Pulse Pathology

Progress Report-48

# Pulse Pathology (Pigeonpea) Report of Work

(June 1985 - May 1986)

ICRISAT

nternational Crops Research Institute for the Semi-Arid Tropics

Patancheru, Andhra Pradesh 502 324, India

*This report has been prepared to share the information with scientists having interest in pigeonpea improvement. This is not an official publication of the Institute and should not be cited.*

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# PULSE PATHOLOGY
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## PULSE PATHOLOGY (PIGEONPEA)

### LIST OF APPROVED PROJECTS (1985-86)

| No. | Title | Project Scientist(s) | Cooperators |
|---|---|---|---|
| CP-117(85)IC | Studies on pathogens causing wilt and root rots of chickpea and pigeonpea | M.P. Havare | Laxman Singh<br>H.A. van Rheenen<br>R. Jambunathan<br>Y.S. Chauhan |
| CP-118(85)IC | Studies on pathogens causing blights of chickpea and pigeonpea | Y.L. Nene | B.L. Jalali (Hisar)<br>S.P.S. Beniwal |
| CP-119(85)IC | Studies on the viruses affecting chickpea and pigeonpea | A.M. Ghanekar<br>Y.L. Nene | D.V.R. Reddy<br>S. Sithanantham<br>Laxman Singh<br>H.A. van Rheenen |
| CP-120(85)IC | Screening for disease resistance in chickpea and pigeonpea | M.V. Reddy<br>A.M. Ghanekar<br>H.A. van Rheenen<br>Laxman Singh | Y.P.S. Rathi (Pantnagar)<br>B.L. Jalali (Hisar) |

**Project: CP-117(85)IC - Studies on pathogens causing wilts and root rots of chickpea and pigeonpea**

**Project: CP-118(85)IC - Studies on the pathogens causing blights of chickpea and pigeonpea**

**Project: CP-119(85)IC - Studies on the viruses affecting chickpea and pigeonpea**

**Project: CP-120(85)IC - Screening for disease resistance in chickpea and pigeonpea**

**Project: CP-117(85)IC - Studies on pathogens causing wilts and root rots of chickpea and pigeonpea**

## I. Summary

Previous season's results on solarization were confirmed. The solar heating of *Fusarium* infested soil reduced the *Fusarium* population in the soil. It also reduced the wilt significantly.

Solarization did not affect the pigeonpea seed quality i.e. seed germination and seed weight.

A soil antagonist, *Penicillium pinophilum* was isolated from solarised soil. It was found to be antagonistic to pigeonpea wilt pathogen (*Fusarium udum*) in laboratory studies.

Internal seedborne *F. udum* was eradicated from pigeonpea seed by treating them with mixture of Benlate + thiram (1:1).

Search for perfect state of *F. udum* continued without any positive evidence of its existance.

Studies on inheritance of wilt resistance in pigeonpea were initiated with a modified pot screening technique.

## II. Introduction

The project became operative from May 1985 with the following objectives:

(a) Investigate the biology and epidemiology of the pathogens.

(b) Work out an integrated control system for each disease.

(c) Assist breeders in inheritance studies.

Work carried out during 1985-86 is reported.

## III. Wilt

### A. Residual effect of solarization

The solar heating of the soil in a part of wilt sick plot (BIL 2B) by application of transparent polythene mulch during summer months in 1984, resulted in a significant decrease in *Fusarium* propagules in solarized soil and pigeonpea wilt. The experiment was repeated in 1985-86 season on the same plot to obtain confirmation of the previous season's results. Residual effects of solarization were also measured by halving block number and imposing + and - solarization treatments on each of the previous season's treatments.

Experiment 1: To compare fresh, residual and double solarization effects on pigeonpea in the same area where 1984-85 trial was conducted.

**Details of the experiment**

Location : Wilt sick plot (BIL 2B)

**Treatments:**

| | |
|---|---|
| **Main plot** | : 1. Irrigation before solarization |
| | : 2. No irrigation |
| **Sub plot** | : 8 treatments |
| **Design** | : Split plot |
| **Replications** | : 3 |
| **Sub plot size** | : 6 x 6 m |
| **Genotypes** | : LRG-30(wilt susceptible); ICP 8863(wilt resistant) |
| **Duration of Solarization** | : 26-4-1985 to 6-6-1985 |

**1. Effect on Fusarium propagules in the soil**

For Fusarium population count soil samples were collected immediately before and after solarization, in mid season (September) and at the time of plant maturity (January). For each treatment, 5 cores of soil to a depth of 15 cm were collected from 5 locations in a plot, bulked and thoroughly mixed. Soil samples were air-dried on a laboratory bench, grinded and sieved to remove stones. Population of F udum was estimated on modified Nash and Snyder's medium. Measured quantity of soil (100 mg) was evenly spread on the surface of the medium in a sterilized petriplate. Petriplates were incubated at 25°C for 5 days and number of Fusarium colonies counted and calculated per gram of soil.

Residual effect of last year's solarization was evident when the soil samples were analysed for Fusarium propagules before polythene was laid on 26-4-84 (Table 1). Two years solarization (1984 and 1985) further reduced the population of Fusarium to less than 40 per gram of soil. Population of Fusarium was significantly less in the treatments where solarization was done this year (1985) than in the treatments with previous year's (1984) solarization. Fusarium propagules were estimated over 1000 per gram of soil in nonsolarized treatments. Similar trend was evident in all the treatments throughout the season, though steady increase of Fusarium propagules was observed in all the treatments.

**2. Effect on wilt**

The effect of soil solarization was clearly evident in reduced wilt incidence in the treatment with solarization in 1985. Residual effect of solarization in reducing the wilt incidence was not observed (Table 2). Also there was no significant difference in wilt incidence among the treatments with 2 years and one year (1985) solarization.

Table 1. Residual effect of solarisation on Fusarium propagules in pigeonpea wilt sick plot, ICRISAT Center, 1984 and 1985.

| Sl. No. | Irrigation | Solarisation 84 | Solarisation 85 | Genotype | No. of Fusarium propagules/gm soil[1] 10.4.85 | 4.6.85 | 10.9.85 | 29.1.86 |
|---|---|---|---|---|---|---|---|---|
| 1. | Unirrigated | P | P | LRG 30 | 509.9 | 32.2 | 136.6 | 944.3 |
| 2. | Unirrigated | NP | P | " | 1079.9 | 131.1 | 203.3 | 866.5 |
| 3. | Unirrigated | P | NP | " | 276.6 | 809.9 | 744.4 | 860.8 |
| 4. | Unirrigated | NP | NP | " | 777.7 | 1236.6 | 1351.0 | 1800.0 |
| 5. | Unirrigated | P | P | ICP 8863 | 561.1 | 31.1 | 112.2 | 394.3 |
| 6. | Unirrigated | NP | P | " | 838.8 | 97.7 | 115.5 | 855.5 |
| 7. | Unirrigated | P | NP | " | 445.5 | 541.0 | 545.5 | 1049.6 |
| 8. | Unirrigated | NP | NP | " | 917.7 | 1131.0 | 1259.9 | 1966.3 |
| 9. | Irrigated | P | P | LRG 30 | 334.4 | 47.7 | 111.1 | 605.5 |
| 10. | Irrigated | NP | P | " | 802.2 | 167.7 | 279.9 | 866.5 |
| 11. | Irrigated | P | NP | " | 405.5 | 601.0 | 673.3 | 1611.0 |
| 12. | Irrigated | NP | NP | " | 989.9 | 1199.8 | 1419.9 | 1583.3 |
| 13. | Irrigated | P | P | ICP 8863 | 252.2 | 39.9 | 124.4 | 577.6 |
| 14. | Irrigated | NP | P | " | 927.7 | 137.7 | 358.8 | 544.3 |
| 15. | Irrigated | P | NP | " | 294.4 | 809.9 | 759.9 | 1211.0 |
| 16. | Irrigated | NP | NP | " | 798.8 | 1224.4 | 1311.1 | 1683.1 |
| SE of solarisation with same or different levels of irrigation | | | | | 91.9 | 91.5 | 92.3 | 176.6 |
| SE of solarisation with same level of irrigation | | | | | 82.4 | 84.2 | 89.7 | 188.7 |
| CV(%) | | | | | 22.3 | 28.3 | 26.2 | 30.0 |

[1]Average of 3 replications; P=Polythene; NP=No Polythene.

Table 2. Residual Effect of solarisation on wilt incidence in pigeonpea in wilt sick plot, ICRISAT Center, 1984 and 85.

| Sl. No. | Irrigation | Solarisation 84 | Solarisation 85 | Genotype | Percent wilt[1] |
|---|---|---|---|---|---|
| 1. | Unirrigated | P | P | LRG 30 | 30.99 (30.3) |
| 2 | Unirrigated | NP | P | " | 24.76 (28.0) |
| 3. | Unirrigated | P | NP | " | 60.46 (51.5) |
| 4. | Unirrigated | NP | NP | " | 51.36 (45.8) |
| 5. | Unirrigated | P | P | ICP 8863 | 0.00 (0.00) |
| 6. | Unirrigated | NP | P | " | 0.09 (1.0) |
| 7. | Unirrigated | P | NP | " | 0.106 (1.1) |
| 8. | Unirrigated | NP | NP | " | 0.03 (2.5) |
| 9. | Irrigated | P | P | LRG 30 | 4.95 (12.7) |
| 10. | Irrigated | NP | P | " | 6.15 (13.3) |
| 11. | Irrigated | P | NP | " | 62.84 (54.4) |
| 12. | Irrigated | NP | NP | " | 53.06 (47.0) |
| 13 | Irrigated | P | P | ICP 8863 | 0.00 (0.0) |
| 14. | Irrigated | NP | P | " | 0.10 (1.0) |
| 15. | Irrigated | P | NP | " | 0.00 (0.0) |
| 16. | Irrigated | NP | NP | " | 0.20 (2.1) |
| SE of solarisation with same or different levels of irrigation | | | | | (6.88) |
| SE of solarisation with same level of irrigation | | | | | (7.07) |
| CV(%) | | | | | (67.4) |

The values in paranthesses are after angular transformation.

1=Average of 3 replications; P=Polythene, NP=No Polythene

**B. Confirmation of solarization effects**

Experiment 2.(Nev):To study effect of solarization in pigeonpea.

The experiment was conducted in a new area in wilt sick plot to confirm the effects of soil solarization in pigeonpea obtained in previous year.

**Treatments:**

**Main plot:**1. Irrigation before solarization
2. No irrigation

**Subplot:** 1. Solarization, LRG 30
2. Solarization, ICP 8863
3. No solarization, LRG 30
4. No solarization, ICP 8863

**Design:** Split plot
**Replications :** 4
**Duration of solarization :** 26-4-1985 - 6-6-1985
**Subplot size :** 6 x 6 m

1. **Effect on Fusarium propagules in the soil**

The effect of solarization on Fusarium udum population reducation was significant in irrigated and unirrigated treatments (Table 3). Fusarium propagules were drastically reduced to 190 to 275 per gram of soil in solarised treatments compared to 1045 to 1175 propagules per gram of soil in the nonsolarised treatments. The similar trend was observed throughout the season.

2. **Effect on wilt**

In genotype 1 (LRG 30) wilt was considerbly reduced in unirrigated solarised treatment. However, similar trend was not observed in irigated plots (Table 4). This may be due to contamination of solarised soil with F. udum from unsolarized plots and or ineffective solar treatment due to torned polythene. Wilt resistant, ICP 8863 remained practically wilt-free in all the treatments.

**C. Isolation of antagonists**

In order to study the changes in soil fungal flora, that would have been brought out due to soil solarization, soil samples from solarised and nonsolarised plots were analysed for fungi.

Potato dextrose agar to which Dicrysticin-S (1g/litre) was added after autoclaving was used for isolations. Measured quantity of soil (100 mg) was evenly spread on the surface of the medium in petriplates. Petriplates were incubated at 25°C for 5 days.

On the basis of their colony characters, 40 different fungi were isolated from solarised soils of chickpea and pigeonpea experiments. The isolated fungi were grown on PDA as pure cultures. On the basis of their frequency and growth rate, 15 fungal cultures were selected for further study.

These fungal cultures were then screened in the laboratory against F. udum and F. oxysporum f.sp. ciceri. All the cultures were multiplied on PDA in petriplates for a week. Active growth of the fungus from the edge of the colony was used by cutting with sterilized cork borer (3 mmd). Growth of the test fungus along with one of the Fusarium was transferred in a petriplate containing potato-dextrose agar to grow as dual culture. Petriplates were incubated at 25°C and examined daily. By 7th day two test fungi over grew and covered petriplates. These two fungi showed their antagonism against F udum in laboratory tests.

These two fungal cultures were sent to CMI, London for identification and were identified as Penicilllium pinophilum Hedgcock. Further work is in progress.

**D. Seed health testing**

Pigeonpea seed harvested from solarization experiment was examined critically for any external infection and abnormality. Seed health testing of samples obtained from different treatments was done using blotter paper technique. Percent germination and 100 seed wt. were also recorded (Table 5). These studies were conducted with only irrigated treatments.

Seeds were also plated on selective medium (NS medium) for detection of Fusarium. Seeds from solarised and nonsolarised treatments were free from infection by Fusarium or any other fungus. On blotter test also we could not detect any pathogen on the seed. There was no apparent effect of solarization of seed germination and 100 seed wt. in wilt-susceptible and resistant cultivars.

**E. Greenhouse testing of soil (solarised and nonsolarised) for pigeonpea pathogens**

After the harvest of the crop in January 86, soil samples were collected from all the treatments for greenhouse testing. The objective was to examine if any other pigeonpea pathogen became dominant in solarised soil in which Fusarium was suppressed. Soil samples from 16 treatments were filled in 15-cm plastic pots (3pot/treatment). Five seeds of LRG 30 were planted in each pot. Pots were irrigated regularly and observed for 60 days for wilt and any other root rot.

Wilted plants were carefully examined from solarized (they were few) and also from nonsolarised treatment. Isolations resulted only in F. udum. There was no other pathogen detected in this experiment.

Table 3. Effect of solarisation on Fusarium propagules in pigeonpea wilt sick plot, ICRISAT Center, 1985

| Sl. No. | Particulars | No. of Fusarium propagules/gm soil[1] 22.4.85 | 6.6.85 | 10.9.85 | 29.1.86 |
|---|---|---|---|---|---|
| 1. | Unirrigated polythene LRG 30 | 1272.4 | 190.0 | 168.3 | 677.5 |
| 2. | Unirrigated no polythene LRG 30 | 1190.8 | 1104.9 | 1569.1 | 1973.7 |
| 3. | Unirrigated polythene ICP 8863 | 1197.4 | 247.4 | 269.8 | 298.7 |
| 4. | Unirrigated no polythene ICP 8863 | 1323.3 | 1105.7 | 1517.4 | 2026.2 |
| 5. | Irrigated polythene LRG 30 | 1251.6 | 275.8 | 582.4 | 727.5 |
| 6. | Irrigated no polythene LRG 30 | 1279.1 | 1174.9 | 1474.1 | 2165.0 |
| 7. | Irrigated polythene ICP 8863 | 1326.6 | 254.9 | 499.9 | 798.7 |
| 8. | Irrigated no polythene ICP 8863 | 1217.4 | 1045.8 | 1467.4 | 2040.0 |
| | SE of solarisation with same or different levels of irrigation | 83.6 | 59.9 | 74.9 | 146.6 |
| | SE of solarisation with same levels of irrigation | 75.8 | 49.6 | 65.8 | 139.1 |
| | CV(%) | 12.0 | 14.7 | 14.0 | 20.8 |

1=Average of 4 replications

Table 4. Effect of solarization on pigeonpea wilt in sick plot, ICRISAT Center, 1985.

| Sl. No. | Particulars | Percent wilt[1] |
|---|---|---|
| 1. | Unirrigated polythene LRG 30 | 25.40 (29.0) |
| 2. | Unirrigated no polythene LRG 30 | 56.55 (53.9) |
| 3. | Unirrigated polythene ICP 8863 | 0.07 (0.8) |
| 4. | Unirrigated no polythene ICP 8863 | 0.24 (2.0) |
| 5. | Irrigated polythene LRG 30 | 44.70 (42.1) |
| 6. | Irrigated no polythene LRG 30 | 41.04 (39.5) |
| 7. | Irrigated polythene ICP 8863 | 0.00 (0.0) |
| 8. | Irrigated no polythene ICP 8863 | 0.16 (1.6) |
| | SE of solarisation with same or different levels of irrigation | (7.83) |
| | SE of solarisation with same levels of irrigation | (7.02) |
| | CV(%) | (66.50) |

Values in parentheses are after angular transformation.

1=Average of 4 replications

## F. Seed Pathology

In our earlier report (1983-84) we have reported the internal seed-borne nature of Fusarium udum. During the year of reporting we have confirmed our earlier finding that F.udum in pigeonpea seed was successfully eradicated by fungicidal seed treatment.

### 1. Studies on internal seedborne F. udum

Pigeonpea seeds were collected from seven cultivars at the time of wilting during January to April 85. Seeds were cleaned, air-dried and kept in closed containers in cold storage.

In all the experiments, unless stated otherwise, (i) 400 seeds of each cultivar were used, (ii) seeds were surface sterilized by a 2-min dip in 2.5% Sodium hypochlorite (clorox) and (iii) Nash and Snyder's medium was used for detection of F.udum. Surface sterilized and/or fungicide treated seeds (10/petriplate) were placed on medium. Petriplates were incubated at 25 C for 10 days.

The 'groving on' test was carried out by soving seeds in autoclaved, fine riverbed sand in 5-cm plastic pots in a greenhouse. The plants were observed 60 days for wilt symptoms. Isolations were attempted from wilted plants.

It was confirmed that highly wilt susceptible cultivars like LRG-30 and ICP-2376 did not carry seed borne infection. Tolerant cultivars like BDN 1, HY 3C and C-11 allow the fungus to get establish in the seed before wilting (Table 6).

Isolates from seeds and wilted plants were identified as F. udum. They were pathogenic to pigeonpea.

### 2. Eradication of F. udum from pigeonpea seed by seed treatment

Seeds collected from diseased plants of BDN 1 and HY 3C in December 1986 were used in seed-treatment studies. Systemic fungicide formulations Benlate 50 W.p. (benomyl), Bavistin WP (carbendazim), Tecto-60 (Thiabendazole), thiram 75 WP and Dithane M-45 were tried. Two fungicidal mixtures, benlate + thiram (1:1) and bavistin + thiram (1:1) were also included for seed-treatment. The fungicidal dosage was 2.5 g of commercial formulation per kg of seed. The treated seeds were plated on medium and sown in pots in green house.

F. udum could not be detected from the seed treated with Benlate + thiram mixture. Benlate and Bavistin alone or with thiram reduced the incidence of the pathogen in the [illegible] to th[illegible] treated ch[illegible]

**Table 5. Percent seed germination and 100 seed wt.(g) of pigeonpea harvested from solarization experiment.**

| S.No. | Irrigation | Solarization 84-85 | Genotype | % Seed Germination | 100 seed wt. |
|---|---|---|---|---|---|
| 1 | Irri. | P - P | LRG 30 | 93.50 | 6.47 |
| 2 | Irri. | NP - P | LRG 30 | 94.25 | 6.88 |
| 3 | Irri. | P - NP | LRG 30 | 96.25 | 6.38 |
| 4 | Irri. | NP - NP | LRG 30 | 96.25 | 6.54 |
| 5 | Irri. | P - P | ICP 8863 | 96.25 | 8.38 |
| 6 | Irri. | NP - P | ICP 8863 | 94.75 | 8.47 |
| 7 | Irri. | P - NP | ICP 8863 | 98.00 | 8.27 |
| 8 | Irri. | NP - NP | ICP 8863 | 92.00 | 8.39 |
| | SE | | | 1.103 | |
| | CV% | | | 2.3 | |

P-Polythene, NP-No Polythene

of pigeonpea cultivars on selective medium and in 'groving on' test.

| Cultivar | Percent seed infected | | Percent wilt | |
|---|---|---|---|---|
| | A | B | A | B |
| ICP 2376 | 0 | 0 | 0 | 0 |
| BDN 1 | 3.75 | 0 | 3.75 | 0 |
| ICPX 78148 | 2.50 | 0 | 2.25 | 0 |
| ICP 1903 | 2.75 | 0 | 2.00 | 0 |
| LRG-30 | 0 | 0 | 0 | 0 |
| HY3C | 4.50 | 0 | 4.0 | 0 |
| C-11 | 2.00 | 0 | 1.50 | 0 |

A=Seeds from diseased plants;
B=Seeds from healthy plants.

Mixture of Benlate and thiram at the equivalent rate were again tried to confirm the earlier findings. Complete eradication was obtained with a fungicidal mixture of Benlate + thiram (1:1) at the rate of 0.25%. The treatment showed its effectiveness on the medium and also in 'growing on' test (Table 7A & 7B).

## G. Search for perfect state of F. udum

The two major asexual spore forms of Fusaria are microconidia and macroconidia. Asexual state is important, since it is pathogenic and more frequently seen in nature.

In some of Fusaria, perfect state is reported. Sexual stage of Fusarium is ascomycetous, which is represented by one to two celled ascospores formed in ascocarp or perithecium. Recently, Gibberella indica has been reported as the perfect state of F.udum from Varanasi. Association of perithecia of Gibberella with wilted plants of pigeonpea was reported from Allahabad. Association of perithecia with wilted and dried pigeonpea plants was also observed by us at ICRISAT Center. But there was no evidence to relate its appearance to F.udum. In view of this, work was taken up to investigate the perfect state of F.udum.

### 1. Examination of the host tissue

Every year we distribute wilted pigeonpea plant pieces in wilt sick plot to maintain its sickness. Diseased material collected in January-February 85 was chopped into small pieces and spread in wilt sick plot in June 1985. Small stem pieces, thus distributed in the field were examined regularly under steriobinocular for perithecia. It was possible to collect the host tissues till December 85.

Wilted pigeonpea plants in fields at ICRISAT Center were also examined periodically. Diseased samples collected from Rahuri, Akola and Gwalior were also examined. Isolations were also attempted, whenever, fruiting bodies were seen on the surface of the stem pieces.

Following perithecial fungi were isolated from wilted pigeonpea plants.

(a) Eupenicillium sp.

(b) Ramichloridium sp.

(c) Neocosmospora vasinfecta

N. vasinfecta was also isolated from wilted pigeonpea plants collected from Coimbatore.

Table 7A. Effect of fungicidal seed treatment on seed-borne Fusarium udum.

| Fungicide | Infection detected on NS Medium (%) | |
|---|---|---|
| | BDN 1 | HY3C |
| Benlate | 2 | 5 |
| Bavistin | 3 | 2 |
| Tecto 60 | 4 | 3 |
| Thiram | 4 | 7 |
| Dithane M-45 | 7 | 8 |
| Benlate + Thiram | 0 | 0 |
| Bavistin + Thiram | 2 | 1 |
| Check | 12 | 17 |

Table 7B. Effect of fungicidal seed treatment on seed-borne Fusarium udum.

| Cultivar | Infection(%) Nash & Snyder's medium | | In sand | | Germination % | |
|---|---|---|---|---|---|---|
| | A | B | A | B | A | B |
| BDN 1 | 13.0 | 0 | 3 | 0 | 87.5 | 89.( |
| HY3C | 19.25 | 0 | 4.25 | 0 | 96.25 | 95.. |
| ICP 1903[2] | 9.75 | 0 | - | - | - | - |

1-Plants were observed for wilting up to 60 days after sowing.

2-ICP-1903 was used only in laboratory test due to shortage of seed

-Chlorax treated (Control), B-Fungicide treated

In addition, two fungi, Gliocladium caterulatum and Colletotrichum gloeosporiodes were also isolated from pigeonpea plants showing wilt symptoms.

