Progress Report 16
Pulse Physiology

# PULSE PHYSIOLOGY
## Progress Report 1984-85

## Part 1
## Pigeonpea Physiology

Y.S. Chauhan and N. Venkataratnam

ICRISAT
International Crops Research Institute for the Semi-Arid Tropics. ICRISAT Patancheru P.O. Andhra Pradesh, India.

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## Pulse Agronomy (Pigeonpea Physiology)
## Staff 1984/85

| | |
|---|---|
| Dr. C. Johansen | Principal Agronomist (From July 1984) |
| Dr. Y.S. Chauhan | Agronomist (Physiology) |
| Dr. J.V.D.K. Kumar Rao | Agronomist II (Microbiology) |
| Mr. N. Venkataratataratnam | Sr. Research Associate I |
| Mr. H.S. Talwar | Research Associate I (Hisar) |
| Mr. G. Mallesham | Field Assistant |
| Mr. R. Narsing Rao | Secretary |
| Ms. G. Bajpai | Junior Office Assistant |
| Mr. S. Nizamuddin | Driver/General Assistant |

Cooperating Scientists

| Breeding | Pathology | Entomology |
|---|---|---|
| Dr. K.B. Saxena | Dr. M.V. Reddy | Dr. S.S. Latteef |
| Dr. K.C. Jain | Dr. Y.L. Nene | Dr. S. Sithanantham |
| Dr. S.C. Gupta | | Dr. W. Reed |
| Dr. D.G. Faris | | |

Commonly used symbols

| | | |
|---|---|---|
| SE | - | standard error of mean |
| ** | - | difference significant at $p < 0.05$ |
| ** | - | difference significant at $p < 0.01$ |
| *** | - | difference significant at $p < 0.001$ |
| NS | - | not significant |

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## 1. Meteorological and Soil Data

In this report we present the results from work carried out between June 1984 and May 1985 at ICRISAT Center and ICRISAT Cooperative Center at Hisar.

The meteorological data were collected from the local observatories and are given in Fig. 1.1 for ICRISAT Center and Fig. 1.2 for ICRISAT Cooperative Center at Hisar. At ICRISAT Center, total rainfall was 670 mm, 16.2% less than the average. The rainy season total (June to October) was 591 mm against the normal 653 mm. Rainfall during September was 39% less than the normal. The average daily maximum temperature also tended to be slightly higher than the normal.

At Hisar also rainfall was below normal. From June to September 331 mm rain fell, which was less than the normal 351 mm.

Experiments at ICRISAT Center were conducted on Vertisol fields BP11, BS8, BIL2B and Alfisol fields RP1A, and RCW8. Experiments were also conducted in greenhouses using different soils. At Hisar, an experiment was conducted in field # 8. The planting dates and fertilizer use are indicated in the Materials and Methods section of each experiment. Soil samples for analysis of pH, electrical conductivity (dS/m) (1:2 soil water extract) were taken at the time of planting. Details of analysis are given in Table 1.1.

All field sowings were done by hand, two seeds per hill were planted and plants were thinned 2-3 weeks after emergence.

Hand weeding was carried out as and when necessary to keep the plots weed free, except in the weed management experiment where it was done as per the treatments. Plant protection measures were taken as necessary to ensure good control over insects pests by the ICRISAT Plant Protection Unit. Irrigations were given as detailed in the Materials and Methods section of each experiment.

We have referred to our previous pigeonpea physiology reports as PPR 1976/77, 1977/78, etc.

This report is not a formal publication of the Institute, but a summary of work in progress. It is intended for limited circulation and should not cited.

Table 1.1. Soil analysis of fields used for pigeonpea physiology experiments in 1984/85. Means and standard errors are given.

| Soil type and field | Sampling depth (cm) | pH | EC (dS/m) (1:2 soil water extract) | Organic carbon (%) | Olsen P mg kg soil-1 |
|---|---|---|---|---|---|
| Vertisol, BP11C | 0-30 | 8.17 ± 0.030 | 0.45 ± 0.029 | 1.07 ± 0.162 | 8.8 ± 3.320 |
| n=5 | 30-60 | 8.10 ± 0.041 | 0.40 ± 0.035 | 0.77 ± 0.065 | 4.7 ± 1.490 |
| | 60-90 | 8.14 ± 0.019 | 0.35 ± 0.023 | 0.55 ± 0.038 | 2.0 ± 0.027 |
| Alfisol, RP1A | 0-30 | 8.20 ± 0.032 | 0.30 ± 0.013 | 0.74 ± 0.099 | 19.4 ± 1.330 |
| n=5 | 30-60 | 7.92 ± 0.050 | 0.25 ± 0.007 | 0.56 ± 0.035 | 6.5 ± 1.180 |
| Alfisol, RCW 8 | 0-30 | 7.77 ± 0.397 | 0.22 ± 0.021 | 0.73 ± 0.114 | 3.4 ± 0.480 |
| n=5 | 30-60 | 7.37 ± 0.320 | 0.24 ± 0.043 | 0.53 ± 0.074 | 2.1 ± 0.450 |
| Entisol, # 8 | 0-15 | 8.14 ± 0.056 | 0.16 ± 0.008 | 0.28 ± 0.040 | 8.4 ± 2.740 |
| (Hisar) n=4 | 15-30 | 8.12 ± 0.048 | 0.26 ± 0.053 | 0.24 ± 0.022 | 2.4 ± 0.515 |
| | 30-60 | 8.06 ± 0.032 | 0.46 ± 0.127 | 0.21 ± 0.017 | 2.5 ± 0.840 |

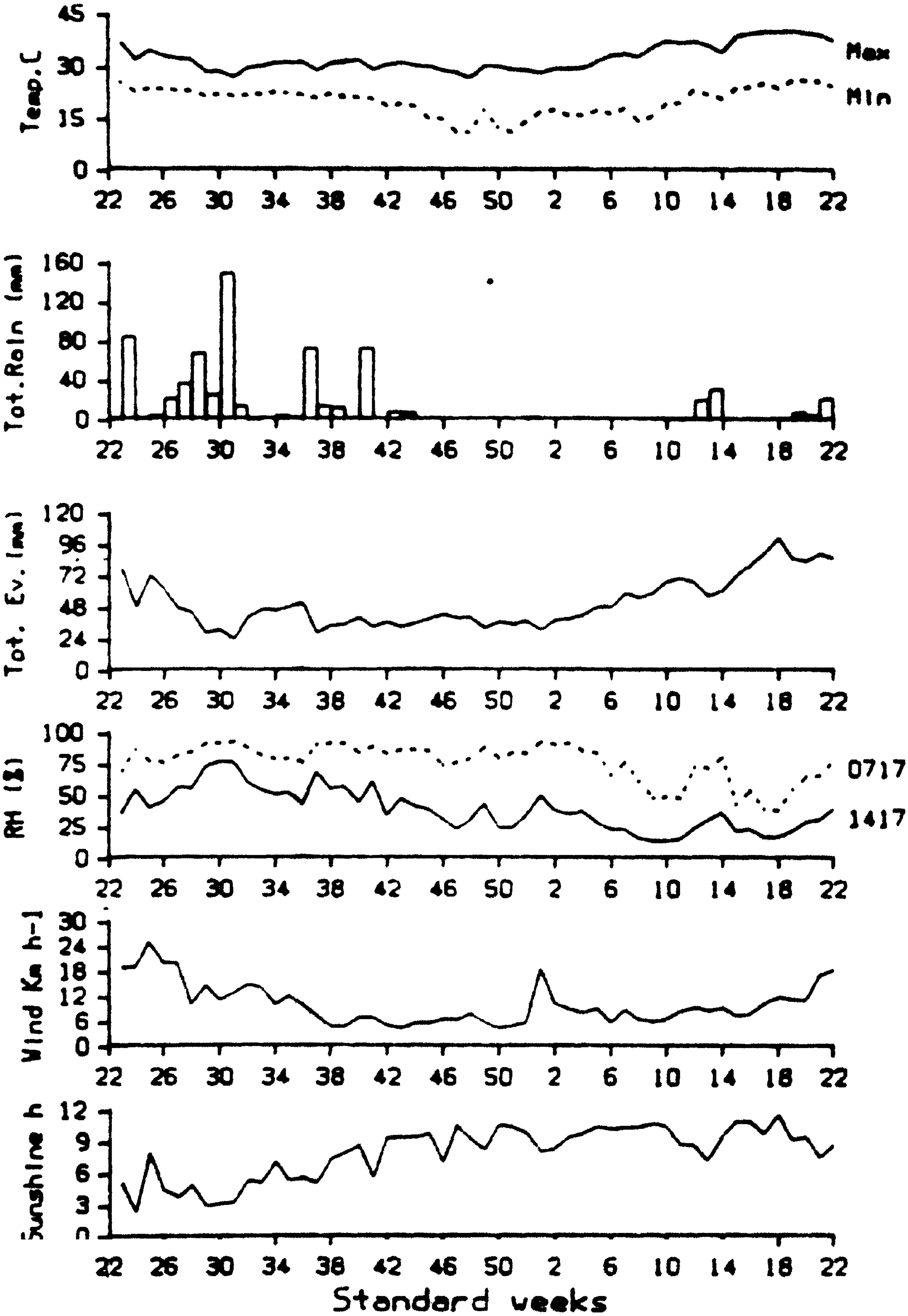


Fig 1.1. Meteorological data for ICRISAT Center (June 1984 to June 1985)

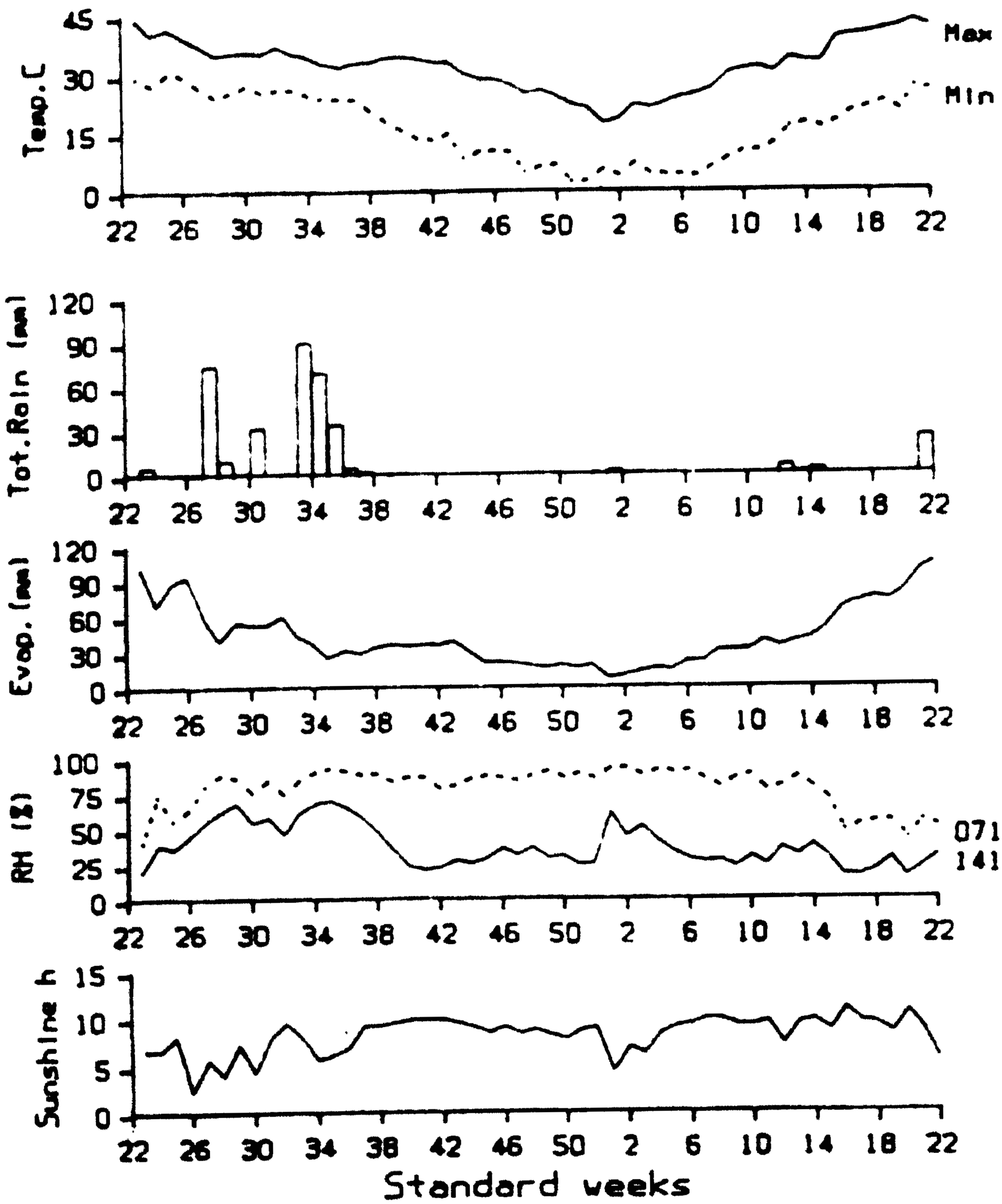


Fig 1.2. Meteorological data for ICRISAT Cooperative Center at Hisar (June 1984 to June 1985)

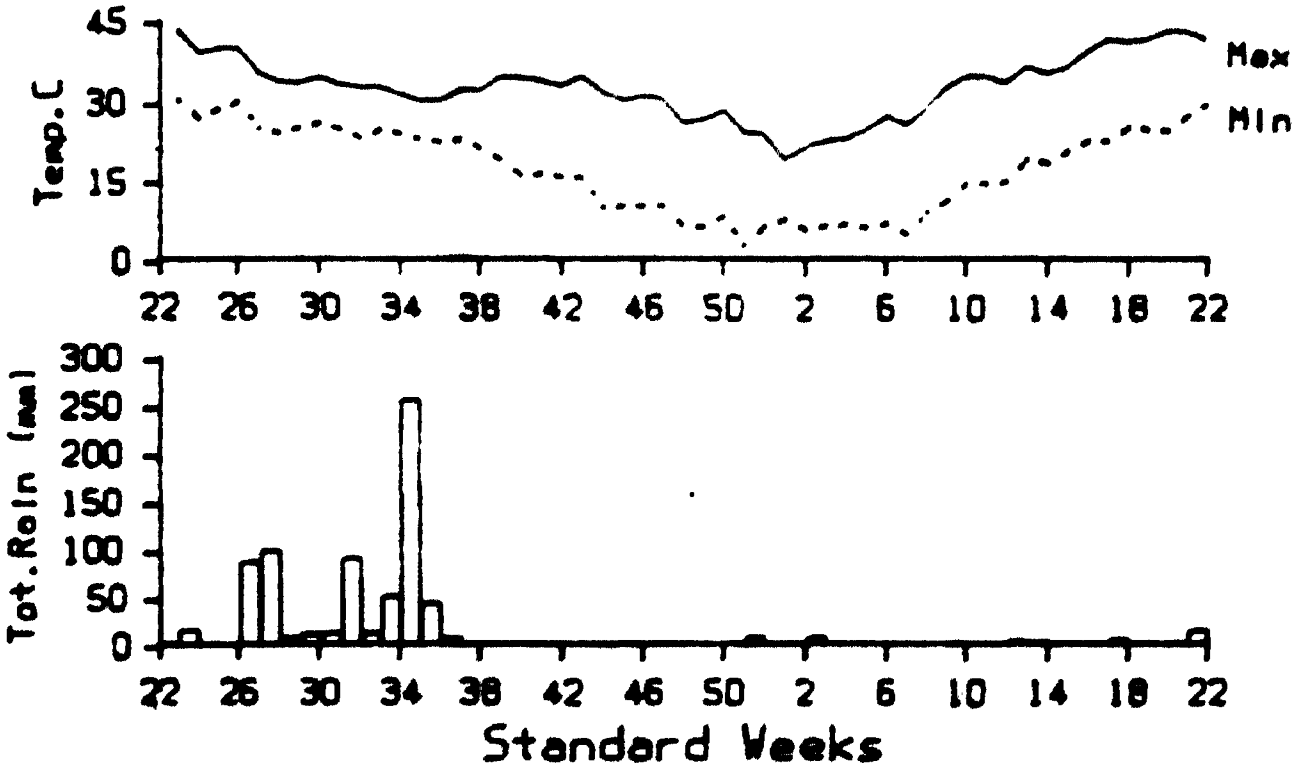


Fig 1.3. Meteorological data for ICRISAT Cooperative Center at Gwalior (June 1984 to June 1985)

