from any symptoms; 5 = Severe symptoms. Disease symptoms not all identified. Mosaic viruses most common.

(10) First column: C = Curved; S = Straight.
Second column: F = Flat; C = Cylindrical.

(11) S = Short; M = Medium; L = Long.

(12) F = Flat; C = Cylindrical.

(13) W = White; Cr = Cream; Br = Brown; Bk = Black; R = Red; Pu = Purple; Go = Golden; D = Dark; L = Light; M = Mottled.

(14) Average number in ten pods per replication.

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

(16) Yield in grams per plot, 15 feet long, 36 inches wide.
LSD, 5% = 143.6 grams
LSD, 1% = 189.5 grams
Coefficient of Variation = 19.4%.

Conversion factors:
Grams per plot to pounds per acre = 2.13.
Grams per plot to kilograms per hectare = 2.43.

Agronomic Data, Regional Pulse Improvement Project
BEAN Yield Test, Karaj, Iran, 1965.

TABLE 7

| (1) Strain No. | (2) Variety or Source | (3) Stand & Vigor | (4) Plant Type | (5) Days from Planting to 1st Flower | (6) Days from Planting to 1st Mat.Pod | (7) Days from Planting to Compl.Mat. | (8) Flower Color | (9) Disease Rating 6/8 | 6/29 | 8/4 | Av. | (10) Pod Shape | (11) Pod Length | (12) Seed Shape | (13) Seed Color | (14) Seeds P/Pod | (15) Seed Size | (16) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 49 | Shiraz (I) | 1.0 | V | 50 | 79 | 98 | W | 1.2 | 1.0 | 1.4 | 1.2 | CF | M | F | W | 6 | 29.0 | 780.8 |
| 47 | Kermanshah(I) | 1.4 | V | 49 | 78 | 96 | W | 1.0 | 1.0 | 1.4 | 1.1 | CF | MS | F | W | 5 | 29.2 | 769.4 |
| | Pinto 111 | 1.0 | V | 37 | 70 | 87 | W | 0 | 1.0 | 1.4 | 0.8 | CF | M | F | BrM | 5 | 37.8 | 746.6 |
| 15 | Isfahan (I) | 1.2 | V | 45 | 76 | 94 | W | 1.2 | 1.0 | 1.4 | 1.2 | CF | M | F | W | 5 | 27.6 | 734.0 |
| | Great Northern 31 | 1.0 | V | 41 | 74 | 89 | W | 1.0 | 1.0 | 1.6 | 1.2 | CF | M | F | W | 5 | 38.2 | 734.0 |
| 50 | Isfahan (I) | 1.0 | V | 49 | 81 | 107 | W | 0.8 | 1.2 | 1.4 | 1.1 | CF | M | F | DR | 6 | 27.2 | 721.6 |
| | Karaj (I) | 1.0 | V | 50 | 78 | 107 | W | 1.2 | 0.6 | 0.8 | 0.9 | CF | M | F | W | 6 | 28.2 | 715.8 |
| 61 | Karaj-10 (I) | 1.0 | V | 46 | 79 | 99 | W | 1.0 | 1.0 | 1.8 | 1.3 | CF | MS | C | W | 6 | 28.0 | 708.2 |
| 11 | Blue Lake | 1.4 | W | 48 | 81 | 102 | W | 1.4 | 1.0 | 2.0 | 1.5 | CC | L | C | W | 7 | 28.2 | 698.6 |
| 37 | Lebanon-3 | 1.4 | V | 49 | 77 | 91 | W | 0.8 | 0.8 | 1.0 | 0.9 | CF | M | F | W | 6 | 28.0 | 693.8 |
| 79 | Bojnurd (I) | 1.0 | V | 48 | 76 | 99 | W | 0.8 | 1.2 | 1.4 | 1.1 | CF | M | F | W | 5 | 29.2 | 688.0 |
| | Great Northern-1140 | 1.0 | V | 37 | 70 | 86 | W | 0.4 | 0 | 1.6 | 0.7 | CF | M | F | W | 5 | 33.8 | 685.8 |
| 80 | Bojnurd (I) | 1.6 | V | 43 | 75 | 89 | W | 1.0 | 0.6 | 1.0 | 0.9 | CF | M | F | W | 5 | 31.8 | 671.2 |
| 65 | Isfahan (I) | 1.4 | V | 48 | 78 | 98 | W | 0.8 | 0.6 | 1.2 | 0.9 | CF | M | F | W | 5 | 28.4 | 671.0 |
| 5 | Res. Tender Green | 1.0 | B | 40 | 81 | 106 | LP | 0.4 | 0.6 | 0.8 | 0.6 | CC | L | C | BkM | 7 | 35.2 | 648.0 |
| | Great Northern-123 | 1.0 | V | 42 | 74 | 89 | W | 0.6 | 0.4 | 1.2 | 0.7 | CF | M | F | W | 5 | 34.8 | 644.8 |
| | Pinto Columbia | 1.0 | V | 37 | 69 | 85 | W | 0.8 | 0.6 | 1.2 | 0.9 | CF | M | F | BrM | 5 | 37.0 | 620.8 |
| 71 | Min. 2394 (I) | 1.0 | B | 46 | 85 | 107 | LP | 0.8 | 0.8 | 1.0 | 0.9 | CC | L | C | DPu | 6 | 39.4 | 619.6 |
| 52 | Min. 290 (I) | 1.6 | V | 48 | 90 | 109 | LP | 2.2 | 1.4 | 1.4 | 1.7 | CF | L | F | Br | 7 | 32.2 | 588.0 |
| 57 | Min. 394 (I) | 1.2 | B | 45 | 85 | 97 | LP | 0.2 | 0.8 | 0.8 | 0.6 | CC | L | C | DPu | 6 | 39.0 | 586.6 |
| 4 | Wade | 1.7 | B | 44 | 81 | 109 | LP | 0.2 | 0.2 | 0.4 | 0.3 | CC | M | C | DPu | 5 | 37.6 | 565.8 |
| 45 | Min. 236 (I) | 1.0 | B | 41 | 84 | 101 | LP | 0.4 | 0.6 | 1.2 | 0.7 | CC | L | C | BrM | 6 | 34.4 | 545.4 |
| 62 | Min. 1365 (I) | 1.0 | B | 43 | 83 | 100 | LP | 0.6 | 1.2 | 1.4 | 1.1 | CC | ML | C | BrM | 6 | 36.2 | 525.8 |
| 24 | Metisse | 2.4 | B | 51 | 89 | 119 | W | 2.2 | 2.8 | 2.4 | 2.5 | SF | L | F | BkM | 5 | 25.0 | 503.8 |
| 20 | Moubacher-Speck | 1.2 | V | 50 | 80 | 107 | W | 0.6 | 0.6 | 2.0 | 1.1 | CC | L | C | W | 7 | 33.4 | 502.0 |
| 63 | Min. 1396 (I) | 1.6 | B | 43 | 77 | 100 | LP | 0.4 | 0.4 | 1.2 | 0.7 | CC | L | C | BrM | 7 | 35.8 | 499.4 |
| 41 | Moghan-20 (I) | 2.0 | B | 49 | 81 | 106 | LP | 2.0 | 1.6 | 1.6 | 1.7 | CC | L | F | LPu | 6 | 25.2 | 490.0 |
| 9 | Contender | 2.2 | B | 40 | 78 | 99 | P | 1.4 | 1.4 | 1.4 | 1.4 | CC | L | C | CrM | 5 | 48.0 | 483.4 |
| 44 | Min. 88 (I) | 1.2 | B | 39 | 77 | 96 | P | 1.0 | 0.8 | 1.2 | 1.0 | CC | L | C | CrM | 5 | 46.2 | 477.4 |
| 67 | Min. 2475 (I) | 2.0 | B | 41 | 79 | 103 | LP | 0.8 | 1.0 | 1.2 | 1.0 | CC | ML | C | CrM | 5 | 44.4 | 468.8 |
| 6 | Tenderlong-15 | 1.2 | B | 39 | 82 | 98 | DP | 0.4 | 0.3 | 1.2 | 0.6 | CC | M | C | BkM | 7 | 33.6 | 440.4 |
| 2 | Giant Stringless Green Pod | 2.0 | B | 39 | 81 | 101 | LP | 1.0 | 0.8 | 1.2 | 1.0 | CC | L | C | BrM | 6 | 34.4 | 422.8 |
| 33 | Khuzestan (I) | 2.2 | B | 46 | 87 | 110 | LP | 1.0 | 2.0 | 2.0 | 1.7 | CF | M | C | R | 4 | 43.6 | 404.4 |
| 35 | Min. 1 (I) | 1.4 | B | 39 | 75 | 101 | LP | 1.2 | 2.2 | 3.0 | 2.1 | SC | ML | C | Go | 5 | 33.4 | 401.8 |
| 7 | Tenderpod | 1.4 | B | 40 | 83 | 102 | W | 1.6 | 2.0 | 3.6 | 2.4 | CC | M | C | WPM | 5 | 29.6 | 366.2 |

Legend for Table 8

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

(2) Names followed by (I) indicate source location names within Iran for local types. Min. numbers are Iran Ministry of Agriculture collection types. American and other named varieties are indicated by name.

(3) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(4) V = Vining type; B = Bush type.

(5) Planting date, May 5, 1965.

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

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

(8) W = White; P = Purple; L = Light; D = Dark.

(9) Rating 0 to 5; 0 = Free from any symptoms; 5 = Severe symptoms. Disease symptoms not all identified. Mosaic viruses most common.

(10) First column: C = Curved; S = Straight.
Second Column: F = Flat; C = Cylindrical.

(11) S = Short; M = Medium; L = Long.

(12) F = Flat; C = Cylindrical.

(13) W = White; Cr = Cream; Br = Brown; Bk = Black; R = Red; Pu = Purple; Go = Golden; D = Dark; L = Light; M = Mottled.

(14) Average number in ten pods per replication.

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

(16) Yield in grams per plot, 15 feet long, 20 inches wide.
LSD, 5% = 102.2 grams
LSD, 1% = 134.9 grams
Coefficient of Variation = 25.1%.

Conversion factors:
Grams per plot to pounds per acre = 3.83.
Grams per plot to kilograms per hectare = 4.37.

Agronomic Data, Regional Pulse Improvement Project
BEAN Yield Test, Varamin, Iran, 1965.