2. **Cultures of F. udum used in perfect state study**

F.udum cultures isolated from wilted pigeonpea plants from the following places are being used to induce perfect state. They are all pathogenic to pigeonpea.

| Culture No. | Location |
|---|---|
| 1 | ICRISAT Center (used in routine work) |
| 2 | ICRISAT Center (isolated from ICP 8863 in 1984. |
| 3 | Varanasi |
| 4 | ICRISAT Center (isolated from ICP 8863 in 1985 |
| 5 | Gvalior |
| 6 | Isolated from several places in A.P. |

3. **Methods adopted to induce perithecia**

(a) Mating in culture

(b) Inoculation of stem pieces with F. udum

(c) Inoculation of pigeonpea seeds

(d) Use of synthetic and nonsynthetic culture media

Inoculated materials are subjected to different temperatures. They are incubated for longer periods and examined periodically.

We hope to conclude this study next year and we will report our work in detail.

**B. Studies on inheritance of wilt resistance**

After perfecting the pot-screening technique (Pulse Pathology (Pigeonpea) Report of Work, June 1984-May 1985) we decided to use it in genetic studies. In this method 5-7-day-old seedlings grown in sterilized sand are root-inoculated with the inoculum multiplied on potato-sucrose broth. Seedlings are then transplanted in autoclaved riverbed sand or soil in 15-cm plastic pots.

Two separate screening tests were conducted to study the inheritance of resistance to F. udum in pigeonpea. In the first test, 7 parents and 21 $F_2$ populations of single crosses in diallel design were tested (Table 8). In the second test 6 lines, 4 testers and $F_1$'s were screened.

**Table 8.** $F_2$ populations of 21 single crosses (diallel design) screened for *F. udum* resistance by root dip technique.

| Sl.No. | Cross | No. of pots | No. of plants tested |
|---|---|---|---|
| 1. | ICP 8859 x ICP 8861 | 8 | 72 |
| 2. | ICP 8859 x ICP 8863 | 9 | 85 |
| 3. | ICP 8859 x ICPL 131 | 9 | 86 |
| 4. | ICP 8859 x ICP 10958 | 9 | 90 |
| 5. | ICP 8859 x ICPL 138 | 8 | 79 |
| 6. | ICP 8859 x ICP 6997 | 10 | 97 |
| 7. | ICP 8861 x ICP 8863 | 6 | 59 |
| 8. | ICP 8861 x ICPL 131 | 9 | 88 |
| 9. | ICP 8861 x ICP 10958 | 9 | 90 |
| 10. | ICP 8861 x ICPL 138 | 7 | 68 |
| 11. | ICP 8861 x ICP 6997 | 9 | 99 |
| 12. | ICP 8863 x ICPL 131 | 9 | 87 |
| 13. | ICP 8863 x ICP 10958 | 7 | 65 |
| 14. | ICP 8863 x ICPL 138 | 9 | 90 |
| 15. | ICP 8863 x ICP 6997 | 9 | 85 |
| 16. | ICPL 131 x ICP 10958 | 10 | 98 |
| 17. | ICPL 131 x ICPL 138 | 9 | 90 |
| 18. | ICPL 131 x ICP 6997 | 9 | 89 |
| 19. | ICP 10958 x ICPL 138 | 6 | 60 |
| 20. | ICP 10958 x ICP 6997 | 7 | 70 |
| 21. | ICPL 138 x ICP 6997 | 9 | 87 |

Seedlings (5-day old) were used. The roots were dipped in inoculum derived from single-spore culture of F. udum (ICRISAT isolate) for a minute and seedlings transplanted in sterilised sand in plastic pots (22 cm d.). Each pot had 10 F plants, 2 plants of susceptible check (LRG 30) and parents. Number of plants showing wilt symptoms were recorded periodically. Final observations were taken after 60 days.

**Project: CP-118(85) IC - Studies on the pathogens causing blights of chickpea and pigeonpea**

## I. Summary

1. A total of 116 ACT entries were screened in pots against P3 isolate of Phytophthora blight; only one entry, T 7 showed a minimum of 57.4 percent blight.

2. Of the 13 species of Atylosia tested, only A. goensis and A. platycarpa showed low blight incidence under greenhouse conditions against P3 isolate.

3. A preliminary test indicated the existance of physiologic races in Phytophthora drechsleri f.sp. cajani.

## II. Introduction

The project was formulated in 1985 with the objective to investigate the biology and epidemiology of the pathogens causing foliar blights of pigeonpea.

## III. Phytophthora blight

### A. Pot screening method

Pigeonpea lines were screened against the more virulent $P_3$ isolate in pots in the greenhouse by the 'drench inoculation' method. Planting, inoculation and recording observations were done as described in Pulse Pathology (Pigeonpea) Report of Work 1977-78. But, 50 ml of the mycelial suspension was poured into each 10 cm dia plastic pots, instead of 100 ml suspension in 20 cm dia pots. The surviving plants were reinoculated by 'rub' method and then transplanted in 30 cm dia plastic pots containing Vertisol. Selfed seed are collected from the surviving plants for retesting.

#### 1. Coordinated Varietal Trial (ACT)

Eighteen entries included in the Extra early Arhar Coordinated Trial (EXACT), nineteen in Early Arhar Coordinated Trial (EACT), seventeen in Arhar Coordinated Trial-1 (ACT-1), thirteen in ACT-2, twenty-five in ACT-3, twenty-one in Medium maturity pigeonpea sterility mosaic and wilt resistant yield trial (MPSMVRY), and three entries in late maturity pigeonpea sterility mosaic and wilt resistant yield trial (LPSMVRY) were tested against P3 isolate. All the 116 CVT entries were found susceptible to blight. Only one entry, T 7 from ACT 3 showed a minimum of 57.4 percent blight (Table 9).

Table 9. Results of pot of screening of ACT entries (1985-86) against Phytophthora blight in the greenhouse at ICRISAT Center, Patancheru.

| S.No. | Entry | Total plants | | Percent blight 1 | | |
|---|---|---|---|---|---|---|
| | | Rep I | Rep II | Rep I | Rep II | Average |
| **EXACT** | | | | | | |
| 1. | AL 1 | 21 | 23 | 100.0 | 100.0 | 100.0 |
| 2. | AL 15 | 23 | 21 | 95.7 | 100.0 | 97.9 |
| 3. | AL 101 | 23 | 24 | 100.0 | 100.0 | 100.0 |
| 4. | DL 78-1 | 23 | 26 | 100.0 | 100.0 | 100.0 |
| 5. | ICPL 317 | 20 | 22 | 100.0 | 100.0 | 100.0 |
| 6. | ICPL 8306 | 19 | 20 | 100.0 | 100.0 | 100.0 |
| 7. | Hy 10 | 6 | 13 | 100.0 | 100.0 | 100.0 |
| 8. | H 76-11 | 21 | 18 | 100.0 | 100.0 | 100.0 |
| 9. | H 76-44 | 24 | 23 | 100.0 | 100.0 | 100.0 |
| 10. | H 76-51 | 22 | 23 | 100.0 | 91.3 | 95.7 |
| 11. | H 76-65 | 22 | 22 | 100.0 | 95.5 | 97.8 |
| 12. | H 81-1 | 19 | 22 | 100.0 | 100.0 | 100.0 |
| 13. | H 82-1 | 20 | 19 | 100.0 | 100.0 | 100.0 |
| 14. | H 82-12 | 20 | 25 | 100.0 | 100.0 | 100.0 |
| 15. | Pusa 85 | 24 | 22 | 100.0 | 100.0 | 100.0 |
| 16. | Pusa 851 | 24 | 21 | 100.0 | 100.0 | 100.0 |
| 17. | TAT 10 | 22 | 22 | 100.0 | 100.0 | 100.0 |
| 18. | TPT 11 | 24 | 24 | 100.0 | 100.0 | 100.0 |
| **RACT** | | | | | | |
| 1. | AL 13 | 21 | 25 | 100.0 | 100.0 | 100.0 |
| 2. | AL 56 | 22 | 23 | 100.0 | 95.7 | 97.9 |
| 3. | AL 57 | 18 | 23 | 94.4 | 95.7 | 95.1 |
| 4. | BSMR 294 | - | - | - | - | - |
| 5. | GAUT 82-53 | 23 | 25 | 100.0 | 100.0 | 100.0 |
| 6. | GAUT 82-55 | 22 | 22 | 95.5 | 90.9 | 93.2 |
| 7. | H 76-24 | 20 | 21 | 100.0 | 100.0 | 100.0 |
| 8. | H 80-110 | 21 | 25 | 100.0 | 100.0 | 100.0 |
| 9. | H 82-26 | 19 | 21 | 100.0 | 100.0 | 100.0 |
| 10. | Hy 11 | - | - | - | - | - |
| 11. | ICPL 151 | 10 | 15 | 100.0 | 100.0 | 100.0 |
| 12. | ICPL 269 | 17 | 19 | 100.0 | 100.0 | 100.0 |
| 13. | ICPL 317 | 19 | 16 | 100.0 | 100.0 | 100.0 |
| 14. | ICPL 8327 | 21 | 23 | 100.0 | 87.0 | 93.5 |
| 15. | MTH 6 | 13 | 17 | 100.0 | 100.0 | 100.0 |

| S.No. | Entry | Total plants | | Percent blight 1 | | |
|---|---|---|---|---|---|---|
| | | Rep I | Rep II | Rep I | Rep II | Average |
| 16. | MTH 10 | 19 | 24 | 100.0 | 100.0 | 100.0 |
| 17. | Pant A 1-1 | 22 | 20 | 100.0 | 94.5 | 97.3 |
| 18. | Pant A 10 | 20 | 22 | 100.0 | 100.0 | 100.0 |
| 19. | Pusa Sveta 2 | 17 | 19 | 100.0 | 100.0 | 100.0 |
| **ACT 1** | | | | | | |
| 1. | COBG 5 | 20 | 20 | 95.0 | 100.0 | 97.5 |
| 2. | DA 8 | 22 | 20 | 100.0 | 100.0 | 100.0 |
| 3. | ICPL 176 | 23 | 17 | 100.0 | 100.0 | 100.0 |
| 4. | ICPL 186 | 19 | 23 | 100.0 | 100.0 | 100.0 |
| 5. | ICPL 288 | 13 | 18 | 100.0 | 100.0 | 100.0 |
| 6. | ICPL 8308 | 16 | 18 | 100.0 | 100.0 | 100.0 |
| 7. | ICPL 8324 | 11 | 12 | 90.9 | 60.0 | 75.5 |
| 8. | ICPL 84074 | - | - | - | - | - |
| 9. | ICPL 84077 | 19 | 20 | 100.0 | 100.0 | 100.0 |
| 10. | Pusa 85 | 23 | 18 | 100.0 | 100.0 | 100.0 |
| 11. | Pant 102 | 20 | 16 | 100.0 | 100.0 | 100.0 |
| 12. | Pant 103 | 20 | 22 | 95.5 | 100.0 | 97.8 |
| 13. | Pant 104 | 18 | 19 | 100.0 | 100.0 | 100.0 |
| 14. | PT 14 | 23 | 23 | 100.0 | 100.0 | 100.0 |
| 15. | PT 20 | 21 | 9 | 100.0 | 100.0 | 100.0 |
| 16. | TT 5 | 20 | 19 | 100.0 | 100.0 | 100.0 |
| 17 | TT 6 | 21 | 22 | 100.0 | 100.0 | 100.0 |
| **ACT 2** | | | | | | |
| 1. | AGS 498 | 23 | 24 | 91.3 | 100.0 | 95.7 |
| 2. | AKT 1 | 22 | 22 | 100.0 | 100.0 | 100.0 |
| 3. | AKT 6 | 22 | 25 | 77.3 | 76.0 | 76.7 |
| 4. | C 11 | 22 | 19 | 95.5 | 100.0 | 97.8 |
| 5. | G 78-3 | 22 | 25 | 81.8 | 88.0 | 84.9 |
| 6. | MA 162 | 13 | 15 | 100.0 | 93.3 | 96.7 |
| 7. | MTH 8 | 21 | 23 | 100.0 | 95.7 | 97.9 |
| 8. | MTH 9 | 25 | 23 | 100.0 | 100.0 | 100.0 |
| 9. | MTH 11 | 22 | 22 | 90.9 | 100.0 | 95.5 |
| 10. | MRG 66 | 22 | 22 | 86.4 | 90.9 | 88.7 |
| 11. | PT 17 | 19 | 23 | 100.0 | 95.7 | 97.9 |
| 12. | PT 18 | 22 | 22 | 100.0 | 100.0 | 100.0 |
| 13. | No.148 | 23 | 25 | 100.0 | 96.0 | [illegible] |

| .No. | Entry | Total plants | | Percent blight 1 | | |
|---|---|---|---|---|---|---|
| | | Rep I | Rep II | Rep I | Rep II | Average |
| **ACT 3** | | | | | | |
| 1. | AGS 522 | 26 | 22 | 88.5 | 63.6 | 76.1 |
| 2. | Bahar | 22 | 21 | 100.0 | 100.0 | 100.0 |
| 3. | DA 15 | 17 | 25 | 70.6 | 76.0 | 73.3 |
| 4. | ICPL 146 | 23 | 20 | 100.0 | 100.0 | 100.0 |
| 5. | ICPL 161 | 21 | 23 | 90.5 | 95.7 | 93.1 |
| 6. | ICPL 360 | 21 | 21 | 100.0 | 100.0 | 100.0 |
| 7. | ICPL 366 | 22 | 23 | 90.9 | 100.0 | 95.5 |
| 8. | KA 1 | - | - | - | - | - |
| 9. | KA 25-1 | 22 | 22 | 100.0 | 100.0 | 100.0 |
| 0. | KA 28 | - | - | - | - | - |
| 11. | KA 32 | - | - | - | - | - |
| 12. | MA 2 | 22 | 24 | 100.0 | 100.0 | 100.0 |
| 13. | MA 95-2 | 18 | 23 | 88.9 | 100.0 | 94.5 |
| 14. | MA 97 | 23 | 21 | 100.0 | 85.7 | 92.9 |
| 15. | MA 128-2 | 12 | 20 | 100.0 | 100.0 | 100.0 |
| 16. | MA 165 | 22 | 25 | 100.0 | 100.0 | 100.0 |
| 17. | MA 166 | - | - | - | - | - |
| 18. | MA 167 | - | - | - | - | - |
| 19. | PDA 1 | - | - | - | - | - |
| 20. | PDA 9 | - | - | - | - | - |
| 21. | PDA 10 | 22 | 28 | 77.3 | 57.1 | 67.2 |
| 22. | PDA 83-3 | - | - | - | - | - |
| 23. | PT 20 | 22 | 24 | 95.5 | 100.0 | 97.8 |
| 24. | T 7 | 24 | 23 | 58.3 | 56.5 | 57.4 |
| 25. | KA 73-1 | - | - | - | - | - |
| **MPSMVRY** | | | | | | |
| 1. | ICPL 227 | 25 | 24 | 92.0 | 100.0 | 96.0 |
| 2. | ICPL 332 | 22 | 22 | 86.4 | 100.0 | 93.2 |
| 3. | ICPL 333 | 24 | 25 | 95.8 | 100.0 | 97.9 |
| 4. | ICPL 335 | 22 | 22 | 100.0 | 95.4 | 97.7 |
| 5. | ICPL 342 | 23 | 26 | 95.7 | 100.0 | 97.9 |
| 6. | ICPL 343 | 26 | 25 | 76.9 | 88.0 | 82.5 |
| 7. | ICPL 345 | 25 | 24 | 100.0 | 100.0 | 100.0 |
| 8. | ICPL 8356 | 23 | 22 | 100.0 | 100.0 | 100.0 |
| 9. | ICPL 8357 | 20 | 21 | 100.0 | 100.0 | 100.0 |
| 0 | ICPL 835 | 23 | 2 | 100.0 | 100.0 | 100.0 |

| S.No. | Entry | Total plants | | Percent blight 1 | | |
|---|---|---|---|---|---|---|
| | | Rep I | Rep II | Rep I | Rep II | Average |
| 11. | ICPL 8362 | 20 | 23 | 100.0 | 97.5 | 98.8 |
| 12. | ICPL 8363 | 23 | 22 | 73.9 | 77.3 | 75.6 |
| 13. | ICPL 84001 | 23 | 24 | 87.0 | 91.7 | 89.4 |
| 14. | ICPL 84002 | 25 | 20 | 92.0 | 95.0 | 93.5 |
| 15. | ICPL 84008 | 24 | 20 | 100.0 | 100.0 | 100.0 |
| 16. | ICPL 84011 | 23 | 21 | 95.7 | 100.0 | 97.9 |
| 17. | ICPL 84016 | 23 | 22 | 95.7 | 100.0 | 97.9 |
| 18. | ICPL 85061 | 22 | 24 | 100.0 | 100.0 | 100.0 |
| 19. | ICPL 85062 | 25 | 26 | 100.0 | 100.0 | 100.0 |
| 20. | ICPL 85063 | 17 | 22 | 100.0 | 100.0 | 100.0 |
| 21. | ICPL 85064 | 23 | 18 | 100.0 | 100.0 | 100.0 |
| **LPSMVRT** | | | | | | |
| 1. | ICPL 84072 | 20 | 23 | 100.0 | 95.7 | 97.9 |
| 2. | ICP 8121 | 25 | 19 | 100.0 | 100.0 | 100.0 |
| 3. | ICPL 83143 | 20 | 19 | 90.0 | 78.9 | 84.5 |
| **Susceptible checks** | | | | | | |
| | HY 3C | 25 | 24 | 100.0 | 100.0 | 100.0 |
| | ICP 2376 | 22 | 19 | 100.0 | 100.0 | 100.0 |

Blight incidence was recorded 10 days after inoculation with the $P_3$ isolate of *Phytophthora drechsleri* f.sp. *cajani*.

**2. Germplasm lines**

Fifteen germplasm lines found resistant to less virulent $P_2$ isolate were tested against $P_3$ isolate; only two lines ICP 8805 and ICP 8700 showed <50 percent blight (Table 10).

**3. Phytophthora blight resistant selections**

Forty-eight progenies of plants resistant to the $P_3$ isolate in earlier pot screening were retested. Three lines, ICP 7815, ICP 8129 and APP 1384 showed <50 percent blight (Table 11).

**4. Sterility mosaic promising lines**

Thirteen sterility mosaic (SM) and wilt promising lines from SM and wilt nursery (RM 3C field, 1984 Kharif), two SM resistant germplasm lines, ICP 10976 and 10977, and one SM resistant selection from Badnapur, BSMR 225 were screened; all the lines were found susceptible to the P3 isolate of blight (Table 12).

**5. Phytophthora blight promising lines**

A total of 79 germplasm lines that showed less than 50 percent blight in earlier pot screening against the $P_3$ isolate were retested; all the lines showed more than 50 percent blight (Table 13).

**6. Advanced lines**

The ten advanced lines tested showed more than 50 percent blight (Table 14) against P3 isolate.

Of the 13 species of Atylosia tested, only A. goensis and A. platycarpa showed less than 20 percent blight (Table 15) against P3 isolate.

**B. Isolates from different locations**

Phytophthora drechsleri f.sp. cajani was isolated from diseased pigeonpea plants collected from Pantnagar (Nainital district), Sivkasi Ka Pura (Bhind district), Haath Rathi Ka Pura (Morena district) and JNKVV Farm (Morena district). All the isolates, except the one obtained from Sivkasi Ka Pura were found to be pathogenic to HY 3C, a blight susceptible cultivar.

**C. Physiologic Races**

Pathogenicity of seven isolates of P. drechsleri f.sp. cajani from different locations in India was proven by drench-inoculation method. Fourteen genotypes were used. Each genotype was planted in four replications (one pot per replication) with twenty-five seeds per pot (10 cm dia plastic). The reaction of these genotypes to the seven isolates indicate the existance of physiologic races (Table 16). The test will be repeated to confirm the results.

Table 10. Results of pot screening of P2 isolate resistant germplasm lines against the $P_3$ isolate of *Phytophthora drechsleri* f.sp. *cajani*

| .No. | Entry | Total plants | Percent blight |
|---|---|---|---|
| 1. | ICP 6974 | 392 | 79.6 |
| 2. | ICP 7798 | 22 | 95.5 |
| 3. | ICP 7810 | 24 | 66.7 |
| 4. | ICP 8282 | 25 | 76.0 |
| 5. | ICP 8287 | 20 | 90.0 |
| 6. | ICP 8328 | 22 | 100.0 |
| 7. | ICP 8332 | 24 | 100.0 |
| 8. | ICP 8562 | 20 | 90.0 |
| 9. | ICP 8564 | 19 | 89.5 |
| 10. | ICP 8568 | 22 | 72.7 |
| 11. | ICP 8619 | 23 | 69.6 |
| 12. | ICP 8688 | 24 | 62.5 |
| 13. | ICP 8700 | 24 | 50.0 |
| 14. | ICP 8701 | 25 | 100.0 |
| 15. | ICP 8805 | 20 | 40.0 |
| | HY 3C (check) | 24 | 95.8 |
| | ICP 2376 (check) | 25 | 100.0 |

Table 11. Results of repeat pot screening of Phytophthora blight resistant selections against the $P_3$ isolate of Phytophthora drechsleri f.sp. cajani.

| S.No. | Entry | Total plants | Percent blight |
|---|---|---|---|
| 1. | ICP 2719-1-Pot P1@ | 25 | 52.0 |
| 2. | ICP 2719-1-Pot P2@ | 34 | 100.0 |
| 3. | ICP 3753-Pot P1@ | 4 | 100.0 |
| 4. | ICP 5097-SWP19 sel.-Pot P1@ | 20 | 90.0 |
| 5. | ICP 5097-SWP19 sel.-Pot P2@ | 135 | 90.4 |
| 6. | ICP 7200-1-Pot P1@ | 6 | 100.0 |
| 7. | ICP 7200-1-Pot P2@ | 17 | 100.0 |
| 8. | ICP 7200-1- Pot P3@ | 26 | 100.0 |
| 9. | ICP 7200-3-Pot P1@ | 29 | 79.3 |
| 10. | ICP 7200-3-Pot P2@ | 8 | 62.5 |
| 11. | ICP 7269-Pot P1@ | 13 | 100.0 |
| 12. | ICP 7269-Pot P2@ | 24 | 100.0 |
| 13. | ICP 7493-Pot P1@ | 86 | 100.0 |
| 14. | ICP 7493-Pot P2@ | 21 | 90.5 |
| 15. | ICP 7815-Pot P1@ | 18 | 88.9 |
| 16. | ICP 7815-Pot P2@ | 13 | 31.8 |
| 17. | ICP 7917-Pot PB@ | 11 | 54.5 |
| 18. | ICP 7917-Pot P3@ | 23 | 87.0 |
| 19. | ICP 7917-Pot P4@ | 8 | 100.0 |
| 20. | ICP 8055-Pot P1@ | 9 | 77.8 |
| 21. | ICP 8087-Pot P1@ | 42 | 83.3 |
| 22. | ICP 8087-Pot PB@ | 18 | 100.0 |
| 23. | ICP 8087-Pot P4@ | 27 | 96.3 |
| 24. | ICP 8087-Pot P5@ | 71 | 97.2 |
| 25. | ICP 8087-Pot P6@ | 16 | 93.8 |
| 26. | ICP 8105-Pot P1@ | 17 | 82.4 |
| 27. | ICP 8105-Pot P2@ | 20 | 70.0 |
| 28. | ICP 8129-Pot P1@ | 4 | 25.0 |
| 29. | ICP 8216-Pot P1@ | 8 | 87.5 |
| 30. | ICPL 87-Pot P1@ | 4 | 100.0 |
| 31. | KPBR 80-2-Pot P1@ | 43 | 88.4 |
| 32. | KPBR 80-2-Pot P2@ | 25 | 76.0 |
| 33. | KPBR 80-2-Pot P3@ | 18 | 61.1 |
| 34. | KPBR 80-2-1-SWP2-Pot PB@ | 18 | 72.2 |
| 35. | KPBR 80-2-1-SWP2-Pot P2@ | 13 | 53.8 |
| 36. | KPBR 80-2-2-SWP1-Pot P1@ | 369 | 92.9 |
| 37. | KPBR 80-2-2-SWP1-Pot P2@ | 61 | 82.7 |
| 38. | KPBR 80-2-2-SWP1-Pot P3@ | 10 | 60.0 |
| 39. | KPBR 80-3-SWP1-Pot P1@ | 50 | 100.0 |
| 40. | KPBR 80-3-SWP1-Pot P2@ | 28 | 100.0 |
| 41. | KPBR 80-3-SWP1-Pot P3@ | 10 | 100.0 |
| 42. | RL 2 (KPR)-1-Pot P1@ | 15 | 100.0 |
| 43. | RL 2 (KPR)-1-Pot P2@ | 81 | 100.0 |
| 44. | RL 2 (KPR)-1-Pot P3@ | 22 | 100.0 |
| 45. | NKR 13-ENT-Pot P1@ | 22 | 100.0 |
| 46. | APP 6-B@-Pot P1@ | 36 | 100.0 |
| 47. | APP 8-B-Pot P1@ | 3 | 66.7 |
| 48. | APP 1384-Pot P1@ | 2 | 50.0 |
| | HY 3C (check) | 24 | 95.8 |
| | ICP 2376 (check) | 25 | 100.0 |