## 2. Effect of sowing date and irrigation on the performance of ICPL 87

### Introduction

The experience gained over the past two years has indicated that short-duration pigeonpea has a remarkable yield potential in peninsular India. Moreover, unlike in northern India, the crop can be harvested up to three times. We obtained up to 5.2 t ha-1 in the 1982/83 season and up to 3.8 t ha-1 in the 1983/84 season from multiple harvests of short-duration genotype ICPL 87. As the potential for multiple harvests from this genotype was better than the other genotypes, ICPL 4 and ICPL 81, particular attention was paid to developing agronomy suitable for this genotype. Experiments conducted over the past two seasons have yielded information on the plant population requirements of this genotype. Also, we have obtained evidence that the first and subsequent harvest yield potential was lower when sowing was delayed. Whether the yields in the delayed sowing could be maintained with irrigation was investigated on both Alfisol and Vertisol fields during this season.

### Materials and Methods

The experiments were conducted in Alfisol (RP1A) and Vertisol (BP11C) fields at ICRISAT Center. The trials on both soils were laid on split-plot design with irrigation as main plots and sowing dates as sub-plots. There were three replications. The sub-plot size was 6 x 4 m.

Four sowings, on 11 June, 26 June, 10 July and 24 July, were carried out on both Alfisol and Vertisol fields. Sowings were done at 30 x 10 cm spacing on 60 cm ridges. The crop received a basal application of 100 kg diammonium phosphate to give 18 kg N and 20 kg P ha-1. A uniform post-sowing irrigation was given with the first sowing on both soils. Further irrigations were given to the irrigated treatment only. These were given 74, 142, 219 and 255 days after the first sowing on Alfisol and 82, 151, 220 and 256 days after the first sowing on Vertisol. Timely weeding and intensive protection were given to the crop.

At maturity of the first flush, a 3.25 m2 area was harvested from each plot for total dry matter estimation. Fresh weight and total number of plants in this sample were recorded. A further sub-sample of 5 plants was drawn. Fresh weight of sub-sample was recorded. The original sample was discarded after picking the pods. Dry weight of sub-sample (at 80°C) and yield components such as number of pods, seeds pod-1 and 100-seed mass were recorded. Pods from the remaining plants not harvested for dry matter estimation were picked by hand, leaving sufficient border plants. The yield estimates in the first, second and third harvests were made from about 18, 14 and 10 m2 area, respectively.

### Results and Discussion

The time to 50% flowering and maturity of the different flushes is given in Table 2.1. There was about 10-12 days difference in the time to 50% flowering in the first and the last sowing. More or less similar differences were seen in time to maturity of different flushes.

The data from both soils for total dry matter and yield of different flushes were analysed together as the error variances were homogenous. This enabled the comparison of productivity in different sowings and the response to irrigation on two soils to be made.

The first flush yield did not differ significantly on two soils (Table 2.2). The interactions of soil with irrigation and sowing dates were, however, significant. Generally, a greater response to irrigation was obtained on Vertisol than on Alfisol, which was surprising. In terms of response to sowing date, yield declined significantly on Alfisol with each successive delay in sowing date but on Vertisol, significant decline in yield occurred only after the 10 July sowing. The irrigation x date of sowing interaction was not significant.

The second flush yield was significantly higher on Alfisol than on Vertisol (Table 2.3). The lower second harvest yield on Vertisol is in agreement with the observations made on medium-duration pigeonpea (PPR 1981/82 Chapter 3) and on short-duration pigeonpea grown during the last season (PPR 1983/84, Chapter 2). Reasons for this appear related to differential N fixing ability of plants on two soils. The response to irrigation and the effect of date of sowing was significant. The second harvest yield declined with delay in sowing date. The soil x date of sowing interaction was significant as a result of a sharper decline in the second flush yield with delayed sowing on vertisol. There was a greater response to irrigation on Alfisol than on Vertisol, which was quite expected in view of the lower water-holding capacity of Alfisol.

The third flush yield similarly was more on Alfisol than on Vertisol (Table 2.4). The effect of date of sowing was significant on the third flush yield. The third flush yields were significantly less in the delayed sowing. The decline may be related to moisture stress. Even though response to irrigation was highly significant the overall third flush yield remained low as compared to the first sowing. The interaction of sowing date with soil was not significant for this flush.

The total yield of the three flushes was as high as 4187 kg ha-1 on Alfisol with irrigation (Table 2.5) which is comparable to that obtained in the previous season. The overall yield was significantly higher on Alfisol than on Vertisol, mainly due to higher multiple harvest yields. Significantly higher yield was obtained with irrigation, and in the first sowing. The overall response to irrigation was significantly more on Alfisol than on Vertisol. The sowing date x irrigation interaction was not significant. However, there was very little response to irrigation in the first sowing.

The effect of sowing date on dry matter production in different flushes is given in Tables 2.6 to 2.8. Sowing date significantly affected dry matter production in all the flushes. Response to irrigation was significant in the first flush, but not in the second and the third flush. Dry matter at the second and the third flush was significantly more on Alfisol than on Vertisol. Thus, in general it appears that both growth and yield are adversely affected on Vertisol during the second and third flush.

Partitioning of dry matter into seed yield during the first flush gradually increased with delay in sowing (Table 2.9). In the latest sowing, harvest index during the first flush was high, 50-60%, on two soils. There may be a slight overestimation in this as fallen leaves were not considered, but still the figures are comparable with rabi pigeonpea. Unlike the first flush, harvest index during the second flush declined significantly in the delayed sowings (Table 2.10). The effect of sowing date was not significant on harvest index during the third flush (Table 2.11). Both, on during the second flush and the third flush, harvest index was significantly more on Alfisol.

Delayed sowings caused significant reduction in the number of pods m-2 and 100-seed mass (Table 2.12). The number of seeds pod-1 was affected during the second harvest only. The 100-seed mass was more in the first flush than the second or third flush.

The results of the study indicate that yields of short-duration pigeonpea were higher on Alfisol than on Vertisol both with and without irrigation, mainly due to greater second and third harvest yields. The reasons for this appear to be related to differential N fixation ability on two soils. In the recently conducted experiments on two soils, we have found that yields of short-duration pigeonpea on vertisols are limited by N supply. Also it has been found in this study that yields of all flushes were generally more in the early sown crop than the late sown crop. In the delayed sowings, irrigation improved the seed yield, but the overall yields remained low as probably there was a limitation on biomass production related to weather conditions.

Table 2.1 Time to 50% flowering and maturity (d) of ICPL 87 sown at 4 sowing dates with irrigation (+) and without irrigation (-), Alfisol and Vertisol, ICRISAT Center, 1984/85

| Phenological stage | 10 June | | 25 June | | 10 Jul | | 25 July | |
|---|---|---|---|---|---|---|---|---|
| | Irrigation | | | | | | | |
| | - | + | - | + | - | + | - | + |
| | Alfisol | | | | | | | |
| 50% flowering | 82 | 82 | 75 | 75 | 75 | 72 | 70 | 70 |
| First flush maturity | 125 | 124 | 121 | 112 | 119 | 125 | 120 | 119 |
| Second flush maturity | 188 | 194 | 186 | 186 | 189 | 184 | 181 | 181 |
| Third flush maturity | 255 | 276 | 248 | 263 | 249 | 252 | 234 | 237 |
| | Vertisol | | | | | | | |
| 50% flowering | 82 | 82 | 77 | 77 | 76 | 71 | 75 | 72 |
| First flush maturity | 124 | 126 | 128 | 128 | 119 | 119 | 119 | 121 |
| Second flush maturity | 186 | 189 | 182 | 189 | 191 | 204 | 196 | 196 |
| Third flush maturity | 255 | 270 | 241 | 236 | 233 | 241 | 218 | 226 |

Table 2.2. Effect of sowing date on yield (kg/ha) during the first flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984-85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 2120 | 1566 | 1843 |
| | IRRG | 1993 | 1743 | 1868 |
| | MEAN | 2057 | 1654 | 1856 |
| 25 JUN | NOIRRG | 1763 | 1352 | 1557 |
| | IRRG | 1617 | 1821 | 1719 |
| | MEAN | 1690 | 1586 | 1638 |
| 10 JUL | NOIRRG | 1238 | 1306 | 1272 |
| | IRRG | 1126 | 1641 | 1383 |
| | MEAN | 1182 | 1473 | 1328 |
| 25 JUL | NOIRRG | 957 | 896 | 926 |
| | IRRG | 1344 | 957 | 1151 |
| | MEAN | 1150 | 927 | 1038 |
| MEAN | NOIRRG | 1520 | 1280 | 1400 |
| | IRRG | 1520 | 1540 | 1530 |
| | MEAN | 1520 | 1410 | 1465 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| ESE | 95.6 | 29.8* | 46.0** | 100.1* | 111.0** | 63.8 | 128.0** |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 42.2 | 65.1 | | 90.2 |
| IRR | | | | | | 65.1 | |
| SOIL.IRR | | | | | | | 92.1 |
| SOIL.DAS | | | | | | | 90.2 |
| CV % | | | | | | | 10.9 |

Table 2.3. Effect of sowing date on yield (kg/ha) during the second flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984/85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 1584 | 1305 | 1444 |
| | IRRG | 1774 | 1127 | 1451 |
| | MEAN | 1679 | 1216 | 1447 |
| 28 JUN | NOIRRG | 1020 | 672 | 846 |
| | IRRG | 1526 | 280 | 903 |
| | MEAN | 1273 | 476 | 874 |
| 10 JUL | NOIRRG | 466 | 464 | 465 |
| | IRRG | 1261 | 391 | 826 |
| | MEAN | 863 | 428 | 645 |
| 25 JUL | NOIRRG | 214 | 117 | 165 |
| | IRRG | 599 | 164 | 381 |
| | MEAN | 406 | 140 | 273 |
| MEAN | NOIRRG | 821 | 639 | 730 |
| | IRRG | 1290 | 490 | 890 |
| | MEAN | 1055 | 565 | 810 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| SED | 35.9** | 29.1* | 50.0** | 46.2** | 71.0** | 67.8 | 98.2 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 41.1 | 70.8 | | 95.9 |
| IRR | | | | | | 70.8 | |
| SOIL.IRR | | | | | | | 100.1 |
| SOIL.DAS | | | | | | | 95.9 |
| CV % | | | | | | | 21.4 |

Table 2.4. Effect of sowing date on yield (kg/ha) during the third flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984/85

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 234 | 99 | 167 |
| | IRRG | 419 | 152 | 286 |
| | MEAN | 327 | 126 | 226 |
| 25 JUN | NOIRRG | 203 | 84 | 143 |
| | IRRG | 442 | 326 | 384 |
| | MEAN | 323 | 205 | 264 |
| 10 JUL | NOIRRG | 94 | 56 | 75 |
| | IRRG | 312 | 146 | 229 |
| | MEAN | 203 | 101 | 152 |
| 25 JUL | NOIRRG | 110 | 33 | 72 |
| | IRRG | 271 | 78 | 174 |
| | MEAN | 190 | 56 | 123 |
| MEAN | NOIRRG | 160 | 68 | 114 |
| | IRRG | 361 | 176 | 268 |
| | MEAN | 261 | 122 | 191 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| SSE | 11.62** | 9.37** | 16.58** | 14.33* | 23.39 | 22.36* | 32.36 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 13.26 | 23.44 | | 31.62 |
| IRR | | | | | | 23.44 | |
| SOIL.IRR | | | | | | | 33.15 |
| SOIL.DAS | | | | | | | 31.62 |
| CV % | | | | | | | 30.0 |

Table 2.5. Effect of sowing date on total Yield (kg/ha) of all the flushes of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984-85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 3938 | 2970 | 3454 |
| | IRRG | 4187 | 3022 | 3605 |
| | MEAN | 4062 | 2996 | 3529 |
| 25 JUN | NOIRRG | 2986 | 2107 | 2546 |
| | IRRG | 3585 | 2427 | 3006 |
| | MEAN | 3285 | 2267 | 2776 |
| 10 JUL | NOIRRG | 1797 | 1826 | 1812 |
| | IRRG | 2699 | 2178 | 2438 |
| | MEAN | 2248 | 2002 | 2125 |
| 25 JUL | NOIRRG | 1280 | 1046 | 1163 |
| | IRRG | 2214 | 1199 | 1706 |
| | MEAN | 1747 | 1122 | 1435 |
| MEAN | NOIRRG | 2500 | 1987 | 2244 |
| | IRRG | 3171 | 2206 | 2689 |
| | MEAN | 2836 | 2097 | 2466 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| ESE | 123.8* | 52.9** | 86.9** | 134.6* | 163.2** | 118.8 | 201.9 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 74.9 | 122.8 | | 168.0 |
| IRR | | | | | | 122.8 | |
| SOIL.IRR | | | | | | | 173.7 |
| SOIL.DAS | | | | | | | 168.0 |
| CV % | | | | | | | 12.2 |

Table 2.6. Effect of sowing date on total dry matter (kg/ha) during the first flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984-85