Table 8

| (1) Strain No. | (2) Variety or Source | (3) Stand & Vigor | (4) Plant Type | (5) Days from Planting to 1st Flower | (6) Days from Planting to 1st Mat.Pod | (7) Days from Planting to Compl.Mat. | (8) Flower Color | (9) Disease Rating 6/21 | 6/30 | 7/22 | Av. | (10) Pod Shape | (11) Pod Length | (12) Seed Shape | (13) Seed Color | (14) Seeds P/Pod | (15) Seed Size | (16) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Pinto 111 | 1.0 | V | 40 | 74 | 86 | W | 0 | 0.2 | 0.8 | 0.3 | CF | M | F | BrM | 5 | 32.8 | 462.4 |
| | Pinto Columbia | 1.0 | V | 39 | 73 | 85 | W | 0 | 0.6 | 1.0 | 0.5 | CF | M | F | BrM | 5 | 32.2 | 419.4 |
| | Great Northern-1140 | 1.0 | V | 41 | 74 | 85 | W | 0.2 | 0.2 | 0.6 | 0.3 | CF | M | F | W | 5 | 29.2 | 418.0 |
| 79 | Bojnurd (I) | 2.0 | V | 47 | 79 | 94 | W | 0.6 | 1.0 | 1.0 | 0.9 | CF | M | F | W | 6 | 22.6 | 412.4 |
| 47 | Kermanshah (I) | 2.6 | V | 47 | 79 | 97 | W | 0.8 | 2.2 | 2.4 | 1.8 | CF | M | F | W | 5 | 24.0 | 385.2 |
| | Great Northern-123 | 2.2 | V | 45 | 73 | 85 | W | 0.4 | 0.4 | 1.4 | 0.7 | CF | MS | F | W | 5 | 29.2 | 366.8 |
| 50 | Isfahan (I) | 1.2 | V | 44 | 85 | 106 | W | 0.6 | 0.8 | 1.0 | 0.8 | CF | M | F | DR | 5 | 21.0 | 364.6 |
| 15 | Isfahan (I) | 2.0 | V | 47 | 79 | 101 | W | 0.4 | 1.4 | 1.2 | 1.0 | CF | M | F | W | 5 | 22.8 | 363.4 |
| | Great Northern-31 | 1.4 | V | 45 | 75 | 88 | W | 0.6 | 1.4 | 1.6 | 1.2 | CF | M | F | W | 5 | 33.2 | 351.6 |
| 37 | Lebanon-3 | 2.0 | V | 47 | 78 | 98 | W | 0.8 | 1.6 | 1.2 | 1.2 | CF | M | F | W | 5 | 20.6 | 348.8 |
| 80 | Bojnurd (I) | 3.2 | V | 44 | 77 | 91 | W | 0.4 | 0.6 | 1.2 | 0.7 | CF | M | F | W | 5 | 27.2 | 345.0 |
| 41 | Moghan-20 (I) | 2.2 | B | 50 | 86 | 102 | P | 0.2 | 0.4 | 1.0 | 0.5 | CC | L | C | LPu | 7 | 20.2 | 342.2 |
| 9 | Contender | 1.8 | B | 42 | 77 | 90 | P | 0 | 0 | 0.4 | 0.1 | CC | ML | C | CrM | 5 | 34.0 | 339.2 |
| 5 | Res. Tender Green | 1.2 | B | 47 | 82 | 101 | P | 1.0 | 2.0 | 1.2 | 1.4 | CC | M | C | BkM | 6 | 23.8 | 336.8 |
| 44 | Min. 88 (I) | 1.2 | B | 42 | 77 | 93 | P | 0.2 | 0.6 | 1.0 | 0.6 | CC | ML | C | CrM | 5 | 34.4 | 329.0 |
| 45 | Min. 236 (I) | 1.6 | B | 46 | 80 | 98 | LP | 0 | 0 | 0 | 0 | CC | L | C | BrM | 6 | 26.2 | 322.0 |
| 65 | Isfahan (I) | 2.2 | V | 48 | 80 | 100 | W | 0.2 | 1.2 | 1.2 | 0.9 | CF | MS | F | W | 5 | 22.0 | 320.0 |
| 2 | Giant Stringless Green Pod | 2.2 | B | 46 | 81 | 100 | LP | 0 | 0 | 0.4 | 0.1 | CC | M | C | BrM | 6 | 27.4 | 319.0 |
| 62 | Min. 1365 (I) | 1.2 | B | 46 | 74 | 99 | LP | 0.2 | 0.2 | 0 | 0.1 | CC | ML | C | BrM | 5 | 25.6 | 317.8 |
| 71 | Min. 2394 (I) | 2.1 | B | 47 | 84 | 104 | LP | 0.6 | 0.4 | 0.8 | 0.6 | CC | ML | C | DPu | 6 | 26.0 | 316.8 |
| 67 | Min. 2475 (I) | 1.8 | B | 44 | 78 | 96 | P | 0.4 | 0.6 | 0.8 | 0.6 | CC | ML | C | CrM | 5 | 33.8 | 312.0 |
| 49 | Shiraz (I) | 3.6 | V | 47 | 78 | 92 | W | 1.0 | 1.2 | 1.8 | 1.3 | CF | M | F | W | 6 | 23.2 | 310.8 |
| 57 | Min. 394 (I) | 1.8 | B | 44 | 89 | 103 | LP | 0 | 0.2 | 0.6 | 0.3 | CC | M | C | DPu | 5 | 28.4 | 309.2 |
| 63 | Min. 1396 (I) | 1.6 | B | 47 | 79 | 100 | LP | 0.2 | 0.2 | 0.2 | 0.2 | CC | L | C | BrM | 7 | 26.8 | 308.0 |
| | Karaj (I) | 1.0 | V | 46 | 82 | 99 | W | 0.6 | 1.2 | 0.8 | 0.9 | CF | M | F | W | 5 | 20.8 | 308.0 |
| 6 | Tenderlong-15 | 1.6 | B | 45 | 81 | 98 | P | 0.6 | 1.8 | 1.8 | 1.4 | CC | ML | C | DPuM | 6 | 26.0 | 302.2 |
| 61 | Karaj-10 (I) | 2.8 | V | 47 | 80 | 94 | W | 0.6 | 1.4 | 2.0 | 1.3 | CF | MS | F | W | 5 | 23.8 | 300.6 |
| 4 | Wade | 2.4 | B | 49 | 84 | 100 | LP | 0.6 | 0.6 | 0.8 | 0.7 | CC | M | C | DPu | 5 | 28.0 | 269.2 |
| 33 | Khuzestan (I) | 1.6 | B | 50 | 87 | 111 | LP | 1.8 | 2.8 | 2.2 | 2.3 | CF | M | F | R | 4 | 27.6 | 254.0 |
| 35 | Min. 1 (I) | 2.4 | B | 42 | 78 | 101 | LP | 2.6 | 3.8 | 3.4 | 3.3 | CC | M | C | Go | 5 | 24.8 | 353.2 |
| 52 | Min. 290 (I) | 2.2 | V | 49 | 89 | 106 | W | 0.2 | 0.8 | 0.4 | 0.5 | CF | L | F | Br | 6 | 25.2 | 249.8 |
| 24 | Metisse | 2.2 | V | 58 | 85 | 103 | W | 1.4 | 2.2 | 2.2 | 1.9 | CC | M | F | BkWM | 6 | 18.0 | 231.4 |
| 11 | Blue Lake | 3.0 | V | 47 | 83 | 100 | W | 1.0 | 2.0 | 1.8 | 1.6 | CC | M | C | W | 6 | 23.2 | 222.6 |
| 7 | Tenderpod | 4.2 | B | 51 | 87 | 107 | W | 1.4 | 2.8 | 2.6 | 2.3 | CC | M | C | IRM | 5 | 20.0 | 151.4 |
| 20 | Moubacher-Speck | 4.6 | V | 48 | 83 | 103 | W | 1.0 | 1.8 | 2.4 | 1.7 | CC | L | C | W | 7 | 27.4 | 133.2 |

of soil. As in cowpeas, the data obtained from the test at Shiraz was so variable and unreliable that they are not included in this report. The row spacing of 36 inches used at Karaj was too wide, and will be reduced to 20 inches (Half a meter) in future years.

Comparing the Karaj and Varamin yield tests, out of the 10 highest yielding strains, 6 occur at both locations. Among these are Pinto 111 and Great Northern 31. At Varamin, Pinto Columbia, Great Northern 1140, and Great Northern 123 also were in the top ten. These five varieties were introduced from the United States. They were developed in the western states for commercial dry bean production. They all have resistance to common bean mosaic virus. In addition, Great Northern 123, Great Northern 1140, and Pinto Columbia also have resistance to the New York 15 strain of bean mosaic. Great Northern 31 is resistant to curly top virus and Pinto Columbia has resistance to several races of bean rust.

Of the other four strains which were top yielders in both tests, numbers 15, 47, and 50 are local Iranian types, while number 37 is a white-seeded bean from Lebanon.

Pinto 111 appeared to be extremely susceptible, more so than any other strain in the test, to a severe spider mite infestation at Varamin. Mr. Gibson estimates that its yield would have been considerably higher had this infestation not occurred.

For comparison, the highest yield, 780 grams per plot at Karaj, with a row spacing of 36 inches, represents a yield of about 1,680 pounds per acre (about 1,900 kilograms per hectare). The highest yield at Varamin, 462 grams per plot at 20 inches (half a meter) between rows represents a yield of 1,980 pounds per acre (about 2,270 kilograms per hectare).

II. Observation Nurseries - The nursery at Karaj consisted of 1,793 single, non-replicated rows, 10 feet long. A listing of the material in this nursery was included in the appendix of Progress Report No. 2. The detailed notes taken on plant and seed characteristics will be assembled in a separate summary and made available.

The Ministry of Agriculture conducted separate observation and screening nurseries of local types at Varamin and other locations, results of which have not been made available.

MUNGBEANS (*Phaseolus aureus*)

Mungbeans do not have the importance in Near and Middle East countries as in areas of South Asia and the Far East. In Iran, they are grown mostly in small patches in almost all areas. Mungbeans commonly follow wheat and are often planted in the wheat stubble after wheat harvest is complete. They are eaten mostly in soups and sometimes as a vegetable in rice.

The following mungbean trials were conducted in 1965:

I. Yield Tests - Replicated yield evaluation tests were planted in Karaj, Varamin, Shiraz, and Dezful. Tables 9 to 11 show the results. Entries for these trials were chosen from the preliminary observation nurseries planted in 1964, from seed obtained through the New Crops Research Branch of the United States Department of Agriculture. Four strains (211, 223, 226, and 246) were local Iranian strains obtained from the Ministry of Agriculture. The results from the Shiraz test were not considered sufficiently reliable to be included. In comparing the Karaj and Varamin and Dezful yield trials, it can be seen that three strains occur among the ten highest yielding strains at both locations. These are accession numbers 171435 (China), 180313 (India), and 183136 (India).

As with cowpeas, mungbeans have a long period during which seed matures. To avoid the danger of seed loss from shattering, several hand harvests were made. The yields obtained from each

Legend for Table 9

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

(2) Source numbers refer to P. I. numbers from New Crops Research Branch, U.S. Department of Agriculture, Beltsville, Maryland, U.S.A. Strain No. 194 originated, and was supplied by the Oklahoma State University. Strains 211, 223, 226, and 246 are from Iran, seed supplied by the Ministry of Agriculture, but source unknown.

(3) Indicates country or other location of origin.

(4) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(5) E = Erect; P = Prostrate; SE = Semi-erect; B = Bushy.

(6) Date of planting, May 10, 1965.

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

(8) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Disease symptoms not all identified.

(9) Mature plant height in centimeters.

(10) S = Straight; MC = Moderately curved; C = Strongly curved.

(11) DG = Dark green; MG = Medium green; LG = Light Green.

(12) DG = Dark green; MG = Medium green; LG = Light green.

(13) Average number from five pods per replication.

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

(15) Yield in grams per plot, 15 feet long, 36 inches wide.
LSD, 5% = 138.3 grams
LSD, 1% = 183.2 grams
Coefficient of Variation = 16.8%.

Conversion factors:
Grams per plot to pounds per acre = 2.13.
Grams per plot to kilograms per hectare = 2.43.

Agronomic Data, Regional Pulse Improvement Project
MUNGBEAN Yield Test, Karaj, Iran, 1965.

Table 9

| (1) Strain No. | (2) Source No. | (3) Source | (4) Stand | (4) Vigor | (5) Plant Type | (6) Days from Planting to 1st Flower | (7) Days from 1st Flower to 1st Mat. Pod | (8) Disease Rating 7/8 | (8) Disease Rating 8/2 | (8) Disease Rating 8/10 | (8) Disease Rating 8/23 | (9) Plant Height | (10) Pod Shape | (11) Pod Color | (12) Seed Color | (13) Seeds P/Pod | (14) Seed Size | (15) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 14003 | Brazil | 1 | 1 | SE | 58 | 24 | 1 | 1 | 1 | 1 | 56 | MC | DG | DG | 12 | 5.00 | 969 |
| 19 | 31710 | Beltsville | 1 | 1 | SE | 60 | 22 | 1 | 1 | 1 | 1 | 58 | S | DG | DG | 12 | 4.50 | 905 |
| 20 | 31728 | Beltsville | 1 | 1 | SE | 62 | 15 | 2 | 1 | 1 | 1 | 62 | S | DG | DG | 13 | 4.86 | 896 |
| 28 | 164336 | India | 1 | 1 | SE | 58 | 21 | 1 | 1 | 1 | 1 | 50 | S | LG | DG | 12 | 5.94 | 869 |
| 42 | 171435 | China | 1 | 1 | P | 55 | 20 | 1 | 1 | 2 | 2 | 40 | MC | DG | DG | 12 | 4.60 | 819 |
| 105 | 212908 | India | 1 | 1 | SE | 56 | 24 | 1 | 1 | 1 | 1 | 47 | MC | LG | DG | 12 | 5.10 | 787 |
| 63 | 180311 | India | 1 | 1 | P | 59 | 23 | 1 | 1 | 1 | 1 | 54 | S | DG | DG | 12 | 4.84 | 784 |
| 64 | 180313 | India | 1 | 1 | P | 57 | 25 | 1 | 1 | 1 | 1 | 42 | S | LG | DG | 11 | 5.02 | 783 |
| 72 | 183136 | India | 2 | 1 | P | 44 | 23 | 1 | 1 | 1 | 1 | 40 | S | LG | DG | 12 | 5.24 | 760 |
| 178 | 271490 | India | 2 | 1 | E | 57 | 21 | 1 | 1 | 2 | 2 | 52 | S | DG | DG | 14 | 3.84 | 755 |
| 84 | 201869 | Iran | 2 | 2 | P | 54 | 23 | 2 | 1 | 2 | 2 | 48 | C | MG | DG | 12 | 5.42 | 750 |
| 185 | 273487 | Korea | 2 | 1 | E | 58 | 23 | 1 | 1 | 2 | 2 | 50 | MC | DG | DG | 13 | 4.76 | 750 |
| 75 | 183458 | India | 1 | 1 | SE | 53 | 21 | 2 | 1 | 2 | 2 | 53 | MC | DG | DG | 12 | 3.82 | 732 |
| 3 | 31287 | Beltsville | 1 | 1 | SE | 43 | 25 | 1 | 1 | 1 | 1 | 43 | S | MG | DG | 11 | 3.56 | 732 |
| 180 | 271492 | India | 1 | 1 | SE | 50 | 21 | 1 | 1 | 1 | 1 | 50 | MC | DG | DG | 14 | 4.44 | 692 |
| 1 | 31080 | Beltsville | 2 | 2 | B | 51 | 23 | 1 | 2 | 1 | 2 | 57 | S | DG | DG | 11 | 4.18 | 689 |
| 36 | 164475 | India | 1 | 1 | SE | 56 | 20 | 1 | 1 | 1 | 1 | 56 | MC | DG | DG | 12 | 4.28 | 687 |
| 104 | 212907 | India | 1 | 1 | P | 57 | 19 | 1 | 1 | 1 | 1 | 44 | MC | LG | G | 12 | 5.08 | 687 |
| 16 | 31569 | Beltsville | 2 | 2 | SE | 53 | 24 | 2 | 1 | 1 | 1 | 39 | S | DG | G | 12 | 3.92 | 681 |
| 82 | 201867 | Iran | 2 | 2 | SE | 59 | 19 | 2 | 1 | 1 | 1 | 52 | S | DG | G | 12 | 2.96 | 679 |
| 74 | 183407 | India | 1 | 1 | SE | 60 | 22 | 1 | 1 | 1 | 1 | 56 | S | DG | G | 12 | 4.54 | 669 |
| 179 | 271491 | India | 1 | 1 | E | 56 | 18 | 1 | 1 | 1 | 1 | 49 | MC | DG | G | 12 | 4.44 | 644 |
| 78 | 183936 | India | 2 | 2 | SE | 52 | 19 | 2 | 1 | 2 | 2 | 51 | S | DG | G | 12 | 2.52 | 656 |
| 107 | 213015 | India | 1 | 1 | P | 63 | 22 | 1 | 1 | 1 | 1 | 42 | S | LG | G | 12 | 5.70 | 653 |
| 61 | 179962 | India | 1 | 1 | SE | 59 | 25 | 2 | 2 | 2 | 2 | 51 | MC | DG | G | 12 | 4.86 | 635 |
| 145 | 227754 | Guatemala | 2 | 2 | B | 59 | 25 | 3 | 3 | 3 | 2 | 42 | M | DG | G | 11 | 3.82 | 623 |
| 106 | 213012 | India | 1 | 1 | SE | 63 | 22 | 1 | 1 | 1 | 1 | 52 | M | DG | Y | 11 | 4.02 | 622 |
| 223 | | Iran | 1 | 1 | SE | 61 | 26 | 1 | 2 | 3 | 2 | 45 | M | LG | G | 12 | 2.86 | 621 |
| 27 | 164301 | India | 1 | 1 | SE | 62 | 20 | 2 | 1 | 2 | 2 | 56 | M | DG | G | 12 | 4.06 | 618 |
| 45 | 174298 | Turkey | 1 | 2 | SE | 60 | 19 | 1 | 1 | 3 | 2 | 49 | M | DG | G | 10 | 4.34 | 579 |
| 43 | 173932 | India | 2 | 2 | B | 59 | 26 | 3 | 3 | 3 | 3 | 49 | MC | MG | G | 12 | 3.06 | 557 |
| 144 | 227248 | Beltsville | 1 | 1 | B | 60 | 28 | 2 | 3 | 3 | 3 | 47 | M | LG | G | 12 | 3.00 | 554 |
| 30 | 164427 | India | 2 | 2 | E | 59 | 24 | 3 | 3 | 3 | 3 | 58 | MC | LG | G | 12 | 3.48 | 522 |
| 211 | | Iran | 1 | 1 | B | 63 | 29 | 2 | 3 | 3 | 3 | 48 | M | MG | G | 11 | 2.82 | 502 |
| 226 | | Iran (Nishapour) | 1 | 1 | B | 64 | 24 | 1 | 2 | 3 | 2 | 47 | M | LG | G | 11 | 2.92 | 501 |
| 128 | 220816 | Afghanistan | 1 | 1 | B | 57 | 33 | 2 | 2 | 3 | 2 | 55 | MC | MG | G | 11 | 2.80 | 499 |
| 194 | | Oklahoma-12 | 2 | 2 | B | 59 | 22 | 3 | 2 | 1 | 2 | 41 | M | LG | G | 12 | 3.68 | 472 |
| 129 | 222116 | Afghanistan | 1 | 1 | B | 62 | 28 | 3 | 4 | 4 | 4 | 46 | MC | LG | G | 10 | 3.10 | 413 |
| 246 | | Iran (Rasht) | 2 | 2 | B | 58 | 20 | 2 | 2 | 3 | 2 | 52 | M | DG | G | 11 | 2.70 | 353 |
| 149 | 237114 | India | 2 | 2 | B | 40 | 20 | 2 | 3 | 4 | 3 | 40 | M | MG | G | 10 | 2.14 | 328 |