Table 12. Performance of sterility mosaic promising lines against P3 isolate of Phytophthora blight under greenhouse conditions.

| S.No. | Entry | Total plants | Percent blight |
|---|---|---|---|
| 1. | ICP 11438-1-S1@-SVB@ | 29 | 89.7 |
| 2. | ICP 11844-SVB@ | 29 | 93.1 |
| 3. | ICP 11934-SVB@ | 22 | 100.0 |
| 4. | PR 5118-2-1-S1@-SVB@ | 22 | 95.5 |
| 5. | PR 5137-1-S1@-SVB@ | 24 | 95.8 |
| 6. | PR 5140-1-S1@-SVB@ | 44 | 100.0 |
| 7. | PR 5145-2-1-S1@-SVB@ | 22 | 90.9 |
| 8. | PR 5149-1-1-S1@-SVB@ | 30 | 100.0 |
| 9. | PR 5164-1-S1@-SVB@ | 20 | 95.0 |
| 10. | PR 5294-1-S1@-SV1@ | 12 | 100.0 |
| 11. | PI 397456-1-2-1-S1@-SVB@ | 25 | 100.0 |
| 12. | PI 397630-1-1-S1@-SVB@ | 27 | 100.0 |
| 13. | Srilanka 477-1-S1@-SVB@ | 22 | 100.0 |
| 14. | ICP 10976 | 10 | 90.0 |
| 15. | ICP 10977 | 23 | 82.6 |
| 16. | BSMR 225 | 21 | 76.2 |
| | HY 3C (check) | 15 | 100.0 |
| | ICP 2376 (check) | 20 | 100.0 |

**Table 13. Results of repeat pot screening of Phytophthora blight promising lines against the $P_3$ isolate of *Phytophthora drechsleri* f.sp. *cajani*.**

| S.No. | Entry | Total plants | Percent blight |
|---|---|---|---|
| 1. | ICP 5498 | 23 | 100.0 |
| 2. | ICP 7330 | 30 | 100.0 |
| 3. | ICP 7362 | 14 | 100.0 |
| 4. | ICP 7371 | 9 | 88.9 |
| 5. | ICP 7381 | 23 | 78.3 |
| 6. | ICP 7385 | 31 | 93.5 |
| 7. | ICP 7387 | 34 | 94.1 |
| 8. | ICP 7396 | 32 | 100.0 |
| 9. | ICP 7409 | 12 | 83.3 |
| 10. | ICP 7412 | 38 | 94.7 |
| 11. | ICP 7417 | 37 | 97.3 |
| 12. | ICP 7419 | 34 | 88.2 |
| 13. | ICP 7420 | 34 | 88.2 |
| 14. | ICP 7423 | 10 | 100.0 |
| 15. | ICP 7428 | 45 | 93.3 |
| 16. | ICP 7476 | 29 | 82.8 |
| 17. | ICP 7492 | 34 | 91.2 |
| 18. | ICP 7493 | 32 | 87.5 |
| 19. | ICP 7494 | 35 | 100.0 |
| 20. | ICP 7518 | 36 | 100.0 |
| 21. | ICP 7600 | 41 | 80.5 |
| 22. | ICP 7643 | 28 | 82.1 |
| 23. | ICP 7685 | 34 | 85.3 |
| 24. | ICP 7697 | 37 | 97.3 |
| 25. | ICP 7710 | 34 | 97.1 |
| 26. | ICP 7712 | 40 | 100.0 |
| 27. | ICP 7713 | 29 | 100.0 |
| 28. | ICP 7714 | 26 | 96.2 |
| 29. | ICP 7720 | 30 | 93.3 |
| 30. | ICP 7724 | 33 | 100.0 |
| 31. | ICP 7728 | 23 | 95.7 |
| 32. | ICP 7734 | 26 | 92.3 |
| 33. | ICP 7735 | 37 | 82.2 |
| 34. | ICP 7736 | 25 | 88.0 |
| 35. | ICP 7739 | 35 | 91.4 |
| 36. | ICP 7740 | 39 | 100.0 |
| 37. | ICP 7743 | 28 | 96.4 |
| 38. | ICP 7745 | 35 | 100.0 |
| 39. | ICP 7751 | 29 | 96.6 |
| 40. | ICP 7782 | 32 | 100.0 |
| 41. | ICP 7784 | 31 | 93.5 |
| 42. | ICP 7785 | 34 | 100.0 |
| 43. | ICP 7792 | 32 | 90.6 |
| 44. | ICP 7793 | 34 | 100.0 |
| 45. | ICP 7796 | 24 | 91.7 |

| S.No. | Entry | Total plants | Percent blight |
|---|---|---|---|
| 46. | ICP 7801 | 32 | 100.0 |
| 47. | ICP 7803 | 28 | 100.0 |
| 48. | ICP 7804 | 33 | 97.0 |
| 49. | ICP 7811 | 32 | 96.9 |
| 50. | ICP 7816 | 15 | 86.7 |
| 51. | ICP 7824 | 28 | 100.0 |
| 52. | ICP 7830 | 33 | 100.0 |
| 53. | ICP 7832 | 29 | 100.0 |
| 54. | ICP 7835 | 32 | 100.0 |
| 55. | ICP 7838 | 45 | 97.8 |
| 56. | ICP 7841 | 36 | 100.0 |
| 57. | ICP 7848 | 34 | 100.0 |
| 58. | ICP 7849 | 40 | 92.5 |
| 59. | ICP 7852 | 4 | 100.0 |
| 60. | ICP 7862 | 32 | 100.0 |
| 61. | ICP 7873 | 23 | 100.0 |
| 62. | ICP 7962 | 33 | 100.0 |
| 63. | ICP 8055 | 28 | 92.9 |
| 64. | ICP 8060 | 31 | 100.0 |
| 65. | ICP 8065 | 31 | 100.0 |
| 66. | ICP 8080 | 45 | 100.0 |
| 67. | ICP 8081 | 33 | 93.9 |
| 68. | ICP 8083 | 33 | 100.0 |
| 69. | ICP 8092 | 33 | 90.9 |
| 70. | ICP 8099 | 32 | 100.0 |
| 71. | ICP 8105 | 32 | 100.0 |
| 72. | ICP 8127 | 41 | 100.0 |
| 73. | ICP 8129 | 32 | 96.9 |
| 74. | ICP 8145 | 41 | 90.2 |
| 75. | ICP 8146 | 18 | 66.7 |
| 76. | ICP 8150 | 30 | 90.0 |
| 77. | ICP 8205 | 36 | 100.0 |
| 78. | ICP 8216 | 30 | 80.0 |
| 79. | ICP 8219 | 32 | 100.0 |
| | MT 3C (check) | 23 | 100.0 |
| | ICP 2376 (check) | 20 | 100.0 |

Table 14. Performance of pigeonpea advanced lines against P3 isolate of Phytophthora blight under greenhouse conditions.

| S.No. | Entry | Total plants | Percent blight |
|---|---|---|---|
| 1. | ICPL 87 | 2483 | 95.3 |
| 2. | ICPL 151 | 1933 | 95.6 |
| 3. | ICPL 8309 | 18 | 66.7 |
| 4. | ICPL 8315 | 35 | 100.0 |
| 5. | ICPL 8322 | 47 | 95.8 |
| 6. | ICPL 8398 | 32 | 75.3 |
| 7. | ICPL 84020 | 41 | 100.0 |
| 8. | ICPL 84031 | 40 | 100.0 |
| 9. | ICPL 84078 | 41 | 100.0 |
| 10. | ICPH 8 | 38 | 94.5 |
| | HY 3C (check) | 47 | 98.0 |
| | ICP 2376 (check) | 44 | 100.0 |

Table 15. Results of pot screening of Atylosia species against the P3 isolate of Phytophthora drechsleri f.sp. cajani.

| S.No. | Atylosia species | Total plants | | Percent blight | | |
|---|---|---|---|---|---|---|
| | | Rep I | Rep II | Rep I | Rep II | Average |
| 1. | A. acutifolia (A 68) | 17 | 18 | 100.0 | 100.0 | 100.0 |
| 2. | A. albicans (PR 4816) | 22 | 23 | 100.0 | 100.0 | 100.0 |
| 3. | A. cajanifolia (PR 4876) | 22 | 24 | 100.0 | 100.0 | 100.0 |
| 4. | A. goensis (JM 3501) | 18 | 21 | 0.0 | 4.8 | 2.4 |
| 5. | A. grandifolia (BC 124363) | 20 | 18 | 100.0 | 94.4 | 97.2 |
| 6. | A. lanceolata (CQ 1619) | 26 | 22 | 100.0 | 100.0 | 100.0 |
| 7. | A. lineata (JM 3366) | 22 | 23 | 100.0 | 95.7 | 97.9 |
| 8. | A. mollis (JM 4311) | 22 | 20 | 100.0 | 100.0 | 100.0 |
| 9. | A. platycarpa (PR 4557) | 18 | 23 | 11.1 | 17.4 | 14.3 |
| 10. | A. reticulata (IBS 2443) | 17 | 24 | 100.0 | 100.0 | 100.0 |
| 11. | A. scarabaeoides (JM 4221) | 25 | 22 | 100.0 | 95.5 | 97.8 |
| 12. | A. sericea (JM 1961) | 19 | 26 | 94.7 | 92.3 | 93.5 |
| 13. | A. volubilis (JM 4200) | 18 | 22 | 83.3 | 68.2 | 75.8 |
| | HY 3C (check) | 20 | 23 | 100.0 | 100.0 | 100.0 |
| | ICP 2376 (check) | 23 | 18 | 100.0 | 100.0 | 100.0 |

Table 16. Reaction of pigeonpea genotypes to seven isolates of Phytophthora drechsleri f.sp. cajani.

| Genotype | P1 (ICRISAT) | Nimar | BHU (Varanasi) | Kanpur | IARI (Delhi) | P 2 (ICRISAT) | BP (ICRISAT) |
|---|---|---|---|---|---|---|---|
| ICP 6997 | S | S | S | S | S | S | m |
| MY 3C | S | S | S | S | S | S | m |
| ICP 7918 | S | 1 | S | S | S | S | R |
| ICP 113 | S | S | S | S | m | S | R |
| ICP 1768 | S | S | S | S | m | m | R |
| ICP 4882 | S | S | S | S | R | R | m |
| ICP 7457 | S | 1 | S | S | R | R | m |
| ICP 752 | S | S | S | S | m | R | R |
| ICP 2376 | S | S | S | m | R | R | m |
| KPBR 80-1-4 | S | S | S | m | m | R | R |
| ICP 7065 | S | S | m | S | R | m | R |
| ICP 7269 | S | S | S | S | R | R | R |
| ICPL 7 | S | S | S | S | R | R | R |
| ICP 7795 | S | S | m | m | R | R | R |

1=Data from one test only.
R=0 to 20 percent blight - resistant.
m=21 to 50 percent blight - moderately susceptible.
S=51 to 100 percent blight - susceptible.

## V. Alternaria blight

*Alternaria tenuissima* was isolated from stems of infected pigeonpeas in BH 21 field. The fungus was not pathogenic when tested under greenhouse conditions. A high concentration of spore suspension was sprayed on the test seedlings. Symptoms were not produced on ICP 7197 (Bahar) (Alternaria blight susceptible) and ICP 2376 (resistant).

The BHU isolate of *A. tenuissima* was multiplied in a 250 ml flask containing 100 ml potato dextrose broth (PDB) and incubated at 30°C in dark for 20 days. Very few conidia were produced. When the mycelial suspension was sprayed on the test seedlings, ICP 7197 and 2376 showed 100 and 0 percent blight, respectively. Good sporulation was observed when the fungus was multiplied in PDB and incubated at 25°C under 8 hr near-UV for 20 days.

**Project: CP-119(85)IC - Studies on the viruses affecting pigeonpea**

## I. Summary


1. Different purification methods were used to purify and isolate the causal pathogen of SM. None of the methods worked except the one where the enzyme Driselase was incorporated in purification schedule, flexuous virus-like particles (VLP) of 12-13 nm width and 250-600 nm in length were observed. However, these VLP did not show ultraviolet absorbance at 260 nm and similar flexuous structures in very low concentration were also observed from healthy leaf tissue.

2. Ultrathin sections of infective mites and SM-infected leaves did not show virus-like particles or any viral inclusion.

3. Mechanical sap transmission of SM pathogen was not successful.

4. SM pathogen was graft transmissible to pigeonpea and bean (Phaseolus vulgaris cv. Bountiful).

5. Using its whitefly vector, Bemisia tabaci Genn. the yellow mosaic (YM) was transmitted to 4 herbaceous plant hosts, namely horsegram (Macrotyloma uniflorum), mungbean (Vigna radiata var-Pusa Baisakhi), Limabean (Phaseolus lunatus cv. Henderson Baby Bush), field bean (Phaseolus vulgaris cv.Topcrop), in addition to pigeonpea.

6. Attempts in sap transmission of YM gave a low rate of success on to field bean ((Phaseolus vulgaris cv. top crop) and mungbean ((Vigna radiata cv. Pusa Baisakhi).


## II. Introduction

The work on the project 'Studies on the viruses affecting pigeonpea' was started from May 1985 and this is the first year of report under this new project. Work done on sterility mosaic (SM) and yellow mosaic (YM) that infect pigeonpea is reported here.

## III. Biology of pathogens

### A. Sterility mosaic

We continued efforts to know the nature of the pathogen causing SM.

#### 1. Purification procedures

#### a. Using protoplasts

Since it was difficult to isolate the causal pathogen of SM from leaves, we made an attempt to isolate protoplasts first, and then rupture them which may hopefully release the causal

pathogen. Because the exact nature of SM pathogen is still not known and with a purpose to have positive control for comparison, we also processed the groundnut leaf tissue infected with peanut mottle virus (PMV) and its control. As we can handle only small quantity of leaf material for protoplast isolation, we started with 30 leaflets from pigeonpea and groundnut. The following procedure for mesophyll protoplast isolation was done three times.

(i) Leaflets were washed with 70% ethanol for 5 minutes.

(ii) Leaflets were transferred to 0.3M clorox solution for 10 minutes.

(iii) Leaves were washed three times with sterilised distilled water, total time 15 minutes for 3 washes.

(iv) Leaves were dried on paper towels for 15 minutes, then floated in 1% solution of Rohament-P, an enzyme, in a petri plate, incubated at 30 C for 30 minutes.

(v) Leaves were transferred in 0.6M sterilised Mannitol solution in a petriplate for 4 hours at room temperature, which helped in plasmolysis of mesophyll cells.

(vi) Leaves were transferred to enzyme solution 2 (0.7% cellulase and 0.1% Macerozyme), incubated at 30°C overnight.

(vii) The petriplates were then swirled to help in release of protoplasts from leaf tissue.

(viii) The protoplast soup was strained with a fine nylon mesh and transferred to clinical centrifuge tubes.

(ix) The tubes were spun in a clinical centrifuge at 400 rpm for 10 minutes. The protoplast pellets which were loose, were resuspended in 0.6 M mannitol, pooled together and centrifuged. The final pellet was resuspended in 1 ml of 0.6M mannitol.

(x) Examined for protoplasts under a light microscope.

(xi) Resuspended protoplast pellet low speeded at 8000 rpm for 10 min.

The protoplasts burst: A pinchful of carborundum may be added before going in for low speed centrifugation as it helps in rupture of more number of protoplasts.

(xii) The supernatant was examined under electron microscope for virus-like particles, if any.

(xiii) The supernatant was layered on a 10 to 40% linear

sucrose gradient and spun at 20,000 rpm, for 2 hours and examined for a opalescence band.

By using the above procedure, we noticed by light microscopy that more number of protoplasts could be isolated from groundnut than from pigeonpea, which had a poor harvest of protoplasts. However, the samples from low speed centrifugation and bands from sucrose density gradients upon examination under electron microscope did not show virus-like particles (VLP) either from pigeonpea (SM infected) or from groundnut (PMV infected). Based on these results we feel that this system may work successfully if we start with 25 g or more of leaf tissue.

b. Using Enzyme Driselase

The procedure used is a slight modification of the procedure used earlier by Takanami and Kubo (J.Gen.Viro. 1979. 44: 153-159).

Infected leaves (fresh)

Using liquid nitrogen, ground the tissue into powder; using a varing blender, further homogenized in 0.1M citrate buffer containing 0.1% sodium thioglycollate and 0.5% Driselase, pH 6-0, 3 ml/G leaf. Dispensed extract in flasks, shaken for 2 hours, expressed through cheesecloth

Extract (Infectivity assay)

Emulsified with one-third volume chloroform, stirred for 20 min, centrifuges at 5000 rpm, 15 min

Aqueous phase

Sodium chloride and polyethylene glycol 8000 were added to make final concentration of 0.2M and 6%, dissolved on a stirrer, and stored for 120 minutes in a refrigerator, centrifuged 8000 rpm, 15 min

Precipitate

Resuspended in 0.01M citrate buffer pH 6.0, stored overnight, centrifuged at 5000 rpm, 10 minutes.

Supernatant (Infectivity assay and EM examination)

30% sucrose cushion in 0.01M citrate containing Nacl (0.2M) and PEG 8000 (6%) cushion occupied 1/3 portion of tube and in rest of the tube, sample layered centrifuged at 20,000 rpm for 120 min.

Pellet

Resuspended in 0.01M citrate buffer, pH 6.0 centrifuged at 5000 rpm, 10 min.

Supernatant (Infectivity assay, EM examination and UV absorbance)

Prepared 10-40% cesium chloride gradients, centrifuged at 25,000 rpm, 1 hour in SW 41 rotor.

The fractions collected at different stages in purification schedule were used for sap inoculation, examined under electron microscope, and their ultraviolet absorbance was seen. Sap inoculation of different fractions on to pigeonpea and other herbaceous indicator hosts did not give positive results. Because earlier we did not get a band in linear sucrose gradient, we shifted to 10-40% cesium chloride gradient and got a diffused band at 2.5 cm from top of the tube. This band when seen under electron microscope showed virus like particles (VLP) of approx. dimensions 12 nm width x 250-600 nm length; similar VLP were seen earlier in PEG precipitate and in sucrose cusion (ICRISAT Annual Report 1985). However, these VLP did not show ultraviolet absorbance typical of nucleoprotein.

Similar VLP were seen in healthy extracts after cesium chloride gradient centrifugation, although their concentration was low. The VLP from infected and healthy preparations were similar.

If we omitted Driselase from the purification schedule, VLP were not seen but instead masses of broom like structures were seen under electron microscope.

C. Using enzyme Rohament-P

The procedure given below, in which Rohament-P was used, is adapted from a procedure used earlier by Cleora J.D'Arcy et al., (Phytopathology 1983(73):755 759).

Infected leaves (pigeonpea)

Use liquid nitrogen, grind the tissue into powder in a mortar-pestle; using a blender, further homogenize in 0.1M sodium phosphate buffer, pH 6.0 containing 0.1% sodium thiglycollate and 1.5% Rohament-P (3ml buffer/G of leaf), dispensed the extract in flasks, shaken for 24 hours, 28°C, express through cheesecloth

Extract

Adjust the extract to pH 6.4 by adding 1N NaOH, measure volume, emulsified with one-third volume chloroform, stirred for 15 min. centrifuged at 4000 rpm 15 min.

Aqueous phase

Sodium chloride and polyethylene glycol (PEG) 8000 was added to make final concentration of 0.2M and 5%, stirred for 30 min at room temperature, stored in refrigerator for another 15 min, centrifuged at 8000 rpm, 15 min.

Precipitate (EM examination)

Resuspended in 50 ml of 0.01M sodium phosphate buffer, pH 6.5

containing 1% Triton x-100, stored overnight in refrigerator, centrifuged at 8000 rpm for 10 minutes.

Super (EM examination)

20% sucrose cushion, centrifugation at 20,000 rpm for 2 hours (the volume of sucrose cushion was 10 ml, rest of the tube filled with the sample).

Pellet (UV absorbance)

Resuspended in 0.01M sodium phosphate buffer, pH 6.5, centrifuged at 5000 rpm 10 min.

Super (EM examination and UV absorbance)

Prepared 10-40% linear sucrose gradients layer the sample, centrifuged at 20,000 rpm for 1 hour.

The pellets obtained after Nacl-PEG precipitation and sucrose cushion did not show virus-like particles (VLP) when examined under electron microscope. After sucrose density gradient centrifugation, there was no opalescent band, and ultraviolet absorbance typical of nucleoprotein was not noticed.

d) Using procedures used for other mite transmitted viruses

There are two procedures reported in literature earlier for purification of wheat streak mosaic and rye grass mosaic viruses. Both of these cereal viruses are transmitted by eriophyid mites.

Purification procedure used for wheat streak mosaic (after, Brakke, M.K. and Ball, E.M. 1968. Purification and antigenicity of wheat streak mosaic virus. Phytopathology 58:963-971).

Infected leaves (100 G)

Used a waring blender, the buffer was 0.01M K2HPO4, pH 8.5, 2 ml buffer/G of leaf, express sap thru cheesecloth, measure volume, adjust to pH 6.0 with IN acetic acid, heated sap 40°C, 1 hour, kept in cold room 1 hour which helped in precipitation of host proteins.

Extract

Centrifuged the extract at 8000 rpm, 20 min

supernatant

Measured volume, its pH was raised to pH 8.0. To this sufficient sodium citrate salt was added to give a 0.01 M concentration. Used a 20% sucrose cushion in 0.01 M sodium citrate and was centrifuged at 28,000 rpm, 2 hours.

pellet

pellet was resuspended in 10 ml of 0.01 sodium citrate, pH 8.0 (1 ml/10 G of leaf), allowed to stand overnight in refrigerator, centrifuged at 8000 rpm, 20 min.

Supernatant

Two ml of super was layered on 10-40% linear sucrose gradient and spun at 23000 rpm, 2 hr. Tubes observed for light scattering.

Samples for electron microscopic examination were taken at various stages during purification and virus-like particles not seen.

Purification procedure used Rye grass mosaic virus (after, Paliwal, Y.C., and Tremaine, J.H. 1976. Multiplication, purification, and properties of ryegrass mosaic virus. Phytopathology 66: 406-414).

Infected leaves (Tissue from ICP 8136 served as control)

Use liquid nitrogen, ground the tissue into powder in a mortar-pestle, by using a ball-mill, further homogenize in 0.01M sodium citrate, pH 7.0, containing 0.02M 2-mercaptoethanol, 3.5 ml/G leaf tissue. In ball mill, the homogenization was for 1 hour in a walk-in cold room (purpose of using ball mill: we thought that in case the SM pathogen is flexuous rod, use of a ball mill will gradually release virus particles from leaf tissue without their breakage), express the extract through muslin cloth.