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 7096 | 6109 | 6602 |
| | IRRG | 6049 | 6553 | 6301 |
| | MEAN | 6572 | 6331 | 6452 |
| 25 JUN | NOIRRG | 5175 | 4661 | 4918 |
| | IRRG | 6436 | 5153 | 5795 |
| | MEAN | 5805 | 4907 | 5356 |
| 10 JUL | NOIRRG | 2899 | 3847 | 3373 |
| | IRRG | 4770 | 4024 | 4397 |
| | MEAN | 3835 | 3935 | 3885 |
| 25 JUL | NOIRRG | 1958 | 1663 | 1810 |
| | IRRG | 3182 | 2122 | 2652 |
| | MEAN | 2570 | 1893 | 2231 |
| MEAN | NOIRRG | 4282 | 4070 | 4176 |
| | IRRG | 5109 | 4463 | 4786 |
| | MEAN | [illegible] | 4267 | 4481 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| SSE | 393.1 | 152.1* | 236.7** | 421.5 | 488.4 | 327.4 | 588.0 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 215.1 | 334.8 | | 463.0 |
| IRR | | | | | | 334.8 | |
| SOIL.IRR | | | | | | | 473.4 |
| SOIL.DAS | | | | | | | 463.0 |
| CV % | | | | | | | 18.3 |

Table 2.7. Effect of sowing date on total dry matter (kg ha⁻¹) during the second flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984-85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 5641 | 3613 | 4627 |
| | IRRG | 5504 | 4061 | 4783 |
| | MEAN | 5572 | 3837 | 4705 |
| 25 JUN | NOIRRG | 3588 | 2591 | 3089 |
| | IRRG | 4547 | 2652 | 3600 |
| | MEAN | 4067 | 2622 | 3344 |
| 10 JUL | NOIRRG | 1733 | 1981 | 1857 |
| | IRRG | 2692 | 2253 | 2472 |
| | MEAN | 2212 | 2117 | 2165 |
| 25 JUL | NOIRRG | 1177 | 831 | 1004 |
| | IRRG | 1850 | 1037 | 1443 |
| | MEAN | 1513 | 934 | 1224 |
| MEAN | NOIRRG | 3034 | 2254 | 2644 |
| | IRRG | 3648 | 2501 | 3074 |
| | MEAN | 3341 | 2377 | 2859 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| ESE | 174.9* | 126.2 | 146.8** | 215.7 | 250.8** | 219.6 | 333.4 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 178.5 | 207.6 | | 310.6 |
| IRR | | | | | | 237.6 | |
| SOIL.IRR | | | | | | | 293.5 |
| SOIL.DAS | | | | | | | 310.6 |
| CV % | | | | | | | 17.8 |

Table 2.9 Effect of [illegible] ing d[illegible] [illegible] during the [illegible] flush of ICPL 87 grown with and [illegible] Alfisol an[illegible]

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 3298 | 1865 | 2581 |
| | IRRG | 2603 | 2066 | 2334 |
| | MEAN | 2950 | 1965 | 2458 |
| 25 JUN | NOIRRG | 1886 | 1217 | 1552 |
| | IRRG | 2795 | 2128 | 2462 |
| | MEAN | 2341 | 1672 | 2007 |
| 10 JUL | NOIRRG | 838 | 1098 | 968 |
| | IRRG | 1860 | 1934 | 1897 |
| | MEAN | 1349 | 1516 | 1433 |
| 25 JUL | NOIRRG | 916 | 486 | 701 |
| | IRRG | 1584 | 985 | 1285 |
| | MEAN | 1250 | 736 | 993 |
| MEAN | NOIRRG | 1735 | 1167 | 1451 |
| | IRRG | 2211 | 1778 | 1994 |
| | MEAN | 1973 | 1472 | 1722 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| ESE | 97.7* | 160.0 | 141.2* | 187.5 | 198.7 | 235.7* | 308.2 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 226.3 | 199.7 | | 333.3 |
| IRR | | | | | | 199.7 | |
| SOIL.IRR | | | | | | | 282.5 |
| SOIL.DAS | | | | | | | 333.3 |
| CV % | | | | | | | 28.4 |

Table 2.9. Effect of sowing date on harvest index (%) of the first flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984/85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 30.0 | 26.1 | 28.0 |
| | IRRG | 33.5 | 26.8 | 30.2 |
| | MEAN | 31.8 | 26.4 | 29.1 |
| 25 JUN | NOIRRG | 40.5 | 29.1 | 34.8 |
| | IRRG | 25.1 | 36.5 | 30.8 |
| | MEAN | 32.8 | 32.8 | 32.8 |
| 10 JUL | NOIRRG | 42.6 | 34.1 | 38.4 |
| | IRRG | 23.5 | 40.8 | 32.2 |
| | MEAN | 33.0 | 37.5 | 35.3 |
| 25 JUL | NOIRRG | 50.0 | 61.5 | 55.7 |
| | IRRG | 42.4 | 47.1 | 44.8 |
| | MEAN | 46.2 | 54.3 | 50.3 |
| MEAN | NOIRRG | 40.8 | 37.7 | 39.2 |
| | IRRG | 31.1 | 37.8 | 34.5 |
| | MEAN | 36.0 | 37.7 | 36.8 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| SEM | 3.73 | 1.39 | 3.30** | 3.98 | 5.50 | 4.27 | 6.96 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 1.97 | 4.66 | | 6.04 |
| IRR | | | | | | 4.66 | |
| SOIL.IRR | | | | | | | 6.59 |
| SOIL.DAS | | | | | | | 6.04 |
| CV % | | | | | | | 31.8 |

Table 2.10. Effect of sowing date on harvest index (%) of the second flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984 85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 28.1 | 35.9 | 32.0 |
| | IRRG | 32.8 | 27.6 | 30.2 |
| | MEAN | 30.4 | 31.7 | 31.1 |
| 25 JUN | NOIRRG | 28.3 | 26.9 | 27.6 |
| | IRRG | 33.8 | 10.6 | 22.2 |
| | MEAN | 31.1 | 18.7 | 24.9 |
| 10 JUL | NOIRRG | 28.2 | 23.6 | 25.9 |
| | IRRG | 50.6 | 17.3 | 34.0 |
| | MEAN | 39.4 | 20.4 | 29.9 |
| 25 JUL | NOIRRG | 18.2 | 14.1 | 16.1 |
| | IRRG | 34.3 | 15.7 | 25.0 |
| | MEAN | 26.2 | 14.9 | 20.6 |
| MEAN | NOIRRG | 25.7 | 25.1 | 25.4 |
| | IRRG | 37.9 | 17.8 | 27.8 |
| | MEAN | 31.8 | 21.4 | 26.6 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| ESE | 2.332* | 1.661 | 1.575** | 2.863* | 3.026** | 2.546** | 3.954 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 2.349 | 2.227 | | 3.600 |
| IRR | | | | | | 2.227 | |
| SOIL.IRR | | | | | | | 3.150 |
| SOIL.DAS | | | | | | | 3.600 |
| CV % | | | | | | | 20.5 |

Table 2.11. Effect of sowing date on harvest index (%) of the third flush of ICPL 87 grown with and without irrigation on Alfisol and Vertisol, ICRISAT Center, rainy season 1984/85.

| DAS | SOIL / IRR | ALFISOL | VERTISOL | MEAN |
|---|---|---|---|---|
| 11 JUN | NOIRRG | 7.9 | 5.5 | 6.7 |
| | IRRG | 17.6 | 7.7 | 12.7 |
| | MEAN | 12.8 | 6.6 | 9.7 |
| 25 JUN | NOIRRG | 10.7 | 7.0 | 8.9 |
| | IRRG | 16.2 | 15.7 | 16.0 |
| | MEAN | 13.4 | 11.4 | 12.4 |
| 10 JUL | NOIRRG | 10.9 | 5.3 | 8.1 |
| | IRRG | 17.0 | 8.0 | 12.5 |
| | MEAN | 14.0 | 6.6 | 10.3 |
| 25 JUL | NOIRRG | 12.0 | 10.7 | 11.4 |
| | IRRG | 17.0 | 7.8 | 12.4 |
| | MEAN | 14.5 | 9.3 | 11.9 |
| MEAN | NOIRRG | 10.4 | 7.1 | 8.8 |
| | IRRG | 17.0 | 9.8 | 13.4 |
| | MEAN | 13.7 | 8.5 | 11.1 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | IRR | DAS | SOIL IRR | SOIL DAS | IRR DAS | SOIL IRR DAS |
|---|---|---|---|---|---|---|---|
| ESE | 0.532** | 0.803* | 1.214 | 0.963 | 1.580 | 1.690 | 2.313 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 1.136 | 1.717 | | 2.391 |
| IRR | | | | | | 1.717 | |
| SOIL.IRR | | | | | | | 2.429 |
| SOIL.DAS | | | | | | | 2.391 |
| CV % | | | | | | | 38.8 |

Table 2.12 Effect of date of sowing on the yield components of a short-duration pigeonpea genotype ICPL 87 (pooled data of an Alfisol and a Vertisol with and without irrigation), ICRISAT Center, 1984/85.

| Yield component | Date of sowing | | | | SE |
|---|---|---|---|---|---|
| | 11 Jun | 25 Jun | 10 Jul | 25 Jul | |
| No. of pods m-2 | | | | | |
| First harvest | 579 | 551 | 461 | 432 | 27.2** |
| Second harvest | 556 | 324 | 277 | 151 | 23.1** |
| Third harvest | 151 | 187 | 118 | 99 | 19.9 |
| No. of seeds pod-1 | | | | | |
| First harvest | 3.37 | 3.34 | 3.58 | 2.87 | 0.242 |
| Second harvest | 2.75 | 2.82 | 2.69 | 2.21 | 0.092* |
| Third harvest | 2.20 | 2.28 | 2.36 | 2.11 | 0.164 |
| 100-seed mass (g) | | | | | |
| First harvest | 9.88 | 8.96 | 8.84 | 8.63 | 0.352 |
| Second harvest | 9.49 | 9.40 | 8.60 | 7.97 | 0.243** |
| Third harvest | 7.32 | 6.57 | 5.91 | 5.81 | 0.397* |

## 3. Effect of harvest methods on the second flush yield of short-duration pigeonpea

### Introduction

Short-duration pigeonpea can give up to three harvests in environments with mild winters (e.g. minimum temperature above 10°C) such as those prevailing in peninsular India (PPR 1982/83 Chapter I). This is mainly due to the short time (about 120 days) taken to produce the first flush and the strong perennial nature of pigeonpea. The seed yield in this multiple harvest system may reach 5.2 t ha-1.

We have earlier reported that the second harvest yield of medium-duration pigeonpea was significantly influenced by the method of harvesting of the first flush (PPR 1977/78 Chapter 4; PPR 1979/80 Chapter 5). However, information on harvest methods suitable for short-duration pigeonpea is lacking. The objective of this study was to obtain this information.

### Materials and Methods

The experiments were conducted on an Alfisol (Udic Rhodustalf) and a Vertisol (Typic Pellustert) at ICRISAT Center in 1984/5. The Alfisols generally hold less than 100 mm plant-available water, and the Vertisols about 250 mm. A basal dose of 100 kg/ha diammonium phosphate (18%N and 20% P) was applied to both soils just prior to sowing.

On both soils two short-duration genotypes, ICPL 81 (indeterminate) and ICPL 87 (determinate), were sown on 15 June 1984 on both sides of 0.6 m ridges at a 0.3 x 0.1 m spacing. At first-flush maturity the following three harvest-method treatments were applied to the crop which had grown about 1 m tall: (1) cutting off the shoots at 0.6m above ground level (ratooning), (2) hand picking the mature pods on the plant, and (3) no harvest (single-harvest only at the second-flush maturity). The experimental treatments of harvest methods and genotypes were laid out in a randomized block design. There were four replications on each soil and the plot size was 6 x 4 m. On both soils, about 19 $m^2$ per plot was harvested for yield estimation. The experiment on the Alfisol was irrigated 70 and 140 days after sowing (DAS) and that on the Vertisol at 77 and 147 DAS. Labour records were kept during the first harvest. In all the treatments, at the second-flush maturity, all pods of plants were harvested by cutting the stems at ground level. All harvested material was threshed by machine and the seed was sun-dried to a moisture content of 8-9% before weighing. The pods that dropped off, mainly during the second flush and its harvest, were also carefully collected and threshed, and their seed yield was included in the second-flush yield of the ratooning and hand picking treatments, and in the total yield of the single-harvest treatment.

## Results and Discussion

For ICPL 81, the first flush of flowering commenced 73 DAS and the pods matured at 115 DAS (Table 3.1). For ICPL 87, flowering commenced at 78 DAS and pods matured at 120 DAS. In all treatments a second flush of pods was produced. Although little rain was received after first flush maturity, the second flush of flowers was supported by stored soil moisture and one irrigation. The second flush of ICPL 81 matured at 90 DAS and of ICPL 87 at 196 DAS in both hand picking and single-harvest treatments. However, the second flush in the ratooning treatment reached maturity 220 DAS in both genotypes. This delay can be attributed to the fact that the flowers in the ratooning treatments developed on new shoots, whereas on intact plants, flowering began on existing shoots soon after the maturity of the first flush.

The error variances for effect of harvest method on yield of first and second flush, total yield, total dry matter at the second flush maturity, and the yield loss due to pod drop on both the Alfisol and the Vertisol were homogeneous, and hence data for the two soils were analysed together (Tables 3.2 to 3.8).

The first-harvest yield of ICPL 81 was significantly lower than for ICPL 87 (Table 3.2). The poor yield of ICPL 81 may be due to its poor emergence, which was 57% on the Vertisol and 32% on the Alfisol, compared with 80% of ICPL 87 on both soils (Table 3.3). Nevertheless, the first-harvest yield of ICPL 81 did not differ significantly between the two soils, which may be due to its plasticity. In an experiment using different plant population densities, a seed yield increase of only 5% of was observed in ICPL 81 when its population was increased from 16 plants/m to 42 plants/m. In both genotypes, the first-harvest yield was similar for both ratooning and hand picking. For the second-harvest yield, the interaction between the harvest method and genotype was highly significant (Table 3.4). The second-harvest yield of ICPL 87 was significantly lower when harvested by ratooning than by hand picking, whereas for ICPL 81 there was no significant difference between first-flush harvest methods (Table 3.3). ICPL 87 has a greater leaf area than ICPL 81 at maturity of the first flush (unpublished results) and may have consequently suffered more from the ratooning.

It appears that the regrowth period at ICRISAT Center, which is in an essentially semi-arid tropical (SAT) environment, was perhaps insufficient for the compensatory regrowth of the ratooned plants. This was reflected in the lower dry matter of ratooned plants at the second-flush maturity than plants in the hand picking treatment (Tables 3.5 and 3.6). Whether a longer regrowth period would enable higher yields in ratooned plants than hand picked plants in a SAT environment is not known. However, it seems important to examine this, particularly since ratooning was much less labour intensive than hand picking. In the present study, the labour requirement (number of man days/ha) for harvesting the first-flush by ratooning was 31 for ICPL 81 and 56 for ICPL 87, as compared with a hand picking requirement of 243 for ICPL 81 and 211 for ICPL 87 (Table 3.7).