Legend for Table 10

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

(2) Source numbers refer to P. I. numbers from New Crops Research Branch, U. S. Department of Agriculture, Beltsville, Maryland, U. S. A. Strain No. 194 originated and was supplied by the Oklahoma State University.

(3) Indicates country or other location of origin.

(4) Rating 1 to 5; 1 = Complete stand, vigorous plants; 5 = Uneven emergence, weak plants.

(5) Planting date, May 5, 1965.

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

(7) Rating 1 to 5; 1 = Free from any disease symptoms; 5 = Severe symptoms. Disease symptoms not all identified.

(8) S = Straight; MC = Moderately curved; C = Strongly curved.

(9) DG = Dark green; MG = Medium green; LG = Light green.

(10) DG = Dark green; MG = Medium green; LG = Light green.

(11) Average number from five pods per replication.

(12) Yield in grams per plot, 15 feet long, 20 inches wide.
LSD, 5% = 97.1 grams
LSD, 1% = 128.2 grams
Coefficient of Variation = 36.9%.

Conversion factors:
Grams per plot to pounds per acre = 3.83.
Grams per plot to kilograms per hectare = 4.37.

Agronomic Data, Regional Pulse Improvement Project
MUNGBEAN Yield Test, Varamin, Iran, 1965.

Table 10

| (1) Strain No. | (2) Source No. | (3) Source | (4) Stand & Vigor | (5) Days from Planting to 1st Flower | (6) Days from 1st Flower to 1st Mature Pod | (7) Disease Rating 7/6 | 7/17 | 7/31 | 8/31 | (8) Pod Shape | (9) Pod Color | (10) Seed Color | (11) Seeds P/Pod | (12) Yield |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 31287 | Beltsville | 1 | 59 | 17 | 1 | 1 | 1 | 1 | S | LG | DG | 10 | 344 |
| 16 | 31569 | Beltsville | 1 | 52 | 20 | 1 | 1 | 1 | 1 | MC | LG | DG | 9 | 310 |
| 36 | 164475 | India | 1 | 60 | 19 | 1 | 1 | 1 | 1 | MC | LG | DG | 9 | 306 |
| 42 | 171435 | China | 1 | 56 | 14 | 1 | 1 | 1 | 1 | S | DG | DG | 11 | 293 |
| 145 | 227754 | Guatemala | 1 | 59 | 24 | 1 | 1 | 1 | 1 | S | LG | DG | 8 | 276 |
| 185 | 273487 | Korea | 1 | 58 | 14 | 2 | 1 | 1 | 1 | MC | MG | DG | 11 | 272 |
| 64 | 180313 | India | 1 | 63 | 21 | 1 | 1 | 1 | 1 | S | LG | DG | 10 | 267 |
| 74 | 183407 | India | 1 | 60 | 20 | 1 | 1 | 1 | 1 | MC | MG | DG | 9 | 265 |
| 1 | 31080 | Beltsville | 2 | 51 | 22 | 1 | 1 | 1 | 1 | S | LG | DG | 11 | 264 |
| 72 | 183136 | India | 1 | 53 | 19 | 1 | 1 | 1 | 1 | S | LG | DG | 9 | 252 |
| 178 | 271490 | India | 1 | 60 | 20 | 1 | 1 | 1 | 1 | S | DG | DG | 10 | 248 |
| 63 | 180311 | India | 1 | 63 | 23 | 1 | 1 | 1 | 1 | S | LG | DG | 11 | 246 |
| 107 | 213015 | India | 1 | 63 | 22 | 1 | 1 | 1 | 1 | MC | LG | DG | 9 | 240 |
| 28 | 164336 | India | 1 | 61 | 17 | 1 | 1 | 1 | 1 | M | LG | DG | 9 | 240 |
| 82 | 201867 | Iran | 1 | 60 | 15 | 1 | 1 | 1 | 1 | M | MG | DG | 10 | 239 |
| 84 | 201869 | Iran | 1 | 57 | 19 | 1 | 1 | 1 | 1 | M | LG | DG | 10 | 235 |
| 194 | | Oklahoma-12 | 1 | 58 | 15 | 1 | 1 | 1 | 1 | S | LG | DG | 9 | 234 |
| 20 | 31728 | Beltsville | 1 | 60 | 24 | 2 | 1 | 1 | 1 | MC | DG | DG | 11 | 234 |
| 179 | 271491 | India | 1 | 59 | 21 | 1 | 1 | 1 | 1 | M | DG | DG | 5 | 232 |
| 75 | 183458 | India | 1 | 59 | 32 | 1 | 1 | 1 | 1 | M | DG | DG | 10 | 230 |
| 19 | 31710 | Beltsville | 1 | 59 | 23 | 1 | 1 | 1 | 1 | M | MG | DG | 10 | 226 |
| 27 | 164301 | India | 1 | 58 | 18 | 2 | 1 | 1 | 1 | M | DG | DG | 9 | 220 |
| 104 | 212907 | India | 1 | 56 | 21 | 1 | 1 | 1 | 1 | M | LG | DG | 13 | 217 |
| 180 | 271492 | India | 1 | 57 | 21 | 1 | 1 | 1 | 1 | MC | LG | DG | 9 | 213 |
| 21 | 14003 | Beltsville | 1 | 59 | 20 | 1 | 1 | 1 | 1 | MC | DG | DG | 12 | 209 |
| 61 | 179962 | India | 1 | 60 | 20 | 2 | 1 | 1 | 1 | MC | MG | DG | 10 | 207 |
| 106 | 213012 | India | 1 | 60 | 22 | 2 | 1 | 1 | 2 | MC | MG | Y | 9 | 170 |
| 78 | 183936 | India | 2 | 53 | 27 | 1 | 1 | 1 | 1 | MC | LG | DG | 11 | 168 |
| 105 | 212908 | India | 2 | 60 | 24 | 1 | 1 | 1 | 1 | S | LG | DG | 10 | 155 |
| 149 | 237114 | India | 1 | 66 | 21 | 1 | 1 | 1 | 1 | MC | LG | DG | 9 | 153 |
| 30 | 164427 | India | 1 | 62 | 22 | 1 | 1 | 1 | 1 | S | LG | DG | 10 | 112 |
| 43 | 173932 | India | 1 | 67 | 17 | 1 | 1 | 1 | 1 | MC | LG | DG | 9 | 81 |
| 129 | 222116 | Afghanistan | 1 | 67 | 18 | 1 | 1 | 1 | 1 | S | MG | DG | 8 | 54 |
| 144 | 227248 | Beltsville | 1 | 69 | 18 | 1 | 2 | 1 | 2 | S | LG | DG | 10 | 32 |
| 128 | 220816 | Afghanistan | 1 | 66 | 19 | 2 | 1 | 1 | 1 | S | LG | DG | 10 | 11 |

Legend for Table 11

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

(2) Source numbers refer to P. I. numbers from New Crops Research Branch, U. S. Department of Agriculture, Beltsville, Maryland, U. S. A. Strain number 194 (Variety
Ok Oklahoma #12) originated and was supplied by the Oklahoma State University.

(3) Indicates country or other location of origin.

(4) Planting date, May 31, 1965.

(5) Yield in kilograms per hectare.

Conversion factor to pounds per acre = 0.88.

Agronomic Data, Regional Pulse Improvement Project
MUNGBEAN Yield Test, Dezful, Iran, 1965.

| (1) Strain No. | (2) Source No. | (3) Variety or Source | (4) Days from Planting to First Flower | (5) Yield |
|---|---|---|---|---|
| 36 | 164475 | India | 53 | 2660 |
| 72 | 183136 | India | 53 | 2415 |
| 20 | 31728 | Beltsville | 54 | 2410 |
| 3 | 31287 | Beltsville | 53 | 2395 |
| 74 | 183407 | India | 54 | 2295 |
| 19 | 31710 | Beltsville | 53 | 2285 |
| 75 | 183458 | India | 53 | 2230 |
| 105 | 212908 | India | 55 | 2230 |
| 185 | 273487 | Korea | 53 | 2175 |
| 21 | 14003 | Beltsville | 53 | 2170 |
| 63 | 180311 | India | 55 | 2165 |
| 16 | 31569 | Beltsville | 52 | 2115 |
| 1 | 31080 | Beltsville | 52 | 2110 |
| 179 | 271491 | India | 55 | 2065 |
| 27 | 164301 | India | 54 | 2060 |
| 104 | 212907 | India | 54 | 2025 |
| 180 | 271492 | India | 54 | 1975 |
| 28 | 164336 | India | 54 | 1970 |
| 194 | | Oklahoma #12 | 53 | 1925 |
| 43 | 173932 | India | 57 | 1870 |
| 107 | 213015 | India | 58 | 1840 |
| 82 | 201867 | Iran | 55 | 1825 |
| 84 | 201869 | Iran | 53 | 1815 |
| 42 | 171435 | China | 53 | 1805 |
| 78 | 183936 | India | 52 | 1730 |
| 106 | 213012 | India | 56 | 1725 |
| 70 | 183065 | India | 54 | 1695 |
| 145 | 227754 | Guatemala | 57 | 1640 |
| 30 | 164427 | India | 53 | 1445 |
| 149 | 237114 | India | 61 | 1340 |
| 129 | 222116 | Afghanistan | 62 | 1285 |
| 128 | 220816 | Afghanistan | 60 | 1180 |
| 114 | 227248 | Beltsville | 65 | 1120 |

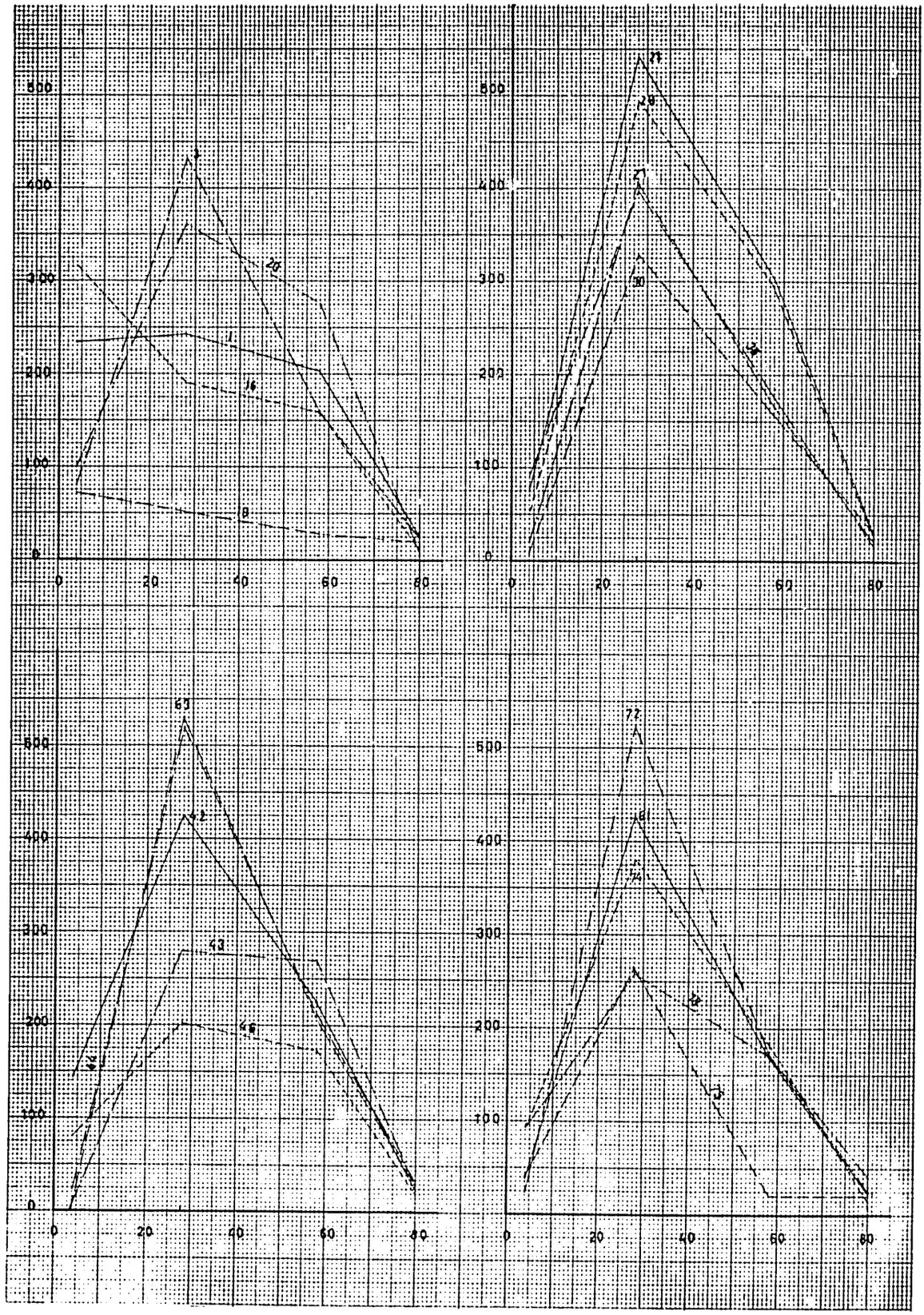
strain at each harvest date are shown in Figure 5. These graphs illustrate the relative earliness and the differences between strains in maturation periods. Because of the late customary planting date for mungbeans, at least in Iran, it appears desirable to develop a variety which combines high yielding ability with earliness and short maturation period.