Extract

Heat the extract at 40°C for 5 minutes, cool it immediately in an ice bath for 1 hour, centrifuged at 8000 rpm for 20 min in GS-3 rotor.

super

Measured volume and sodium chloride and PEG 8000 were added to make a final concentration of 0.2M and 6%, dissolved with a magnetic stirrer for 30 min, and kept for another 90 min in a freezer (-20C). centrifuged at 7500 rpm 15 min.

precipitate

Resuspended in 0.01M sodium citrate, pH 7.0 (in one-fourth of the original volume), halt overnight, low speed at 5000 rpm, 15 min

Supernatant

centrifuged at 25000 rpm, 2 hrs. in R-35 rotor

Pellet

Resuspended in 2 ml of 0.1M sodium citrate, pH 7.0, allowed to soak for 2 hourse, low speed 5000 rpm, 15 min

**super**

**centrifuged at 25000 rpm, 2 hours in R35 rotor**

**Pellet**

**Resuspended the pellet in 1 ml of 0.01M sodium citrate, pH 7.0, soak overnight, lov speed at 5000 rpm, 15 min.**

**Super**

**At different stages during purification, the samples were examined under electron microscope for virus like particles. Virus-like particles were not seen and the ultraviolet absorbance readings at 260 nm and 280 nm were not indicative of a nucleoprotein.**

2. **Electron microscopy**

a) **Mite dip**

About 500 live eriophyid mites from infected pigeonpea leaves were picked with the help of single eyelash transfer brush, deposited in a cavity slide, and later crushed these in a glass tissue homogenizer. The drop with triturates of infective mites was put on a strip of parafilm. Copper grids were put on the drop for about 5 minutes, lifted with forceps, lightly rinsed with water, and then was put into a drop of 2% uranyl acetate for a few seconds. When these grids were examined under electron microscope (EM) few elongated flexuous particles of various dimensions were seen and these were similar to the viruslike particles (VLP) that we earlier examined from infected pigeonpea leaves. Such particles were not seen when triturates of healthy mites were examined under EM. However, we could do this just once and this needs to be comfirmed.

b) Ultrathin sections of mite

The mites collected from SM-infected leaves and pathogen-free mites from pigeonpea cv.ICP 8136 were used. The processing of material before it is ready for ultrathin sectioning was earlier described in Pulse Pathology Progress Report 45 (June 1984-May 1985). VLP were not identified in ultrathin sections of mites and further attempts are necessary.

c) Ultrathin sections of leaf

Infected pigeonpea leaves of cv. NP-(WR) 15 and cv BDN-1 and their healthy leaf tissue picked up from plants raised in glasshouse were used. The processing of leaf material for ultrathin sectioning was described earlier in Pulse Pathology Progress Report 45 (June 1984-May 1985).

Definite virus inclusion or any other type of inclusion was not observed in infected material.

In ultrathin sections of infected leaves of cv.BDN-1 some nuclear changes were observed in the form of increased electron density but no conclusion could be derived. No VLP was seen in ultrathin sections.

In ultrathin sections of infected leaves of cv.MP(VR)15, some membrane bound inclusions with radiating bands were found. However, enough number of ultrathin sections were not scanned to draw a definite conclusion.

3. Mechanical sap transmission

The sterility mosaic infected leaf tissue (about 20 G) was triturated in liquid nitrogen in a mortar pestle and the fine leaf powder was homogenized in 0.1M sodium citrate buffer, pH 6.0 containing 0.1% sodium thiglycollate and 0.5% Driselase, an enzyme, in a Waring blender, in ratio of 5 ml buffer/G of leaf (volume/wt). Following herbaceous plants (5 plants of each, minimum) were used in sap inoculation. Plants were earlier dusted with carborundum. Bean (Phaseoulus vulgaris cv.Bountiful), Necotiana clevendii, N. tabacum cv. Samsun-NN, Tetragonia expansa (new Zealand spinach), limabean (Phaseolus lunatus cv.Henderson Baby Bush), and pigeonpea cv.BDN 1. Results of mechanical sap transmission onto pigeonpea or other plant sp. were negative.

4. Graft transmission

The tissue implantation method of grafting was used. In this, approx. 1 cm length stem pieces from infected pigeonpea, earlier treated with 0.3% Metasystox to kill mites, were used as scions and these were implanted by making a slit on the stem below the growing point of healthy plants (served as stock) of pigeonpea cv BDN-1, bean (Phaseoulus vulgaris cv.Bountiful), limabean (Phaseolus lunatus cv.Henderson Baby Bush). At least 10 plants of each plant sp.were used and adequate controls kept.

Of the 24 pigeonpea grafted, 1 plant showed symptoms of SM and of 10 bean cv.Bountiful grafted, 4 plants showed symptoms of yellowing of veins and mosaic. In Bountiful bean, the pathogen was systemic up to second trifoliate; however, later the plants own defence system seemed to have not allowed further advance of the pathogen and symptoms disappeared in new leaves. We were not successful in graft transmission of SM in bean cv.Kentuckey, and in limabean cv.Henderson Baby Bush.

B. Yellow Mosaic

Yellow mosaic (YM) of pigeonpea is not economically important disease at the moment, but has a potential to become serious.

We studied the experimental host range of YM via its whitefly vector. Also, since YM has not been found sap transmissible, we made attempts to sap-transmit this virus to pigeonpea and to other herbaceous plant species.

1. Experimental host range of YM

The cotton whitefly, Bemisia tabaci Genn. was collected from a cotton field and was maintained on cotton in cages and used in experimental host range studies.

The table below shows the different herbaceous hosts used, besides pigeonpea, to know the host range of the YM (Table 17).

Whiteflies used in transmission studies were given a pre-acquisition starvation of about 1 hour; these were given acquisition access feeding for 2 days on a yellow mosaic infected pigeonpea twig which was kept in a water bottle to keep it turgid. These whiteflies were released for transmission feeding for 2 days on different test plant species. We released 50 whiteflies per plant and at least 5 plants of each host spicies were used except for lima bean. Among the different host species tested, Vigna radiata (mungbean cv. Pusa Baisakhi) was observed as a good assay host for YM.

2. Mechanical sap transmission of YM

Infected leaf tissue of YM established in mungbean var. Pusa Baisakhi via whiteflies was used in mechanical sap transmission. The leaf tissue was triturated in 0.1M potassium phosphate buffer, pH 7.8 containing 0.2% mercaptoethanol in a mortar-pestle in proportion of 1:4 (wt:vol). The sap was kept cold and was rubbed onto carborundum-dusted leaves of test plants. A minimum of 10 plants of mungbean, Phaseolus vulgaris cv.Topcrop, pigeonpea cv.ICP 11242 were used.

Of 24 plants of mungbean var Pusa Baisakhi sap inoculated, one plant showed yellow mosaic symptoms. Similarly of 10 plants of bean (Phaseolus vulgaris cv.Topcrop), 2 plants showed leaf curling and death of the plant; this symptom in Top crop bean was similar to the symptoms earlier observed after release of whiteflies.

Table 17. Experimental host range of yellow mosaic virus of pigeonpea.

| S.No. | Plant species | # plants infected/ # of plants inoculated | Symptoms | Recovery Assay on pigeonpea (ICP-1) or mungbean var. Pusa Baisakhi |
|---|---|---|---|---|
| 1. | Horsegram (Macrotyloma uniflorum) | 2/4 | Yellow mosaic, systemic | Positive |
| 2. | Chickpea (Cicer arietinum) var.Glabrous Mutant | 0/5 | - | - |
| 3. | Mungbean (Vigna radiata) var.Pusa Baisakhi | 5/8 | Yellow mosaic, systemic, sometimes downward leaf curling noticed first, followed by yellow mosaic in new leaves. | Positive |
| 4. | Groundnut (Arachis hypogea) var.Kopargaon (ICG #0360) | 0/5 | | |
| 5. | Pigeonpea (Cajanus cajan) | | | |
| | ICP 1 | 5/20 | Islands of intense yellow mosaic lesions on leaf lamina, sometimes yellow mosaic covers the entire leaf lamina | Positive |
| | ICP 11242 | 3/8 | Similar as above | Positive |
| 6. | Rice bean (Vigna umbellata) var/RBL 1) | 0/6 | - | - |
| 7. | Bean (Phaseolus vulgaris) | 4/8 | Downward curling of leaves, new trifoliates shortened,and become brittle. Intense yellow mosaic, as seen in pigeonpea and mungbean not observed | Not done |
| 8. | Bean (Phaseolus vulgaris) cv.Pinto | 0/5 | - | - |
| 9. | Limabean (Phaseolus lunatus) | 1/3 | Intense yellow mosaic not seen; the new trifoliates instead showed reduction in size of trifoliate and mosaic mottle. | Not done |
| 10. | Squash (cucurbita mixima) var.Black magic | 0/6 | - | - |

- = indicates no symptoms or negative results

**Project:** CP-120(85) IC - Screening for disease resistance in chickpea and pigeonpea

## I. Summary

### Screening nurseries

1. Very high, early and uniform incidence of wilt (average 98% with a range of 97-100%) was achieved in wilt sick plots by criss-cross ploughing of the plots, adding inoculum just before sowing, early sowing (in the first fortnight of June) and good weed control especially through the application of pre-emergence herbicides. This has enabled very effective screening of germplasm and breeding materials.

2. Equally high level of incidence of sterility mosaic (SM) (average 99-100%) was achieved in 2.3 ha SM nursery by following infector-hedge and leaf-stapling inoculation techniques.

3. Screening for combined resistance to wilt and SM was effectively carried out in 0.4 ha. Alfisol field.

4. Screening for combined resistance to wilt, SM and phytophthora blight (PB) was done in 1 ha Alfisol field. Screening for wilt and SM resistance was very effective but screening against PB was not effective due to low disease development.

5. The Fusarium population in all the sick plots before sowing is being estimated to understand the variation in wilt incidence within and over the seasons.

### Wilt resistance

1. Three additional germplasm lines resistant to wilt were identified. These were ICP-12942, -13056, and -13165. Among 6 ICPL lines screened, ICPL-84006, -84014, and -84015 showed <10% wilt.

2. The results of screening of ACT materials against wilt showed that except some ICPL lines from MPSMWRY most other lines are susceptible. Entries of EXACT and EACT showed comparatively less wilt than the late lines.

3. A total of 444 early, 5138 medium, 90 late, and 314 other breeding materials were evaluated for wilt resistance to assist the breeders in development of wilt resistant varieties.

4. None of the 10 Mahyco lines tested showed <20% wilt.

5. For wilt, 2 multilocation nurseries were operated; IIUTPWR in India and IPWN in East Africa. In IIUTPWR, 44 lines were provided to 11 cooperators and results were received from 8. ICP-9174 showed <20% wilt at all 8 locations in India. In IPWN, 34 lines were supplied to 3 cooperators. ICP 12733, -12738, -12741, -12748, and -12753 showed <10% wilt at ICRISAT and BVUMBWE in Malawi.

**SM resistance**

1. Fifty two additional germplasm lines resistant to SM (0%) were identified and 17 of these had <20% wilt.

2. Among the ACT lines, in addition to ICPLs, some lines in ACT3 were also found promising against SM. Some ACT entries have been purified for SM resistance by repeated screening and selfing of resistant plants.

3. A total of 545 early, 640 medium, 35 late, and 365 other breeding materials were evaluated for SM resistance to assist the breeders in developing SM resistiant cultivars.

4. Out of 10 Mahyco lines, two lines; MPPL8 and MPPL10 showed <10% SM.

5. Out of 32 Heliothis promising lines, four lines; PI-396986, ICP-6831, ICP-7198 and ICP 4769 showed <20% wilt and SM.

6. SPP of three early ICPLs i.e. ICPL-146, ICPL-151, and ICPL-155 were screened for SM resistance in pots. ICPL-146 showed uniform ringspot reaction. None of 310 SPP of ICPL 151 was free from SM but some isolated plants showed ringspot or mild mosaic reaction. In ICPL 155, some SPP were uniformly resistant while others were susceptible.

7. One multilocation trial; IIUTPSMR was operated in India. In this trial, 39 lines were provided to 10 cooperators. Results were received from 6 locations. ICP 7035, 7234, 8862, 10976, 10979, 10984, 11049, 11207, BSMR 225, 235, 258 and ICPL 8324 showed <20% SM at all 6 locations.

**Phytophthora blight resistance**

1. For phytophthora blight, one multilocation trial, IIUTPPBR was operated in India. Nine lines were supplied to 5 cooperators and results from 4 locations showed that no line was promising accross locations.

**Multiple disease resistance**

1. Two germplasm lines; PR 5149 and PI 397630 showed <10% wilt and SM.

2. 230 medium, 10 late and 25 male sterile breeding materials were evaluated for combined resistance to wilt and SM.

3. Two multilocation trials for multiple disease resistance were conducted in India for the first year. In IIUTPMDR-A, for wilt and SM resistance, 54 lines were provided to 4 cooperators. The line ICP 8869 showed <10% and ICP 8860 <20% wilt and SM accross locations. In IIUTPMDR-B, for SM and PB resistance, 9 lines were provided to 3 cooperators and ICP 11304 showed promise for SM and PB at all the locations.

4. 234 early, 259 medium and 56 late breeding materials were evaluated for wilt, SM, and PB resistance in the multiple disease nursery.

**Wilt and Heliothis resistance**

1. Wilt resistance of ICP 4769, ICP 6831 and ICP 7198, which were known to be Heliothis and wilt resistant was confirmed.

17 F2 and F3 wilt and Heliothis tolerant populations were evaluated for wilt resistance.

## II. Introduction

This project has been formulated in January 1985 with the following objectives.

To identify broad based/durable sources of resistance for wilt, sterility mosaic, Phytophthora and Alternaria bights of pigeonpea to help breeders in developing pigeonpea varities with broad based/ durabe resistance to individual and combination of diseases.

During 1985-86 the work carried out under this project consisted of creation of large scale artificial epiphytotics of wilt, sterility mosaic and phytophthora blight in the field for screening germplasm and breeding materials, identification of new sources of resistance from germplasm, screening of breeding materials and multilocation testing of resistant lines to identify lines with broad based resistance and share the seed of resistant materials with the scientists of the national programs.

## III. Screening nurseries

### A. Wilt sick plots

Vertisol sick plots BIL 2A and BIL 2B (1.8 ha) at ICRISAT Center were used for screening for wilt resistance. These fields are being used since 1977-78 season. In order to obtain uniform, early and high incidence of wilt and maintain high level of

sickness for the subsequent seasons the following steps were undertaken.

1. Application of wilt inoculum (chopped pigeonpea wilted plants collected from sickplots and other fields) in the field just before sowing.

2. Criss cross ploughing of sick plots for uniform distribution of inoculum.

3. Early sowing i.e. first fortnight of June to get good growth of pigeonpea.

4. Good weed control thru pre-emergence application of herbicides (0.75 kg Basalin + 1 kg prometryne per ha) and hand weeding.

5. More frequent use of susceptible check ICP 2376 i.e. 1:2 instead of 1:4.

These above steps helped in obtaining more than 98 percent average wilt incidence in the susceptible check. The wilt incidence was also very uniform (range 97.0-100.0 percent) (Table 18). The wilt incidence in the two wilt sick plots for the past 9 years is given in Table 19. The other aspect observed during the current season was that the wilt incidence almost reached peak by flowering time and it has helped in selfing of the resistant material.

From this season data on Fusarium population in the sick plots before sowing is being collected. For this purpose sick plots were divided into 10 x 10 m grids and from each grid 20 sub-soil samples were drawn. The data on Fusarium propagules and final wilt incidence is presented in table 20. In general the Fusarium population was low in vertisols than in Alfisols but the wilt incidence was high in both soils. The data also revealed big variation in Fusarium population in the sick plots even after 9 years of their development.

**B. Sterility mosaic nursery**

A 2.3 ha plot in vertisol field BIL 7B was used for screening against sterility mosaic (SM). Both infector-hedge and leaf stapling inoculation techniques were used for creating the artificial epiphytotics of the disease. Inoculation through the leaf stapling technique was carried out as disease incidence in the infector hedge was very low. However the combined use of both the techniques helped in getting high incidence (99.0 percent) of the disease in the susceptible check BDN-1 which was planted after every 10 test rows. The range was vary also narrow (97.0-100.0 percent) indicating uniform development of disease.

**Table 18. Final disease incidence of wilt, SM and PB in susceptible checks in different pigeonpea disease nurseries during 1985-86 at ICRISAT Center.**

| Field | Diseases | Area (ha) | Check cultivar (Susc. check) | Percent disease incidence | Range | Frequency of susc. check |
|---|---|---|---|---|---|---|
| BIL 2A | Wilt | 0.8 | ICP 2376 | 99 | 99-100 | 1:2 |
| BIL 2B | Wilt | 1.0 | ICP 2376 | 98 | 97-99 | 1:2 |
| BIL 7C | SM | 2.3 | BDN 1 | 99 | 97-100 | 1:10 |
| RM 8E | Wilt | 0.3 | ICP 2376 | 99 | 99-100 | 1:8 |
| RM 3C | SM | 0.1 | ICP 8863 | 100 | | 1:8 |
| RP 18 | Wilt | 1.0 | ICP 2376 | 91 | 86-100 | 1:2 |
| | SM | | ICP 8863 | 93 | 89-92 | 1:8 |
| | PB | | HY 3C | 53 | - | 1:8 |
| BM 16C | Wilt, Heliothis | 1.0 | T 21 | 91 | - | 1:4 |

SM=Sterility mosaic, PB=Phytophthora blight

**Table 19. Pigeonpea wilt incidence in susceptible cv. ICP 2376 in vertisol sick plots BIL 2A & 2B at ICRISAT Center (1977-1986).**

| Year | BIL 2A | | BIL 2B | |
|---|---|---|---|---|
| | % wilt | | % wilt | |
| | Early | Harvest | Early | Harvest |
| 1977-78 | 2.3 | 71.8 | 1.1 | 61.5 |
| 1978-79 | 24.0 | 93.5 | 27.3 | 93.3 |
| 1979-80 | 24.2 | 90.9 | 18.0 | 96.4 |
| 1980-81 | 26.2 | 74.1 | 30.9 | 77.4 |
| 1981-82 | 41.0 | 82.4 | 22.6 | 66.9 |
| 1982-83 | 17.9 | 92.8 | 17.3 | 90.0 |
| 1983-84 | 30.3 | 86.6 | 11.9 | 69.0 |
| 1984-85 | 11.6 | 90.8 | 13.1 | 84.0 |
| 1985-86 | - | 99.0 | - | 98.0 |

Table 20. Fusarium population and pigeonpea wilt incidence in different wilt sick plots during 1985-86 at ICRISAT Center.

| Field/Nursery | Fusarium popula-1,2 tion/g soil | Percent wilt at maturity |
|---|---|---|
| RM 3C (Wilt + SM nursery) | 4985 (4820-5380) | 99.5 (99.3-99.7) |
| RM 8E (Wilt nursery) | 8350 (6500-9300) | 89.4 (80.5-98.1) |
| RP 18 (Wilt+SM+PB nursery) | 4075 (3340-5060) | 91.0 (86.0-99.5) |
| BIL 2A (Wilt nursery) | 3086 (1600-4100) | 99.5 (99.2-99.7) |
| BIL 2B (Wilt nursery) | 2633 (2100-3900) | 98.2 (97.4-99.1) |
| BM 16C (Wilt+Heliothis nursery) | 3240 (2300-5500) | 91.0 |

1=Fusarium count at the time of sowing (First fortnight o June).
2=Average of 4 reps.

C. Multiple disease nurseries

1. Wilt + sterility mosaic

Alfisol sick plots RM 3C (0.1 ha) and RM 8E (0.3 ha) were used for screening for combined resistance to wilt and SM. For wilt all the steps taken for wilt sick plots were followed. Wilt and SM susceptible checks (ICP 2376 and ICP 8863) were alternated after every 4 test rows. For SM inoculation in RM 3C infector hedge technique was used and in RM 8E leaf stapling technique was followed. In both the plots, both wilt and SM incidence in the susceptible checks was nearly 100.0 percent.

2. Wilt + sterility mosaic + phytophthora blight

A 1.0 ha Alfisol plot (RP-18) was used for screening for multiple disease resistance. For obtaining high and uniform incidence of wilt, the steps mentioned under wilt sickplots were followed. For SM infector hedge technique was used. for phytophthora blight, inoculation with zoospores suspension (10,000 spores/ml) coupled with perfo-irrigation in the seedling stage and stem cut inoculation and furrov-irrigation in the adult plant stage were followed. The wilt and SM incidence was quite high but phytophthora blight incidence was lov.

D. Wilt + Heliothis nursery

A 1.0 ha vertisol field (BM 16C) was used for this purpose. This plot was selected as it is adjacent to the unsprayed area where high incidence of Heliothis is expected. A large amount of pigeonpea wilt chopped material was incorporated before sowing. Surprisingly a very high incidence (91 percent) of wilt was obtained in the susceptible check in the first year itself.

IV. SCREENING FOR RESISTANCE

A. Wilt

Most of the pigeonpea germplasm available with GRU, ICRISAT has already been screened for wilt resistance and several good sources of resistance were identified. At present the emphasis is on multilocation testing of the resistant lines and screening of the breeding materials. The screening for wilt resistance this season has been very effective as the susceptible check showed near 100.0 percent wilt by flowering time throughout the sick plots.

1. Germplasm selections

Thirteen single plant germplasm selections from 1984-85 screening were retested in BIL 2B. The results are presented in table 21. The plant stand was very lov for many lines. Three selections showed no wilt.

2. ICPL lines

Six ICPL lines and an advanced line were retested for wilt

resistance. The results presented in table 22 show that most of these lines are promising for wilt resistance.

3. **ACT materials**

The entries of EXACT, EACT, ACT 1, ACT 2, ACT 3, MPSMVRY, and LPSMVRY were tested for the r reaction against wilt. All the trials were laid out in RBD with two replications. ICP 2376 was the susceptible check In EXACT, EACT and ACT 1, the wilt reaction is from the ratooned crop In the main crop the early lines did not show much wilt The results presented in tables 23,24,25,26,27,28 and 29 show that only some entries in MPSVRY are resistant to wilt.

The susceptiblity of entries in ACT's to wilt indicate that not much progress has been made in breeding for wilt resistance in spite of availability of good sources of resistance.

4. **Breeding materials**

Screening of breeding materials in early, medium and late maturity groups was the major work under this project. The list of various breeding materials screened is presented in tables 30,31,32 and 33. The detailed results have been provided to the breeders. Generally the advanced lines which are in yield trials were tested in RBD with 2 replications.

5. **MAHYCO lines**

Ten lines received from MAHYCO were tested for their wilt reaction (table 34). None of them were resistant.

6. **Multilocation testing**

Along with screening of breeding materials, multilocation testing of resistant germplasm and advanced breeding lines was the major activity under this project. Two multilocation trials were organised for wilt resistance.

a) **ICAR-ICRISAT Uniform Trial for Pigeonpea Wilt Resistance (IIUTPWR) 1985-86**

This trial is organised in India in collaboration with Directorate of Pulse Research (DPR), (ICAR), Kanpur. The list of cooperators and locations of this nursery are given in table 35. The reaction of the entries at different locations is given in table 36. The trial was well conducted at most of the locations and effective screening was obtained. Quite a few lines such as ICP 8858, 8863, 9174, 12745, ICPL 84008 and ICPL 84013 showed broad based resistance. (resistant in 7-8 out of 8 locations).