In the treatment where harvesting of the first-flush of pods was delayed until the second flush of pods had matured, in both genotypes the total yield obtained in the single harvest was similar to the yield of two separate harvests in the hand picking treatment (Table 3.8). In ICPL 87 it was significantly more than the total yield of the ratooning treatment. This suggests that the presence of mature first-flush pods does not affect the formation of pods in the second flush. This harvest method, therefore, had an advantage over hand picking and ratooning, as the yield was not lowered, while there was no labour requirement for a first-flush harvest. Thus, unless one wants to harvest the crop earlier, both flushes may be harvested together. However, in the single-harvest treatment there was a slightly greater yield loss in the form of increased dropping of pods. There is also a possibility of rain, diseases, and insects damaging the crop when mature pods are left on the plants.

Table 3.1. Days to flowering and maturity of cv. ICPL 81 and ICPL 87 in ratooning (R) and hand pod picking (H) treatments, mean values for Alfisol and Vertisol, ICRISAT Center, 1983/84.

| | ICPL 81 | | ICPL 87 | |
|---|---|---|---|---|
| Phenological stage | R | H | R | H |
| Days to 50% flowering | 73 | 73 | 78 | 78 |
| Days to first flush maturity | 115 | 115 | 120 | 120 |
| Days to second flush maturity | 220 | 190 | 220 | 195 |

Table 3.2. Effect of method of first flush harvest on first flush seed yield (kg/ha) of ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center rainy season 1984/85

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 1379 | 1323 | 1351 |
| | ICPL 87 | 1934 | 2135 | 2033 |
| | MEAN | 1656 | 1729 | 1693 |
| RATOON | ICPL 81 | 1376 | 1275 | 1325 |
| | ICPL 87 | 2033 | 2348 | 2190 |
| | MEAN | 1704 | 1812 | 1758 |
| COMB HAR | ICPL 81 | 0 | 0 | 0 |
| | ICPL 87 | 0 | 0 | 0 |
| | MEAN | 0 | 0 | 0 |
| MEAN | ICPL 81 | 1377 | 1299 | 1338 |
| | ICPL 87 | 1983 | 2242 | 2112 |
| | MEAN | 1680 | 1770 | 1725 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | 37.1 | 37.3** | 37.3 | 94.8** | 94.9 | 52.7 | 108.4 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF | | | | | | | |
| SOIL | | | | 52.7 | 52.7 | | 74.5 |
| SOIL.GENO | | | | | | | 74.5 |
| SOIL.HMETHOD | | | | | | | 74.5 |
| CV% | | | | | | | 9.6 |

Table 3.3. Effect of method of first flush harvest on plants/m2 at first flush on ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center rainy season 1984/85.

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 17 | 11 | 14 |
| | ICPL 87 | 26 | 26 | 26 |
| | MEAN | 21 | 19 | 20 |
| RATOON | ICPL 81 | 20 | 10 | 15 |
| | ICPL 87 | 27 | 27 | 27 |
| | MEAN | 24 | 19 | 21 |
| COMB HAR | ICPL 81 | 0 | 0 | 0 |
| | ICPL 87 | 0 | 0 | 0 |
| | MEAN | 0 | 0 | 0 |
| MEAN | ICPL 81 | [illegible] | 11 | 15 |
| | ICPL 87 | [illegible] | [illegible] | 27 |
| | MEAN | [illegible] | [illegible] | 21 |

EFFECTIVE STANDARD ERROR OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | [illegible] | 0.473** | 0.463 | 1.577** | 1.577 | 0.654 | 1.707 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF | | | | | | | |
| SOIL | | | | 0.654 | 0.654 | | 0.925 |
| SOIL.GENO | | | | | | | 0.925 |
| SOIL.HMETHOD | | | | | | | 0.925 |
| CV% | | | | | | | 8.6 |

Table 3.4. Effect of method of first flush harvest on second flush seed yield (kg ha⁻¹) on ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center rainy season 1984/85

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 577 | 728 | 653 |
| | ICPL 87 | 1243 | 1694 | 1468 |
| | MEAN | 910 | 1211 | 1061 |
| RATOON | ICPL 81 | 466 | 628 | 547 |
| | ICPL 87 | 524 | 1037 | 780 |
| | MEAN | 495 | 832 | 664 |
| COMB HAR | ICPL 81 | 0 | 0 | 0 |
| | ICPL 87 | 0 | 0 | 0 |
| | MEAN | 0 | 0 | 0 |
| MEAN | ICPL 81 | 522 | 678 | 600 |
| | ICPL 87 | 883 | 1365 | 1124 |
| | MEAN | 703 | 1022 | 862 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | 53.4** | 35.4** | 35.4** | 64.1** | 64.1 | 50.1** | 81.3 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 50.1 | 50.1 | | 70.8 |
| SOIL.GENO | | | | | | | 70.8 |
| SOIL.HMETHOD | | | | | | | 70.8 |
| CV% | | | | | | | 16.4 |

Table 3.5. Effect of method of first flush harvest on first flush total dry matter [illegible] of ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center rainy season [illegible]

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 2783 | 2696 | 2739 |
| | ICPL 87 | 4007 | 4877 | 4442 |
| | MEAN | 33[illegible]5 | 3786 | 3591 |
| RATOON | ICPL 81 | 2231 | 2261 | 2246 |
| | ICPL 87 | 2872 | 3673 | 3272 |
| | MEAN | 2552 | 2967 | 2759 |
| COMB HAR | ICPL 81 | 0 | 0 | 0 |
| | ICPL 87 | 0 | 0 | 0 |
| | MEAN | [illegible] | 0 | 0 |
| MEAN | ICPL 81 | 250[illegible] | 2[illegible]8 | 2493 |
| | ICPL 87 | 34[illegible] | 4[illegible]5 | [illegible] |
| | MEAN | [illegible] | [illegible] | 31[illegible]5 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | 120.3 | 41.5** | 8[illegible].5** | 145.3** | 145.3 | [illegible]5.3** | 135.[illegible] |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF | | | | | | | |
| SOIL | | | | 1[illegible]5.3 | 115.3 | | 163.[illegible] |
| SOIL.GENO | | | | | | | 163.[illegible] |
| SOIL.HMETHOD | | | | | | | 163.[illegible] |
| CV% | | | | | | | 10.[illegible] |

Table 3.[illegible] Effect of method of first flush harvest on total stem dry matter (kg ha[illegible]) at second flush on ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center, rainy season 19[illegible]

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 220[illegible] | 1968 | 2087 |
| | ICPL 87 | 276[illegible] | 3183 | 2973 |
| | MEAN | 2485 | 2575 | 2530 |
| RATOON | ICPL 81 | 1765 | 1633 | 1699 |
| | ICPL 87 | 2348 | 2637 | 2492 |
| | MEAN | 205[illegible] | 2135 | 2096 |
| COMB HAR | ICPL 81 | 0 | 0 | 0 |
| | ICPL 87 | 0 | 0 | 0 |
| | MEAN | 0 | 0 | 0 |
| MEAN | ICPL 81 | 198[illegible] | 180[illegible] | 1893 |
| | ICPL 87 | 255[illegible] | 291[illegible] | 2733 |
| | MEAN | 2271 | 2355 | 23[illegible] |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | [illegible]2 | 80.0** | 82.0** | 102.1** | 102.1 | 9[illegible] | 132.7 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF | | | | | | | |
| SOIL | | | | [illegible].5 | 84.8 | | 119.9 |
| SOIL.GENO | | | | | | | 119.9 |
| SOIL.HMETHOD | | | | | | | 119.9 |
| CV% | | | | | | | 15.4 |

**Table 3.7.** Effect of method of first flush harvest on mandays for first harvest on ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center rainy season 198[illegible]

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 258 | 227 | 243 |
| | ICPL 87 | 248 | 174 | 211 |
| | MEAN | 253 | 201 | 227 |
| RATOON | ICPL 81 | 29 | 33 | 31 |
| | ICPL 87 | 3[illegible] | 77 | 56 |
| | MEAN | 32 | 55 | 43 |
| COMB HAR | ICPL 81 | 0 | 0 | 0 |
| | ICPL 87 | 0 | 0 | 0 |
| | MEAN | 0 | 0 | 0 |
| MEAN | ICPL 81 | [illegible] | [illegible] | 137 |
| | ICPL 87 | [illegible] | 126 | 133 |
| | MEAN | [illegible] | 128 | 135 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | 7.15 | [illegible] | 6.29** | 9.52 | 9.52** | [illegible]** | 13.03** |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 8.89 | 8.[illegible] | | 12.58 |
| SOIL.GENO | | | | | | | 12.58 |
| SOIL.HMETHOD | | | | | | | 12.58 |
| CV% | | | | | | | 18.6 |

Table 3.8. Effect of method of first flush harvest on total (first+second) flush yield (kg ha-1) on ICPL 87 and ICPL 81 grown on Alfisol and Vertisol, ICRISAT Center rainy season 1984/85

| HMETHOD | SOIL / GENO | VERTISOL | ALFISOL | MEAN |
|---|---|---|---|---|
| HANDPICK | ICPL 81 | 1956 | 2051 | 2004 |
| | ICPL 87 | 3177 | 3829 | 3503 |
| | MEAN | 2566 | 2940 | 2753 |
| RATOON | ICPL 81 | 1842 | 1902 | 1872 |
| | ICPL 87 | 2557 | 3385 | 2971 |
| | MEAN | 2199 | 2644 | 2421 |
| COMB HAR | ICPL 81 | 1747 | 2380 | 2064 |
| | ICPL 87 | 3260 | 3786 | 3523 |
| | MEAN | 2503 | 3083 | 2793 |
| MEAN | ICPL 81 | 1848 | 2111 | 1980 |
| | ICPL 87 | 2998 | 3667 | 3332 |
| | MEAN | 2423 | 2889 | 2656 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | SOIL | GENO | HMETHOD | SOIL GENO | SOIL HMETHOD | GENO HMETHOD | SOIL GENO HMETHOD |
|---|---|---|---|---|---|---|---|
| ESE | 83.4** | 45.0** | 55.2** | 94.7** | 104.9 | 78.0* | 130.7* |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | | | | | |
| SOIL | | | | 63.7 | 78.0 | | 110.3 |
| SOIL.GENO | | | | | | | 110.3 |
| SOIL.HMETHOD | | | | | | | 110.3 |
| CV% | | | | | | | 8.3 |

## 4. Comparison of growth and yield of short-duration genotypes in the Hisar and Hyderabad environments

### Introduction

The growth of short-duration pigeonpea genotypes is generally better in the Hisar environment than at ICRISAT Center although there may not be large differences in yield at the two places (PPR 1982/83, Chapter 2). Part of the growth differences appear to be due to prolonged duration at Hisar, probably due to the long photoperiod and warm temperatures. The high temperatures may not only delay flowering, but may affect the growth rates as well. The growth of pigeonpea at Hisar and Patancheru has been compared by comparing total dry matter accumulated at maturity. A sequential destructive sampling may help comparing the differences in crop growth at different stages. We compared the growth and yield of short-duration pigeonpea grown at Hisar and Patancheru to understand whether indeed pigeonpea has higher growth rates at Hisar. At Patancheru, for comparison, a medium-duration pigeonpea genotype was also included.

### Materials and Methods

The experiments were conducted on Alfisol (RP1A) Vertisol (BP11C) at ICRISAT Center and on Entisol (Field # 8) at Hisar. The trial was laid out in a randomized block design with three replications at ICRISAT Center and four replications at Hisar. The plot size was 9 x 6 m. At ICRISAT Center a basal dose of 100 kg diammonium phosphate ha-1 was applied in both the soils.

At ICRISAT Center three cultivars, ICPL 87 (determinate), ICPL 81 (indeterminate) and BDN 1 were sown on 14 June 1984 on Vertisol and 15 June 1984 on Alfisol. ICPL 87 and ICPL 81 were sown at 30 cm row-to-row spacing on both sides of the 60 cm ridges. BDN 1 was planted on the top of each ridge. At Hisar three genotypes, ICPL 81, ICPL 87 and ICPL 161 (indeterminate) were planted on 19 July 1984 on both sides of 60 cm ridges at 30 cm row-to-row and 10 cm plant-to-plant spacing.

Destructive growth analysis from 1.4-3.24 m2 area was carried out at 20-40 days intervals. At Hisar destructive growth analysis was carried out from 2.7 m2 area at 15 days intervals. Days to 50% flowering and maturity of each genotype were recorded at each place.

At ICRISAT Center, the first and second flush was harvested by picking the pods by hand in ICPL 87 and ICPL 81 and the crop was removed from the ground at the third harvest. At Hisar, the crop was cut at the ground level at the first harvest itself. At maturity of each flush, 12-18 m2 area was harvested to estimate yield, total dry matter and the components of yield.

## Results and Discussion

At both ICRISAT Center and Hisar, short-duration genotypes took 72-78 days to flower (Table 4.1). However, time taken to maturity was longer at Hisar than at ICRISAT Center. The length of reproductive phase was therefore more at Hisar than at ICRISAT Center; it was 39-44 days at ICRISAT Center and 66-83 days at Hisar. The length of reproductive phase for BDN 1, the medium duration genotype grown at ICRISAT Center only, was 70 days.

The typical growth patterns obtained for all the genotypes are given in Fig. 4.1-4.3. At Hisar, the total dry matter accumulated by maturity was 750 g m-2 for ICPL 81, and 900 g m-2 by ICPL 87 and ICPL 161. The greater dry matter accumulated by ICPL 87 and ICPL 161 may be due to their slightly longer duration than ICPL 81. At ICRISAT Center the dry matter production of ICPL 81 was very low, due to low plant stand (Fig. 4.2-4.3). ICPL 87, which had reasonable stand, grew better than ICPL 81 at ICRISAT Center. Nevertheless it was still not comparable to its growth at Hisar. The dry matter accumulation rates were higher at Hisar than at ICRISAT Center for ICPL 87. This observation is in conformity with our earlier observation that growth of pigeonpea at Hisar is better, probably due to warmer weather and greater sunshine hours (PPR 1982/83, Chapter 2). The rates of growth for BDN 1 were higher at the later stages due to its longer vegetative growth phase.

Within the two soils at ICRISAT Center, the dry matter production of ICPL 87 and BDN 1 was better on Alfisol than on Vertisol. The reason for this may be better soil aeration and nitrogen fixation on Alfisol.

The maximum leaf area indices attained for all the three genotypes, ICPL 81, ICPL 87 and ICPL 161 were between 4-6 at Hisar (Fig. 4.1). The leaf area retained at maturity was maximum in ICPL 87 followed by ICPl 161 and least in ICPL 81. This indicates that ICPL 87 has lower leaf senescence. At ICRISAT Center, only BDN 1 attained a maximum leaf area index of about 5. The leaf area index of ICPL 81 was very low due to the low plant stand (Fig. 4.2, 4.3). On Alfisol, the maximum leaf area index was higher than on Vertisol, except in the case of ICPL 81.

The plant height, no. of primary branches etc. are given in Table 4.2. Plant height at maturity in the short-duration genotypes was higher at Hisar, than at Patancheru. The determinate genotype ICPL 87 attained less height at all the locations and had fewer branches.

The dry matter (air dry) and seed yields harvested at Hisar are given in Table 4.3. Total air dry matter was up to 25,700 kg ha-1 in ICPL87 which was higher than the other two genotypes ICPL81 and ICPL161, but its seed yield of this genotype was only 2700 kg ha-1.