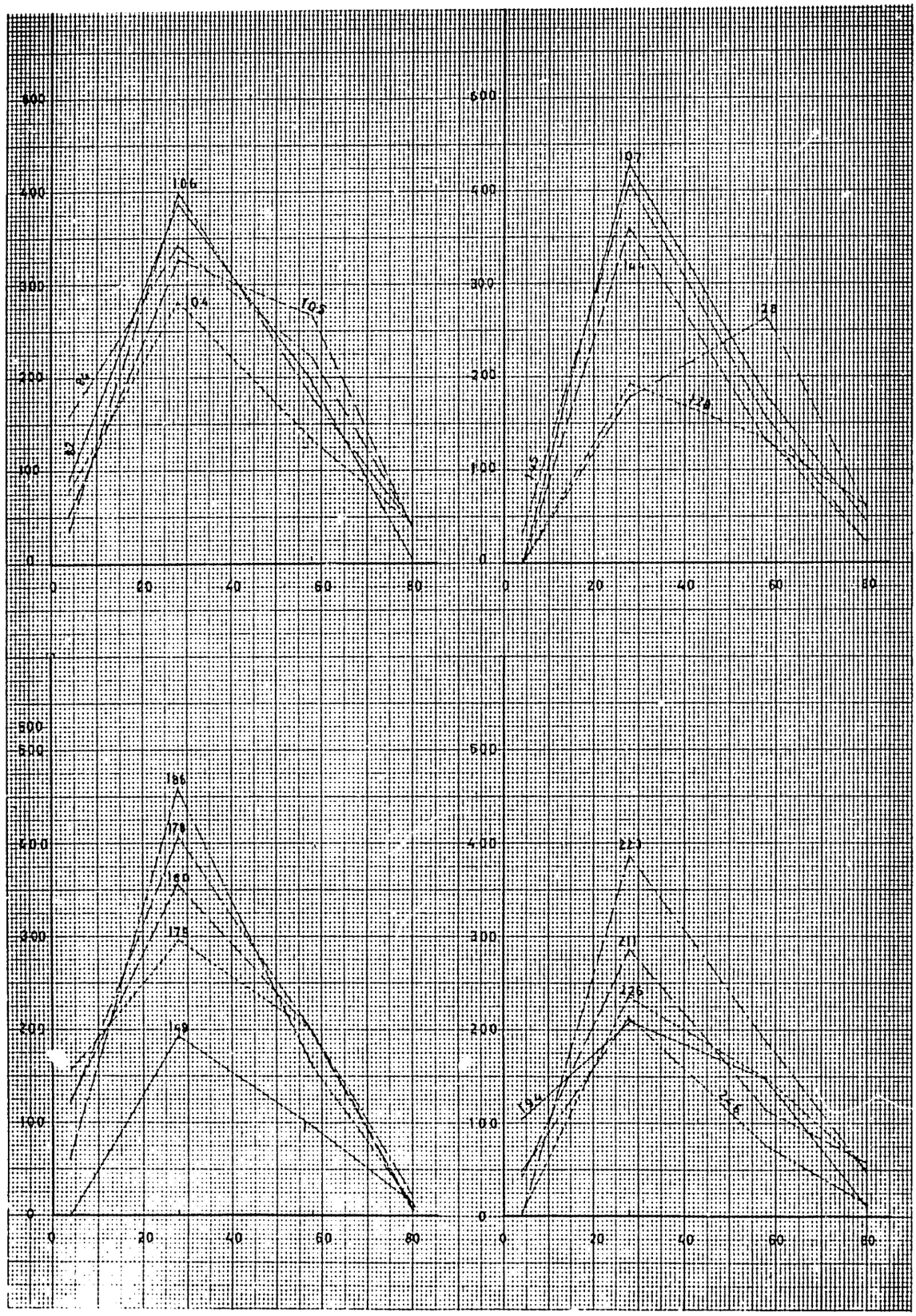
II. Observation Nurseries - The nursery at Karaj consisted of 950 single, non-replicated rows, 10 feet long. As with the other crops, detailed notes on plant and seed characteristics were made, which will be assembled in a separate summary and made available to anyone interested. A listing of materials included in this nursery was given in the appendix of Progress Report No. 2.

The Ministry of Agriculture also had a separate mungbean nursery of local types at several locations in Iran.

FIGURE 5: Yields of 40 strains of Mungbeans at different harvest dates.

The ordinates indicate grams of seed per plot; the abscissas indicate harvest dates in days from July 15.


500
400
300
200
100
0
0
20
40
60
80
63
42
43
46
77
61
54
30
29
25
16
8


600
400
300
200
100
0
0
20
40
60
80
106
104
105
97
94
28
186
179
180
175
149
223
211
126
124
125

LENTILS (*Lens esculenta*)

Lentils are grown in all countries of the Near and Middle East. They are mostly consumed in soup, mixed with other vegetables, and sometimes meat.

As insufficient seed was available for the 1965 season, no lentil yield trails were conducted by Project personnel. The Iranian Ministry of Agriculture conducted a lentil yield evaluation test at Varamin, of which the data are not yet available.

An observation nursery was planted at Karaj containing 1,311 lines, a listing of which is in the appendix of Progress Report No. 2. This nursery was severely hit by a disease tentatively identified as a Fusarium wilt. Very little seed was obtained, and most of this material will be planted again in 1966 for further screening.

The Ministry of Agriculture planted nurseries of local types at the various locations in Iran. Most of this material, however, was represented in the Karaj nursery.

BROADBEANS (Vicia faba)

Broadbeans are one of the most important pulse crops in Near and Middle East countries. In Egypt, for instance, broadbeans, cooked overnight to a paste, and with bread, lemon juice, olive oil or some other additive, constitute a staple breakfast food for many people. They are also grown extensively in Turkey, where Orobanche, broomrape (a parasitic weed) is particularly bad and does considerable damage to this crop. In Jordan, broadbeans are grown in the Jordan Valley, and consumed both in the green and the dry stage. The principal broadbean area in Iran is in Fars and Khuzistan provinces in southwestern Iran. They are planted in the fall and harvested as green beans in April. Large quantities are brought by truck to Tehran. Very few are harvested as dry beans. There is also a limited acreage of broadbeans in the Caspian coast area.

Favism, a hemolytic type of disease, caused by ingestion of broadbeans or inhalation of broadbean pollen, in certain minority groups of people which have a genetically determined enzyme deficiency, is of considerable concern in several countries in the region. Some research is apparently being done, such as that conducted by Hebrew University in Israel. It is hoped that when the request for a U. S. food nutritionist-chemist for the Project staff is approved, some attention can be paid to this disease. The Iranian Ministries of Health, Education and

Agriculture have instituted a technical committee to study possible work to be done in this field.

Because broadbeans are not a spring-planted crop in Iran, all available material was planted in the fall of 1965, in an observation nursery in Khuzistan province, in cooperation with the Khuzistan Development Service.

## ENTOMOLOGY

Kenneth E. Gibson
Research Entomologist

Entomological activities in the Regional Pulse Improvement Project were initiated in 1965 by the appearance of the pea aphid, Macrosiphum pisi Harris, on some experimental plantings of dry peas at Karaj, Iran, on May 7, 1965. Their appearance was followed on May 21 by appearance of the pea weevil, Bruchus Pisorum, also on peas. On June 1, eggs and newly hatched larvae of the beet armyworm (Spodoptera exigua Hubner) were noted on the foliage of some of the pulse crops and weeds in experimental plots at Karaj, Iran. On June 14, damage was noticed on chickpea pods in the areas of both Karaj and Varamin, Iran, where pulse crops were being experimentally grown. These areas are about 50 miles apart--Karaj 25 miles west, and Varamin about 25 miles southeast of the capital city of Tehran. This damage proved to result from the larval feeding of the cottom bollworm (corn earworm or tomato fruitworm), Heliothis zea. On July 10, spider mite populations (the two-spotted mite--Tetranychus bimaculatus-complex) were noted building up, primarily in the dry bean plots at Varamin. Significant populations showed up later at Karaj on both dry beans and mungbeans. Between 10 and 15 July, a heavy infestation of jassids (species currently unknown) appeared in the experimental pulse crop plantings at Karaj, particularly in

the cowpea and dry bean plots.

The above listing comprises what appeared to be the major insect pests of pulse crops grown in the indicated areas in North-central Iran in 1965.

In addition, the following insect pests were noted in relatively small numbers, and should be given consideration as potentially serious pests. Some green peach aphids (*Myzus persicae Sulzer*) were noted mixed with pea aphids on the foliage of most of the pulse crops a few days after plant emergence. These will doubtless prove to be efficient virus vectors. Both thrips and leaf-miners were observed on the foliage of the dry peas during the time the pea aphid was prevalent. Both the thrips and the leaf-miner larvae were occasioning some injury to the foliage, but it was not severe. The leaf-miner concerned was not the spinach leaf-miner, since the fully-grown larvae of the latter emerge from leaf tissue and drop to the ground to pupate, while the former were found pupating within the leaves. Spittle bugs (species unknown to date) in moderate numbers were noted during the month of August, continuing through harvest, almost exclusively on cowpeas. A few were seen on mungbeans. Grasshoppers, or locusts, were quite prevalent, and occasionally numerous, but caused no appreciable damage this season. Of course, a heavy locust migration through this area would be potentially extremely destructive.

PEA APHIDS

Pea aphids appeared first on dry peas, probably because this was the first crop to emerge. They appeared later on the lentils, chickpeas, cowpeas, dry beans, and mungbeans, shortly after the plants emerged. They appeared initially in large numbers on all crops. However, this initial population consisted almost entirely of alate forms, and the only crop that was appreciably colonized was the dry peas.

Some alate green peach aphids were also seen mixed with the pea aphids. After a few days, the alate population left all crops except the dry peas, and on this latter crop some colonization took place. No insecticidal control was attempted against aphids on any of the crops last season. No direct feeding injury was observed, but in mid-summer, virus symptoms were very prevalent, especially in the dry beans. Symptoms were also quite noticeable in the cowpeas, the lentils, and the mungbeans. The crop which showed the least evidence of virus symptoms was chickpeas. In all probability, the prevalence of aphids on these crops for a relatively short time when the plants were very young, was responsible for the transmission of the virus to them.

The nature of these virus diseases, their importance, method of spread, and possibilities of control by controlling the insect vector or vectors, will be the subject of close and

cooperative study, with plant pathology personnel, when greenhouse facilities are available. If the transmission follows the pattern of most aphid-vectored plant viruses, a very early and very effective aphid control program will be necessary to appreciably reduce the virus incidence. A plant-breeding program for virus resistance may be more effective than insecticidal insect-vector control, and should at least be an important phase of the disease control program.

PEA WEEVIL

Insecticides were not obtained and applied to the dry peas early enough in the season to effectively control the pea weevil. Sprays of DDT-Lindane, malathion, and carbaryl were applied on June 10, 1965, but at this time it was noticed that oviposition holes in the pods were prevalent, so obviously the spray application was made too late to be effective.

After harvest, the threshed and cleaned pea seed was examined to determine the amount of weevil damage to the 15 different varieties grown. A total of 2500 seed was examined from each variety. The examinations were made in lots of 500 each; the 5 samples of 500 seed each were taken representatively from the total bulk of threshed and cleaned seed of each variety. The following table shows the results of the examinations, and counts in terms of percent weevil-damaged seed in each variety.

TABLE 12

Percent of Weevil-Damaged Dry Pea Seed Found
In 15 Varieties After Harvest.

Karaj, Iran - 1965 Season

| Variety | Number of Seed Examined | Number of Seed Weevil-Damaged | Percent of Seed Weevil-Damaged |
|---|---|---|---|
| Little Marvel | 2500 | 72 | 2.9 |
| No. 868 | 2500 | 109 | 4.4 |
| Edinburgh | 2500 | 132 | 5.3 |
| No. 739 | 2500 | 174 | 7.0 |
| No. 1385 | 2500 | 187 | 7.5 |
| Wando | 2500 | 215 | 8.6 |
| No. 1332 | 2500 | 254 | 10.2 |
| Karand | 2500 | 272 | 10.9 |
| Pride | 2500 | 278 | 11.1 |
| Kalind | 2500 | 319 | 12.8 |
| Ride de Knight | 2500 | 322 | 12.9 |
| Morse's Progress | 2500 | 336 | 13.4 |
| No. 1891 | 2500 | 484 | 19.4 |
| No. 1337 | 2500 | 509 | 20.4 |
| No. 2288 | 2500 | 557 | 22.3 |

Unfortunately, the data was so recorded that it was impossible to statistically analyze it. However with the damage figures arranged in ascending order in Table 12, it is easy to see there are some very real differences in the amount of weevil damage among several of the varieties. Unfortunately, Little Marvel, the variety which showed the least damage from pea weevil, was the least thrifty grown here, and the lowest yielder.