Table 21. Reaction of of pigeonpea germplasm selections (1984-85) against wilt in vertisol sick plot (BIL 2B) during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | Total plants | Percent wilt |
|---|---|---|---|
| 1. | ICP-12807-W1@ | 2 | 50.0 |
| 2. | ICP-12814-W1@ | 14 | 21.4 |
| 3. | ICP-12880-W1@ | 25 | 24.0 |
| 4. | ICP-12942-W1@ | 14 | 0.0 |
| 5. | ICP-12942-W2@ | 53 | 0.0 |
| 6. | ICP-12973-W1@ | 20 | 40.0 |
| 7. | ICP-13056-W1@ | 2 | 0.0 |
| 8. | ICP-13063-W1@ | 4 | 25.0 |
| 9. | ICP-13073-W1@ | 21 | 9.5 |
| 10. | ICP-13146-W1@ | - | - |
| 11. | ICP-13164-W1@ | 2 | 100.0 |
| 12. | ICP-13165-W1@ | 7 | 14.3 |
| 13. | ICP-13165-W2@ | 1 | 0.0 |
| 14. | ICP-2376 (wilt susc. check) | 413 | 88.1 |

Table 22. Reaction of ICPL lines to wilt in vertisol sick plot (BIL 2B) during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | Total plants | Percent wilt |
|---|---|---|---|
| 1. | ICPL 84005 | 99 | 18.2 |
| 2. | ICPL 84006 | 95 | 1.0 |
| 3. | ICPL 84009 | 100 | 14.0 |
| 4. | ICPL 84012 | 130 | 24.6 |
| 5. | ICPL 84014 | 123 | 9.8 |
| 6. | ICPL 84015 | 81 | 4.9 |
| 7. | ICPX 78153-W27-WB-WB@ | 102 | 7.8 |
| 8. | ICP 2376 wilt susc. check | 549 | 92.0 |

Table 23. Reaction of EXACT entries to wilt in sick plot (BIL 2B) during 1985-86 at ICRISAT Center.

| S.No. | Entry | Total plants | | Percent wilt in ratoon crop | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AL 1 | 71 | 55 | 88.7 | 89.1 | 88.9 |
| 2. | AL 15 | 82 | 90 | 95.1 | 91.1 | 93.1 |
| 3. | AL 101 | 56 | 91 | 92.8 | 74.7 | 83.6 |
| 4. | DL 78-1 | 57 | 147 | 84.2 | 90.5 | 87.3 |
| 5. | ICPL 317 | 80 | 23 | 88.8 | 69.6 | 79.2 |
| 6. | ICPL 8306 | 81 | 90 | 90.1 | 83.3 | 86.7 |
| 7. | Hy 10 | 5 | 6 | 100.0 | 100.0 | 100.0 |
| 8. | H 76-11 | 92 | 140 | 100.0 | 88.6 | 94.3 |
| 9. | H 76-44 | 76 | 65 | 76.3 | 83.1 | 79.7 |
| 10. | H 76-51 | 132 | 60 | 93.2 | 93.3 | 93.2 |
| 11. | H 76-65 | 68 | 190 | 92.6 | 88.9 | 90.7 |
| 12. | H 81-1 | 92 | 84 | 94.6 | 54.8 | 74.7 |
| 13. | H 82-1 | 55 | 145 | 96.4 | 45.5 | 71.0 |
| 14. | H 82-12 | 66 | 92 | 83.3 | 97.8 | 90.5 |
| 15. | Pusa 85 | 88 | 82 | 80.8 | 78.0 | 83.9 |
| 16. | Pusa 851 | 72 | 94 | 81.9 | 88.3 | 85.1 |
| 17 | TAT 10 | 75 | 78 | 89.3 | 89.7 | 89.5 |
| 18. | TAT 11 | 18 | 22 | 94.4 | 95.4 | 94.9 |
| 19. | ICP 2376 (wilt check) | 33 | 38 | 100.0 | 99.4 | 99.7 |

Table 24. Reaction of EACT entries to wilt in sick plot (BIL 2B) during 1985-86 at ICRISAT Center.

| S.No. | Entry | Total plants | | Percent wilt in ratoon crop | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AL 13 | 42 | 54 | 92.8 | 100.0 | 96.4 |
| 2. | AL 56 | 85 | 90 | 89.4 | 94.4 | 91.9 |
| 3. | AL 57 | 115 | 170 | 98.2 | 97.0 | 97.6 |
| 4. | BSMR 294 | 20 | 9 | 65.0 | 55.5 | 60.2 |
| 5. | GAUT 82-53 | 33 | 93 | 90.9 | 96.7 | 93.8 |
| 6. | GAUT 82-55 | 64 | 88 | 45.3 | 71.5 | 58.4 |
| 7. | H 76-24 | 85 | 93 | 98.8 | 94.6 | 96.7 |
| 8. | H 80-110 | 57 | 216 | 84.2 | 89.3 | 86.8 |
| 9. | H 82-26 | 98 | 89 | 93.8 | 93.2 | 93.5 |
| 10. | Hy 11 | 7 | 5 | 71.4 | 80.0 | 75.7 |
| 11. | ICPL 151 | 71 | 60 | 98.5 | 95.0 | 96.8 |
| 12. | ICPL 269 | 70 | 73 | 91.4 | 95.8 | 93.6 |
| 13. | ICPL 317 | 39 | 86 | 92.3 | 88.3 | 90.3 |
| 14. | ICPL 8327 | 57 | 79 | 67.2 | 93.6 | 80.4 |
| 15. | MTH 6 | 59 | 52 | 52.5 | 50.0 | 51.2 |
| 16. | MTH 10 | 42 | 92 | 95.2 | 95.6 | 95.4 |
| 17. | Pant A 1-1 | 61 | 114 | 93.4 | 96.4 | 94.9 |
| 18. | Pant A 10 | 63 | 78 | 92.0 | 89.7 | 90.8 |
| 19. | PUSA SWETA 2 | 77 | 88 | 85.7 | 87.5 | 86.6 |
| | ICP 2376 (wilt check) | 67 | 70 | 100.0 | 99.8 | 99.9 |

**Table 25. Reaction of ACT1 entries to wilt in sick plot (BIL 2B) during 1985-86 at ICRISAT Center.**

| S.No. | Entry | Total plants | | Percent wilt in ratoon crop | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | CORG 5 | 100 | 100 | 98 0 | 91 0 | 94.5 |
| 2. | DA 8 | 31 | 68 | 90.3 | 00.0 | 95.1 |
| 3. | ICPL 176 | 26 | 48 | 92.3 | 97 9 | 95.1 |
| 4. | ICPL 186 | 62 | 68 | 91 9 | 61 7 | 76.8 |
| 5. | ICPL 288 | 61 | 101 | 67.2 | 42.5 | 54.9 |
| 6. | ICPL 8308 | 41 | 21 | 78.0 | 76.1 | 77.0 |
| 7. | ICPL 8324 | 12 | 19 | 33.3 | 47.3 | 40.3 |
| 8. | ICPL 84074 | 19 | 13 | 89.4 | 92.3 | 90.8 |
| 9. | ICPL 84077 | 66 | 83 | 83.3 | 89.1 | 86.2 |
| 10. | Pusa 85 | 52 | 25 | 94.2 | 92.0 | 93.1 |
| 11. | Pant 102 | 98 | 78 | 81.6 | 97.4 | 89.5 |
| 12. | Pant 103 | 63 | 75 | 87.3 | 100.0 | 93.6 |
| 13. | Pant 104 | 80 | 72 | 85.0 | 91.6 | 88.3 |
| 14. | PT 14 | 67 | 74 | 76.1 | 90.5 | 83.3 |
| 15. | PT 20 | 79 | 82 | 56.9 | 63.4 | 60.1 |
| 16. | TT 5 | 77 | 86 | 94.8 | 95.3 | 95.0 |
| 17. | TT 6 | 74 | 90 | 90.5 | 90.0 | 90.2 |
| | ICP 2376 (wilt check) | 34 | 30 | 99.4 | 99.7 | 99.5 |

**Table 26. Reaction of ACT2 entries to wilt in sick plot (BIL 2A) during 1985-86 at ICRISAT Center.**

| S.No. | Entry | Total plants | | Percent wilt | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AGS 498 | 52 | 74 | 75.0 | 64.8 | 69.9 |
| 2. | AKT 1 | 74 | 70 | 79 7 | 88.5 | 84.1 |
| 3. | AKT 6 | 84 | 140 | 97.6 | 96.4 | 97.0 |
| 4. | C 11 | 44 | 28 | 100.0 | 96.4 | 98.2 |
| 5. | G 78-3 | 72 | 39 | 100.0 | 100.0 | 100.0 |
| 6. | MA 162 | 39 | 28 | 94.8 | 92.8 | 93.8 |
| 7. | MTH 8 | 46 | 53 | 100.0 | 100.0 | 100.0 |
| 8. | MTH 9 | 74 | 80 | 93.2 | 91.2 | 92.2 |
| 9. | MTH 11 | 108 | 78 | 98.1 | 94.8 | 96.4 |
| 10. | MRG 66 | 77 | 95 | 100.0 | 98.9 | 99.4 |
| 11. | PT 17 | 76 | 115 | 98.6 | 95.6 | 97.1 |
| 12. | PT 18 | 64 | 46 | 96.8 | 93.4 | 95.1 |
| 13. | No.148 | 31 | 60 | 96.7 | 96.6 | 96.6 |
| | ICP 2376 (wilt check) | 105 | 84 | 99.9 | 100.0 | 99.9 |

Table 27. Reaction of ACT3 entries to wilt in sick plot (BIL 2A) during 1985-86 at ICRISAT Center.

| S.No. | Entry | Total plants | | Percent wilt | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AGS 522 | 57 | 95 | 87.7 | 98.9 | 93.3 |
| 2. | Bahar | 28 | 61 | 92.8 | 100.0 | 96.4 |
| 3. | DA 15 | 18 | 18 | 77.7 | 88.8 | 83.2 |
| 4. | ICPL 146 | 90 | 105 | 75.5 | 90.4 | 83.0 |
| 5. | ICPL 161 | 71 | 72 | 85.9 | 93.0 | 89.4 |
| 6. | ICPL 360 | 74 | 71 | 90.5 | 84.5 | 87.5 |
| 7. | ICPL 366 | 75 | 51 | 76.0 | 90.0 | 83.0 |
| 8. | KA 1 | 15 | 19 | 86.6 | 84.2 | 85.4 |
| 9. | KA 25-1 | 41 | 47 | 60.9 | 87.2 | 74.0 |
| 10. | KA 28 | 12 | 20 | 66.6 | 85.0 | 75.8 |
| 11. | KA 32 | 6 | 11 | 83.3 | 81.8 | 82.5 |
| 12. | MA 2 | 70 | 94 | 75.7 | 68.0 | 71.9 |
| 13. | MA 95-2 | 46 | 76 | 78.2 | 81.5 | 79.9 |
| 14. | MA 97 | 55 | 66 | 90.9 | 66.6 | 78.8 |
| 15. | MA 128-2 | 10 | 13 | 60.0 | 84.6 | 72.3 |
| 16. | MA 165 | 11 | 7 | 63.6 | 57.1 | 60.3 |
| 17. | MA 166 | 9 | 14 | 55.5 | 57.1 | 56.3 |
| 18. | MA 167 | 31 | 30 | 80.6 | 86.6 | 83.6 |
| 19. | PDA 1 | 8 | 5 | 75.0 | 80.0 | 77.5 |
| 20. | PDA 9 | 15 | 11 | 93.3 | 100.0 | 96.6 |
| 21. | PDA 10 | 44 | 57 | 100.0 | 91.2 | 95.6 |
| 22. | PDA 83-3 | 16 | 25 | 87.5 | 92.0 | 89.8 |
| 23. | PT 20 | 77 | 45 | 87.0 | 95.5 | 91.2 |
| 24. | T 7 | 22 | 32 | 72.7 | 81.2 | 77.0 |
| 25. | KA 73-1 | 10 | 12 | 20.0 | 25.0 | 22.5 |
| | ICP 2376 (wilt check) | 119 | 105 | 97.3 | 99.4 | 98.3 |

Table 28. Reaction of MPSMVRY entries to wilt in sick plot (BIL 2A) during 1985-86 at ICRISAT Center.

| S.No. | Entry | Total plants | | Percent wilt | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | ICPL 227 | 77 | 76 | 2.6 | 13.3 | 7.9 |
| 2. | ICPL 332 | 77 | 127 | 100.0 | 100.0 | 100.0 |
| 3. | ICPL 333 | 45 | 72 | 0.0 | 25.0 | 12.5 |
| 4. | ICPL 335 | 61 | 62 | 16.4 | 25.8 | 21.1 |
| 5. | ICPL 342 | 68 | 96 | 82.3 | 89.5 | 85.9 |
| 6. | ICPL 343 | 59 | 70 | 100.0 | 98.5 | 99.2 |
| 7. | ICPL 345 | 72 | 110 | 70.8 | 77.2 | 74.0 |
| 8. | ICPL 8356 | 49 | 96 | 14.3 | 5.2 | 9.8 |
| 9. | ICPL 8357 | 74 | 185 | 10.8 | 20.5 | 15.7 |
| 10. | ICPL 8358 | 61 | 101 | 1.6 | 8.9 | 5.2 |
| 11. | ICPL 8362 | 96 | 70 | 13.5 | 15.7 | 14.6 |
| 12. | ICPL 8363 | 77 | 86 | 2.6 | 12.7 | 7.7 |
| 13. | ICPL 84001 | 27 | 43 | 44.4 | 51.1 | 47.8 |
| 14. | ICPL 84002 | 90 | 76 | 27.7 | 19.7 | 23.7 |
| 15. | ICPL 84008 | 82 | 65 | 11.0 | 9.2 | 10.1 |
| 16. | ICPL 84011 | 78 | 75 | 15.4 | 16.0 | 15.7 |
| 17. | ICPL 84016 | 37 | 61 | 13.5 | 4.9 | 9.2 |
| 18. | ICPL 85061 | 63 | 60 | 12.7 | 15.0 | 13.[illegible] |
| 19. | ICPL 85062 | 58 | 84 | 12.1 | 20.2 | 16.1 |
| 20. | ICPL 85063 | 54 | 64 | 90.7 | 95.3 | 93.0 |
| 21. | ICPL 85064 | 40 | 96 | 67.5 | 26.0 | 46. |
| | ICP 2376 (wilt check) | 99 | 105 | 99.1 | 99.7 | 99. |

**Table 29.** Reaction of LPSHVRY entries to wilt in sick plot (BIL 2A) during 1985-86 at ICRISAT Center.

| S.No. | Entry | Total plants | | Percent wilt | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 22. | ICPL 84072 | 48 | 130 | 39.5 | 33.8 | 36.7 |
| 23. | ICP 8121 | 75 | 127 | 96.0 | 92.1 | 94.0 |
| 24. | ICPL 83143 | 68 | 115 | 60.2 | 69.5 | 64.9 |
| | ICP 2376 (wilt check) | 99 | 105 | 99.9 | 99.7 | 99.8 |

**Table 30.** List of early pigeonpea breeding materials screened for wilt resistance in sick plot (BIL 2B) at ICRISAT Center during 1985-86.

| S.No. | Material | Entries | Reps. |
|---|---|---|---|
| 1. | Multilocation trial entries | 108 | 2 |
| 2. | Retesting and purification of ICPL's | 19 | 2 |
| 3. | F2 bulks | 3 | - |
| 4. | F3 populations | 7 | - |
| 5. | Station trial entries | 292 | 1 |
| 6. | Vegetable type F3 bulks | 10 | 2 |
| 7. | EPVTT entries | 5 | 2 |
| | TOTAL | 444 | |

**Table 31.** List of medium pigeonpea breeding materials screened for wilt resistance in sick plots (BIL 2A) at ICRISAT Center during 1985-86.

| S.No. | Material | Entries |
|---|---|---|
| 1. | MPSHVRY entries | 9 |
| 2. | LRG 30 BC1F4 spp. | 17 |
| 3. | F4 sps (inheritance study) | 300 |
| 4. | F7 sps | 258 |
| 5. | F7 spp | 183 |
| 6. | F3, F4 and F6 bulks | 4 |
| 7. | Advanced lines from trials | 287 |
| 8. | LRG 30 M2 materials | 4080 |
| | TOTAL | 5138 |

Table 32. List of late pigeonpea breeding materials screened for wilt resistance in sick plot (BIL 2B) at ICRISAT Center during 1985-86.

| S.No. | Material | Entries |
|---|---|---|
| 1. | SPS from advanced lines (ICPL and ICP) | 43 |
| 2. | Advanced lines | 45 |
| 3. | F5 and F6 bulks | 2 |
| | TOTAL | 90 |

Table 33. List of male sterile, hybrid and high protein lines screened against wilt during 1985-86 (BIL 2A) at ICRISAT Center.

| S.No. | Material | Entries |
|---|---|---|
| 1. | MS 3783 BC2F4 | 23 |
| 2. | MS 3783 BC5 F1/BC5 F2 | 8 |
| 3. | MS 7086 BC5 F2 | 6 |
| 4. | WR MS 3A | 7 |
| 5. | WR MS 4A | 47 |
| 6. | MS BDN-1, C 11 sibs and MS BDN-1, selfed progenies | 102 |
| 7. | Wilt resistant hybrids | 30 |
| 8. | Yield test lines | 27 |
| 9. | High protein genetic stocks | 64 |
| | TOTAL | 314 |

Table 34. Performance of Mahyco Pigeonpea lines against wilt in vertisol sick plot (BIL 2B) during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | Total plants | Percent wilt |
|---|---|---|---|
| 1. | MPPL-1 | 5 | 40.0 |
| 2. | MPPL-2 | 4 | 75.0 |
| 3. | MPPL-3 | 13 | 69.2 |
| 4. | MPPL-4 | 14 | 92.9 |
| 5. | MPPL-5 | 9 | 22.2 |
| 6. | MPPL-6 | 2 | 100.0 |
| 7. | MPPL-7 | 17 | 47.1 |
| 8. | MPPL-8 | 138 | 30.8 |
| 9. | MPPL-9 | 9 | 77.8 |
| 10. | MPPL-10 | 7 | 28.6 |
| | ICP 2376 (wilt susc. check) | 306 | 91.0 |

Table 35. List of cooperators and locations of IIUTPVR 1985-86.

1. Dr. T.B. Anilkumar, (Bangalore), Annigeri
2. Dr. K.K. Zote, Badnapur
3. Dr. S.N. Pillai, Baroda
4. Dr. B. Misra, Dholi
5. Dr. V.B. Bidari, Gulbarga
6. Dr. K.S. Amin, DPR, Kanpur
7. Dr. Mahendra Pal, IARI, New Delhi
8. Dr. G. Arjunan, Pudukottai
9. Dr. D.K. Jha, Ranchi
10. Mr. N.J. Bindre, Rahuri
11. Dr. S.C. Agarwal, Sehore
12. Dr. M.V. Reddy and Dr. Y.L. Nene, ICRISAT, Patancheru

Table 36. ICAR-ICRISAT Uniform Trial for Pigeonpea Wilt Resistance (IUTPWR 1985-86).

| Cultivar | Percent wilt | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Badnapur | Baroda | IARI New Delhi | Gulbarga | Sehore | Ranchi | ICRISAT | Pudukottai | No. locations with <20 % wilt |
| ICP 3461 | 23 | 21 | 17 | 15 | 14 | 56 | 4 | 0 | 5 |
| ICP 3465 | 28 | 27 | 20 | 34 | 0 | 35 | 18 | 0 | 4 |
| ICP 8858 | 11 | 20 | 33 | 13 | 8 | 7 | 3 | 6 | 7 |
| ICP 8859 | 24 | 1 | 83 | 37 | 40 | 25 | 14 | 0 | 3 |
| ICP 8861 | 11 | 42 | 70 | 21 | 5 | 34 | 33 | 0 | 3 |
| ICP 8862 | 9 | 50 | 68 | 49 | 4 | 0 | 79 | 0 | 4 |
| ICP 8863 | 8 | 30 | 8 | 6 | 0 | 0 | 15 | 0 | 7 |
| ICP 8864 | 49 | 2 | 46 | 25 | 1 | 18 | 10 | 2 | 5 |
| ICP 9174 | 9 | 14 | 18 | 10 | 3 | 14 | 2 | 7 | 8 |
| ICP 11295 | 17 | 1 | 63 | 16 | 7 | 48 | 62 | 1 | 5 |
| ICP 11297 | 14 | 25 | 36 | 18 | 0 | 18 | 48 | 3 | 5 |
| ICP 12725 | 47 | 18 | 43 | 28 | 6 | 48 | 8 | 0 | 4 |
| ICP 12726 | 23 | 28 | 64 | 33 | 23 | 25 | 2 | 9 | 2 |
| ICP 12727 | 73 | 17 | 52 | 56 | 25 | 78 | 6 | 7 | 3 |
| ICP 12729 | 44 | 32 | 23 | 50 | 8 | 38 | 16 | 0 | 3 |
| ICP 12731 | 10 | 14 | 63 | 8 | 17 | 53 | 6 | 0 | 6 |
| ICP 12745 | 8 | 0 | 18 | 24 | 19 | 15 | 2 | 0 | 7 |
| ICP 12748 | 20 | 35 | 22 | 10 | 4 | 9 | 2 | 2 | 6 |
| ICP 12752 | 13 | 29 | 79 | 19 | 9 | 10 | 7 | 3 | 6 |
| ICP 12758 | 22 | 26 | 60 | 27 | 17 | 23 | 3 | 4 | 4 |
| ICP 12759 | 14 | 4 | 20 | 27 | 8 | 10 | 1 | 2 | 6 |
| ICPL 84002 | 33 | 24 | 51 | 33 | 11 | 27 | 10 | 12 | 3 |
| ICPL 84003 | 14 | 20 | 63 | 24 | 19 | 20 | 6 | 13 | 6 |
| ICPL 84004 | 41 | 29 | 17 | 26 | 14 | 10 | 20 | 11 | 5 |
| ICPL 84007 | 28 | 17 | 27 | 15 | 10 | 15 | 12 | 2 | 6 |
| ICPL 84008 | 6 | 42 | 19 | 15 | 1 | 17 | 7 | 10 | 7 |
| ICPL 84010 | 74 | 16 | 90 | 43 | 50 | 10 | 36 | 12 | 3 |
| ICPL 84011 | 21 | 19 | 78 | 21 | 10 | 15 | 5 | 8 | 5 |
| ICPL 84013 | 11 | 19 | 29 | 18 | 9 | 19 | 2 | 9 | 7 |
| ICPL 84015 | 28 | 40 | 88 | 10 | 7 | 35 | 4 | 7 | 4 |
| ICPL 84017 | 6 | 29 | 23 | 20 | 4 | 22 | 5 | 6 | 5 |
| BWR 217 | 16 | 48 | 72 | 66 | 21 | 3 | 41 | 8 | 3 |
| BWR 369 | 12 | 45 | 44 | 18 | 11 | 31 | 27 | 2 | 5 |
| BWR 370 | 8 | 48 | 24 | 13 | 7 | 9 | 6 | 2 | 6 |
| BWR 245 | 28 | 33 | 19 | 7 | 1 | 24 | 10 | 0 | 5 |
| BWR 67 | 38 | 23 | 18 | 29 | 8 | 18 | 37 | 8 | 4 |
| AWR 74 15 | 14 | 37 | 24 | 11 | 26 | 14 | 0 | 0 | 5 |
| Banda Palera | 27 | 1 | 6 | 32 | 0 | 0 | 2 | 0 | 6 |
| ICPL 8362 | 14 | 37 | 85 | 25 | 34 | 18 | 8 | 12 | 4 |
| ICPL 8357 | 15 | 10 | 71 | 20 | 24 | 41 | 58 | 7 | 4 |
| ICPL 335 | 14 | 37 | 52 | 47 | 7 | 9 | 5 | 2 | 6 |
| ICPL 8324 | 17 | 26 | 43 | 42 | 8 | 19 | 36 | 0 | 6 |
| ICPL 8332 | 92 | 24 | 33 | 93 | 0 | 50 | 48 | 4 | 2 |
| ICPL 95 | 65 | 34 | 46 | 50 | 36 | 42 | 8 | 3 | 2 |
| ICP 2376 | 100 | 48 | 91 | 85 | 91 | 66 | 95 | 52 | |
| (Range) | | (12-87 | (55-100) | (64-95 | (73-100) | (26-98) | (84-100) | (20-81) | |

Kanpur - Data received but not included as stand was poor due to Phytophthora blight
Results from Anniqeri, Dholi and Rahuri were not received.