At ICRISAT Center harvests of grain were made at the different times. The yield, total dry matter, and plant stand is given in Tables 4.4 and 4.5. In the October harvest no yield was obtained from BDN 1 as it was just beginning to flower then. In the December harvest, when BDN 1 had matured, the second flush of ICPL 81 and ICPL 87 had also matured. In March, a second harvest of BDN 1 and a third harvest of short-duration genotypes was taken (Table 4.4). The total yield was maximum in ICPL 87 on both soils followed by BDN 1. The advantage of yield was particularly greater in ICPL 87 if only two harvests are considered. ICPL 81 was poor yielding mainly due to poor stand (Table 4.5). From the point of view of dry matter production, BDN 1 was superior in both December and March harvests to the short-duration genotypes.

In terms of per day grain productivity at Hisar, ICPL 81 was sûperior followed by ICPL 87 (Table 4.6). The per day productivity at ICRISAT Center on Alfisol was better for ICPL 87 than at Hisar but for ICPL 81 it was inferior at ICRISAT Center. The per day productivity at ICRISAT Center was better on Alfisol for ICPL 87 and BDN 1. The per day productivity of ICPL 87 was greater during the second harvest than the first harvest. The per day productivity was very low during the third harvest.

The results of the study confirm that growth of pigeonpea is better at Hisar both due to higher growth rates and longer duration. The slower growth at ICRISAT Center may be due to both lower temperatures as well as poor soil conditions, such as those on Vertisols. Under nonlimiting moisture conditions on Alfisols short-duration pigeonpea has better yield potential than MDP.

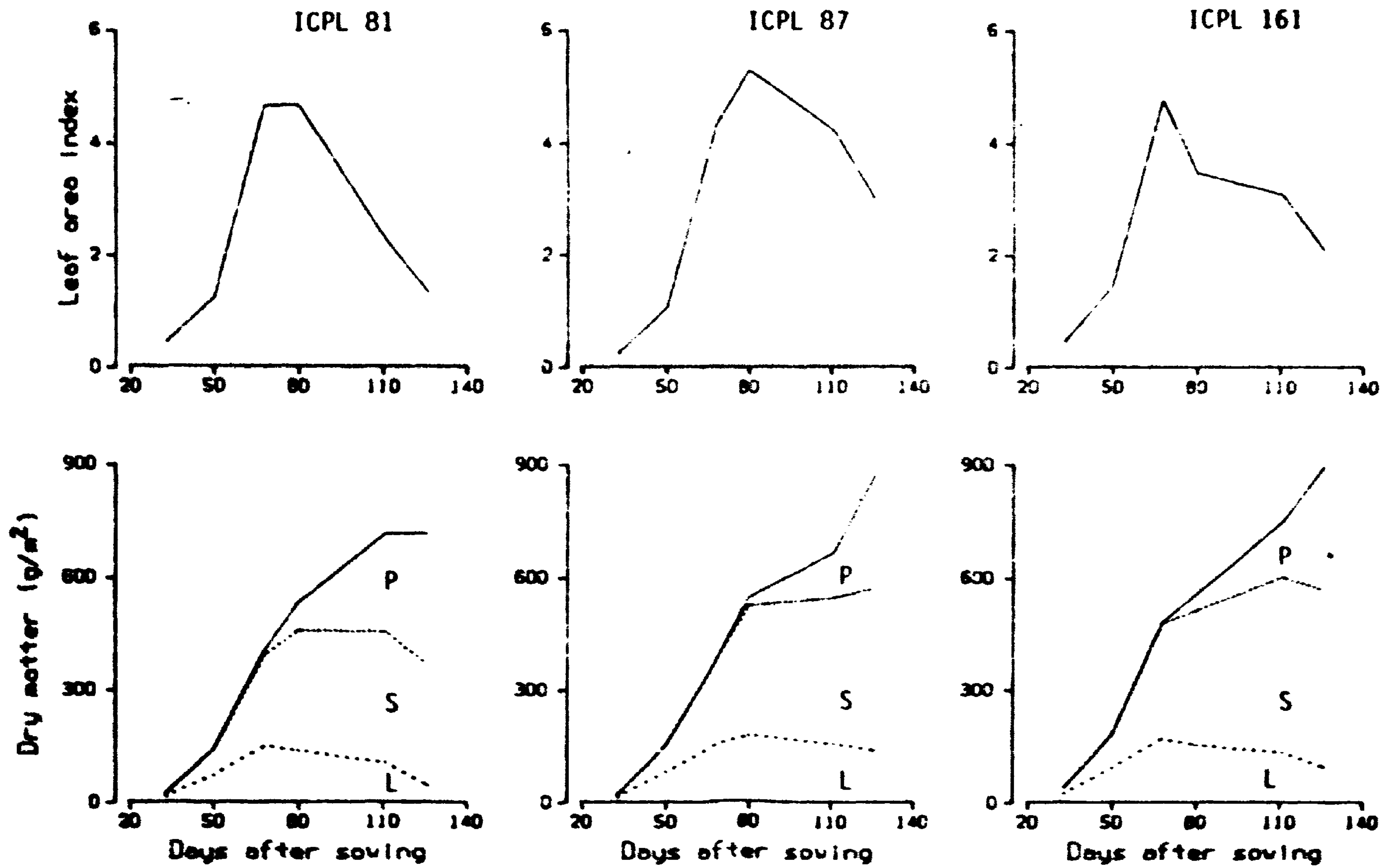


Figure 4.1. Dry matter accumulation and leaf area index at different days after sowing of three short-duration Pegeonpea genotypes, ICPL 81, ICPL 87 and ICPL 161 grown at Hisar, rainy season, 1984/85.

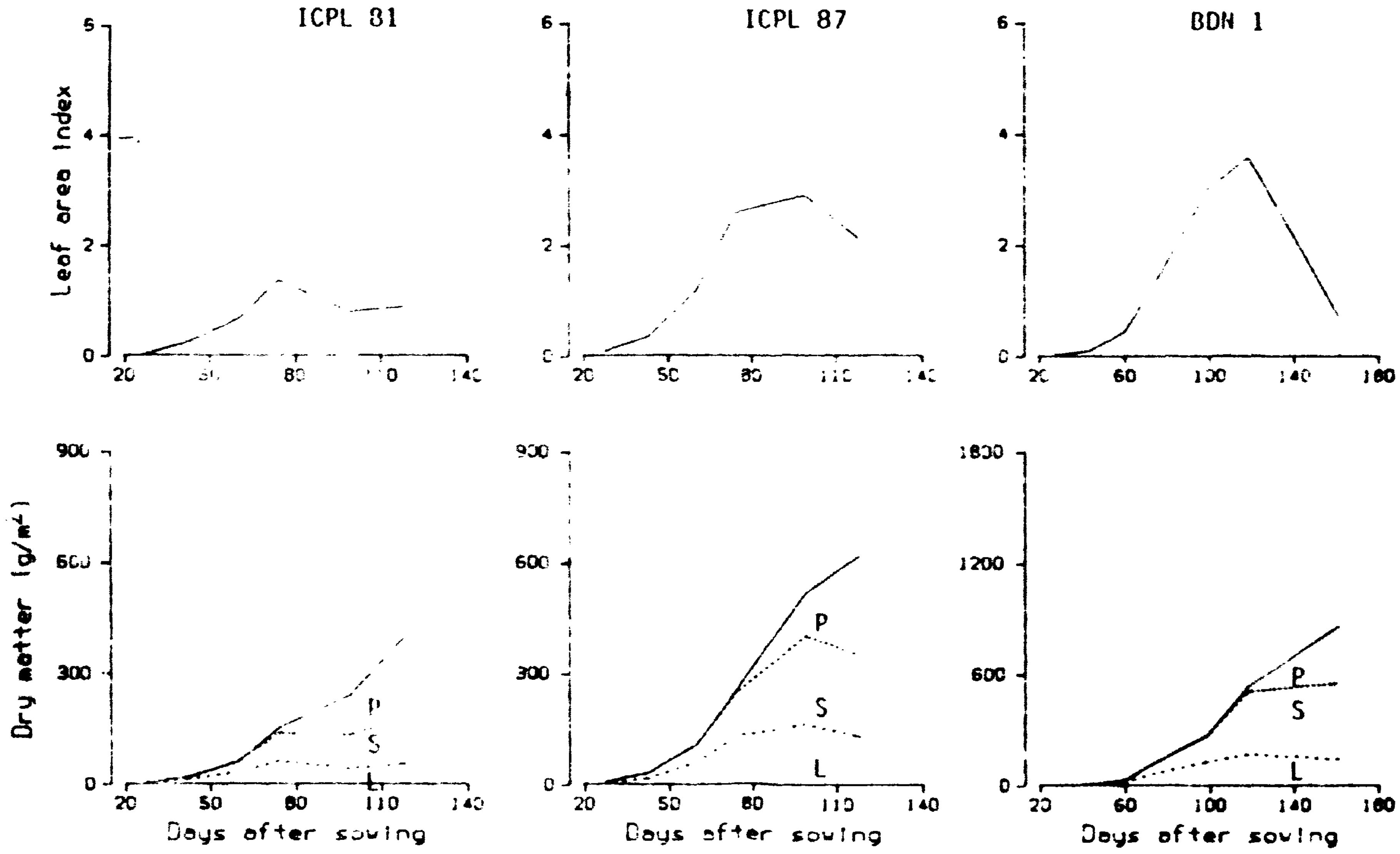


Figure 4.2. Dry matter accumulation and leaf area indix at different days after sowing of three Pigeonpea genotypes ICPL 81, ICPL 87 and BDN 1 grown on Vertisol, ICRISAT center rainy season, 1984/85.

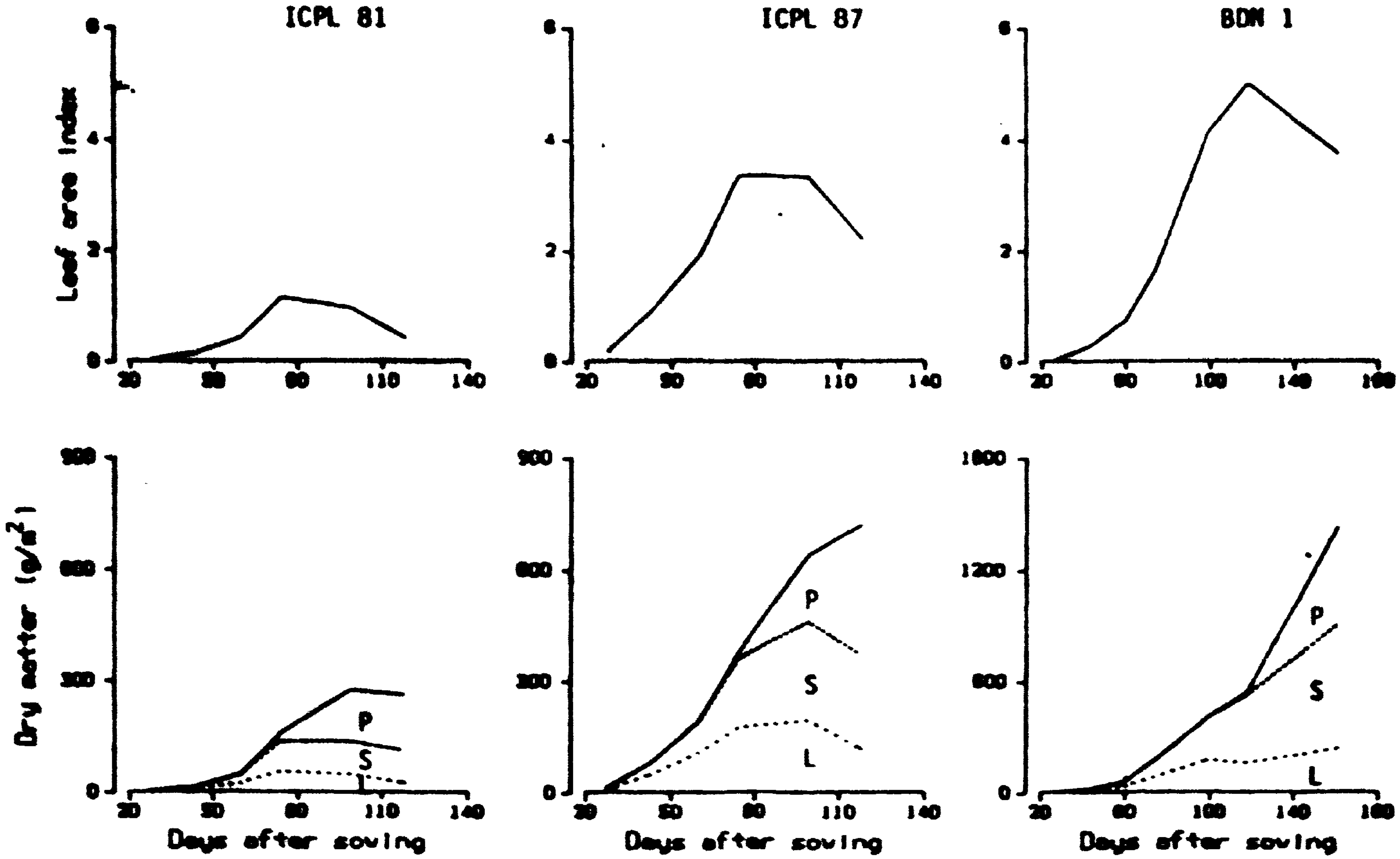


Fig 4.3. Dry matter accumulation and leaf area indix at different days after sowing of three Pigeonpea genotypes ICPL 81, ICPL 87 and BDN 1 grown Alfisol, ICRISAT center rainy season, 1984/85.