BEET ARMYWORM

Eggs and newly hatched larvae of the beet armyworm were first noted on the foliage of some pulse crops on June 1, and on June 3, considerable damage was noticed on the foliage of dry beans, cowpeas, and mungbeans. On this date, also, populations of 2 to 3 beet armyworm larvae per plant were noticed on chickpeas. Spraying was started on this date for experimental control of this insect. Three materials were used; a DDT-lindane combination, malathion, and carbaryl. The DDT-lindane combination was applied at the rate of one pound of actual DDT and 0.28 pound of lindane per acre, and the other two materials each at the rate of one pound actual per acre. Since the beet armyworm is a very omnivorous, as well as a voracious feeder, it was felt necessary to give as complete protection as possible to all plots. Consequently, the majority of the experimentally planted acreage was sprayed with the DDT-lindane combination, using a tractor-mounted sprayer. Harvesting procedures did not make it practical

to obtain separate yield records where the three different materials had been used, so no comparison is possible of the three, in terms of possible differences in yield of the same crop. However, observations subsequent to applications indicate all three materials were effective in preventing severe damage to any of the crops sprayed. Only a single spray application was made for control of the beet armyworm, and as might be expected, both the DDT-lindane and the carbaryl appeared somewhat more effective than the malathion, since both the chlorinated hydrocarbon (DDT-lindane combination) and carbamate (carbaryl) insecticides would be expected to have a longer residual action than malathion, which is a relatively short-lived organo-phosphorous material. Experiments for the specific purpose of making a comparative evaluation of these relatively safe insecticides are planned for the 1966 season.

CORN EARWORM (Tomato fruitworm - Cotton bollworm)

Discernable damage from this insect was confined to the chickpeas. Seed pods had formed on this crop prior to June 14, and on this date, it was noticed that a number of pods had been attacked by lepidopterous larvae, which consistently bored a single hole in a pod, entered, and devoured all the seed in the pod. This pest has been tentatively identified as the corn earworm (tomato fruitworm, or cotton bollworm).

On June 16, sprays were applied to a series of 125 three-row

plots at Karaj. One row in each plot was sprayed with a DDT-lindane combination at the rate of one pound of DDT and 0.28 pound of lindane per acre. A second row in each plot was sprayed with carbaryl at one pound of toxicant per acre. The third row in each plot was left as an unsprayed check. Sprays were applied at 30 gallons per acre. On June 17, the same spray procedure was followed in a series of 130 plots at Varamin.

At harvest, 100-pod samples were picked at random from each plot and examined for damage by the corn earworm larvae. In addition, the threshed and cleaned seed from the individual rows of each plot were weighed, and the weights totaled for each treatment. A summary of the results of the examinations and weighings is shown in Table 13, based on replication of total full-length field rows receiving the same treatment, rather than individual plots.

It is obvious that the sprays were not applied early enough to be as effective as they will need to be. However, they do show promise. In the Karaj plots, both the DDT-lindane and carbaryl applications effected a statistically significant reduction in percent damage below that shown in the untreated check, and the carbaryl also showed a significantly higher yield. In the Varamin plots, the sprays appeared non-effective, probably because of an earlier season and more advanced damage before the sprays were applied. In many instances, when pods were opened from the

TABLE 13

Heliothis zea Larval Damage to Chickpea Pods In Experimental Plots, and Seed Weights From Various Treatments.

Karaj and Varamin, Iran - 1965 Season

| Treatment | Location | Percent Damaged Pods | Total Seed Weight for Treatment |
|---|---|---|---|
| DDT-lindane | Karaj, Iran | 4.5* | 50,830 grams [1] |
| Carbaryl | Karaj, Iran | 4.7* | 54,634 grams [1] |
| Untreated check | Karaj, Iran | 9.4* | 48,020 grams [1] |
| LSD - 5% level | Karaj, Iran | 3.3 | 5,227 grams |
| LSD - 1% level | Karaj, Iran | 4.1 | No significant difference |
| DDT-lindane | Varamin, Iran | 9.5** | 52.729 grams [2] |
| Carbaryl | Varamin, Iran | 7.9** | 54,560 grams [2] |
| Untreated check | Varamin, Iran | 7.6** | 52,913 grams [2] |

* - Average of 125 plots

** - Average of 130 plots

[1] - Total weight from 125 plots (Plots 5 meters long and 3 meters wide)

[2] - Total weight from 130 plots (Plots 5 meters long and 1½ meters wide)

sprayed rows, half-devoured seeds and a dead Heliothis zea larva were found inside. No such instances were found in the unsprayed check rows. Obviously, these larvae had obtained a lethal dose of insecticide in boring through the pod, and had not survived long enough to completely devour the seed inside.

The following two tables show in considerable detail the amount of damage to 25 and 26 different strains of chickpeas, respectively, in Karaj and Varamin. These tabulations of records are from 3-row plots, 5 meters long, and 5 replicate plots of each strain. Row A in each tabulation was the one sprayed with the DDT-lindane combination; Row B was sprayed with carbaryl; and Row C was the unsprayed check.

In each table, the various strains of chickpeas have been arranged in descending order of seed yield for Row B. This was the middle row of each plot, and the one used in calculating yield. The information for the other rows, and the damage records, were placed to correspond with the proper strain number, regardless of rank. However, the rank of each entry is shown, adjacent to it. There seems to be a general similarity of trend in yield in the 3 rows of each strain, especially at the upper and lower levels. The damage seems to vary widely between strains and between rows, with no consistent corresondence between amount of pod damage and yield. However, it has already been shown above in the case of the Karaj plots that

TABLE 14

*Heliothis zea* (corn earworm) damage to chickpea seed, and results of one application each of two insecticides, reflected by damage counts and seed yields - Karaj, Iran, 1965.

| | | Percent of Damaged Pods | | | | | | Seed Yield - Grams per Row | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Row A | | Row B | | Row C | | Row A | | Row B | | Row C | |
| Strain No. | Identity or Source | % Dam. | Rank | % Dam. | Rank | % Dam. | Rank | Grams | Rank | Grams | Rank | Grams | Rank |
| 331 | Cyprus | 9.6 | 25 | 10.2 | 25 | 13.8 | 22 | 767 | 1 | 687 | 1 | 647 | 1 |
| 329 | Karaj | 6.0 | 21 | 5.0 | 20 | 11.2 | 20 | 557 | 2 | 654 | 2 | 525 | 2 |
| 80 | PKPS | 5.6 | 18 | 4.2 | 13 | 15.2 | 24 | 424 | 10 | 619 | 3 | 501 | 4 |
| 310 | Ghuchan | 3.8 | 12 | 4.0 | 12 | 12.0 | 21 | 467 | 6 | 569 | 4 | 513 | 3 |
| 332 | Torbat Heydari | 5.6 | 20 | 9.2 | 24 | 13.8 | 23 | 545 | 3 | 526 | 5 | 435 | 9 |
| 235 | Spain | 3.2 | 10 | 4.4 | 16 | 8.6 | 11 | 363 | 18 | 497 | 6 | 395 | 11 |
| 307 | Ghazvin | 3.2 | 9 | 3.6 | 9 | 6.6 | 7 | 431 | 9 | 467 | 7 | 473 | 6 |
| 3 | PKPS | 1.6 | 1 | 4.6 | 17 | 8.8 | 13 | 453 | 7 | 452 | 8 | 384 | 13 |
| 225 | Iran | 3.6 | 11 | 4.8 | 18 | 5.6 | 3 | 403 | 13 | 452 | 9 | 289 | 20 |
| 34 | PKPS | 1.8 | 3 | 7.0 | 23 | 17.4 | 25 | 383 | 15 | 451 | 10 | 453 | 8 |
| 77 | PKPS | 9.0 | 24 | 6.0 | 22 | 6.6 | 8 | 370 | 17 | 450 | 11 | 356 | 14 |
| 18 | PKPS | 4.0 | 13 | 2.8 | 6 | 10.6 | 17 | 421 | 11 | 450 | 12 | 309 | 17 |
| 63 | PKPS | 6.8 | 23 | 5.0 | 19 | 10.4 | 16 | 442 | 8 | 447 | 13 | 329 | 16 |
| 305 | Ardabil | 3.0 | 7 | 2.0 | 2 | 3.8 | 1 | 404 | 12 | 431 | 14 | 433 | 10 |
| 306 | Kermanshah | 4.6 | 15 | 2.0 | 3 | 6.0 | 4 | 310 | 21 | 428 | 15 | 282 | 21 |
| 231 | Iran | 2.6 | 4 | 2.4 | 5 | 5.0 | 2 | 402 | 14 | 418 | 16 | 470 | 7 |
| 309 | Nishabour | 3.2 | 8 | 2.4 | 4 | 7.8 | 10 | 542 | 4 | 411 | 17 | 483 | 5 |
| K-ch | Karaj | 6.6 | 22 | 4.2 | 15 | 11.0 | 19 | 361 | 19 | 397 | 18 | 344 | 15 |
| 337 | Iran | 4.6 | 14 | 4.2 | 14 | 7.4 | 9 | 266 | 23 | 370 | 19 | 250 | 24 |
| 237 | Afghanistan | 5.6 | 19 | 5.6 | 21 | 6.2 | 5 | 492 | 5 | 352 | 20 | 387 | 12 |
| 302 | Ghazvin | 2.8 | 5 | 2.0 | 1 | 9.8 | 14 | 228 | 24 | 335 | 21 | 276 | 22 |
| 303 | Azarshahr | 2.8 | 6 | 3.8 | 10 | 8.8 | 12 | 278 | 22 | 328 | 22 | 294 | 19 |
| 93 | PKPS | 5.6 | 17 | 3.0 | 7 | 10.8 | 18 | 370 | 16 | 292 | 23 | 275 | 23 |
| 13 | PKPS | 5.2 | 16 | 3.2 | 8 | 10.0 | 15 | 318 | 20 | 278 | 24 | 303 | 18 |
| 96 | PKPS | 1.8 | 2 | 4.0 | 11 | 6.6 | 6 | 182 | 25 | 172 | 25 | 158 | 25 |

TABLE 15

Heliothis zea (corn earworm) damage to chickpea seed, and results of one application each of two insecticides, reflected by damage counts and seed yields - Varamin, Iran, 1965.

| | | Percent of Damaged Pods | | | | | | Seed Yield--Grams per Row | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Row A | | Row B | | Row C | | Row A | | Row B | | Row C | |
| Strain No. | Identity or Source | % Dam. | Rank | % Dam. | Rank | % Dam. | Rank | Grams | Rank | Grams | Rank | Grams | Rank |
| 305 | Ardabil | 5.0 | 2 | 3.2 | 2 | 4.4 | 1 | 526 | 1 | 570 | 1 | 524 | 1 |
| 331 | Cyprus | 10.6 | 19 | 8.2 | 14 | 7.4 | 18 | 454 | 5 | 548 | 2 | 433 | 10 |
| 307 | Ghazvin | 4.6 | 1 | 3.0 | 1 | 4.4 | 2 | 453 | 6 | 539 | 3 | 485 | 4 |
| 329 | Karaj | 10.4 | 18 | 4.4 | 5 | 5.4 | 6 | 439 | 7 | 502 | 4 | 502 | 3 |
| 309 | Nishabour | 9.0 | 13 | 6.2 | 10 | 8.4 | 19 | 514 | 2 | 494 | 5 | 456 | 6 |
| 231 | Iran | 7.8 | 10 | 4.8 | 7 | 6.4 | 12 | 396 | 15 | 478 | 6 | 373 | 18 |
| V-ch | Varamin | 10.0 | 17 | 11.2 | 23 | 5.4 | 7 | 434 | 10 | 477 | 7 | 466 | 5 |
| 3 | PKPS | 14.4 | 25 | 10.8 | 21 | 12.0 | 24 | 401 | 13 | 458 | 8 | 357 | 23 |
| 80 | PKPS | 5.6 | 3 | 8.2 | 15 | 10.4 | 22 | 435 | 9 | 450 | 9 | 365 | 21 |
| 34 | PKPS | 12.0 | 22 | 12.4 | 25 | 10.4 | 21 | 426 | 11 | 442 | 10 | 508 | 2 |
| 303 | Azarshahr | 6.4 | 5 | 4.6 | 6 | 5.6 | 8 | 379 | 17 | 439 | 11 | 449 | 8 |
| 310 | Ghuchan | 8.4 | 11 | 4.0 | 4 | 6.2 | 11 | 470 | 4 | 435 | 12 | 418 | 12 |
| 1 | PKPS | 7.2 | 8 | 12.8 | 26 | 12.6 | 26 | 485 | 3 | 433 | 13 | 452 | 7 |
| 225 | Iran | 7.4 | 9 | 5.0 | 8 | 6.8 | 14 | 414 | 12 | 430 | 14 | 410 | 13 |
| 332 | Torbat Heydari | 11.4 | 20 | 8.0 | 13 | 5.0 | 4 | 366 | 18 | 417 | 15 | 443 | 9 |
| K-ch | Karaj | 9.8 | 15 | 8.6 | 17 | 6.8 | 15 | 351 | 21 | 414 | 16 | 359 | 22 |
| 93 | PKPS | 14.0 | 24 | 11.2 | 22 | 9.8 | 20 | 436 | 8 | 399 | 17 | 367 | 20 |
| 18 | PKPS | 11.8 | 21 | 10.2 | 20 | 12.4 | 25 | 379 | 16 | 393 | 18 | 370 | 19 |
| 96 | PKPS | 17.4 | 26 | 9.2 | 18 | 11.4 | 23 | 336 | 25 | 387 | 19 | 387 | 17 |
| 77 | PKPS | 8.8 | 12 | 8.2 | 16 | 7.0 | 16 | 349 | 22 | 373 | 20 | 404 | 14 |
| 306 | Kermanshah | 7.0 | 7 | 5.3 | 9 | 5.3 | 5 | 304 | 26 | 373 | 21 | 325 | 25 |
| 63 | PKPS | 9.5 | 14 | 4.0 | 3 | 6.0 | 9 | 337 | 24 | 361 | 22 | 399 | 15 |
| 302 | Ghazvin | 6.2 | 4 | 9.6 | 19 | 4.8 | 3 | 358 | 20 | 361 | 23 | 426 | 11 |
| 13 | PKPS | 10.0 | 16 | 6.8 | 11 | 7.4 | 17 | 348 | 23 | 347 | 24 | 323 | 26 |
| 5 | PKPS | 6.6 | 6 | 11.6 | 24 | 6.6 | 13 | 397 | 14 | 335 | 25 | 396 | 16 |
| 237 | Afghanistan | 12.4 | 23 | 7.6 | 12 | 6.0 | 10 | 361 | 19 | 321 | 26 | 327 | 24 |

there was a real difference in the amount of damage between the sprayed and unsprayed rows, which was also partially reflected in differences in seed yield. A study of the figures in unsprayed Row C of the damage category in both tables indicates there is a wide range of innate susceptibility, or apparent tolerance or resistance to attack by this insect (from 3.8 to 17.4 percent damaged pods in the Karaj plots, and from 4.4 to 12.6 percent in the Varamin plots). There may be a possibility for some selection and breeding work to incorporate a tolerance or resistance factor into some of the otherwise desirable lines or strains. For example, strain numbers 305, 307, and 329 at Varamin all showed relatively little damage from this insect and were among the highest yielders. Strain numbers 302 and 306 also showed little damage, but were mediocre or poorer in yield. In the experimental plots at Karaj, strain numbers 231 and 305 showed little damage and yielded well, and strain numbers 225 and 306 also had little damage, but were below average in yield.