**b) International Pigeonpea Wilt Nursery (IPWN) 1985-86**

This nursery is conducted in India, Kenya, and Malawi. The cooperators and locations are given in table 37. the reaction of the entries at ICRISAT and Malawi is given in table 38. Many lines showed higher wilt incidence in Malawi than at ICRISAT. The lines ICP 12733, ICP 12738, ICP 12741, ICP 12750, ICP 12753 and ICP 12755 showed less than 10% wilt at both the locations.

**B. STERILITY MOSAIC**

As in case of wilt, screening for SM resistance was very effective. In SM screening nursery very high natural incidence of wilt also developed enabling evaluation of all the materials both for SM and wilt resistance.

**1. Germplasm**

Two hundred and thirty eight new germplasm accessions from GRU mostly originating from Kenya were screened for SM resistance. Of these thrity seven lines were free from SM infection. These were ICP 12768, 12782, 12807, 12808, 12819, 12885, 12898, 12904, 12923, 12928, 12936, 12942, 12971, 12972, 12973, 13004, 13027, 13030, 13031, 13035, 13046, 13051, 13069, 13070, 13071, 13072, 13073, 13076, 13087, 13108, 13129, 13142, 13152, 13153, 13164, 13166, and 13169.

Several other lines showed less than 10% SM infection. It is interesting to see such high frequency of resistance from the germplasm originating from kenya where SM incidence is not reported. Most of these lines were very late, tall and less branching types with large, thick, and dark green leaves. It will be interesting to study whether the thick leaves have any association with SM resistance.

Seventeen of the 37 lines which showed 0.0 percent SM had less than 20.0 percent wilt. These were ICP 12807, 12808, 12973, 13046, 13051, 13069, 13070, 13071, 13073, 13076, 13087, 13108, 13142, 13152, 13153, 13164 and 13166.

Most of the exotic germplasm lines showed high susceptibility to bacterial leaf spot and stem canker while indigenous lines such as BDN-1 showed high level of tolerance. Compared to green stem types, purple stem types were more tolerant.

**2. Germplasm selections**

Thirty eight single plant selections made from twentyone germplasm lines during 1983-84 season were retested. The data presented in table 39 show that 15 accessions had no SM. The seed of these lines has been stored in the cold room and is available for cooperators.

### 3. ACT materials

The reactions of EXACT, EACT, ACT-1, ACT-2, ACT-3, MPSMVRY, and LPSMVRY entries to SM are given in tables 40,41,42,43,44,45 and 46. In addition to ICPL's, some other lines in ACT 3 showed resistance to SM. These were Bahar, DA 15, ICPL 146, ICPL 366, KA 1, KA 32, MA 97, MA 166, MA 167, PDA 10 and KA 73 1.

### 4. ACT selections

The seed of resistant plants selected from 1983 ACT entries were retested. The data presented in table 47 show that most of these are resistant to SM However, most of them showed susceptiblity to wilt except ICPL 311.

### 5. Breeding material

The list of early, medium, late and other breeding materials screened for SM resistance is given in table 48. The detailed data has been provided to the breeders.

### 6. MAHYCO lines

Ten lines received from MAHYCO were tested for their reaction to sterility mosaic (table 49) MPPL-8 and 10 showed promise against SM.

### 7. Heliothis tolerant lines

Thirty two lines that showed promise against Heliothis and SM in the previous seasons were retested. Most of these lines were promising against SM. Few lines; PI 396986, ICP 4769, ICP 6831, ICP 7198, also showed promise against wilt (Table 50).

### 8. Pot screening of early ICPL's

Three hundred and ten SPP of ICPL 151, and 100 SPP of each of ICPL 155 and ICPL 146 were screened against SM in pots. BDN-1 and ICP 7867 were used as susceptible and resistant checks, respectively. Each SPP was planted in one 20 cm diameter earthen pot (10 plants). The susceptible check BDN1 showed 100.0 percent SM while ICP 7867 remained free.

In case of ICPL 151, all the 310 SPP showed 100.0 percent infection. But in some SPP there were a few plants with mild mosaic or ring spot symptoms. Selfed seed of these plants was handed over to the breeders. In ICPL 146, all the 100 SPP showed uniformly ring spot symptoms. In ICPL 155, while most of the progenies showed 100.0 percent susceptibility, 8 progenies showed 0.0 to 11.0 percent infection. These were ICPL 155-26, -27, -29, -74, -75, -76, [illegible] and 78. ICPL 155-97 showed uniformly mild mosaic symptoms.

Table 37. List of cooperators and locations of IPWN 1985-86.

1. Dr. V.W. Saka
   Bunda College of Agriculture
   University of Malawi
   P.O. Box 219
   Lilongwe
   Malawi

2. Dr. Andrew T. Daudi
   Plant Nematologist
   Bvumbwe Agricultural Research Station
   P.O. Box 5748
   Limbe
   Malawi

3. Dr. Abdul Sakoor
   Plant Breeder
   Katumani Dryland Farming Research
   and Development Project
   P.O. Box 340
   Machakos
   Kenya

4. Dr. M.V. Reddy, and Dr. Y.L. Nene, ICRISAT, Patancheru, India

Table 38. Reaction of IPWN 1985-86 entries to wilt at ICRISAT, Hyderabad and Bvumbve, Malavi during 1985-86.

| Cultivar | Percent wilt | |
|---|---|---|
| | ICRISAT | Malavi |
| ICP 3461 | 0.0 | 65.5 |
| ICP 3465 | 4.6 | 52.3 |
| ICP 6997 | 88.2 | 100.0 |
| ICP 8858 | 4.3 | 54.8 |
| ICP 8859 | 8.7 | 57.1 |
| ICP 8861 | 4.3 | 73.9 |
| ICP 8862 | 88.1 | 100.0 |
| ICP 8863 | 3.1 | 35.6 |
| ICP 8864 | 10.5 | 95.0 |
| ICP 9174 | 1.[illegible] | 55.0 |
| ICP 10958 | 14.4 | 73.3 |
| ICP 11294 | 10.2 | 100.0 |
| ICP 11295 | 4.[illegible] | 16.7 |
| ICP 11297 | 50.0 | 58.3 |
| ICP 12725 | 11.1 | 73.3 |
| ICP 12726 | 1.4 | 41.7 |
| ICP 12727 | 2.1 | 37.3 |
| ICP 12729 | 4.[illegible] | 59.5 |
| ICP 12730 | 15.8 | 27.5 |
| ICP 12731 | 68.8 | 16.7 |
| ICP 12733 | 4.3 | 9.1 |
| ICP 12738 | 3.6 | 4.8 |
| ICP 12741 | 3.3 | 2.4 |
| ICP 12744 | 2.5 | 47.6 |
| ICP 12745 | 1.0 | 32.1 |
| ICP 12746 | 56.8 | 100.0 |
| ICP 12748 | 3.4 | 8.9 |
| ICP 12750 | 17.1 | 25.5 |
| ICP 12752 | 2.2 | 100.0 |
| ICP 12753 | 2.2 | 6.3 |
| ICP 12755 | 3.0 | 15.3 |
| ICP 12758 | 2.1 | 16.8 |
| ICP 12759 | 0.0 | 65.9 |
| ICPL 8343 | 54.0 | 97.1 |
| ICP 2376 | 84.3 | 100.0 |
| (wilt susc. check) | (69.9-98.1) | |

Table 39. Reaction of 1983-84 sterility mosaic promising germplasm selections to sterility mosaic and wilt during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | Total plants | % SM | % Wilt |
|---|---|---|---|---|
| 1. | ICP-6005 1 1 S1@ | 1 | 0.0 | 0.0 |
| 2. | ICP-6005-1-1 S2@ | 2 | 0.0 | 0.0 |
| 3. | ICP-6005 3 1 S1@ | 37 | 5.4 | 91.8 |
| 4. | ICP-6005 3 1 S2@ | 6 | 0.0 | 100.0 |
| 5. | ICP-6006 1-S1@ | 37 | 67.5 | 94.5 |
| 6. | ICP-6006 1-S2@ | 51 | 41.7 | 70.5 |
| 7. | ICP-6008-1-S1@ | 1 | 100.0 | - |
| 8. | ICP-6008 1 S2@ | 1 | 0.0 | 0.0 |
| 9. | ICP-6013 1 S1@ | 17 | 0.0 | 29.4 |
| 10. | ICP-6013 1-S2@ | 19 | 5.6 | 26.3 |
| 11. | ICP-6017 1 S1@ | 14 | 0.0 | 7.1 |
| 12. | ICP-6017 1-S2@ | 5 | 0.0 | 0.0 |
| 13. | ICP-6018 1 S1@ | 25 | 0.0 | 72.0 |
| 14. | ICP-6018-1-S2@ | 5 | 0.0 | 80.0 |
| 15. | ICP-6036-1 S1@ | 20 | 5.0 | 85.0 |
| 16. | ICP-6036-1 S2@ | 13 | 38.5 | 46.1 |
| 17. | PR 6037 1 1 S1@ | | | - |
| 18. | PR 6061 1 1 S1@ | 4 | 0.0 | 0.0 |
| 19. | PR 1680-1-S1@ | 50 | 2.0 | 84.0 |
| 20. | PR 1680-1-S2@ | 16 | 0.0 | 50.0 |
| 21. | PR 6119-1 S1@ | 69 | 0.0 | 30.4 |
| 22. | PR 6119-1-S2@ | 39 | 56.1 | 69.2 |
| 23. | PR 6120-1-S1@ | 43 | 0.0 | 88.3 |
| 24. | PR 6120-1 S2@ | 31 | 9.7 | 96.7 |
| 25. | PR 6121-1-S1@ | 59 | 1.7 | 38.9 |
| 26. | PR 6121-1-S2@ | 54 | 9.3 | 48.1 |
| 27. | PR 6140-1-1-S1@ | 7 | 0.0 | 14.2 |
| 28. | PR 5354-B-1-S1@ | 43 | 7.0 | 30.2 |
| 29. | PR 5354-B-1-S2@ | 52 | 0.0 | 34.6 |
| 30. | PR 5364-1-S1@ | 21 | 19.0 | 71.3 |
| 31. | PR 5370-1-S1@ | 25 | 0.0 | 56.0 |
| 32. | PR 5370-1-S2@ | 38 | 0.0 | 23.6 |
| 33. | PR 5322-2-1-S1@ | 5 | 0.0 | 40.0 |
| 34. | PR 5509-1-S1@ | 51 | 0.0 | 74.5 |
| 35. | PR 5509-1-S2@ | 15 | 0.0 | 40.0 |
| 36. | PR 5564-1-S1@ | 38 | 2.6 | 31.5 |
| 37. | PR 6567-1-S1@ | 31 | 16.1 | 61.2 |
| 38. | PR 6567-1-S2@ | 3 | 0.0 | 100.0 |
| 39. | MEN-1 (SM susc. check) | 40 | 100.0 | 100.0 |

In the SM nursery high incidence of wilt was observed and reaction of the lines to both diseases was studied.

**Table 40. Reaction of EXACT entries to SM at ICRISAT Center during 1985-86.**

| S.No. | Entry | Total plants | | Percent SM | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AL 1 | 48 | 37 | 100.0 | 100.0 | 100.0 |
| 2. | AL 15 | 47 | 72 | 100.0 | 97.2 | 98.6 |
| 3. | AL 101 | 89 | 70 | 98.8 | 98.5 | 98.6 |
| 4. | DL 78-1 | 53 | 46 | 100.0 | 100.0 | 100.0 |
| 5. | ICPL 317 | 69 | 14 | 98.5 | 100.0 | 99.2 |
| 6. | ICPL 8306 | 42 | 74 | 100.0 | 98.6 | 99.3 |
| 7. | Hy 10 | 13 | 2 | 100.0 | 100.0 | 100.0 |
| 8. | H 76-11 | 65 | 77 | 100.0 | 100.0 | 100.0 |
| 9. | H 76-44 | 122 | 74 | 100.0 | 100.0 | 100.0 |
| 10. | H 76-51 | 77 | 60 | 100.0 | 100.0 | 100.0 |
| 11. | H 76-65 | 97 | 72 | 100.0 | 100.0 | 100.0 |
| 12. | H 81-1 | 47 | 106 | 97.8 | 100.0 | 98.9 |
| 13. | H 82-1 | 78 | 79 | 100.0 | 100.0 | 100.0 |
| 14. | H 82-12 | 93 | 124 | 100.0 | 100.0 | 100.0 |
| 15. | Pusa 85 | 68 | 84 | 95.5 | 92.8 | 94.1 |
| 16. | Pusa 851 | 90 | 80 | 100.0 | 100.0 | 100.0 |
| 17 | TAT 10 | 45 | 77 | 97.7 | 100.0 | 98.9 |
| 18. | TAT 11 | 21 | 20 | 100.0 | 100.0 | 100.0 |
| | BDN 1 (SM check) | 79 | 67 | 95.1 | 97.0 | 96.0 |

Table 41. Reaction of EACT entries to SM at ICRISAT Center during 1985-86.

| S.No. | Entry | Total plants | | Percent disease | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AL 13 | 77 | 57 | 100.0 | 100.0 | 100.0 |
| 2. | AL 56 | 74 | 96 | 97.2 | 97.9 | 97.5 |
| 3. | AL 57 | 107 | 98 | 100.0 | 100.0 | 100.0 |
| 4. | BSMR 294 | 23 | 22 | 0.0 | 0.0 | 0.0 |
| 5. | GAUT 82-53 | 24 | 70 | 100.0 | 100.0 | 100.0 |
| 6. | GAUT 82-55 | 59 | 59 | 100.0 | 100.0 | 100.0 |
| 7. | H 76-24 | 86 | 56 | 95.3 | 86.1 | 90.7 |
| 8. | H 80-110 | 126 | 85 | 94.4 | 100.0 | 97.2 |
| 9. | H 82-26 | 102 | 91 | 100.0 | 98.9 | 99.4 |
| 10. | Hy 11 | 12 | 8 | 66.6 | 100.0 | 83.3 |
| 11. | ICPL 151 | 43 | 31 | 83.7 | 100.0 | 91.9 |
| 12. | ICPL 269 | 63 | 45 | 19.0 | 28.8 | 23.9 |
| 13. | ICPL 317 | 63 | 49 | 100.0 | 100.0 | 100.0 |
| 14. | ICPL 8327 | 77 | 80 | 62.3 | 65.0 | 63.6 |
| 15. | MTH 6 | 46 | 87 | 84.7 | 89.6 | 87.1 |
| 16. | MTH 10 | 62 | 30 | 100.0 | 100.0 | 100.0 |
| 17. | Pant A 1-1 | 54 | 51 | 92.5 | 94.1 | 93.3 |
| 18. | Pant A 10 | 43 | 29 | 88.3 | 100.0 | 94.1 |
| 19. | Pusa Sweta 2 | 37 | 54 | 100 0 | 96.2 | 98.1 |
| | BDN 1 (SM check) | 44 | 56 | 100.0 | 100.0 | 100.0 |

Table 42. Reaction of ACT I entries to SM at ICRISAT Center during 1985-86.

| S.No. | Entry | Total plants | | Percent disease | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | CORG 5 | 65 | 93 | 95.3 | 93.5 | 94.4 |
| 2. | DA 8 | 63 | 62 | 85.7 | 69.3 | 77.5 |
| 3. | ICPL 176 | 56 | 46 | 0.0 | 0.0 | 0.0 |
| 4. | ICPL 186 | 47 | 84 | 87.2 | 95.2 | 91.2 |
| 5. | ICPL 288 | 57 | 64 | 0.0 | 0.0 | 0.0 |
| 6. | ICPL 8308 | 38 | 42 | 0.0 | 4.7 | 2.3 |
| 7. | ICPL 8324 | 19 | 21 | 0.0 | 9.5 | 4.8 |
| 8. | ICPL 84074 | 20 | 15 | 0.0 | 0.0 | 0.0 |
| 9. | ICPL 84077 | 86 | 53 | 2.3 | 0.0 | 1.1 |
| 10. | Pusa 85 | 24 | 39 | 87.5 | 87.1 | 87.3 |
| 11. | Pant 102 | 45 | 87 | 93.3 | 86.2 | 89.8 |
| 12. | Pant 103 | 75 | 101 | 94.6 | 97.0 | 95.8 |
| 13. | Pant 104 | 89 | 75 | 91.0 | 90.6 | 90.8 |
| 14. | PT 14 | 37 | 92 | 59.4 | 83.6 | 71.5 |
| 15. | PT 20 | 52 | 54 | 80.7 | 48.1 | 64.4 |
| 16. | TT 5 | 89 | 103 | 97.7 | 95.1 | 96.4 |
| 17. | TT 6 | 58 | 85 | 86.2 | 94.0 | 90.1 |
| | BDN 1 | 14 | 30 | 92.8 | 90.0 | 91.4 |

Table 43. Reaction of ACT 2 entries to SM at ICRISAT Center during 1985-86.

| S.No. | Entry | Total plants | | Percent disease | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AGS 498 | 52 | 62 | 100.0 | 100.0 | 100.0 |
| 2. | AKT 1 | 72 | 59 | 100.0 | 100.0 | 100.0 |
| 3. | AKT 6 | 84 | 128 | 100.0 | 100.0 | 100.0 |
| 4. | C 11 | 42 | 41 | 100.0 | 100.0 | 100.0 |
| 5. | G 78-3 | 84 | 93 | 100.0 | 100.0 | 100.0 |
| 6. | MA 162 | 30 | 38 | 86.6 | 71.0 | 78.8 |
| 7. | MTH 8 | 72 | 87 | 100.0 | 100.0 | 100.0 |
| 8. | MTH 9 | 66 | 102 | 100.0 | 100.0 | 100.0 |
| 9. | MTH 11 | 108 | 78 | 100.0 | 100.0 | 100.0 |
| 10. | MRG 66 | 102 | 122 | 100.0 | 100.0 | 100.0 |
| 11. | PT 17 | 63 | 114 | 92.6 | 92.9 | 92.8 |
| 12. | PT 18 | 73 | 50 | 100.0 | 98.0 | 99.0 |
| 13. | No. 148 | 73 | 53 | 100.0 | 100.0 | 100.0 |
| | BDN-1 (SM check) | 54 | 53 | 100.0 | 100.0 | 100.0 |

Table 44 Reaction of ACT 3 entries to SM at ICRISAT Center during 1985-86.

| S.No. | Entry | Total plants | | Percent disease | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | AGS 522 | 49 | 66 | 100.0 | 98.4 | 99.2 |
| 2. | Bahar | 39 | 54 | 0.0 | 0.0 | 0.0 |
| 3. | DA 15 | 20 | 32 | 0.0 | 3.1 | 1.5 |
| 4. | ICPL 146 | 63 | 104 | 1.5 | 0.9 | 1.2 |
| 5. | ICPL 161 | 47 | 94 | 87.2 | 91.4 | 89.3 |
| 6. | ICPL 360 | 61 | 72 | 100.0 | 97.2 | 98.6 |
| 7. | ICPL 366 | 71 | 83 | 2.8 | 3.6 | 3.2 |
| 8. | KA 1 | 12 | 11 | 8.3 | 9.0 | 8.7 |
| 9. | KA 25-1 | 36 | 29 | 88.8 | 86.2 | 87.5 |
| 10. | KA 28 | 30 | 52 | 93.3 | 96.1 | 94.7 |
| 11. | KA 32 | 12 | 18 | 0.0 | 5.5 | 2.7 |
| 12. | MA 2 | 58 | 61 | 55.1 | 53.6 | 54.6 |
| 13. | MA 95-2 | 55 | 60 | 29.0 | 25.0 | 27.0 |
| 14. | MA 97 | 18 | 21 | 5.5 | 9.5 | 7.5 |
| 15. | MA 128-2 | 24 | 48 | 20.8 | 10.4 | 15.6 |
| 16. | MA 165 | 35 | 33 | 60.0 | 42.4 | 51.2 |
| 17. | MA 166 | 26 | 14 | 3.8 | 0.0 | 1.9 |
| 18. | MA 167 | 78 | 64 | 6.4 | 7.8 | 7.1 |
| 19. | PDA 1 | 13 | 17 | 46.1 | 11.7 | 28.9 |
| 20. | PDA 9 | 45 | 37 | 31.1 | 54.0 | 42.5 |
| 21. | PDA 10 | 34 | 37 | 2.9 | 2.7 | 2.8 |
| 22. | PDA 83-3 | 25 | 22 | 88.0 | 72.7 | 80.3 |
| 23. | PT 20 | 71 | 64 | 28.9 | 73.4 | 51.1 |
| 24. | T 7 | 36 | 35 | 72.2 | 65.7 | 69.0 |
| 25. | KA 73-1 | 16 | 20 | 0.0 | 15.0 | 7.5 |
| | BDN 1 (SM check) | | | 92.8 | 90.0 | 91.4 |

**Table 45. Reaction of MPSHVRY entries to SH at ICRISAT Center during 1985-86.**

| S.No. | Entry | Total plants | | Percent disease | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | ICPL 227 | 63 | 76 | 0.0 | 6.5 | 3.2 |
| 2. | ICPL 332 | 103 | 108 | 100.0 | 100.0 | 100. |
| 3. | ICPL 333 | 73 | 70 | 100.0 | 100.0 | 100. |
| 4. | ICPL 335 | 35 | 66 | 0.0 | 0.0 | 0. |
| 5. | ICPL 342 | 68 | 86 | 0.0 | 0.0 | 0. |
| 6. | ICPL 343 | 86 | 102 | 0.0 | 0.0 | 0. |
| 7. | ICPL 345 | 111 | 94 | 0.0 | 0.0 | 0. |
| 8. | ICPL 8356 | 58 | 83 | 100.0 | 100.0 | 100. |
| 9. | ICPL 8357 | 107 | 112 | 100.0 | 100.0 | 100. |
| 10. | ICPL 8358 | 89 | 39 | 100.0 | 100.0 | 100. |
| 11. | ICPL 8362 | 79 | 82 | 0.0 | 0.0 | 0. |
| 12. | ICPL 8363 | 87 | 69 | 2.2 | 1.4 | 1. |
| 13. | ICPL 84001 | 62 | 80 | 100.0 | 100.0 | 100. |
| 14. | ICPL 84002 | 73 | 78 | 98.6 | 96.1 | 97. |
| 15. | ICPL 84008 | 44 | 98 | 100.0 | 98.9 | 99. |
| 16. | ICPL 84011 | 66 | 61 | 7.6 | 29.5 | 18. |
| 17. | ICPL 84016 | 93 | 91 | 100.0 | 100.0 | 100. |
| 18. | ICPL 85061 | 133 | 52 | 100.0 | 100.0 | 100. |
| 19. | ICPL 85062 | 73 | 92 | 100.0 | 100.0 | 100. |
| 20. | ICPL 85063 | 94 | 99 | 1.0 | 0.0 | 0. |
| 21. | ICPL 85064 | 79 | 60 | 1.2 | 0.0 | 0.6 |
| | BDN-1 (SH check) | 84 | 70 | 98.8 | 97.1 | 98. |

Table 46. Reaction of LPSMVRventries to SM at ICRISAT Center during 1985-86.

| S.No. | Entry | Total plants | | Percent disease | | Mean |
|---|---|---|---|---|---|---|
| | | R I | R II | R I | R II | |
| 1. | ICPL 84072 | 75 | - | 13.3 | - | 13.3 |
| 2. | ICP 8121 | 72 | 106 | 5.5 | 0.0 | 2.7 |
| 3. | ICPL 83143 | 108 | 88 | 43.5 | 36.3 | 39.9 |
| | BDN 1 (SM check) | 84 | 70 | 98.8 | 97.1 | 98.0 |

Table 47. Reaction of ACT-83 selections to sterility mosaic and wilt (BIL 7B) during 1985-86 at ICRISAT Center.