Table 4.1 Time (d) to 50% flowering, maturity of ICPL 81, ICPL 87 and ICPL 161 grown on Entisol, Hisar, 1984/85 and ICPL 81, ICPL 87 and BDN1 grown on Alfisol and Vertisol, ICRISAT Center, 1984/85.

| Genotype | 50% flowering | I flush maturity | II flush maturity | III flush maturity |
|---|---|---|---|---|
| | Phenological stage | | | |
| | | Entisol (Hisar Subcenter) | | |
| ICPL 81 | 71 | 137 | - | - |
| ICPL 87 | 77 | 160 | - | - |
| ICPL 161 | 74 | 153 | - | - |
| | | Alfisol (ICRISAT Center) | | |
| ICPL 81 | 73 | 112 | 208 | 276 |
| ICPL 87 | 78 | 122 | 196 | 279 |
| BDN 1 | 112 | 182 | 258 | - |
| | | Vertisol (ICRISAT Center) | | |
| ICPL 81 | 74 | 115 | 190 | 276 |
| ICPL 87 | 78 | 122 | 196 | 279 |
| BDN 1 | 127 | 182 | 266 | - |

Table 4.2. Plant height (cm), no. of primary branches, of pigeonpea genotype on Entisol at Hisar, Alfisol and Vertisol, ICRISAT Center, rainy season 1984/85.

| | Plant height | No. of primary branches |
|---|---|---|
| | Entisol | |
| ICPL 81 | 181 | 20.8 |
| ICPL 87 | 149 | 18.7 |
| ICPL 161 | 190 | 26.9 |
| SE | 9.8 | 1.40 |
| | Alfisol | |
| ICPL 81 | 101 | 7.87 |
| ICPL 87 | 91 | 5.7 |
| BDN 1 | 165 | 20.7 |
| | Vertisol | |
| ICPL 81 | 88 | 6.5 |
| ICPL 87 | 77 | 5.3 |
| BDN 1 | 159 | 13.6 |

Table 4.3. Total dry matter, seed yield and components of yield of 3 short-duration pigeonpea genotypes grown on Entisol, ICRISAT Cooperative Center, Hisar, rainy season 1984/85.

| Variable | Genotype ICPL 81 | ICPL 87 | ICPL 161 | SE |
|---|---|---|---|---|
| Total dry matter (kg ha-1) | 19940 | 25700 | 15360 | ±1371** |
| Yield (kg ha-1) | 2736 | 2710 | 2316 | ±160 |
| Pods plant-1 | 134.3 | 97.5 | 94.8 | ±12.10 |
| 100-seed mass (g) | 8.31 | 10.75 | 9.99 | ±0.252 |

Table 4.4. Comparison of yield (kg ha-1) in different harvests of ICPL 81, ICPL 87 and BDN 1 grown on Alfisol and Vertisol, ICRISAT Center, rainy season 1984/85.

| Genotype | Alfisol | Vertisol | Mean | Alfisol | Vertisol | Mean |
|---|---|---|---|---|---|---|
| | October harvest | | | December harvest | | |
| ICPL 81 | 1337 | 1327 | 1332 | 601 | 562 | 581 |
| ICPL 87 | 2378 | 1792 | 2082 | 1713 | 1359 | 1536 |
| BDN 1 | 0 | 0 | 0 | 2337 | 2401 | 2369 |
| | | ±133.3 | ±75.0** | | ±98.0 | ±71.3* |
| | | (106.1)a | | | (100.8) | |
| Mean | 1858 | 1559 | | 1550 | 1441 | 1496 |
| | | ±110.2 | | | ±53.2 | |
| | March harvest | | | Total harvest | | |
| ICPL 81 | 360 | 315 | 338 | 2298 | 2204 | 2251 |
| ICPL 87 | 419 | 173 | 296 | 4570 | 3323 | 3917 |
| BDN 1 | 1037 | 720 | 879 | 3374 | 3121 | 3248 |
| | | ±79.8 | ±58.5** | | ±145.0 | ±75.4** |
| | | (82.7) | | | (106.6) | |
| Mean | 605 | 402 | 504 | 3394 | 2882.9 | 3138.4 |
| | | ±42.5* | | | ±115.9** | |

a SE values in parentheses are for comparing means at the same level of soil.

**Table 4.5. Comparison of total dry matter (kg ha-1) in the different harvests and plants/m² of ICPL 81, ICPL 87 and BDN 1 grown on Alfisol and Vertisol, ICRISAT Center, rainy season, 1984/85.**

| Genotype | Alfisol | Vertisol | Mean | Alfisol | Vertisol | Mean |
|---|---|---|---|---|---|---|
| | | October harvest | | | December harvest | |
| ICPL 81 | 5431 | 5098 | 5265 | 3076 | 3617 | 3346 |
| ICPL 87 | 8115 | 7270 | 7692 | 5099 | 4680 | 4889 |
| BDN 1 | 0 | 0 | 0 | 9687 | 7640 | 8664 |
| | | ±375.9 | ±308.8** | ±411.1 | | ±307.8** |
| | | (436.7)a | | (435.3) | | |
| Mean | 6773 | 6184 | | 6478 | 5954 | 5312 |
| | | ±214.4 | | ±206.5* | | |
| | | March harvest | | | Plants/m2 | |
| ICPL 81 | 2050 | 1752 | 1901 | 7.0 | 15.6 | 11.3 |
| ICPL 87 | 4131 | 2142 | 3137 | 26.6 | 26.1 | 26.3 |
| BDN 1 | 7694 | 5425 | 6560 | 4.8 | 4.9 | 4.9 |
| | | ±428.5 | ±225.4** | | ±0.83** | ±0.56** |
| | | (318.7)* | | | (0.70) | |
| Mean | 4625 | 3106 | 3865.8 | 12.8 | 15.5 | 14.2 |
| | | ±340.4* | | ±0.520* | | |

a SE values in parentheses are for comparing means at the same level of soil.

**Table 4.6. Comparison of per day productivity (kg ha-1 day-1) of ICPL 81, ICPL 87, ICPL 161, BDN 1 grown on, Entisol, Hisar, rainy season 1984/85 and Alfisol and Vertisol, ICRISAT Center.**

| Genotype | I harvest | II harvest | III harvest | Overall |
|---|---|---|---|---|
| | | Entisol | | |
| ICPL 81 | 20.0 | - | - | 20.0 |
| ICPL 87 | 16.9 | - | - | 16.9 |
| ICPL 161 | 15.1 | - | - | 15.1 |
| | | Alfisol | | |
| ICPL 81 | 11.9 | 6.3 | 5.3 | 8.3 |
| ICPL 87 | 19.5 | 23.2 | 5.1 | 16.2 |
| BDN 1 | 12.8 | 13.6 | - | 13.1 |
| | | Vertisol | | |
| ICPL 81 | 11.5 | 8.6 | 3.7 | 8.0 |
| ICPL 87 | 14.7 | 18.4 | 2.1 | 11.9 |
| BDN 1 | 13.2 | 8.6 | - | 11.7 |

## 5. Effects of different rates of fertilizer nitrogen and phosphorus on the growth and yield of short-duration pigeonpea

### Introduction

Short-duration pigeonpea has shown a high yield potential at ICRISAT Center. In most of these trials, basal doses of 100 kg diammonium phosphate were applied, giving 18 kg N and 20 kg P/ha. However, when yield levels in the range of 4000-5000 kg ha-1 are attained, pigeonpea may remove nearly 160-200 kg N ha-1 and about 12-15 kg P ha-1. In addition to this there could be some nutrients immobilized in the stem and leaves. Unless there is sufficient fixation of N by the plants, the additional N may be either removed by the soil or the yield may be reduced. In order to determine the fertilizer requirements for optimizing the yield, the effect of different rates of N and P was investigated.

### Materials and Methods

The trial was conducted in an Alfisol field (RCW8) at ICRISAT Center, Patancheru. The field had 2.4-3.4 mg Olsen P kg soil-1.

Six levels of Nitrogen, 0, 20, 40, 80 (40 kg ha-1 as basal and 40 kg ha-1 at first flush maturity), and 80 kg ha-1 were applied as urea. There were three phosphorus levels 0, 21 and 42 kg P ha-1 applied as single superphosphate (SSP). Urea was applied by hand in furrows. SSP was applied by tractor by fixing the application rate at 300 kg ha-1. Where 42 kg P $ha^{-1}$ was to be applied the SSP was applied twice at 300 kg ha-1 application rate. The field design of the trial was 6 x 3 factorial with four replications. The plot size was 4.5 x 4 m.

Sowing was done at 37.5 x 8 cm on both sides of 75 cm ridges on 6 July 1984. The trial was irrigated twice, the first time at 13 July and the second time on 6 September.

Observations on time to 50% flowering and maturity were recorded. At maturity and total dry matter was estimated from 2.63 m2 area. Seed yield was estimated from additional 9.19 m2 area.

### Results and Discussion

The available P in the soil was generally low at 2.4 to 3.4 mg kg-1 soil (Table 1.1). In spite of this there was no effect of applied P, nor was there any response to nitrogen in any of the traits measured (Table 5.1 to 5.6). One of the reasons for the lack of response could be a high variability observed in this field which was also reflected in high cvs. The interactions between N and P were also absent for the various traits (Table 5.1 to 5.5). The variation in the yield was not due to plant stand (Table 5.7), but due to the field variability.

Effect of N and P was not seen on days to flowering which occurred between 78 to 82, and maturity, which occurred between 112-115 days after sowing.

Table 5.1. Effect of nitrogen and phosphorous application on yield (kg/ha) of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P<br>NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mean |
|---|---|---|---|---|
| 0Kg N | 884 | 588 | 845 | 772 |
| 20Kg N | 753 | 498 | 572 | 608 |
| 40Kg N | 691 | 812 | 617 | 707 |
| 80Kg N | 847 | 837 | 870 | 851 |
| 40*2Kg N | 805 | 1042 | 1186 | 1011 |
| Mean | 796 | 756 | 818 | 790 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN<br>P |
|---|---|---|---|
| ESE | 97.2 | 75.3 | 168.4 |
| CV% | | | 42.7 |

Table 5.2. Effect of nitrogen and phosphorous application on total dry matter (kg/ha) of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P<br>NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mean |
|---|---|---|---|---|
| 0Kg N | 2585 | 1694 | 2467 | 2249 |
| 20Kg N | 2495 | 1829 | 2031 | 2118 |
| 40Kg N | 1784 | 2709 | 2462 | 2318 |
| 80Kg N | 2324 | 2987 | 2674 | 2662 |
| 40*2Kg N | 2104 | 3350 | 2784 | 2746 |
| Mean | 2259 | 2514 | 2484 | 2419 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN<br>P |
|---|---|---|---|
| ESE | 291.4 | 225.8 | 504.8 |
| CV% | | | 41.7 |

Table 5.3. Effect of nitrogen and phosphorous application on harvest index (%) of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P / NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mean |
|---|---|---|---|---|
| 0Kg N | 34.7 | 44.9 | 32.1 | 37.2 |
| 20Kg N | 30.6 | 29.5 | 28.3 | 29.5 |
| 40Kg N | 40.3 | 30.4 | 27.7 | 32.8 |
| 80Kg N | 37.0 | 31.2 | 33.0 | 33.7 |
| 40*2Kg N | 41.7 | 33.0 | 49.2 | 41.3 |
| Mean | 36.9 | 33.8 | 34.0 | 34.9 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN P |
|---|---|---|---|
| ESE | 3.70 | 2.87 | 6.42 |
| CV% | | | 36.8 |

Table 5.4. Effect of nitrogen and phosphorous application on 100-seed mass (g) of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P / NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mean |
|---|---|---|---|---|
| 0Kg N | 8.5 | 8.2 | 8.8 | 8.5 |
| 20Kg N | 9.1 | 8.3 | 8.9 | 8.8 |
| 40Kg N | 7.7 | 9.0 | 8.5 | 8.4 |
| 80Kg N | 8.6 | 7.4 | 9.0 | 8.3 |
| 40*2Kg N | 8.6 | 9.0 | 8.9 | 8.8 |
| Mean | 8.5 | 8.4 | 8.8 | 8.6 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN P |
|---|---|---|---|
| ESE | 0.36 | 0.28 | 0.62 |
| CV% | | | 14.5 |

Table 5.5. Effect of nitrogen and phosphorous application on seeds/pod of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P / NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mean |
|---|---|---|---|---|
| 0Kg N | 2.6 | 2.9 | 2.8 | 2.7 |
| 20Kg N | 2.9 | 2.5 | 2.1 | 2.5 |
| 40Kg N | 2.9 | 3.1 | 2.7 | 2.9 |
| 80Kg N | 2.6 | 2.8 | 2.9 | 2.8 |
| 40*2Kg N | 2.5 | 2.8 | 2.8 | 2.7 |
| Mean | 2.7 | 2.8 | 2.7 | 2.7 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN P |
|---|---|---|---|
| ESE | 0.12 | 0.09 | 0.21 |
| CV% | | | 15.2 |

Table 5.6. Effect of nitrogen and phosphorous application on pod m-2 of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P / NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mean |
|---|---|---|---|---|
| 0Kg N | 408 | 251 | 363 | 341 |
| 20Kg N | 273 | 235 | 297 | 268 |
| 40Kg N | 296 | 299 | 263 | 286 |
| 80Kg N | 394 | 388 | 333 | 371 |
| 40*2Kg N | 416 | 413 | 491 | 440 |
| Mean | 357 | 317 | 349 | 341 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN P |
|---|---|---|---|
| ESE | 43.0 | 3[illegible].3 | 74.5 |
| CV% | | | 43.6 |

Table 5.7. Effect of nitrogen and phosphorous application plants/m2 of ICPL 87 grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| P<br>NITROGEN | 0Kg P | 21Kg P | 42Kg P | Mea |
|---|---|---|---|---|
| 0Kg N | 25.9 | 23.6 | 24.9 | 24.8 |
| 20Kg N | 28.1 | 23.5 | 26.2 | 25.9 |
| 40Kg N | 25.3 | 25.2 | 26.0 | 25.5 |
| 80Kg N | 23.2 | 29.6 | 26.1 | 26.3 |
| 40*2Kg N | 23.3 | 27.8 | 27.9 | 26.3 |
| Mean | 25.2 | 25.9 | 26.2 | 25.8 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | NITROGEN | P | NITROGEN<br>P |
|---|---|---|---|
| ESE | 1.15 | 0.89 | 1.99 |
| CV% | | | 15.5 |

## 6. Effect of phosphorus (P) and sulfur (S) nutrition on the phenology and yield of short-duration pigeonpea

### Introduction

In a pot experiment conducted during the last season, marked responses to single superphosphate (SSP) application were recorded in flowering, leaf area retention and yield (PPR 1983/84, Chapter 4). Timely maturity of short-duration pigeonpea is desirable for the success of double cropping systems. Similarly, high leaf area retention is desirable for the success of multiple harvest systems. However, since SSP contains other elements, including S, we could not definitely attribute the responses to P application. Both to confirm previous years responses and to determine that responses obtained were due to P, a pot experiment was conducted using different levels of P and S.

### Materials and Methods

The pot experiment was conducted in greenhouse with day/night temperatures of about 30/10-20 C at ICRISAT Center using an Alfisol and Vertisol low in Olsen available P (<0.5 mg $kg^{-1}$ soil). The Alfisol was collected from the same site as in the previous year when big responses to P application were obtained. The chemical characteristics of the soils are given in Table 6.1. The soils were low in Olsen P.

Three levels of P, 0, 40 and 80 mg P kg-1 soil were applied as Ca3(PO)4 and three levels of S, 0, 65 and 130 mg kg-1 soil were applied as CaSO4.2H2O. These were mixed thoroughly with 10 kg of finely (<5 mm) sieved soil in each round plastic pot of 25 cm top diameter. Seeds of ICPL 6, a short-duration cultivar selected from T21, were inoculated with Rhizobium strain IC 3195 and sown on 5 September 1984. Eight seeds per pot were sown, which upon emergence were thinned to 4 per pot. The treatments were arranged in a randomized block design with two treatment factors, P and S. The soils were treated as distinct environments. There were three replications. The pots were irrigated about three times a week.

Observations were made on leaf number plant-1 at three stages of growth, on branch number and plant height, and in addition at maturity on dry matter and grain yield. The effect of P and S was determined on yield components also.