In addition to the above, 100-pod samples have been obtained and examined from each of the 360 plots at Karaj that were not sprayed for control of this pest. The damage ranged from 0 to 78 percent in the 360 plots, and averaged 17 percent. This figure, of course, represents a total seed loss. If damage figures of this magnitude are to be a usual occurrence, this insect must be considered one of the serious and important pests of the chickpeas.

SPIDER MITES (Two-Spotted Mites)

On July 10, 1965, it was noticed that spider mite populations were building up, primarily in the dry bean plots at Varamin. Significant populations never appeared at Varamin on the chickpeas, cowpeas, or mungbeans. However, some records were taken on July 31, 1965, on the foliage injury to cowpeas at Varamin, occasioned by both mite and jassid feeding. The injury occasioned by both mites and jassids is shown separately in the following Table 16.

A numerical injury index has been used in this table to show severity of symptoms from both mite and jassid feeding. The index ranges from 0 (no feeding injury apparent on foliage) to 5 (very severe injury). The injury from both mites and jassids is arranged in ascending order for the 44 strains of cowpeas grown in the experimental plots at Varamin, and each figure represents the average of 5 replicate plots.

There was very little severe injury from the jassids and the range of injury symptoms was not very extensive. The injury to the foliage from mites extended over a somewhat greater range, from milder to more severe symptoms.

None of this injury to the cowpea foliage was considered serious enough to warrant the application of insecticides or miticides. The range of injury index for both mites and jassids indicates there may be some innate tolerance or resistance to

TABLE 16

Jassid & Mite injury to cowpea foliage as reflected by foliage appearance, Varamin, Iran, 1965.

| Strain No. | Identity or Source | Severity of symp. from Jassid fdg. Inj.Index | Rank | Strain No. | Identity or Source | Severity of symptoms from Mite feeding Inj.Index | Rank |
|---|---|---|---|---|---|---|---|
| | Jackson | | | | Brown | | |
| 255 | Purple Hill | 2.0 | 1 | 206 | Eye Cream | 1.4 | 1 |
| 124 | South Africa | 2.2 | 2 | 189 | Arlington | 1.8 | 2 |
| 189 | Arlington | 2.2 | 3 | 204 | Brabham Victor | 2.0 | 3 |
| 206 | Br. Eye Cream | [illegible] | 4 | 76 | Belgian Congo | 2.2 | 4 |
| 232 | Davis Pea | 2.2 | 5 | 302 | Sumptuous | 2.2 | 5 |
| 302 | Sumptuous | 2.2 | 6 | 308 | Victor | 2.2 | 6 |
| 44 | Turkey | 2.4 | 7 | 41 | Turkey | 2.4 | 7 |
| 123 | South Africa | 2.4 | 8 | 54 | Turkey | 2.4 | 8 |
| 169 | South Africa | 2.4 | 9 | 263 | Long Pod Cream | 2.4 | 9 |
| 173 | India | 2.4 | 10 | 300 | Sp.Purple Hill | 2.4 | 10 |
| 300 | Sp.Purple Hill | 2.4 | 11 | 124 | South Africa | 2.6 | 11 |
| 301 | Swanee | 2.4 | 12 | 163 | Nigeria | 2.6 | 12 |
| 305 | Texas Cream #40 | 2.4 | 13 | 177 | India | 2.6 | 13 |
| 323 | Topset | 2.4 | 14 | 249 | Inst. #0154 | 2.6 | 14 |
| 53 | Lebanon | 2.6 | 15 | 44 | Turkey | 2.8 | 15 |
| 115 | Pakistan | 2.6 | 16 | 115 | Pakistan | 2.8 | 16 |
| 136 | Guatemala | 2.6 | 17 | 123 | South Africa | 2.8 | 17 |
| 149 | Spain | 2.6 | 18 | 169 | South Africa | 2.8 | 18 |
| 151 | Nigeria | 2.6 | 19 | 195 | Blackeye #7 | 2.8 | 19 |
| 166 | Nigeria | 2.6 | 20 | 214 | Cal. Hackeye | 2.8 | 20 |
| 194 | Blackeye #5 | 2.6 | 21 | 232 | Davis Pea | 2.8 | 21 |
| 204 | Brabham Victor | 2.6 | 22 | 50 | Turkey | 3.0 | 22 |
| 214 | Cal. Hackeye | 2.6 | 23 | 136 | Guatemala | 3.0 | 23 |
| 248 | Honolulu | 2.6 | 24 | 151 | Nigeria | 3.0 | 24 |
| 325 | Princess Ann | 2.6 | 25 | 170 | Portugal | 3.0 | 25 |
| 54 | Turkey | 2.8 | 26 | 175 | India | 3.0 | 26 |
| 163 | Nigeria | 2.8 | 27 | 255 | J. Purple Hill | 3.0 | 27 |
| 170 | Portugal | 2.8 | 28 | 301 | Swanee | 3.0 | 28 |
| 175 | India | 2.8 | 29 | 305 | Texas Cream #40 | 3.0 | 29 |
| 266 | Monarch | 2.8 | 30 | 320 | Texas Cream #12 | 3.0 | 30 |
| 308 | Victor | 2.8 | 31 | 210 | Cabbage Pea | 3.2 | 31 |
| 41 | Turkey | 3.0 | 32 | 215 | Calra | 3.2 | 32 |
| 50 | Turkey | 3.0 | 33 | 231 | Cream White | 3.2 | 33 |
| 177 | India | 3.0 | 34 | 248 | Honolulu | 3.2 | 34 |
| 195 | Blackeye #7 | 3.0 | 35 | 323 | Topset | 3.2 | 35 |
| 210 | Cabbage Pea | 3.0 | 36 | 173 | India | 3.4 | 36 |
| 231 | Cream White | 3.0 | 37 | 266 | Monarch | 3.4 | 37 |
| 249 | Inst. #0154 | 3.0 | 38 | 327 | Iran | 3.4 | 38 |
| 327 | Iran | 3.0 | 39 | 53 | Lebanon | 3.6 | 39 |
| 338 | Iran | 3.0 | 40 | 149 | Spain | 3.6 | 40 |
| 76 | Belgian Congo | 3.2 | 41 | 194 | Blackeye #5 | 3.6 | 41 |
| 215 | Calra | 3.2 | 42 | 166 | Nigeria | 3.8 | 42 |
| 320 | Texas Cream #12 | 3.2 | 43 | 325 | Princess Ann | 3.8 | 43 |
| 263 | Long Pod Cream | 3.4 | 44 | 338 | Iran | 3.8 | 44 |

attack or feeding by these pests in some strains, and other things being equal, possibly consideration should be given to these desirable characteristics in the plant breeding phase of the Project work. Strain numbers 189, 206, and 302, for example, all showed relatively little injury from the feeding of both these pests.

Yields were not obtained from these plots.

The dry beans were planted in 3-row plots, and three miticides were experimentally applied, one to each row of each plot, for comparative evaluation. The materials were Trithion (one-half pound toxicant per acre), Imidan (one pound toxicant per acre), and malathion (one pound toxicant per acre). All sprays were applied at the rate of 30 gallons per acre. A ten percent granular formulation of Union Carbides' 21149, an experimental systemic miticide, was applied in a small trench in the soil, about 2 inches deep and about 2 inches away from the bean plant roots, to a total of 200 linear feet of bean rows, on one side of the rows only, at the rate of 5 pounds of toxicant per acre. The material was applied in two locations in the bean plots; one where mites were evident although damage was not yet apparent, and another where the plants were more nearly mature, and the mite infestation was considerably more severe and further advanced.

No evidence of significant populations of mites appeared in the plots at Karaj until August 28, 1965. At that time, noticeable populations were found in various areas in the dry bean

plantings, but the beans were practically mature at the time, and the mites posed no threat to the crop. At the same time, spotted infestations were noted in the mungbeans, some of which were not nearly mature. It was thought these populations might develop to damaging numbers, and if so, would provide an opportunity to test the value of some relatively late-season applications of miticides. Four replicate plots were sprayed with Imidan at the rate of one pound of toxicant per acre, and four with Trithion at one-half pound per acre. Eight replicate plots were left untreated as checks.

An application of 10% granular 21149 was also made to some mungbeans in Karaj in the same manner as the replication was made to dry beans at Varamin earlier in the season.

On August 16, 1965, the sprayed and UC-21149-treated plots at Varamin were examined. The plots sprayed with Imidan, malathion, and Trithion showed no apparent effect in mite reduction below that in some untreated rows left as checks. Damage was not severe, but mites were prevalent and numerous, and doubtless had occasioned some damage to the bean plants. Yield data was obtained from the plots sprayed with the three different miticides, and there was no statistically significant difference in the seed yields from the three treatments. Under such conditions, spray applications should be started earlier, and probably more than one application will be required.

Detailed results of spraying the dry beans for mite control are shown in the following Table 17. The "A" rows were sprayed with Imidan at the rate of one pound of toxicant per acre; the "B" rows with Malathion at one pound toxicant per acre; and the "C" rows with Trithion at one-half pound of toxicant per acre.

The strains are arranged in the table in descending order of seed yield for Row "B". The yields in Rows A, B, and C show a rough correspondence so far as ranks of the strain numbers are concerned, especially at each end of the columns representing yield range. However, there seems to be no correlation between apparent mite damage to the foliage and yield. It is quite obvious that some of the high-yielding strains are also quite susceptible to injury from mite feeding, and maintain their place at the top of the yield test in spite of the relatively high mite damage. These include varieties Great Northern 1140, Pinto Columbia, Pinto 111, and Kermanshah (Iran). Timely and adequate applications of effective miticides should result in further increased yields from these obviously desirable strains.

Wide differences were noticed between the UC-21149-treated and the untreated rows. There was considerable green foliage on the treated plants, while those from untreated check rows were completely dried up. Where mite infestations were moderately severe, the UC-21149 appeared to have been effective in prolonging the life of the plants.

TABLE 17

Mite injury to foliage of dry beans, and results of application of three different miticides, as reflected by seed yields - Varamin, Iran, 1965.

| Strain No. | Identity or Source | Severity of Damage Symptoms: Damage | Severity of Damage Symptoms: Rank | Average Seed Yield-Grams/Plot: Row A Grams | Row A Rank | Row B Grams | Row B Rank | Row C Grams | Row C Rank |
|---|---|---|---|---|---|---|---|---|---|
| E | Pinto 111 | 4.2 | 34 | 397 | 4 | 462 | 1 | 409 | 2 |
| D | Pinto Columbia | 4.4 | 35 | 452 | 2 | 419 | 2 | 368 | 4 |
| A | Gr.Northern 1140- | 3.8 | 32 | 474 | 1 | 418 | 3 | 358 | 7 |
| 79 | Bojnurd (Iran) | 2.6 | 18 | 300 | 17 | 412 | 4 | 351 | 8 |
| 47 | Kermanshah (I) | 3.0 | 26 | 341 | 7 | 385 | 5 | 345 | 9 |
| C | Gr.Northern 123- | 3.6 | 31 | 237 | 29 | 367 | 6 | 306 | 17 |
| 50 | Isfahan (I) | 1.8 | 5 | 341 | 8 | 365 | 7 | 318 | 15 |
| 15 | Isfahan (I) | 2.8 | 21 | 323 | 11 | 357 | 8 | 329 | 10 |
| B | Gr.Northern 31 | 3.8 | 33 | 328 | 9 | 352 | 9 | 273 | 26 |
| 37 | Lebanon | 3.0 | 24 | 322 | 12 | 349 | 10 | 280 | 23 |
| 80 | Bojnurd (I) | 3.0 | 29 | 292 | 19 | 345 | 11 | 324 | 12 |
| 41 | Moghan 20 (I) | 1.6 | 2 | 395 | 5 | 342 | 12 | 429 | 1 |
| 9 | Contender | 3.0 | 23 | 294 | 18 | 339 | 13 | 297 | 19 |
| 5 | Res.Tender Green- | 1.8 | 4 | 314 | 15 | 337 | 14 | 386 | 3 |
| 44 | Min. 88 (I) | 3.0 | 25 | 259 | 24 | 329 | 15 | 322 | 14 |
| 45 | Min. 236 (I) | 2.6 | 15 | 321 | 13 | 322 | 16 | 323 | 13 |
| 65 | Isfahan (I) | 2.6 | 17 | 277 | 21 | 320 | 17 | 227 | 29 |
| 2 | Giant Stringless Green Pod | 2.8 | 19 | 214 | 31 | 319 | 18 | 276 | 25 |
| 62 | Min. 1365 (I) | 2.4 | 13 | 315 | 14 | 318 | 19 | 205 | 31 |
| 71 | Min. 2394 (I) | 1.6 | 3 | 326 | 10 | 317 | 20 | 361 | 5 |
| 67 | Min. 2475 (I) | 2.8 | 22 | 277 | 22 | 312 | 21 | 280 | 24 |
| 49 | Shiraz (I) | 3.0 | 27 | 237 | 28 | 311 | 22 | 259 | 27 |
| 57 | Min. 394 (I) | 2.4 | 12 | 429 | 3 | 309 | 23 | 326 | 11 |
| 63 | Min. 1396 (I) | 3.0 | 28 | 278 | 20 | 308 | 24 | 315 | 16 |
| K-ch | Karaj (I) | 2.0 | 8 | 267 | 23 | 308 | 25 | 293 | 21 |
| 6 | Tenderlong-15 | 2.4 | 10 | 252 | 26 | 302 | 26 | 285 | 22 |
| 61 | Karaj-10 (I) | 2.6 | 16 | 258 | 25 | 301 | 27 | 297 | 20 |
| 4 | Wade | 1.6 | 1 | 350 | 6 | 269 | 28 | 359 | 6 |
| 33 | Khuzestan (I) | 2.6 | 14 | 196 | 32 | 254 | 29 | 298 | 18 |
| 35 | Min. 1 (I) | 3.2 | 30 | 234 | 30 | 253 | 30 | 236 | 28 |
| 52 | Min. 290 (I) | 2.0 | 7 | 247 | 27 | 250 | 31 | 187 | 34 |
| 24 | Metisse | 2.2 | 9 | 166 | 35 | 231 | 32 | 200 | 32 |
| 11 | Blue Lake | 2.0 | 6 | 180 | 33 | 223 | 33 | 166 | 35 |
| 7 | Tenderpod | 2.8 | 20 | 312 | 16 | 151 | 34 | 197 | 33 |
| 20 | Moubacher Spk. | 2.4 | 11 | 177 | 34 | 133 | 35 | 221 | 30 |

Both the sprayed and UC-21149-treated plants at Karaj showed no effects from the treatments. Both types of treatments in the mungbeans were indistinguishable from the checks. These applications were made relatively late in the season; soon after application, the weather became much cooler and there were frequent rains. The mite populations were effectively suppressed by natural conditions, and there was no opportunity to evaluate the miticides.