| S. No. | Pedigree | R I | | | R II | | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total plants | % SM | % wilt | Total plants | % SM | % wilt | % SM | % wilt |
| 1. | MA-97(BHU)-1-SB0-S0 | 38 | 0.0 | 86.8 | 30 | 0.0 | 46.6 | 0.0 | 66.7 |
| 2. | PDA-2-S10 | 42 | 0.0 | 97.6 | 27 | 0.0 | 55.5 | 0.0 | 76.5 |
| 3. | PDA-7-S10 | 37 | 2.7 | 43.2 | 20 | 0.0 | 85.0 | 1.3 | 64.1 |
| 4. | MA-2-S10 | 47 | 0.0 | 51.0 | 36 | 5.5 | 72.2 | 2.7 | 61.6 |
| 5. | MA-97 | 30 | 0.0 | 93.3 | 24 | 0.0 | 87.5 | 0.0 | 90.4 |
| 6. | DA-15 | 45 | 0.0 | 15.5 | 44 | 0.0 | 47.7 | 0.0 | 31.6 |
| 7. | ICPL-311 | 38 | 0.0 | 2.6 | 39 | 0.0 | 10.2 | 0.0 | 6.4 |
| 8. | PDA-3 | 32 | 0.0 | 96.8 | 28 | 0.0 | 75.0 | 0.0 | 85.9 |
| 9. | DA-13 | 33 | 0.0 | 100.0 | 31 | 0.0 | 90.3 | 0.0 | 95.1 |
| 10. | ICPL-358 | 36 | 0.0 | 66.6 | 27 | 0.0 | 48.1 | 0.0 | 57.3 |
| 11. | MA-95-2-S10 | 35 | 5.7 | 97.1 | 29 | 3.4 | 100.0 | 4.5 | 98.5 |
| 12. | BDN-1 | 75 | 72.0 | 58.6 | 35 | 91.4 | 22.8 | 81.7 | 40.7 |
| 13. | T-21 | 63 | 84.1 | 74.6 | 53 | 90.5 | 60.3 | 87.3 | 67.4 |
| 14. | GW-3 | 134 | 92.5 | 69.4 | 118 | 83.0 | 61.0 | 87.7 | 65.2 |
| 15. | ICP-10976 (Res. check) | 49 | 0.0 | 32.6 | 40 | 0.0 | 35.0 | 0.0 | 33.8 |
| 16. | ICP-7867 (Res. check) | 32 | 0.0 | 21.8 | 62 | 0.0 | 16.1 | 0.0 | 18.9 |
| 17. | BDN-1 (SM susc. check) | 154 | 100.0 | - | 155 | 96.1 | - | 98.0 | - |

Table 48. List of pigeonpea breeding materials screened for SM resistance during 1985-86 at ICRISAT Center.

| Maturity | Materials | No. of entries | Reps. |
|---|---|---|---|
| Early | Multilocation trial entries | 108 | 2 |
| | Retesting and purification of ICPL's | 127 | 2 |
| | Station trial entries | 292 | 1 |
| | F4 and F5 bulks | 3 | 1 |
| | Vegetable F3 bulks | 10 | 1 |
| | EPWYT entries | 5 | 1 |
| | TOTAL | 545 | |
| Medium | BDN 1 BC3F4 and C 11 BC3F4 SPS (resistant) | 138 | 1 |
| | BDN 1 BC3F4 and C 11 BC3F4 SPS (susceptible) | 122 | 1 |
| | C 11 and BDN 1 backcross bulks | 2 | 1 |
| | MPSMWRY entries | 5 | 1 |
| | F7 bulks | 9 | 1 |
| | F3 bulks (from Test No.86, 84k) | 11 | 1 |
| | F3 bulks | 33 | 1 |
| | Advanced lines from trials | 287 | 1 |
| | Advanced lines test for multiplication | 33 | 1 |
| | TOTAL | 640 | |
| Late | F2 bulks | 1 | 1 |
| | Advanced lines | 34 | 1 |
| | TOTAL | 35 | 1 |
| Male sterile, hybrids and high protein lines | MS 3783, 7086, and 7035 lines | 13 | 1 |
| | MSBDN 1 and C 11 progenies | 200 | 1 |
| | MS 4A lines | 42 | 1 |
| | SM resistant hybrids | 18 | 1 |
| | Yield test lines | 27 | 1 |
| | HPL genetic stocks | 65 | 1 |
| | TOTAL | 365 | |

Table 49. Reaction of MAHYCO lines to sterility mosaic at ICRISAT Center during 1985 86.

| Pedigree | Total plants | SH plants | Percent SH |
|---|---|---|---|
| MPPL 1 | 24 | 24 | 100.0 |
| 2 | 6 | 6 | 100.0 |
| 3 | 10 | 10 | 100.0 |
| 4 | 16 | All plants wilted | |
| 5 | 19 | 19 | 100.0 |
| 6 | 13 | 3 | 23.0 |
| 7 | 19 | 19 | 100.0 |
| 8 | 17 | 0 | 0.0 |
| 9 | 19 | All plants wilted | |
| 10 | 21 | 1 | 4.7 |

Table 58. Reaction of pigeonpea SM predising entomology selections to SM and wilt during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | R I | | | R II | | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total plants | % SM | % wilt | Total plants | % SM | % wilt | % SM | % wilt |
| 1. | ICP-8583-E1-2-EB-1-1-1-SBe-SBe | 45 | 4.4 | 55.5 | 42 | 0.0 | 69.0 | 2.2 | 62.2 |
| 2. | ICP-7176-5-E1-1-1-1-SBe-SBe | 46 | 0.0 | 21.7 | 39 | 2.5 | 43.5 | 1.2 | 32.6 |
| 3. | ICP-3615-E1-3EB-1-1-1-SBe-SBe | 23 | 8.6 | 39.1 | 22 | 18.1 | 22.7 | 13.3 | 30.9 |
| 4. | PPE-45-E2-3EB-1-1-1-SBe-SBe | 15 | 0.0 | 93.3 | 4 | 0.0 | 62.5 | 0.0 | 77.9 |
| 5. | ICP-8130-E1-2EB-1-1-1-SBe-SBe | 43 | 18.6 | 44.1 | 51 | 0.0 | 80.3 | 9.3 | 62.2 |
| 6. | ICP-8595-E1-2EB-1-1-1-SBe-SBe | 32 | 0.0 | 93.7 | 35 | 0.0 | 88.5 | 0.0 | 91.1 |
| 7. | ICP-8689-E1-2EB-1-1-1-SBe-SBe | 51 | 1.9 | 64.7 | 36 | 0.0 | 100.0 | 0.9 | 82.3 |
| 8. | ICP-8325-E1-3EB-1-1-SBe-SBe | 50 | 0.0 | 88.1 | 36 | 0.0 | 97.2 | 0.0 | 92.6 |
| 9. | PI-394440-EB-2EB-1-1-SBe-SBe | 28 | 3.5 | 50.0 | 63 | 4.6 | 25.5 | 4.0 | 37.7 |
| 10. | PI-396588-EB-2EB-1-1-SBe-SBe | 43 | 0.0 | 86.0 | 47 | 0.0 | 76.5 | 0.0 | 81.2 |
| 11. | ICP-8135-1-1-2-1-SBe-SBe | 43 | 2.3 | 60.4 | 49 | 4.0 | 48.9 | 3.1 | 54.6 |
| 12. | ICP-8301-1-2-2-1-SBe-SBe | 47 | 0.0 | 53.1 | 51 | 0.0 | 84.3 | 0.0 | 68.7 |
| 13. | ICP-8128-2-3-2-2-1-SBe-SBe | 43 | 0.0 | 86.0 | 38 | 0.0 | 86.8 | 0.0 | 86.4 |
| 14. | ICP-8860-5-1-SBe-SBe | 48 | 2.0 | 14.5 | 47 | 0.0 | 34.0 | 1.0 | 24.2 |
| 15. | PI-397731-2-1-SBe-SBe | 23 | 0.0 | 26.0 | 42 | 0.0 | 47.6 | 0.0 | 36.8 |
| 16. | PI-397731-3-1-SBe-SBe | 49 | 0.0 | 73.4 | 37 | 0.0 | 67.5 | 0.0 | 70.4 |
| 17. | PI-394571-2-1-SBe-SBe | 50 | 0.0 | 42.0 | 38 | 0.0 | 36.8 | 0.0 | 39.4 |
| 18. | PI-394571-3-1-SBe-SBe | 39 | 0.0 | 38.4 | 37 | 0.0 | 70.2 | 0.0 | 54.3 |
| 19. | PI-394571-4-1-SBe-SBe | 44 | 0.0 | 90.9 | 31 | 0.0 | 93.5 | 0.0 | 92.2 |
| 20. | PI-394571-5-1-SBe-SBe | 44 | 0.0 | 95.4 | 51 | 0.0 | 84.3 | 0.0 | 89.8 |
| 21. | PI-397275-1-S10-SBe | 20 | 10.0 | 45.0 | 38 | 2.6 | 23.6 | 6.3 | 34.3 |
| 22. | PI-397677-1-S10-SBe | 27 | 44.4 | 33.3 | 35 | 20.0 | 54.2 | 32.2 | 43.7 |
| 23. | PI-396946-1-S10-SBe | 39 | 2.5 | 0.0 | 47 | 0.0 | 25.5 | 1.2 | 12.7 |
| 24. | ICP-8094-2-1-S10-SBe | 47 | 0.0 | 25.5 | 57 | 0.0 | 49.1 | 0.0 | 37.3 |
| 25. | ICP-10659-S10-SBe | 44 | 38.6 | 65.9 | 43 | 25.5 | 74.4 | 32.0 | 70.1 |
| 26. | ICP-5036-S10-SBe | 56 | 0.0 | 94.6 | 45 | 4.4 | 97.7 | 2.2 | 96.1 |
| 27. | ICP-6831-S10-SBe | 44 | 0.0 | 27.2 | 48 | 0.0 | 12.5 | 0.0 | 19.8 |
| 28. | HA-2-S10-SBe | 42 | 0.0 | 83.3 | 51 | 0.0 | 66.6 | 0.0 | 74.9 |
| 29. | ICP-7194-S10-SBe | 36 | 0.0 | 11.1 | 42 | 0.0 | 0.0 | 0.0 | 5.5 |
| 30. | ICP-4886-S10-SBe | 34 | 0.0 | 61.7 | 43 | 0.0 | 97.6 | 0.0 | 79.6 |
| 31. | ICP-4769-S10-SBe | 26 | 3.8 | 7.6 | 41 | 2.4 | 17.0 | 3.1 | 12.3 |
| 32. | QW-3-4EB-S10-SBe | 44 | 0.0 | 27.2 | 38 | 0.0 | 50.0 | 0.0 | 38.6 |
| 33. | BDN1 | 112 | 94.6 | 14.2 | 46 | 95.6 | 23.9 | 95.1 | 19.0 |
| 34. | ICPL 84071 MPSRY | 36 | 8.3 | 27.7 | 21 | 0.0 | 38.0 | 4.1 | 32.8 |
| 35. | ICP-7867 Hel. susceptible | 62 | 0.0 | 28.8 | 38 | 0.0 | 2.6 | 0.0 | 15.7 |
| 36. | ICP-1908 Hel. Resistance | 57 | 100.0 | 57.8 | 55 | 98.1 | 81.8 | 99.0 | 69.8 |
| | BDN-1 (SM susc. check) | 244 | 98.5 | - | 102 | 100.0 | - | 99.7 | - |

9. Multilocation testing

The list of cooperators and locations of ICAR-ICRISAT Uniform Trial for Pigeonpea Sterility Mosaic Resistance (IIUTPSMR) is given in table 51. The reaction of these entries at six different locations is given in table 52. Several lines such as ICP 7035, 7234, 10976, 10984, 11049, 11207, BSMR 225 and BSMR 235, showed less than 10.0 percent SM across locations (Badnapur, ICRISAT Patancheru, Kanpur, Kumarganj, Pantnagar, Pudukkottai).

C. PHYTOPHTHORA BLIGHT

The main emphasis is on identification of sources of resistance to P3 isolate of the fungus. Screening of the germplasm is carried out in pots in the glass house. There is no separate programme for breeding for resistance to blight alone at present. Screening in the field for blight resistance is carried out in a multiple disease nursery where wilt and SM are also present. As soon as sources of resistance to P. isolate are identified, a breeding program will be undertaken.

1. Multilocation testing

The lines that are found promising in the pot screening to P2 isolate and field tolerant lines are tested in ICAR-ICRISAT Uniform Trial for pigeonpea Phytophthora Blight Resistance (IIUTPPBR). The list of cooperators and locations are given in table 53. The reaction of the lines at different locations is given in table 54. At ICRISAT this nursery was planted in the multiple disease nursery. As most of the lines died due to wilt, their reaction to blight could not be obtained. Most of the lines showed susceptibility at 4 of the locations where proper screening was carried out. The line KPBR 80-1-4 showed <20% blight at Varanasi and DPR Kanpur.

D. MULTIPLE DISEASE RESISTANCE

Screening for combined resistance to the three major diseases, wilt, SM and phytophthora blight has been in progress for the past several years. Several germplasm accessions with resistance to two diseases have been identified. Breeding for resistance to wilt and SM has also made good progress especially in the medium maturity group. Progress on breeding for combined resistance to phytophthora blight wilt and blight and SM has been slow because of lack of good sources of resistance to all the isolates of blight fungus.

1. Wilt + SM

A 0.4 ha plot in Alfisol (RM 3C andRM 8E) is being used for screening for combined resistance to wilt and SM. The field is highly sick for wilt and also high incidence of SM was created.

**a) Germplasm selections**

Single plant selections made from 13 germplasm accessions during 1984-85 season were retested. The data is presented in table 55. All the lines were free from SM. Two lines PR 5149 and PI 397630 also showed <10% wilt.

**b) Breeding materials**

The list of breeding materials screened for combined resistance to wilt and SM is presented in table 56. The detailed results have been provided to the breeders.

**c) Multilocation testing (IIUTPMDR-A, 1985-86)**

This is the first year of conducting ICAR-ICRISAT Uniform Trial for Pigeonpea Multiple Disease Resistance. This is a collaborative trial between ICRISAT and ICAR. This trial consists of two sets. Set A with lines having combined resistance to wilt and SM and set B with lines having combined resistance/tolerance to SM and phytophthora blight.

The list of cooperators and locations of IIUTPMDR-A is given in table 57. The reaction of the lines at different location is given in table 58. Two lines; ICP 8860 and ICP 8869 showed <20% wilt and SM accross 4 locations.

**2. Wilt + SM + Phytophthora blight**

**a) Selections from cultivars**

Eight resistant SPS made from some cultivars in this nursery last season were retested. The results presented in table 59 show that no selection was resistant to wilt and SM.

**b) Heliothis tolerant lines**

Thirty two lines received from pulse entomology as promising to Heliothis were tested in the multiple disease nursery. SM incidence in this trial was less and the screening for this disease cannot be considered effective (Table 60 and 61). For wilt three lines; ICP 4769, ICP 6831 and ICP 7198 showed less than 20.0 percent disease.

**c) ICRISAT breeding materials**

The list of pigeonpea breeding materials screened in the multiple disease nursery is given in table 62. The detailes have been provided to breeders.

**d) Multilocation testing IIUTPMDR-B (1985-86)**

The list of cooperators and locations of IIUTPMDR-B (SM and blight resistance) is given in table 63 and the results in table 64. Though some lines were resistant to SM accross locations, none was resistant to phytophthora blight.

Table 51. List of cooperators and locations of IIUTPSMR 1985-86.

| | |
|---|---|
| 1. | Dr. K.K. Zote, Badnapur |
| 2. | Dr. T.B. Anilkumar, Bangalore |
| 3. | Dr. K.S. Amin, DPR, Kanpur |
| 4. | Dr. R.P. Gupta, Kumargunj |
| 5. | Dr. Gurdip Singh, Ludhiana |
| 6. | Dr. H.S. Thripati, Pantnagar |
| 7. | Dr. G. Arjunan, Pudukottai |
| 8. | Mr. N.J. Bindre, Rahuri |
| 9. | Dr. S.C. Agarval, Sehore |
| 10. | Dr. V.B. Chauhan, Varanasi |
| 11. | Dr. M.V. Reddy, and Dr. Y.L. Nene, ICRISAT, Patancheru |

Table 52. ICRISAT-ICAR Uniform Trial for Pigeonpea Sterility Mosaic Resistance (IIUTPSMR 1985-86).

| Entry | Percent SM | | | | | | |
|---|---|---|---|---|---|---|---|
| | Badnapur | ICRISAT | Kanpur | Kumarganj | Pantnagar | Pudukkottai | No. of locations with <20 % SM |
| ICP 6997 | 8 | 3 | 13 | 6 | 0 | 25 | 5 |
| ICP 7035 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| ICP 7234 | 0 | 0 | 0 | 0 | 2 | 18 | 6 |
| ICP 7898 | 4 | 1 | 5 | 7 | 0 | 100 | 5 |
| ICP 8094 | 11 | 23 | 2 | 10 | 0 | 38 | 4 |
| ICP 8862 | 9 | 3 | 2 | 0 | 0 | 13 | 6 |
| ICP 10976 | 0 | 0 | 0 | 4 | 0 | 0 | 6 |
| ICP 10978 | 3 | 0 | 50 | 23 | 2 | 88 | 3 |
| ICP 10979 | 0 | 0 | 0 | 19 | 0 | 20 | 6 |
| ICP 10984 | 2 | 0 | 0 | 3 | 0 | 0 | 6 |
| ICP 10986 | 10 | 1 | 3 | 19 | 0 | 63 | 5 |
| ICP 10991 | 0 | 4 | 9 | 3 | 5 | 25 | 5 |
| ICP 10993 | 0 | 5 | 45 | 6 | 0 | 17 | 5 |
| ICP 10996 | 6 | 0 | 2 | 22 | 0 | 89 | 4 |
| ICP 11049 | 3 | 0 | 0 | 0 | 4 | 0 | 6 |
| ICP 11204 | 0 | 0 | 2 | 4 | 0 | 42 | 5 |
| ICP 11206 | 0 | 0 | 0 | 2 | 3 | 25 | 5 |
| ICP 11207 | 4 | 0 | 0 | 0 | 0 | 10 | 6 |
| ICP 11231 | 0 | 0 | 0 | 11 | 0 | 50 | 5 |
| BSMR 160 | - | - | - | - | - | - | - |
| BSMR 225 | 0 | 4 | 5 | 4 | 0 | 0 | 6 |
| BSMR 235 | 0 | 0 | 2 | 10 | 0 | 0 | 6 |
| BSMR 251 | 0 | 1 | 2 | 20 | 0 | 78 | 5 |
| BSMR 258 | 0 | 2 | 7 | 18 | 0 | 19 | 6 |
| BSMR 268 | 0 | 0 | 2 | 26 | 0 | 75 | 4 |
| BSMR 277 | 0 | 0 | 0 | 17 | 0 | 50 | 5 |
| BSMR 285 | 0 | 1 | 6 | 21 | 0 | 75 | 4 |
| BSMR 311 | 0 | 0 | 6 | 48 | 0 | 10 | 5 |
| BSMR 602 | 0 | 0 | 3 | 13 | 0 | 67 | 5 |
| BWR 190 | 3 | 0 | 0 | 1 | 0 | 59 | 5 |
| ICPL 84071 | 2 | 10 | 5 | 12 | 0 | 100 | 5 |
| ICPL 8343 | 0 | 2 | 0 | 13 | 0 | 88 | 5 |
| ICPL 83120 | 6 | 12 | 7 | 40 | 2 | 100 | 4 |
| ICPL 146 | 0 | 2 | 0 | 6 | 0 | 76 | 5 |
| ICPL 269 | 11 | 18 | 0 | 6 | 0 | 50 | 5 |
| ICPL 8324 | 8 | 0 | 8 | 13 | 0 | 0 | 6 |
| ICPL 8308 | 22 | 23 | 11 | 6 | 0 | 75 | 3 |
| ICP 7197 | 5 | 1 | 50 | 40 | 0 | 0 | 4 |
| ICP 7182 | 100 | 97 | 87 | 95 | 7 | 93 | - |
| (Range) | | (90-100) | (70-100) | (88-100) | (0-32) | (72-100) | |

Varanasi - Data received but SM incidence was negligible and hence not included.

Table 53. List of cooperators and locations of IIUTPPBR 1985-86

1. Dr. S.N. Pillai, Baroda
2. Dr. K.S. Amin, DPR, Kanpur
3. Dr. H.S. Thripati, Pantnagar
4. Dr. S.C. Agarval, Sehore
5. Dr. V.B. Chauhan, Varanasi
6. Dr. H.V. Reddy, and Dr. Y.L. nene, ICRISAT, Patancheru

Table 54. Reaction of the entries of IIUTPPBR to blight at different locations during 1985-86.

| Cultivar | Percent blight | | | |
|---|---|---|---|---|
| | Pantnagar | Sehore | Varanasi | DPR Kanpur |
| ICP 28 | 100 | 55 | 55 | 42 |
| ICP 113 | 55 | 84 | 30 | 27 |
| ICP 1529 | 75 | 42 | 22 | 27 |
| ICP 4135 | 45 | 68 | 23 | 31 |
| KPBR 80-1-4 | 48 | 27 | 10 | 19 |
| ICPL 161 | 85 | 23 | 29 | 27 |
| ICPL 288 | 100 | 87 | 83 | 47 |
| ICPL 8309 | 63 | 43 | 13 | 39 |
| ICP 7119 | 100 | 98 | 100 | 41 |
| (Range) | | (93.2-100) | | (25-64) |

At Baroda the blight incidence in the susceptible check ICP 7119 was negligible thus the data is not reported. At ICRISAT, because of severe wilt incidence no reaction could not be obtained.

Table 55. Reaction of 1984 SM promising germplasm selections to SM and wilt in SM and wilt nursery (RM 8E) 1985-86 at ICRISAT Center.

| S. No. | Pedigree | R I | | | R II | | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total plants | Percent SM | Percent wilt | Total plants | Percent SM | Percent wilt | Percent SM | Percent wilt |
| 1. | ICP 11934 | 27 | 0.0 | 63.9 | 9 | 0.0 | 55.5 | 0.0 | 59.7 |
| 2. | ICP 11438 | 24 | 0.0 | 62.5 | 17 | 0.0 | 47.0 | 0.0 | 54.7 |
| 3. | PR 5149 | 21 | 0.0 | 19.0 | 2 | 0.0 | 0.0 | 0.0 | 9.5 |
| 4 | PR 5145 | 13 | 0.0 | 23.1 | 9 | 0 0 | 33.3 | 0.0 | 28.2 |
| 5. | PR 5137 | 13 | 0.0 | 46 1 | 11 | 0.0 | 90.9 | 0.0 | 68.5 |
| 6. | PI 397456 | 16 | 0.0 | 18.8 | 5 | 0.0 | 40.0 | 0.0 | 29.4 |
| 7. | PR 5164 | 12 | 0.0 | 8.3 | 9 | 0.0 | 22.2 | 0.0 | 15.2 |
| 8. | ICP 11844 | 20 | 0.0 | 40.0 | 9 | 0 0 | 11.1 | 0.0 | 25.5 |
| 9. | PI 397630 | 5 | 0.0 | 0 0 | 12 | 0.0 | 16.7 | 0.0 | 8.3 |
| 10. | Sri Lanka 477-1 | 16 | 0.0 | 25.0 | 3 | 0.0 | 33.3 | 0.0 | 29.1 |
| 11. | PR-5140 | 14 | 0.0 | 21.4 | 13 | 0.0 | 38.5 | 0.0 | 29.9 |
| 12. | PR 5294 | 11 | 0.0 | 100.0 | 5 | 0.0 | 10.0 | 0.0 | 100.0 |
| 13. | PR-5118 | 13 | 0.0 | 30.7 | 18 | 0.0 | 66.6 | 0.0 | 48.6 |
| | ICP 8863 (SM susc. check) | 46 | 76.3 | - | 40 | 78.9 | - | 77.6 | - |
| | ICP 2376 (wilt susc. check) | 92 | - | 98.4 | 61 | - | 98.2 | - | 98.3 |

Table 56. List of pigeonpea breeding materials screened for combined resistance to wilt and SM during 1985-86 (RM 3C & RM 8E) at ICRISAT Center.

| Maturity | Material | Entries | Reps. |
|---|---|---|---|
| Medium | MPSMWRY | 10 | 1 |
| | F3 bulks population (test No.87.84k) | 5 | 1 |
| | ICPL 227 SPP's | 84 | 1 |
| | Vegetable DT yield test bulks | 76 | 1 |
| | Vegetable NDT yield test bulks | 55 | 1 |
| | TOTAL | 230 | |
| Late | LPAY entries | 10 | 1 |
| Male steriles | MS NPWR-15 BC5F2s | 7 | 1 |
| | WRMS 3783 BC2F4s | 18 | 1 |
| | TOTAL | 25 | |

Table 57. List of cooperators and locations of IIUTPMDR-A 1985-86 (Wilt + SM resistance).