### Results and Discussion

The effect of P was significant for most of the growth attributes, but the effect of S was not significant on any of the growth attributes (Table 6.2). This implies that the response obtained particularly on Alfisol was that of P.

In the present experiment also there were no characteristic symptoms of P deficiency on Alfisol when growth was remarkedly reduced by P deficiency. The effect of P deficiency on growth attributes was marked on Alfisol only. The interaction between soil x P was significant for number of leaves at 25 and 61 DAS, and plant height (cm) and number of primary branches. Leaf area at maturity was significantly increased on both soils by P application. On Vertisol, number of leaves in the no P treatment was significantly less and there was greater senescence in this treatment. On Alfisol number of leaves remained low at all the stages of growth in the no P treatment.

Time to both flowering and maturity was markedly delayed by P deficiency (Table 6.2). On Vertisol the delay was 4-8 days but on Alfisol the delay was as up to about 40 days. This effect of P application on the phenology of pigeonpea has implications for short-duration pigeonpea grown in double cropping systems. Any delay in the maturity of pigeonpea can delay sowing of the subsequent crop beyond the optimum time. Thus, ensuring an adequate P supply to pigeonpea is an important consideration for maximizing yields of both the crops grown. This finding would also complicate predictions of phenology which are currently based on photoperiod and temperature effects where soil P is not taken into consideration.

For pigeonpea grown in multiple harvest systems, the present results have another important implication. Good ratoon harvest yield depends on high leaf area retention at maturity of the first flush. Leaf area retention at maturity markedly declined at low P level on both soils.

Significantly reduced seed yields were obtained in the no P treatment on both soils (Table 6.3). The reduced yields levels were not only associated with reduced dry matter production but also partitioning. There was no effect of P application on seeds pod-1. The 100-seed weight and pods plant-1 were significantly reduced under conditions of severe P deficiency. The soil x P interactions were significant for seed yield, total dry matter, harvest index, 100-seed mass and pods plant-1. Generally, greater response to P application was obtained on Alfisol than Vertisol, even though both soils had low initial P levels (>0.5 mg Olsen P kg-1 soil). The difference may be related to the differential fixation and P release characteristics of the two soils.

Table 6.1 Soil chemical characteristics of Alfisol and Vertisol used.

| Soil | pH | Ec ds/m | Organic Carbon(%) | Olsen P (mg $kg^{-1}$ soil) |
|---|---|---|---|---|
| Alfisol | 6.2 | 0.15 | 0.47 | 0.5 |
| Vertisol | 8.5 | 0.15 | 0.58 | 1.0 |

6.2 Effect of P and S application on some morphological parameters of ICPL 6 grown in pots using Alfisol (A) and Vertisol (V), ICRISAT Center 1984/85.

| Soil | P level mg kg-1 soil | S level mg kg-1 soil | Number of leaves at 25 DAS | 61 DAS | Mat. | Leaf area (cm2) | Pl. ht. (cm) at mat. | No. of PB at mat. | Time to 50% fl. (days) | Mat. (days) |
|---|---|---|---|---|---|---|---|---|---|---|
| V | 0 | 0 | 4.2 | 22.8 | 10.4 | 55.9 | 100 | 2.9 | 69 | 122 |
| | | 65 | 4.5 | 20.8 | 6.8 | 48.1 | 100 | 1.9 | 69 | 121 |
| | | 130 | 4.3 | 19.9 | 4.8 | 36.7 | 94 | 1.8 | 76 | 124 |
| | 40 | 0 | 4.9 | 30.8 | 15.1 | 134.1 | 104 | 3.4 | 63 | 109 |
| | | 65 | 4.9 | 35.2 | 13.7 | 161.1 | 110 | 3.8 | 66 | 114 |
| | | 130 | 4.5 | 31.0 | 15.0 | 149.4 | 106 | 3.8 | 68 | 116 |
| | 80 | 0 | 4.5 | 32.8 | 17.9 | 166.8 | 106 | 4.1 | 68 | 116 |
| | | 65 | 4.7 | 31.5 | 21.5 | 215.3 | 112 | 4.0 | 68 | 118 |
| | | 130 | 4.5 | 33.4 | 16.7 | 157.0 | 108 | 4.2 | 66 | 116 |
| A | 0 | 0 | 2.9 | 6.4 | 5.0 | 18.1 | 40 | 0.8 | 120 | 157 |
| | | 65 | 3.0 | 7.9 | 2.3 | 6.6 | 42 | 0 | 110 | 145 |
| | | 130 | 2.9 | 7.2 | 3.3 | 13.2 | 43 | 0.33 | 115 | 155 |
| | 40 | 0 | 4.0 | 17.7 | 7.3 | 44.1 | 90 | 0.8 | 76 | 119 |
| | | 65 | 3.9 | 17.9 | 8.8 | 51.5 | 90 | 2.0 | 73 | 121 |
| | | 130 | 3.8 | 20.2 | 8.7 | 53.9 | 90 | 2.3 | 72 | 141 |
| | 80 | 0 | 5.1 | 28.3 | 12.5 | 75.8 | 104 | 4.1 | 67 | 117 |
| | | 65 | 4.7 | 25.6 | 24.8 | 143.5 | 96 | 5.3 | 63 | 116 |
| | | 130 | 4.9 | 27.1 | 17.3 | 99.7 | 95 | 3.4 | 63 | 116 |
| SE | Soil | | 0.06* | 0.07** | 1.17 | 10.8* | 0.4** | 0.19* | 0.6** | 1.0* |
| | P | | 0.07** | 0.69** | 1.18** | 10.8** | 1.2** | 0.19** | 0.9** | 1.4* |
| | S | | 0.07 | 0.69 | 1.18 | 10.8 | 1.2 | 0.19 | 0.9 | 1.4* |
| | Soil x P | | 0.11** | 0.80* | 1.80 | 16.5 | 1.5** | 0.30** | 1.2** | 1.9** |
| | | | | (0.97) | (1.67) | (15.3) | (1.7) | (0.26) | (1.3) | |
| | Soil x S | | 0.11 | 0.80 | 1.80 | 16.5 | 1.5 | 0.30 | 1.2 | 1.9 |
| | | | | (0.97) | (1.67) | (15.3) | | (0.26) | (1.3) | |
| | P x S | | 0.18 | 1.19 | 2.05 | 18.8 | 2.1 | 0.32* | 1.6 | 2.4** |
| | Soil x P x S | | 0.18 | 1.59 | 2.97 | 27.3 | 2.84 | 0.48 | 2.3 | 3.4 |
| | | | | (1.68) | | (26.5) | (2.99) | | | |

For comparing means at same levels of treatments SEs are given in parentheses
PB - primary branches; Mat. - maturity.

Table 6.3. Effect of P application on the dry matter yield, harvest index and yield components of ICPL 6 grown in pots using Alfisol (A) and Vertisol (V) ICRISAT Center, 1984/85.

| Soil | P level mg kg-1 soil | Dry weight g plant-1 Seed | Total | Harvest index (%) | 100-seed mass (g) | Seeds pod-1 | Pods plant-1 |
|---|---|---|---|---|---|---|---|
| V | 0 | 0.83 | 6.4 | 12.4 | 6.0 | 3.0 | 5.2 |
| | 40 | 3.84 | 19.3 | 19.4 | 6.4 | 2.6 | 22.3 |
| | 80 | 4.77 | 22.7 | 20.9 | 6.8 | 2.8 | 26.0 |
| A | 0 | 0.37 | 1.8 | 18.7 | 4.8 | 2.9 | 2.6 |
| | 40 | 2.92 | 13.2 | 22.3 | 7.4 | 2.9 | 14.1 |
| | 80 | 5.30 | 23.1 | 23.0 | 7.7 | 2.7 | 26.4 |
| SE | Soil | 0.21 | 0.83 | 0.35* | 0.15 | 0.06 | 0.88 |
| | P | 0.17** | 0.69** | 0.43** | 0.16** | 0.13 | 0.78** |
| | Soil x P | 0.28** | 1.16** | 0.61** | 0.24** | 0.28 | 1.25** |
| | | (0.23) | (0.97) | | (0.22) | (0.23) | |

For comparing SE for the same level of P.

## 7. Effect of shading during the vegetative period on the growth and yield of medium-duration pigeonpea genotypes

### Introduction

Medium-duration pigeonpea is commonly grown in intercrops mainly with cereals. Intercropped pigeonpea faces above-ground competition for space and light and below-ground competition for water and nutrients from the companion crops. Differences in plant type and phenology patterns between pigeonpea cultivars may provide differences in the ability to compete and perform in an intercrop situation. Particular advantage for intercropping may not necessarily be apparent in the sole crop situation in which this type of pigeonpea is normally evaluated. Simultaneous comparison between the performance in a sole crop and intercrop is desirable to identify genotypes better suited to intercropping, but it is usually not possible for logistical reasons. To expedite the identification of genotypes better suited to intercropping, particular characteristics which may play a major role in determining the performance of a genotype in an intercrop need to be identified through suitable screening methods.

Shading is one of the most commonly observed effects of sorghum or millet crops on pigeonpea growing in an intercrop. The effects of shading on different genotypes during the vegetative stages have not been evaluated. It may be that genotypes differ in their ability to grow under shaded conditions. This aspect was investigated this year by artificially shading 10 genotypes of medium-duration pigeonpea.

### Materials and Methods

The trial was conducted on a Vertisol field BP11C. The field design of the trial was a split plot with 66% shading and control (unshaded) as the main plots and 10 pigeonpea genotypes, C 11, ICP 1951, HY 3C, ICPL 270, ICPL 1196, ICP 1-6, APAU 2208, LRG 30, ICPL 304, and ICP 1, as the subplots. The genotypes were sown on 26 June 1984 on 75-cm wide ridges and furrows. Plant-to-plant spacing was 30 cm. The shading treatment was imposed on 6 Sep 1984 (73 days after planting) by erecting a canopy of sarlon cloth (two layers) at 1.5 m above the ground level. The sarlon cloth was removed on 5-11-84, i.e. 60 days after imposition. The main plot size was 3 x 50 m and the subplot size 3 x 4 m. No irrigation was given except a postsowing irrigation on 28 Jan.

Observations on days to 50% flowering, days to maturity, TDM at flowering and maturity, yield and yield components were recorded. The net plot size at final harvest was 5.55 m2.

### Results and Discussion

The shading treatment delayed days to 50% flowering by 19 to 29 days and days to maturity by 26 to 31 days (Table 7.1). The delay in flowering and maturity could be attributed to slow growth in the shading treatment. At the 50% flowering, mean dry matter accumulation (g plant-1) in the shading treatment was 36% lower than the nonshaded control (Table 7.2).

The plants in the shading treatment tended to recover from the shading effect and the TDM (g plant-1) was only 18% lower than the unshaded control at maturity (Table 7.2.). However, this may be due to over estimation of weights on per plant basis as TDM on kg ha-1 basis was lower by 31% in the shading treatment at maturity (Table 7.2). The genotype x shading treatment interaction for TDM was highly significant. The greatest reduction in TDM by the shading treatment was caused in APAU 2208 and least in ICP 1951. The differences among genotypes and shading treatments were also significant.

The effect of shading was significant in yield also (Table 7.3), but the characteristics of interest, the genotype x shading treatment interaction, was not significant. In terms of percent reduction in yield, however, genotypes appeared to differ. The maximum reduction was observed in HY 3C and the least reduction in ICP 1951. But other genotypes such as ICPL 270 and ICPL 304 also gave similar yields under shading treatment as the ICP 1951. The mean reduction in yield due to shading was 48% which is comparable to reduction in yield normally observed due to intercropping of pigeonpea. Part of the reduction in yield under the shading treatment could be due to a marginal reduction in the plant stand which average 2.8 plants/m2 compared to 3.4 plants/m2 in the control.

The variation in yield due to shading came from all the yield components - the 100-seed weight, seeds per pod and the pods/m-2 (Table 7.3). This was rather surprising, as 100-seed weight and seeds per pod are considered to be fairly stable yield components in pigeonpea. Interaction of shading treatment with genotype was highly significant for 100-seed weight. It could be that after removal of shades, vegetative growth actively competes with the developing sinks. The reduction in yield due to the shading treatment was 48% whereas the reduction in pods/m-2 has only 30%. The reduction in 100-seed weight was 6% and that of seeds pod-1 22%.

Due to the lack of genotype x shading interaction, it is difficult to say whether shading could be used for screening pigeonpea genotypes. However, the relative reduction could be used for comparison. On the basis of relative yield reduction, ICP 1951 appeared most promising and HY 3C least promising. The results require further confirmation.

Table 7.1. Effect of shading (66%) on days to 50% flowering and maturity of 10 medium-duration genotypes of pigeonpea grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| | Genotype | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Shading treatment | C 11 | ICP 1951 | NY 3C | ICPL 270 | ICPL 1196 | ICP 1-6 | APAU 2208 | LRG 30 | ICPL 304 | ICP 1 |
| | Days to 50% flowering | | | | | | | | | |
| No shade (A) | 130 | 119 | 134 | 119 | 131 | 131 | 128 | 128 | 130 | 120 |
| 66% shade (B) | 157 | 147 | 158 | 148 | 157 | 150 | 148 | 148 | 157 | 148 |
| B - A | 27 | 28 | 24 | 29 | 26 | 19 | 20 | 20 | 27 | 28 |
| | Days to maturity | | | | | | | | | |
| No shade (A) | 186 | 178 | 187 | 175 | 180 | 187 | 186 | 179 | 186 | 177 |
| 66% shade (B) | 214 | 207 | 218 | 207 | 207 | 218 | 212 | 207 | 215 | 207 |
| B - A | 28 | 29 | 31 | 32 | 27 | 31 | 26 | 28 | 29 | 30 |