Spider mites will doubtless be a potential hazard to the pulse crops each season, and should be considered very seriously. However, in the light of these preliminary observations and tests, it seems possible that populations appearing late in the season may not be of major significance.

JASSIDS

Between July 10 and 15, 1965, it was noticed that there was a very heavy infestation of jassids in the experimental pulse crops at Karaj, particularly in the cowpea and dry bean plots. The results of their feeding were shown in a splotched or stippled appearance of the leaves, so they showed many irregular, almost white areas. Apparently, the jassids were destroying the chlorophyll, or preventing its production in the leaves. It is also possible they were transmitting a virus, and the splotched leaves were symptoms. Between July 21 and August 2, 1965, replicated plots of cowpeas and dry beans were

sprayed with a 0.2 percent dimethoate emulsion at the rate of 30 gallons of spray (8 oz. actual dimethoate)per acre.

Between 28 and 30 August, all plots in the experiment were examined, and each treated and untreated check row evaluated on the basis of jassid damage to the foliage. In the cowpeas, this was generally reflected in foliage color (or the lack of it), and in the dry beans, severe injury was frequently reflected in 100% foliage loss on the examination dates. Each row was rated on a numerical basis from 0 to 5. Zero indicated no apparent jassid damage; 5 indicated extremely severe damage symptoms.

The following two tables, 18 and 19, show in detail the results of the dimethoate application to the foliage of both cowpeas and dry beans, as reflected by improved appearance of the foliage over that in unsprayed checks.

The unsprayed checks of both crops show considerable variation in injury symptoms among the different strains. There is a fairly good correlation in the rank of foliage injury in the sprayed and unsprayed check rows of cowpeas (Table 18) so far as strain numbers are concerned, with the foliage in the sprayed rows showing consistently less feeding injury than the checks. Yield records were not obtained from the cowpeas.

The dry beans (Table 19) also show a fairly good correlation of strains so far as foliage injury is concerned, between the sprayed and unsprayed rows. Here again, with 3 minor exceptions,

TABLE 18

Jassid injury to foliage of cowpeas, and results of spraying with Dimethoate, as reflected by foliage appearance. Karaj, Iran, 1965.

| Strain No. | Identity or Source | Foliage Injury Index: Sprayed Rows | Rank | Unsprayed Check | Rank |
|---|---|---|---|---|---|
| 44 | Turkey | 1.3 | 1 | 1.6 | 1 |
| 300 | Sp.Purple Hill | 1.3 | 2 | 2.0 | 6 |
| 41 | Turkey | 1.4 | 3 | 2.2 | 7 |
| 54 | Turkey | 1.4 | 4 | 1.8 | 2 |
| 204 | Brabham Victor | 1.4 | 5 | 2.0 | 4 |
| 232 | Davis Pea | 1.4 | 6 | 2.0 | 5 |
| 76 | Belgian Congo | 1.5 | 7 | 2.4 | 9 |
| 255 | J.Purple Hill | 1.6 | 8 | 2.8 | 13 |
| 301 | Swanee | 1.6 | 9 | 1.8 | 3 |
| 136 | Guatemala | 1.7 | 10 | 2.4 | 10 |
| 266 | Monarch | 1.7 | 11 | 3.0 | 16 |
| 50 | Turkey | 1.9 | 12 | 3.0 | 14 |
| 206 | Browneye Cream | 1.9 | 13 | 2.4 | 11 |
| 308 | Victor | 2.0 | 14 | 2.2 | 8 |
| 248 | Honolulu | 2.1 | 15 | 3.2 | 20 |
| 338 | Iran | 2.1 | 16 | 3.4 | 31 |
| 189 | Arlington | 2.2 | 17 | 2.8 | 12 |
| 231 | Cream White | 2.2 | 18 | 3.2 | 19 |
| 325 | Princess Ann | 2.2 | 19 | 3.2 | 23 |
| 149 | Spain | 2.3 | 20 | 3.4 | 27 |
| 175 | India | 2.3 | 21 | 3.0 | 15 |
| 177 | India | 2.3 | 22 | 3.2 | 17 |
| 263 | Long Pod Cream | 2.3 | 23 | 3.4 | 30 |
| 302 | Sumptuous | 2.3 | 24 | 3.2 | 22 |
| 169 | South Africa | 2.4 | 25 | 3.4 | 28 |
| 249 | Inst. #0154 | 2.4 | 26 | 3.2 | 21 |
| 327 | Iran | 2.4 | 27 | 3.2 | 24 |
| 53 | Lebanon | 2.5 | 28 | 3.4 | 25 |
| 214 | Cal.Hackeye #7 | 2.5 | 29 | 3.8 | 38 |
| 210 | Cabbage Pea | 2.6 | 30 | 3.4 | 29 |
| 195 | Blackeye #7 | 2.7 | 31 | 3.6 | 35 |
| 215 | Calra | 2.7 | 32 | 3.2 | 18 |
| 163 | Nigeria | 2.8 | 33 | 3.6 | 33 |
| 173 | India | 2.8 | 34 | 3.8 | 37 |
| 305 | Texas Cream-40 | 2.8 | 35 | 3.8 | 39 |
| 124 | South Africa | 2.9 | 36 | 3.4 | 26 |
| 194 | Blackeye #5 | 2.9 | 37 | 3.6 | 34 |
| 151 | Nigeria | 3.0 | 38 | 3.6 | 32 |
| 170 | Portugal | 3.0 | 39 | 3.8 | 36 |
| 320 | Texas Cream-12 | 3.0 | 40 | 3.8 | 40 |
| 323 | Topset | 3.2 | 41 | 3.8 | 41 |
| 166 | Nigeria | 3.5 | 42 | 4.4 | 44 |
| 123 | South Africa | 3.9 | 43 | 4.0 | 43 |
| 115 | Pakistan | 4.0 | 44 | 4.0 | 42 |

TABLE 19

Jassid injury to foliage of dry beans, and results of spraying with Dimethoate, as reflected by foliage appearance and seed yields. Karaj, Iran, 1965.

| Strain No. | Identity or Source | Foliage Injury Index: Sprayed Rows Injury Index | Sprayed Rows Rank | Unsprayed check Injury Index | Unsprayed check Rank | Seed Yield--Grams/Plot: Sprayed Rows Grams | Sprayed Rows Rank | Unsprayed Check Grams | Unsprayed Check Rank |
|---|---|---|---|---|---|---|---|---|---|
| E | Pinto 111 | 1.8 | 1 | 2.4 | 1 | 756 | 3 | 656 | 8 |
| C | Gr.Northern 123- | 1.8 | 2 | 2.4 | 2 | 637 | 14 | 578 | 18 |
| B | Gr.Northern 31 | 1.9 | 3 | 3.0 | 4 | 756 | 4 | 731 | 1 |
| 37 | Lebanon-3 | 2.0 | 4 | 2.8 | 3 | 699 | 8 | 623 | 14 |
| 80 | Bojnurd (I) | 2.0 | 5 | 3.0 | 5 | 693 | 11 | 655 | 9 |
| 49 | Shiraz (I) | 2.1 | 6 | 3.0 | 6 | 770 | 1 | 710 | 2 |
| D | Pinto Columbia | 2.1 | 7 | 3.6 | 20 | 605 | 18 | 532 | 21 |
| 5 | Res.Tender Green- | 2.2 | 8 | 3.2 | 9 | 635 | 15 | 629 | 13 |
| 6 | Tenderlong-15 | 2.2 | 9 | 3.4 | 12 | 444 | 32 | 365 | 32 |
| 15 | Isfahan (I) | 2.2 | 10 | 3.4 | 13 | 701 | 7 | 651 | 11 |
| 50 | Isfahan (I) | 2.2 | 11 | 3.6 | 21 | 717 | 5 | 655 | 10 |
| 35 | Min. 1 (I) | 2.3 | 12 | 3.4 | 14 | 413 | 34 | 317 | 35 |
| 47 | Kermanshah (I) | 2.3 | 13 | 3.0 | 7 | 757 | 2 | 665 | 6 |
| 65 | Isfahan (I) | 2.3 | 14 | 3.4 | 15 | 694 | 9 | 657 | 7 |
| 79 | Bojnurd (I) | 2.3 | 15 | 3.4 | 16 | 712 | 6 | 704 | 3 |
| 4 | Wade | 2.5 | 16 | 3.2 | 10 | 566 | 19 | 538 | 20 |
| 41 | Moghan-20 (I) | 2.7 | 17 | 3.8 | 25 | 472 | 27 | 418 | 27 |
| 57 | Min. 394 (I) | 2.7 | 18 | 3.4 | 17 | 629 | 16 | 590 | 16 |
| 71 | Min. 2394 (I) | 2.7 | 19 | 3.8 | 26 | 557 | 20 | 580 | 17 |
| K-ch | Karaj (I) | 2.7 | 20 | 3.4 | 18 | 694 | 10 | 695 | 4 |
| 7 | Tenderpod | 2.8 | 21 | 3.6 | 22 | 364 | 35 | 324 | 34 |
| 24 | Metisse | 2.8 | 22 | 3.0 | 8 | 489 | 25 | 427 | 26 |
| 44 | Min. 88(I) | 2.8 | 23 | 3.4 | 19 | 471 | 28 | 439 | 24 |
| 61 | Karaj-10 (I) | 2.8 | 24 | 4.0 | 30 | 668 | 12 | 680 | 5 |
| 20 | Moubacher-Spkld. | 2.9 | 25 | 3.2 | 11 | 457 | 31 | 405 | 29 |
| 9 | Contender | 3.0 | 26 | 3.8 | 27 | 434 | 33 | 386 | 31 |
| 52 | Min. 290 (I) | 3.0 | 27 | 4.4 | 34 | 556 | 21 | 430 | 25 |
| 33 | Khuzestan | 3.2 | 28 | 4.4 | 35 | 461 | 30 | 408 | 28 |
| A | Gr.Northern 1140- | 3.3 | 29 | 3.6 | 23 | 623 | 17 | 641 | 12 |
| 11 | Blue Lake | 3.6 | 30 | 3.8 | 28 | 646 | 13 | 602 | 15 |
| 2 | Giant Stringless Green Pod | 3.7 | 31 | 3.6 | 24 | 482 | 26 | 400 | 30 |
| 62 | Min. 1365 (I) | 3.7 | 32 | 4.0 | 31 | 519 | 24 | 449 | 23 |
| 67 | Min. 2475 (I) | 4.0 | 33 | 4.0 | 32 | 469 | 29 | 353 | 33 |
| 45 | Min. 236 (I) | 4.2 | 34 | 3.8 | 29 | 528 | 22 | 554 | 19 |
| 63 | Min. 1396 (I) | 4.3 | 35 | 4.2 | 33 | 524 | 23 | 460 | 22 |

the sprayed rows show consistently less foliage injury than the unsprayed rows. There does not seem to be any direct or consistent correlation between reduced foliage injury and yield, according to the ranking of the various strains. However, with 5 minor exceptions, the sprayed rows showed higher yields than the unsprayed check in each strain.

The unsprayed check rows showed foliage injury measured by the injury index, ranging from 2.4 to 4.4, and the strains with the highest injury index were among the poorer yielders. As in the case of most of the other pulse crops under observation during the 1965 season, there seem to be good possibilities for some selection and breeding in both the cowpeas and dry beans for tolerance or resistance to jassid attack and damage.

The following brief tabulation summarizes the results of the dimethoate applications to cowpeas and dry beans, based on visual observations of foliage condition, approximately 4 weeks after treatment was completed.

TABLE 20

Effectiveness of Single Application of Dimethoate
In Controlling Jassid Damage to Cowpea and
Dry Bean Foliage.

Karaj, Iran - 1965 Season

| Crop | Average Damage | | LSD | |
|---|---|---|---|---|
| | Sprayed Rows | Check | 5% of Level | 1% of Level |
| Cowpeas | 2.31* | 3.08* | 0.59 | No. sig. |
| Dry beans | 2.70* | 3.42* | 0.63 | " " |

* = Based on numerical rating from 0 to 5, with larger numbers indicating increased damage.

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A statistical anyalysis of the observational data shows a significant reduction in foliage damage (at the 5% level only) in the sprayed rows below that in the unsprayed check rows in both crops. More effective results will be obtained by initiating control measures sooner, and probably more than one application will be necessary.