1. Dr. K.K. Zote, Badnapur
2. Dr. K.S. Amin, DPR, Kanpur
3. Dr. G. Arjunan, Pudukkottai
4. Mr. N.J. Bindre, Rahuri
5. Dr. M.V. Reddy, and Dr. Y.L. nene, ICRISAT, Patancheru

Table 58 Reaction of the entries of IIUTPMDR-A (wilt and SM resistance) at different locations during 1985-86.

| S. No. | Entry | Percent disease | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Badnapur | | Kanpur | | Pudukkottai | | | ICRISAT Hyderabad | |
| | | Wilt | SM | Wilt[1] | SM[2] | PB | Wilt | SM | Wilt | SM |
| 1. | ICP 8860 | 9.4 | 4.7 | 0.0 | 0.0 | 9.5 | 0.0 | 17.9 | 12.5 | 0.0 |
| 3. | ICP 8861 | 18.3 | 0.0 | - | 0.0 | 100.0 | 0.0 | 27.3 | 5.0 | 1.5 |
| 3. | ICP 8862 | 30.3 | 0.0 | 0.0 | 0.0 | 75.0 | 0.0 | 6.6 | 57.3 | 3.5 |
| 4. | ICP 8867 | 9.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 16.6 | 41.6 | 1.1 |
| 5. | ICP 8869 | 5.6 | 0.0 | 0.0 | 7.7 | 50.0 | 0.0 | 0.0 | 6.8 | 6.8 |
| 6. | ICP 10960 | 0.0 | 0.0 | 0.0 | 7.7 | 100.0 | 0.0 | 7.0 | 41.1 | 30.0 |
| 7. | ICP 11289 | 15.6 | 0.0 | - | 0.0 | 100.0 | 0.0 | 78.5 | 30.5 | 1.2 |
| 8. | ICP 11290 | 57.9 | 0.0 | 0.0 | 0.0 | 33.3 | 0.0 | 65.6 | 41.5 | 0.0 |
| 9. | ICP 11291 | 51.4 | 2.2 | 0.0 | 0.0 | 36.3 | 0.0 | 28.1 | 23.3 | 1.0 |
| 10. | ICP 11296 | 12.5 | 0.0 | 100.0 | - | - | 0 0 | 0.0 | 58.6 | 0.0 |
| 11. | ICP 11297 | 0.0 | 0.0 | - | 9.1 | 100.0 | 0.0 | 0.0 | 23.5 | 0.0 |
| 12. | ICP 11298 | 40.0 | 0.0 | - | 8.3 | 100.0 | 0.0 | 14.9 | 34.8 | 0.0 |
| 13. | BSMR 65 | 10.3 | 0.0 | 0.0 | 0.0 | 62.5 | 0.0 | 0.0 | 29.3 | 2.9 |
| 4. | BSMR 540 | 2.4 | 0.0 | 0.0 | 0.0 | 45.0 | 0.0 | 22.5 | 27.8 | 0.0 |
| 5. | BSMR 294 | 6.5 | 0.0 | 0.0 | 0.0 | 50.0 | 0.0 | 16.6 | 25.9 | 0.0 |
| 16. | BSMR 544 | 4.2 | 0.0 | 0.0 | 0.0 | 40.0 | 0.0 | 25.0 | 30.3 | 0.0 |
| 17. | BSMR 736 | 10.9 | 0.0 | 0.0 | 5.5 | 62.5 | 0.0 | 30.7 | 32.7 | 0.0 |
| 18. | BSMR 268 | 94.7 | 2.3 | 0.0 | 0 0 | 10.0 | 0.0 | 50.0 | 80.0 | 0.0 |
| 9. | BSMR 520 | 6.8 | 0.0 | 0.0 | 0.0 | 12.5 | 0.0 | 39.3 | 23.8 | 1.6 |
| 0. | BSMR 595 | 96.2 | 0.0 | 0.0 | 0.0 | 66.6 | 0.0 | 50.0 | 87.1 | 0.0 |
| 1. | BSMR 101 | 15.4 | 0.0 | 0.0 | 0.0 | 100.0 | 0.0 | 3.9 | 25.6 | 0.0 |
| 2. | BSMR 225 | 44.6 | 0.0 | - | 0.0 | 100.0 | 0.0 | 10.0 | 54.8 | 7.6 |
| 3. | BSMR 277 | 36.0 | 0.0 | 0.0 | 0.0 | 66.6 | 0.0 | 0.0 | 14.6 | 7.1 |
| 4. | BSMR 285 | 79.5 | 2.6 | 5.6 | 9.1 | 44.4 | 0.0 | 91.7 | 52.7 | 1.4 |
| 9. | BSMR 235 | 69.6 | 0.0 | 0.0 | 10.0 | 24.9 | 0.0 | 11.1 | 56.1 | 0.0 |
| 6. | BSMR 251 | 87.5 | 4.5 | 0.0 | 9.1 | 16.6 | 0.0 | 87.5 | 79.1 | 0.0 |
| 7. | BSMR 258 | 76.7 | 0.0 | 0.0 | 11.2 | 83.3 | 0.0 | 16.6 | 77.5 | 0.0 |
| 8. | BSMR 160 | 52.9 | 0.0 | - | 0.0 | 100.0 | 0.0 | 0.0 | 51.6 | 2.6 |
| 9. | BSMR 311 | 35.3 | 2.4 | 0.0 | 0.0 | 0.0 | 0.0 | 11.1 | 79.0 | 0.0 |
| 0. | BSMR 602 | 20.6 | 0.0 | 0.0 | 0.0 | 55.0 | 0.0 | 16.6 | 72.0 | 44.3 |
| 1. | BSMR 1 | 26.3 | 0.0 | - | 0.0 | 100.0 | 0.0 | 60.6 | 15.1 | 0.0 |
| 2. | BSMR 2 | 45.6 | 2.5 | 50.0 | 7.1 | 50.0 | 0.0 | 50.0 | 93.2 | 18.0 |
| 3. | BWR 67 | 32.9 | 51.4 | 0.0 | 0.0 | 0.0 | 0.0 | 60.5 | 80.8 | 93.8 |
| 4. | BWR 97 | 2.3 | 0.0 | 16.6 | 33.3 | 66.6 | 0.0 | 63.4 | 26.0 | 100.0 |
| 5. | BWR 135 | 32.6 | 40.0 | 0.0 | 18.1 | 20.0 | 0.0 | 71.5 | 77.0 | 64.6 |
| 6. | BWR 153 | 5.3 | 11.8 | - | 0.0 | 100.0 | 0.0 | 75.0 | 32.6 | 28.4 |
| 7. | BWR 154 | 16.7 | 0.0 | 0.0 | 11.1 | 30.0 | 0.0 | 30.0 | 10.9 | 0.0 |
| 8. | BWR 159 | 8.3 | 5.6 | 0.0 | 0.0 | 0.0 | 0.0 | 16.6 | 14.3 | 25.4 |
| 9. | BWR 175 | 7.8 | 0.0 | 0.0 | 0.0 | 34.2 | 0.0 | 0.0 | 35.4 | 0.0 |
| 00. | BWR 190 | 43.9 | 5.3 | 0.0 | 20.6 | 50.0 | 0.0 | 43.2 | 61.8 | 11.9 |
| 41. | BWR 198 | 14.9 | 7.5 | 0.0 | 30.0 | 100.0 | 0.0 | 25.0 | 49.5 | 9.1 |
| 42. | BWR 217 | 12.9 | 29.7 | 0.0 | 50.0 | 48.0 | 0.0 | 78.2 | 56.3 | 87.8 |
| 43. | BWR 254 | 8.2 | 0.0 | 0.0 | 27.7 | 80.0 | 0.0 | 49.9 | 31.0 | 100.0 |
| 44. | BWR 259 | 24.3 | 0.0 | 0.0 | 0.0 | 68.8 | 0.0 | 0.0 | 29.5 | 0.0 |
| 45. | BWR 245 | 29.5 | 74.3 | 0.0 | 27.2 | 71.4 | 0.0 | 47.4 | 34.6 | 98.1 |
| 46. | BWR 301 | 5.0 | 0.0 | 0.0 | 14.2 | 35.4 | 0.0 | 4.2 | 40.7 | 0.0 |
| 47. | BWR 321 | 29.0 | 8.8 | 50.0 | 0.0 | 75.0 | - | - | 26.4 | 32.0 |
| 48. | BWR 322 | 26.9 | 5.1 | 0.0 | 20.0 | 37.7 | 0.0 | 33.6 | 47.7 | 18.0 |
| 49. | BWR 332 | 8.9 | 4.8 | - | 20.0 | 100.0 | 0.0 | 26.9 | 38.5 | 48.0 |
| 50. | BWR 369 | 17.7 | 2.4 | 0.0 | 6.6 | 87.5 | 0.0 | 35.0 | 22.3 | 6.0 |
| 51. | BWR 370 | 13.1 | 100.0 | 0.0 | 85.7 | 71.4 | 0.0 | 84.0 | 46.4 | 100.0 |
| 52. | BWR 250 | 6.4 | 5.6 | 0.0 | 5 8 | 83.8 | 0.0 | 39.1 | 33.1 | 100.0 |
| 53. | ICP 2370 (wilt check) | 100.0 | - | 19.6 (0-100) | - | 55.1 (0-100) | 32.7 (20-75) | - | 98.9 (97-100) | 100.0 |
| 54. | ICP 7182 (SM check) | - | 100.0 | - | 78.1 (45-100) | - | 83.6 (50-100) | | | |

caution.
2. One replication only.
ICP 8869 showed <10% SM and wilt accross locations and
ICP 8860 showed <20% SM and wilt accross locations

Table 59. Reaction of some selections from pigeonpea cultivars to sterility mosaic, and wilt, in the multiple disease nursery (RP 18) during 1985-86 at ICRISAT Center.

| No. | Pedigree | Total plants | Percent SM | Percent wilt |
|---|---|---|---|---|
| 1. | ICP-8863@-SVB@ (SM plants) | 142 | 100.0 | 32.3 |
| 2. | ICP-8863@-SVB@ (Late SM symptoms) | 108 | 29.6 | 11.1 |
| 3. | ICP-8863-OP-SVB@ (more pods) | 108 | 100.0 | 25.3 |
| 4. | Gujarat local-SVPB@ | 132 | 42.4 | 46.2 |
| 5. | BDNA-5-SVPB@ | 141 | 90.7 | 95.7 |
| 6. | PDA-84-2-SVPB@ | 123 | 1.5 | 97.5 |
| 7. | PDA-83-3-SVPB@ | 49 | 40.8 | 67.3 |
| 8. | BWR-175-SVPB@ | 133 | 24.8 | 0.0 |
| | ICP 8863 (SM susc. check) | 265 | 74.7 | - |
| | ICP 2376 (wilt susc. check) | 484 | - | 87.0 |

Table 60. Reaction of entomologically promising lines to sterility Mosaic and wilt in the multiple disease nursery (RP 18) during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | R I | | | R II | | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total plants | Percent SM | Percent wilt | Total plants | Percent SM | Percent wilt | Percent SM | Percent wilt |
| 1. | ICP-8127 | 50 | 0.0 | 48.0 | 29 | 3.4 | 62.1 | 1.7 | 55.0 |
| 2. | ICP-810 | 44 | 20.4 | 72.7 | 61 | 13.1 | 90.2 | 16.7 | 44.7 |
| 3. | ICP-1903 | 44 | 18.2 | 100.0 | 21 | 0.0 | 100.0 | 9.1 | 100.0 |
| 4. | ICP-8571 | 40 | 15.0 | 95 0 | 35 | 0.0 | 94.3 | 7 5 | 94.6 |
| 5 | GS-1 | 26 | 11.5 | 100.0 | 29 | 10.3 | 79.3 | 10.9 | 89.6 |
| 6. | ICP-7041 | 15 | 13.3 | 100.0 | 46 | 6.5 | 89.1 | 9.9 | 94.5 |
| 7 | ICP-8010 | 23 | 0.0 | 86.9 | 55 | 1.8 | 96.4 | 0.9 | 91.6 |
| 8 | ICP-7050 | 37 | 5.4 | 89.2 | 55 | 18 2 | 92.7 | 11.8 | 91.0 |
| 9. | ICP-4640 | 76 | 15 8 | 80.3 | 27 | 11.1 | 96.3 | 13.4 | 88.3 |
| 10. | ICP-7496 | 62 | 9.7 | 87 1 | 41 | 12.2 | 80.4 | 10.9 | 83.7 |
| 11. | ICP-7176-18-E2 | 9 | 11.1 | 55.5 | 10 | 0.0 | 90.0 | 5.5 | 72.7 |
| 12 | ICP-8102-E1 | 35 | 0.0 | 68.6 | 30 | 3.3 | 26.7 | 1.6 | 73.0 |
| 13. | PPE-36-2 | 70 | 1.4 | 87.1 | 39 | 7.7 | 58.9 | 4.5 | 73.0 |
| 14. | ICP-1925-(IG)-2 | - | - | - | - | - | - | - | - |
| 15. | ICP-5766 | 55 | 1.8 | 96.4 | 25 | 20.0 | 80.0 | 10.9 | 88.2 |
| 16 | PPE-38-1 | 64 | 7.8 | 92 2 | 40 | 5.0 | 85.0 | 6.4 | 88.6 |
| | ICP 8863 (SM susc. check) | 101 | 27.8 | - | 131 | 17.8 | - | 22.8 | - |
| | ICP 2376 (wilt susc. check) | 214 | - | 93.4 | 176 | - | 92.3 | - | 92.8 |

Table 61. Reaction of entomologically promising lines to sterility mosaic and wilt in the multiple disease nursery (RP 18) during 1985-86 at ICRISAT Center.

| S.No. | Pedigree | R I | | | R II | | | Average | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total plants | Percent SM | Percent wilt | Total plants | Percent SM | Percent wilt | Percent SM | Percent wilt |
| 1. | ICP-6831 | 38 | 0.0 | 5 3 | - | - | - | 6.3 | 15.6 |
| 2. | ICPL-288 | 28 | 0.0 | 50 0 | 40 | 2.5 | 67.5 | 1.2 | 59.0 |
| 3. | ICP-6915 | 5 | 0.0 | 20 0 | 23 | 0.0 | 73.9 | 0 0 | 47.0 |
| 4. | ICP-4769 | 18 | 0.0 | 5 5 | 6 | 0.0 | 16.7 | 0 0 | 11.1 |
| 5 | ICP-10659 | 38 | 7.9 | 78 9 | 29 | 10 3 | 86.2 | 9 1 | 82 5 |
| 6. | ICP-8660 | 20 | 5.0 | 45.0 | 23 | 0 0 | 82.6 | 2.5 | 63 8 |
| 7 | ICP-11410(MKR-13) | 53 | 9 4 | 43.4 | 60 | 11.7 | 40.0 | 10.5 | 41 7 |
| 8 | ICPL-84060 | 20 | 15.0 | 95 0 | 61 | 0 0 | 96 7 | 7 5 | 96.0 |
| 9 | ICP-4307 | 5 | 0 0 | 100 0 | 7 | 0 0 | 71 4 | 0.0 | 85.7 |
| 10 | MA-2 | 40 | 0.0 | 17 5 | 91 | 0 0 | 31 9 | 0 0 | 24.7 |
| 11 | ICP-8669 | 36 | 0.0 | 86 1 | 35 | 8.6 | 100.0 | 4 3 | 93 0 |
| 12 | ICP-5498 | 35 | 2.9 | 31 4 | 37 | 0 0 | 37 8 | 1 4 | 34 4 |
| 13 | ICP-4886 | 39 | 0 0 | 97.4 | 72 | 2 8 | 97 2 | 1 4 | 97.3 |
| 14 | ICP-7198 | 29 | 0 0 | 17 2 | 20 | 5 0 | 20 0 | 2 5 | 18 6 |
| 15 | ICP-4070 | 23 | 4 3 | 56 5 | 20 | 5 0 | 75 0 | 4 6 | 65 8 |
| 16. | Gw-3 | 36 | 5.5 | 86.1 | 30 | 0 0 | 63 3 | 2 7 | 74 7 |
| | ICP-8863 (SM susc check) | 63 | 61 0 | - | 126 | 26 1 | - | 43 5 | - |
| | ICP-2376 | 197 | - | 83 4 | 182 | - | 75 3 | | 79 3 |

Table 62. List of Pigeonpea Breeding materials screened in the multiple disease nursery during 1985-86 (RP 18) at ICRISAT Center.

| Maturity group | Materials | Entries | Reps. |
|---|---|---|---|
| Early | Multilocation trial entries | 108 | 2 |
| | Retesting and purification of ICPL's | 22 | 2 |
| | F5 bulks | 2 | 1 |
| | ICPL 269 SPP. | 100 | 1 |
| | ICPL bulks (ICPL 8327, and 269) | 2 | 1 |
| | TOTAL | 234 | |
| Medium | F5 SPP. | 170 | 1 |
| | F5 SPP. (from bulk populations) | 89 | 1 |
| | TOTAL | 259 | |
| Late | F3 SPP. | 22 | 1 |
| | Advanced lines | 30 | 1 |
| | F3 bulks | 4 | 1 |
| | TOTAL | 56 | |

Table 63. List of cooperators and locations of IIUTPMDR-B 1985-86 (SM + PB resistance).

1. Dr. K.S. Amin, DPR, Kanpur, Uttar Pradesh
2. Dr. H.S. Thripati, Pantnagar, Uttar Pradesh
3. Dr. G. Arjunan, Pudukkottai, Tamil Nadu
4. Dr. M.V. Reddy, and Dr. Y.L. Nene, ICRISAT, Patancheru

Table 64. Reaction of the entries of IIUTPMDR-B (SM and PB resistance) at different locations during 1985-86.

| S. No. | Entry | Kanpur1 Wilt Trial[1] | Kanpur1 SM Trial[1] | PB Trial[1] | PB Trial[2] | Pantnagar P. Blight | Pudukkottai SM | ICRISAT[2] Wilt | ICRISAT[2] SM |
|---|---|---|---|---|---|---|---|---|---|
| | | Percent disease | | | | | | | |
| 1. | ICP 8466 | 0.0 | 0.0 | 0.0 | 0.0 | 100.0 | 6.3 | 61.8 | 0.0 |
| 2. | ICP 11290 | 0.0 | 0.0 | 35.7 | 0.0 | 92.5 | 88.9 | 13.2 | 9.6 |
| 3. | ICP 11300 | 0.0 | 0.0 | 75.0 | 16.7 | 100.0 | 85.4 | 91.8 | 0.0 |
| 4. | ICP 11301 | - | 0.0 | 100.0 | 0.0 | 80.5 | 18.5 | 45.8 | 0.0 |
| 5. | ICP 11302 | 0.0 | 0.0 | 83.3 | 5.1 | 93.5 | 29.8 | 90.0 | 0.0 |
| 6 | ICP 11303 | 3.1 | 36.2 | 49.3 | 0.0 | 88.7 | 34.4 | 59.9 | 0.0 |
| 7 | ICP 11304[3] | 3.6 | 0.0 | 3.4 | 0.0 | 34.8 | 11.1 | 5.2 | 0.0 |
| 8 | ICP 7182 | 3.4 | 64.5 | 55.1 | - | 100.0 | 71.8 | - | 61.3 |
| | (SM check) | (0-8) | (32-87) | (33-80) | | | (58-86) | | (45-77) |
| 9 | ICP 7119 | 0.0 | 0.0 | 88.9 | 25.3 | 99.0 | 7.6 | - | - |
| | (PB check) | | | (87-100) | (13-47) | (99-100) | (0-19 | | |

1=Plant stand was poor and the results to be treated with caution
2=Phytophthora blight screening was not possible as the stand was affected by wilt
3=ICP 11304 only showed some promise against SM and phytophthora blight across locations.

## B. WILT + HELIOTHIS

### 1. Wilt + Heliothis tolerant lines

Eleven Heliothis and wilt tolerant SPP of 3 germplasm lines were retested. All these lines were found resistant to wilt (Table 65). There were ICP 4769, ICP 6831 and ICP 7198.

### 2. Breeding materials

Seventeen F2, and F3 bulks (Table 66) and 2800 LRG 30 M2 progenies were screened for wilt resistance and the results provided to breeders.

Table 65. Advanced screening of wilt and Heliothis tolerant pigeonpea germplasm lines against wilt in wilt + Heliothis nursery 1985-86 (BH 16C) at ICRISAT Center.

| S.No. | Material | Total plants | Wilted plants | Percent wilt |
|---|---|---|---|---|
| 1. | ICP 4769-WB0-V10 | 214 | 6 | 2.8 |
| 2. | ICP 4769-WB0-V20 | 190 | 2 | 1.1 |
| 3. | ICP 4769-WB0-V30 | 256 | 6 | 2.3 |
| 4. | ICP 4769-WB0-V40 | 255 | 2 | 0.8 |
| 5. | ICP 4769-WB0-V50 | 92 | 6 | 6.5 |
| 6. | ICP 6831-WB0-V10 | 122 | 4 | 3.3 |
| 7. | ICP 6831-WB0-V20 | 70 | 0 | 0.0 |
| 8. | ICP 6831-WB0-V30 | 66 | 0 | 0.0 |
| 9. | ICP 7198-WB0-V10 | 60 | 0 | 0.0 |
| 10. | ICP 7198-WB0-V20 | 60 | 2 | 3.3 |
| 11. | ICP 7198-WB0-V30 | 170 | 20 | 11.8 |
| 12. | ICP 1903 E10 (susceptible to wilt but tolerant to Heliothis) | 267 | 264 | 98.9 |

ICP 6831 is agronomically desirable with spreading habit. It is of medium-late maturity type.

Table 66. Wilt incidence in F2 and F3 wilt x Heliothis tolerant populations in wilt + Heliothis nursery during 1985-86 (BH-16C) at ICRISAT Center.

| S.No. | Cross No. | Generation | Total plants | Wilted plants | Percent wilt |
|---|---|---|---|---|---|
| 1. | ICPX 830109 | F2 | 2200 | 892 | 40.5 |
| 2. | ICPX 830110 | F2 | 2224 | 261 | 11.7 |
| 3. | ICPX 830111 | F2 | 1904 | 769 | 40.4 |
| 4. | ICPX 830111(RC4) | F2 | 1450 | 643 | 42.3 |
| 5. | ICPX 830112 | F2 | 1849 | 1120 | 60.6 |
| 6. | ICPX 830113(RC4) | F2 | 1988 | 1702 | 85.6 |
| 7. | ICPX 830114 | F2 | 2921 | 943 | 32.3 |
| 8. | ICPX 830115 | F2 | 2555 | 1121 | 43.9 |
| 9. | ICPX 830116 | F2 | 2930 | 1456 | 49.6 |
| 10. | ICPX 830117 | F2 | 1774 | 365 | 20.6 |
| 11. | ICPX 830118 | F2 | 3035 | 1368 | 45.1 |
| 12. | ICPX 830119 | F2 | 1637 | 1504 | 91.9 |
| 13. | ICPX 830120 | F2 | 2958 | 1296 | 43.8 |
| 14. | ICPX 830121 | F2 | 1925 | 1678 | 87.2 |
| 15. | ICPX 820132-WB | F3 | 2429 | 1300 | 53.5 |
| 16. | ICPX 820133-WB | F3 | 1686 | 1539 | 91.3 |
| 17. | ICPX 83 EB 022 (MS C 11 x ICPL 332) | F2 | 3556 | 3500 | 98.4 |