OTHER INSECT PESTS

Some of the other pests mentioned briefly earlier, which were not serious pests in 1965, could prove to be so another season, and must be seriously considered and watched carefully. These include aphids other than the pea aphid (possible virus vectors), grasshoppers or locusts, spittle bugs, a leaf miner (prevalent in the foliage of dry beans), and a lepidopterous larva found feeding in and blasting the buds and blooms of cowpeas.

BENEFICIAL INSECTS

Such beneficial insects as Coccinellids, small parasitic Hymenoptera, Nabids, Reduviids, and Chrysopids were all noted in the pulse crop plots during the 1965 season, and doubtless did their part in keeping the noxious insect population at the normal biological level here.

LIGHT TRAP

A light trap (20% black light) was put into operation on

June 14, 1965, and has been tended nightly to date. The nightly catch during the summer months was of considerable volume. Lepidoptera, particularly Noctuids, were quite plentiful; also some small Diptera, Hymenoptera, and Chrysopids. During the winter season, many nights no insects are taken, but it is planned to operate the trap nightly through the winter and into the spring and summer months in order to obtain some accurate data on the beginning date of seasonal activity of the insects of the area.

The catches of insects will be sorted, and representative specimens sent to taxonomic authorities for identification. A Regional Pulse Improvement Project insect collection has been started, and it is hoped to make it representative and useful for reference and study.

## SOIL AND CROP MANAGEMENT

Glenn M. Horner
Soil Scientist-Agronomist

### SOIL CHARACTERISTICS

The sites used for variety yield tests, strain trials, and other experiments varied in regard to temperature and soil properties. Summer temperatures at Varamin were about 5° C. warmer than at Karaj, due primarily to the lower altitude at Varamin. Thus, Varamin had a longer growing season.

Soils at the experimental sites are alluvial, with only slight profile development. They are underlain with a gravel substratum at a depth of about two meters or more. Subsurface drainage is adequate, and no appreciable drainage problems exist.

The soils differ in their physical and chemical properties (Tables 21 and 22). Texturally, they range from a silty clay at Varamin to a sandy clay loam at Shahriar. The soils are calcareous with pH values greater than 8. Total soluble salts were highest in the Shahriar soil; however, the salt content was well within the tolerance limits of pulse crops at all of the sites.

TABLE 21

Mechanical Analysis of Soils Used For Experimental Plots

| Location | % Sand | % Silt | % Cley | Soil Class (U.S.) |
|---|---|---|---|---|
| Varamin | 16.8 | 41.0 | 42.2 | Silty clay |
| Karaj | 33.8 | 33.4 | 32.8 | Clay loam |
| Shahriar | 54.8 | 24.0 | 21.2 | Sandy clay loam |

TABLE 22

Chemical Properties of Soils Used For Experimental Plots

| Location | Conductivity, EC x $10^3$ mmhos/cm. | pH [1] | Available [2] Phosphorus, ppm |
|---|---|---|---|
| Varamin | 0.04 | 8.3 | 9.0 |
| Karaj | 0.06 | 8.4 | 5.0 |
| Shahriar | 0.15 | 8.1 | 4.5 |

[1] 1:1 soil to water ratio.

[2] Sodium bicarbonate soluble.

Values of available soil prosphorus reflect previous fertilization practices. The Varamin soil, with 9.0 ppm (medium level) of available P, had received approximately 300 kg/ha of $P_2O_5$ annually during the past four years. Less fertilizer had been at Karaj (records are indefinite), and no phosphorus fertilizer had been applied previously at Shahriar.

Surface crusting, which impeded the emergence of seedlings, was a soil management problem at Varamin and Karaj. Different methods of handling this problem were employed. In some cases, a preplanting irrigation was used to bring soil moisture to an optimum level at planting time. If a crust formed before the plants emerged, or if the first irrigation occurred after planting, the soil surface was kept soft by subsequent irrigations, or the crust was broken mechanically.

RHIZOBIUM INOCULATION

Seed inoculation of several pulse crops with strains of rhizobia from the U. S. Soils Laboratory had only a slight effect on nodulation at the bloom stage, and on seed production (Table 23). There was no appreciable change in the number of nodules found on chickpeas and dry beans at the pre-bloom stage on June 25 (Project Report No. 2), and at the bloom stage on July 25. However, the number of nodules smaller than 2 mm. increased 3-fold on cowpeas, and 9-fold on mungbeans during this period. The number of nodules larger than 2 mm. on mungbeans increased by one-half. Approximately 90% of the nodules in both the inoculated and uninoculated treatments contained the reddish pigment that indicates the presence of efficient strains of rhizobia.

TABLE 23

Influence of Rhizobium Inoculation on Nodulation and Crop Yields, at Karaj, Iran, 1965.

| | Number of nodules per plant [1] | | | | Seed Yield | |
|---|---|---|---|---|---|---|
| | Inoculated | | Uninoculated | | Inoculated | Uninoculated |
| Crop | < 2mm. | >2mm | < 2mm | >2mm | Tons/ha | Tons/ha |
| Chickpeas | 15.9 | 7.8 | 14.5 | 7.4 | 1.35 | 1.46 |
| Dry Beans | 6.3 | 7.1 | 11.5 | 11.6 | 1.49 | 1.39 |
| Cowpeas | 58.0 | 18.8 | 41.0 | 18.3 | 2.54 | 2.26 |
| Mungbeans | 53.9 | 18.7 | 30.5 | 13.9 | 1.66 | 1.57 |

[1] Determinations made July 25, 1965. Averages of 20 plants.

Rhizobia inoculation had no apparent effect on the growth of these four pulse crops. Differences in plant heights and seed yields for the inoculated and the uninoculated treatments were not significant. Also, differences in plant color were not detected. These results indicate the presence of relatively efficient strains of rhizobia in the soil at Karaj. There is need for additional studies to determine the distribution of efficient strains of rhizobia under different soil and climatic conditions.

FERTILIZATION

There is a lack of information concerning soil fertility requirements of pulse crops grown in various Iranian soils. This applies particularly to phosphorous requirements and the correlation between soil test values and the response of pulse crops to fertilization. Limited fertilizer studies have been conducted with pulse crops. These crops were not included in an extensive soil fertility project conducted from 1961 to 1965 by the Ministry of Agriculture and the Food and Agriculture Organization of the United Nations.

Results of the above tests showed that nitrogen and phosphorus fertilization gave highly profitable yield increases for nonleguminous crops such as wheat (irrigated), sugar beets, cotton, and rice. These tests were located in farmers' fields, generally on land that had not previously received chemical fertilizers.

Fertilizer trials were established in 1965 by the Regional Pulse Improvement Project at the Karaj and Varamin Experiment Stations, and on a privately-owned farm near Shahriar. Concentrated superphosphate was side-dressed at rates of 0, 25, 50, and 100 kg. of P per hectare. A blanket application of ammonium nitrate (100 kg. N/ha) was applied to all plots. Five replications were used. Cowpeas, dry beans (two varieties), and mungbeans were grown at Karaj and Varamin, while dry beans (white) and mungbeans were grown at Shahriar.

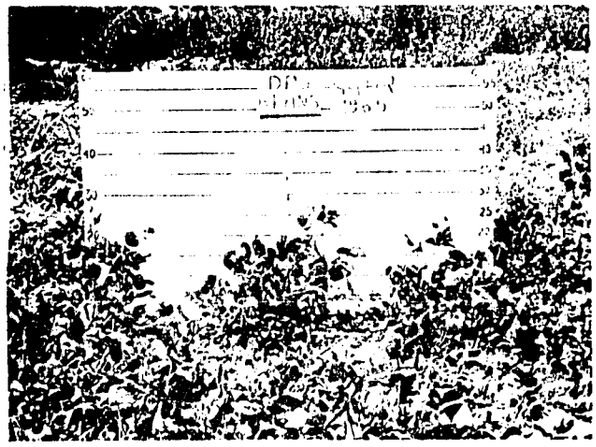
The influence of phosphorus fertilization on the yields of different crops at the three locations is given in Table 24. Yield responses to phosphorus were not statistically significant at the 5% level at Varamin or Karaj, although for the majority of crops, the check plots yielded slightly less than the high P plots. At Shahriar, however, yields for the two high P rates were significantly greater than the check at 5%. Differences in plant height and vigor were clearly evident, as shown by the photographs in Figure 6. The 25-kilogram rate of P had no effect on yield, nor were any growth differences visually evident.

This variation in crop response to phosphorus fertilization at the three locations may be associated with previous fertilization. The Varamin soil was fertilized with approximately 300 kg/ha of $P_2O_5$ in each of the last four years. Phosphorus was previously applied to the Karaj soil also, but the amount is unknown. The Shahriar soil was not fertilized previously. Levels of available P prior to planting were 9.0, 4.5, and 4.0 ppm at Varamin, Karaj, and Shahriar, respectively. The P level at Varamin falls in the medium range of availability; therefore, the lack of fertilizer response at this location could be predicted. However, the low value for the Karaj soil indicated a probable phosphorus deficiency, which was not shown by the yield data.

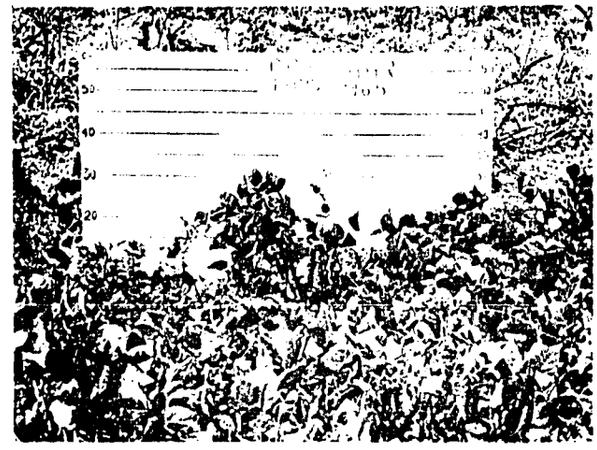
TABLE 24

Influence of Phosphorus Fertilization on Seed Yields of Pulse Crops (tons/ha).

| Location and Crop | Fertilizer rates, kg. P/ha. | | | |
|---|---|---|---|---|
| | 0 | 25 | 50 | 100 |
| Varamin: | | | | |
| Cowpeas | 1.28 | 1.33 | 1.36 | 1.26 |
| Dry beans (white) | 3.01 | 3.22 | 3.01 | 3.20 |
| Dry beans (pinto) | 2.12 | 2.09 | 2.13 | 2.40 |
| Mungbeans | 0.88 | 0.86 | 0.94 | 1.05 |
| Mean | 1.82 | 1.88 | 1.86 | 1.98 |
| Karaj: | | | | |
| Cowpeas | 1.22 | 1.34 | 1.42 | 1.36 |
| Dry beans (white) | 0.98 | 0.97 | 1.16 | 1.09 |
| Dry beans (pinto) | 1.85 | 2.07 | 2.12 | 2.13 |
| Mungbeans | 1.30 | 1.28 | 1.18 | 1.27 |
| Mean | 1.34 | 1.42 | 1.47 | 1.46 |
| Shahrier: | | | | |
| Dry beans (white) | 0.57 | 0.50 | 0.98 | 1.30 |
| Mungbeans | 0.43 | 0.45 | 0.64 | 0.66 |
| Mean | 0.50 | 0.46 | 0.81 | 0.98 |



Untreated



100 kg/ha of P

Untreated

100 kg/ha of P

FIGURE 6. Effect of phosphate fertilizer on crop growth at Shahriar. Above: Dry beans; below: Mungbeans.

## PLANT PATHOLOGY REPORT

Walter J. Kaiser
Research Plant Pathologist

In the 1965 pulse variety trials, diseases caused by viruses and soil-borne fungi appeared to be of utmost importance. Symptoms typical of virus diseases were prevalent in many of the pulse varieties. Insects have been implicated as the primary agent in transmission and spread of pulse viruses, since insects known to be vectors of legume viruses have been recorded in the pulse plots. Various techniques are being used to identify the virus diseases of pulse crops in Iran.

A severe wilting disease was recorded in selections of chickpeas and lentils. Soil was collected from plots where wilt incidence was high, and has been planted to wilt susceptible varieties. Isolations will be made from plants showing wilt symptoms. Pathogenicity tests will be conducted with the micro-organisms isolated from wilt plants to determine the cause of the disease.

A number of plant disorders of unknown cause were observed in some of the pulse acquisitions. The cause of these disorders will be investigated this year, should they reoccur.

Some of the research projects which will be initiated in 1966 are:

1. Identification of the plant pathogens of pulse crops.

2. Survey of the pulse crop diseases present in Iran.

3. Determination of alternate hosts of the pulse plant pathogens.

4. Mode of survival of pulse pathogens in the absence of susceptible pulse crops.

5. Effect of environment on disease development and spread.

6. Control of pulse diseases by various methods (e.g. soil fumigation, resistance).

7. Importance of seed in the spread and survival of pulse pathogens.

8. Laboratory studies on the growth, sporulation, variation, and pathogenicity of micro-organisms pathogenic to pulse crops.

9. Virus diseases of pulse crops transmitted by insects and related studies on insect transmission of pulse viruses (in cooperation with the Entomologist).

## SOUTH ASIA - FAR EAST RESEARCH CENTER, INDIA

A memorandum of understanding was signed by the United States and Indian Governments in July, 1965, for the establishment of the second center for regional research on pulse crops.

Because of the hostilities between India and Pakistan, preparations for project operations were delayed until December, 1965. At that time, Dr. van Schaik, Project Leader, and Mr. Lansing, Administrative Officer, spent two weeks in New Delhi and made arrangements with US AID and the Government of India to start the project in that country. A trip report was filed with appropriate authorities.

On December 1, 1965, Dr. Richard Matsuura, Plant breader-Geneticist, reported for duty. Dr. Matsuura has spent the previous four years as an agricultural missionary in India.

Dr. Floyd Williams, formerly Plant Pathologist with the University of Maryland, arrived in India in early January, 1966, to take up the plant pathology position with the project.

It is anticipated that during the course of 1966, Mr. Kenneth E. Gibson, Entomologist, and Mr. Walter E. Lansing, Administrative Officer, will transfer from Tehran to New Delhi.

Dr. Matsuura and Dr. Williams have started an ambitious program to collect germ plasm and a wide range of information on pulse crops in India.