**Table 7.2 Effect of shading (66%) on the TDM at flowering and maturity of 10 medium-duration pigeonpea genotypes. Vertisol. ICRISAT Center, rainy season 1984/85.**

| GENO / SHADING | C11 | ICP1951 | HY3C | ICPL270 | ICPL1196 | ICP1-6 | AFAU2219 | [illegible] | [illegible] | ICP[illegible] | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | TDM (g plant-1) at flowering | | | | | | |
| NOSHADE (A) | 163.7 | 157.1 | 116.7 | 168.6 | 129.8 | 150.4 | [illegible] | 189.2 | 121.8 | 167.0 | 154.1 |
| 66%SHADE (B) | 109.6 | 64.9 | 78.3 | 110.7 | 76.5 | 131.2 | 127.0 | 93.[illegible] | 98.2 | 106.9 | 98.7 |
| | | | | | +21.2 | (20.01)a | | | | | +10.73 |
| MEAN | 139.1 | 111.0 | 97.5 | 139.6 | 103.1 | 140.8 | 153.7 | 131.[illegible] | [illegible] | 137.0 | 12[illegible] |
| | | | | | +14.75 | | | | | | |
| B % of A | 65 | 41 | 67 | 65 | 59 | 87 | 7[illegible] | [illegible] | [illegible] | 64 | [illegible] |
| | | | | | TDM (g plant-1) at maturity | | | | | | |
| NOSHADE | 231.3 | 222.5 | 121.0 | 198.3 | 153.0 | 241.0 | [illegible] | 281.5 | 277.3 | 217.8 | 212.9 |
| 66%SHADE | 191.3 | 154.1 | 105.7 | 159.1 | 179.5 | 237.8 | 201.3 | 207.4 | 226.3 | 1[illegible]3.4 | 180.6 |
| | | | | | +36.42 | (32.4[illegible]) | | | | | 19.45 |
| MEAN | 211.3 | 188.3 | 113.3 | 178.7 | 166.3 | 239.4 | [illegible] | 244.5 | 252.1 | 180.6 | 196.7 |
| | | | | | +22.95** | | | | | | |
| B % of A | 83 | 69 | 87 | 80 | 85 | 99 | [illegible] | 74 | 98 | 66 | |
| | | | | | TDM (kg ha-1) at maturity | | | | | | |
| NOSHADE | 11439 | [illegible] | 62[illegible] | [illegible] | [illegible]700 | 11685 | [illegible] | 110[illegible]7 | [illegible] | [illegible] | 10138 |
| 66%SHADE | 7079 | 728[illegible] | 5[illegible]91 | 7[illegible]25 | 6397 | 7868 | [illegible] | 68[illegible]7 | 78[illegible] | [illegible] | [illegible] |
| | | | | | +[illegible]65.4 | (615.3)** | | | | | +313.5* |
| MEAN | [illegible] | 758[illegible] | [illegible] | 8[illegible]78 | 8003 | 9777 | [illegible] | [illegible]482 | [illegible] | [illegible] | 9[illegible]36 |
| | | | | | +435.1** | | | | | | |
| B % of A | 62 | 92 | 87 | 72 | 65 | 67 | [illegible] | [illegible]2 | [illegible] | [illegible] | |

a SE values in parenthesis are for comparing means at the same level of shading treatment

Table 7.3. Effect of shading (66%) on yield and yield components of 10 medium-duration pigeonpea genotypes, Vertisol, ICRISAT Center, rainy season 1984-85.

| GENO / SHADING TREATMENT | C11 | ICP1951 | HY3C | ICPL270 | ICPL1196 | ICP1-6 | APAU2208 | LRG30 | ICPL304 | ICP1 | MEAN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Seed yield (kg ha-1) | | | | | | |
| NOSHADE (A) | 2975 | 2384 | 1785 | 2804 | 2598 | 3006 | 2996 | 2749 | 2961 | 2919 | 2710 |
| 66%SHADE (B) | 1528 | 1722 | 675 | 1735 | 1312 | 1261 | 1364 | 1277 | 1703 | 1562 | 1414 |
| | | | | | | ±209.2 (184.1)a | | | | | ±115.2* |
| MEAN | 2252 | 2053 | 1230 | 2270 | 1955 | 2133 | 2180 | 2013 | 2332 | 2261 | 2066 |
| | | | | | | ±130.2** | | | | | |
| B % OF A | 51 | 72 | 38 | 62 | 51 | 42 | 46 | 47 | 58 | 54 | |
| | | | | | 100-seed weight (g) | | | | | | |
| NOSHADE | 9.6 | 9.7 | 13.1 | 10.8 | 8.6 | 9.9 | 8.8 | 7.8 | 9.4 | 9.5 | 9.7 |
| 66%SHADE | 9.2 | 9.9 | 10.4 | 11.2 | 8.6 | 8.5 | 8.3 | 8.0 | 8.6 | 8.5 | 9.1 |
| | | | | | | ±0.35** | | | | | ±0.09 |
| MEAN | 9.4 | 9.8 | 11.7 | 11.0 | 8.6 | 9.2 | 8.6 | 7.9 | 9.0 | 9.0 | 9.4 |
| | | | | | | ±0.25 | | | | | |
| | | | | | Seeds pod-1 | | | | | | |
| NOSHADE | 2.6 | 2.9 | 2.5 | 2.8 | 2.9 | 2.6 | 2.8 | 2.6 | 2.8 | 2.6 | 2.7 |
| 66%SHADE | 2.0 | 2.3 | 2.1 | 2.0 | 2.2 | 1.9 | 2.3 | 2.2 | 2.0 | 2.2 | 2.1 |
| | | | | | | ±0.18 (0.19) | | | | | ±0.02** |
| MEAN | 2.3 | 2.6 | 2.3 | 2.4 | 2.5 | 2.2 | 2.5 | 2.4 | 2.4 | 2.4 | 2.4 |
| | | | | | | ±0.13 | | | | | |
| | | | | | Pods m-2 | | | | | | |
| NOSHADE | 1181 | 854 | 546 | 954 | 1045 | 1166 | 1226 | 1351 | 1130 | 1223 | 1060 |
| 66%SHADE | 861 | 749 | 317 | 785 | 715 | 790 | 724 | 731 | 989 | 845 | 791 |
| | | | | | | ±103.4 (98.8) | | | | | ±43.6* |
| MEAN | 1021 | 801 | 432 | 870 | 880 | 978 | 975 | 1041 | 1060 | 1034 | 909 |
| | | | | | | ±69.9** | | | | | |

a SE values in the parenthesis are for comparing means at the same level of shading treatment.

8. Possible annual type

Pigeonpea is intrinsically a perennial plant. By nature therefore, the plant retains a considerable proportion of assimilates in the stems and roots for survival and future growth. Since pigeonpea is commonly grown as an annual, such a conservative mechanism may not be desirable as it might be responsible for lowering of harvest index. In order to improve the partitioning of dry matter into yield we have sought to develop annual pigeonpea (PPR 1980/81 Chapter VI). During the past season we selected a progeny in M4 generation of which 57% plants died by maturity. These plants, upon examination, were found to be disease free. The single plant progenies of this material were grown in M5 generation in this season.

## Materials and Methods

Seeds of BDN 1, a medium-duration pigeonpea genotype, exposed to gamma radiation according to the details described in PPR 1980/81 Chapter VI, were in M5 generation in this season. Until M3 these were sown as bulk and at maturity only seeds from apparently disease-free dead plants were collected. From M4 generation onward single plant progenies were grown. One of the lines in M4 generation showing 57% mortality was grown in M5 generation in this season. The progenies of dead plants were tested along with green plants and BDN 1. Sowing was done at 60 x 15 cm spacing on 23 July 1984. Three sets of the same 10 progeny rows were irrigated while another three sets of the same progenies were unirrigated. Two differential irrigations were given, at 40 and 109 days after sowing. At harvest, green and dead plants in each set of progeny rows, including check BDN 1, were counted. TDM and seed yields of individual rows were recorded, which were pooled among the progenies of a set to obtain a realistic estimate of different traits.

## Results and Discussion

Time to 50% flowering in various progenies varied between 100 and 103 days and time to maturity was 180 days, when these were harvested along with BDN 1.

The survival pattern in M5 generation indicated that while progenies derived from the dead plants had 35-40% mortality, progenies derived from green plants had only 12-22% mortality indicating gradual recovery of perennial character (Table 8.1). By contrast BDN 1 had only 2-3.5% mortality. The dry matter production and yield were higher in BDN 1 followed by progenies derived from the green plants. Even harvest index was not better in progeny showing high mortality, which was somewhat discouraging. However, it was not wholly unexpected as mutation can bring other undesirable changes in plants. We expect, once the annuality trait is stabilized, it would then be possible to incorporate it in high yielding backgrounds. However, for the present we should continue to select and purify this trait.

Table 8.1. Comparison of survival (%), seed yield, TDM and HI of M5 progenies and BDN 1 grown with and without irrigation. Vertisol, ICRISAT Center, rainy season 1984/85.

| Progeny | Survival (%) | | Seed yield (t ha-1) | | TDM (t ha-1) | | HI (%) | |
|---|---|---|---|---|---|---|---|---|
| | -Irr | +Irr | -Irr | +Irr | -Irr | +Irr | -Irr | +Irr |
| BDN 1 | 98.0 | 96.5 | 2.06 | 2.0 | 5.52 | 5.48 | 36.7 | 36.5 |
| M5 (derived from green plants) | 87.9 | 78.3 | 1.52 | 1.65 | 3.09 | 5.0 | 39.0 | 33.1 |
| M5 (derived from dead plants) | 60.9 | 65.1 | 1.17 | 1.35 | 3.63 | 4.23 | 32.1 | 31.8 |

## 9. Effect of terminal moisture stress on the growth and yield of 10 medium-duration pigeonpea genotypes

### Introduction

In peninsular India, medium-duration pigeonpea genotypes sown in June or July begin to flower in October or November and mature in December or January. During the period between flowering and maturity little or no rain is received and the crop usually grows on stored moisture. In the years when rainfall is less or on soils of low moisture holding capacity, the crop suffers from moisture stress. We have found that the reduction in the yield due to stress during the reproductive period is nearly 50% on Alfisol and 23% on Vertisol (PPR 1982/83). There was reduction in TDM and its partitioning. These responses need to be confirmed so that the need for screening medium-duration pigeonpea genotypes for terminal drought tolerance could be established. Last year we imposed the line source moisture gradient as 9 medium-duration genotypes in order to determine genotypic differences in response to terminal stress. We, however, found that the method was too labor intensive for our resources. We therefore decided to study the performance of same lines using empirical comparison of yield with and without irrigation.

### Materials and Methods

Two experiments were conducted, one on Alfisol field RP13 and another on Vertisol field BP11A.

In the Alfisol experiment, 9 pigeonpea genotypes, ICP 1-6, C 11, BDN 1, LRG 30, ICPH 2, ICPH 6, APAU 2208, ICPL 304, and LRG 36, were grown with and without irrigation, after sowing on 14 June 1984. The sowing was done on 75 cm ridges at 30 cm plant-to-plant spacing. A basal dose of 100 kg DAP ha-1 was applied prior to sowing. The field design of the experiment was split plot with the irrigation treatments in the main plots and the genotypes in the sub-plots. There were three replications. The sub-plot size was 6 x 4 m. Plant stand on Alfisol is given in Table 9.9.

Two uniform irrigations were given, on 25 June and 25 August 1984. Further irrigations were given only to one of the treatments (irrigated) on 31 October (139 DAS), 19 November (158 DAS) and 10 December (179 DAS).

In the Vertisol field, after the incorporation of a basal dose of 100 kg DAP ha-1, 9 pigeonpea genotypes, ICP 1-6, C 11, BDN 1, ICPL 770, LRG 30, ICPH 2, ICPH 6, APAU 2208 and ICPL 304, were sown on 26 June 1984. The genotypes were sown in RBD. There were three replications and the plot size was 6 x 4 m. Sowing was done at 75 x 30 cm spacing. A postsowing irrigation was given on 28 June, but thereafter no irrigation was given.

Observations on phenology, yield, yield components and TDM were recorded in both fields. The net area harvested at maturity was 16.6 m2 on Alfisol and 11.0 m2 on Vertisol.

## Results and Discussion

Days to 50% flowering varied from 118 to 139 DAS on Alfisol and 109 to 131 DAS on Vertisol (Table 9.1). Maturity of all the genotypes was earlier under nonirrigated conditions. The latest maturing cultivar on both soils was ICP 1-6, taking 186 to 203 days to mature, and the earliest was ICPL 270, taking 167 to 172 days to mature.

On Alfisol, the effect of terminal stress was significant for the mean yield of genotypes, but the genotype effect and its interaction with irrigation was not significant (Table 9.2). Terminal moisture stress caused nearly 47% reduction in yield, which is similar to that observed last year. Within different genotypes the reduction varied from 32 to 57%. The maximum reduction of 57% was seen in C 11 and least in ICPH 6, which was 32%. The irrigated yields were very high in this experiment, maximum yield of 3056 kg ha-1 was obtained from LRG 36. The unirrigated yield was maximum for BDN 1 followed by ICPH 6. As both these genotypes flowered earlier some advantage of escape contributing high yield under terminal stress is possible.

The effect of moisture stress was not significant for TDM production, although a 36% lower biomass was obtained in the stressed treatment (Table 9.3). Neither the differences among genotypes nor the genotype x irrigation interaction were significant. The partitioning of dry matter into seed yield, however, was significantly lower in the stress treatment than the irrigated treatment (Table 9.4). There were significant differences among genotypes for HI which tended to be associated with days to maturity.

The yield component that was affected by stress was the number of pods plant-1; 100-seed mass and number of seeds pod-1 were not affected significantly (Tables 9.5, 9.6, 9.7 and 9.8).

On Vertisol, yield obtained varied between 2092 and 2407 kg ha-1, the genotypic differences were not significant. The maximum yielding genotype was C 11 and the lowest was ICPH 6 (Table 9.10). The latter gave good yields on Alfisol, but not on Vertisol. Differences in TDM were also not significant, but its partitioning, as reflected by HI, was significantly different among the genotypes. There were significant differences among genotypes for 100-seed weight, pods plant-1 and pods m-2.

The correlation between Alfisol and Vertisol yields indicated that seed yield on Vertisol was highly correlated (r = 0.81**) with seed yield on Alfisol with irrigation, but not with without irrigation. The correlation of yield under stress with days to flowering and maturity was also not significant though there was an indication of a negative relationship.

It appears that although terminal stress has a definite adverse effect on seed yield of pigeonpea, particularly on Alfisol, a larger range of germplasm will have to be screened in order to examine the extent of genotypic difference in response to terminal drought stress.

Table 9.1. Time to 50% flowering (DF) and maturity (DM) of medium-duration pigeonpea genotypes grown with and without irrigation on Alfisol and on Vertisol, ICRISAT Center, rainy season 1984/85.

| | Alfisol | | | | Vertisol | |
|---|---|---|---|---|---|---|
| | DF | | DM | | | |
| Genotype | -Irr | +Irr | -Irr | +Irr | DF | DM |
| ICP 1-6 | 139 | 139 | 188 | 203 | 131 | 186 |
| C 11 | 121 | 121 | 181 | 191 | 130 | 180 |
| BDN 1 | 113 | 113 | 168 | 183 | 109 | 172 |
| ICPL 270 | 118 | 118 | 167 | 183 | 119 | 172 |
| LRG 30 | 131 | 131 | 171 | 189 | 130 | 179 |
| ICPH 2 | 118 | 118 | 171 | 191 | 119 | 170 |
| ICPH 6 | 118 | 118 | 169 | 183 | 128 | 180 |
| APAU 2208 | 121 | 121 | 183 | 200 | 128 | 180 |
| ICPL 304 | 133 | 133 | 188 | 203 | 130 | 180 |
| LRG 36 | 133 | 133 | 181 | 189 | NT | NT |

NT = Not tested

Table 9.2. Effect of moisture stress during the reproductive stage on the yield (kg ha-1) of medium-duration pigeonpea grown with and without irrigation, Alfisol, ICRISAT Center, rainy season, 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean | 100 - (A/B) x 100 |
|---|---|---|---|---|
| ICP 1-6 | 1302 | 2468 | 1885 | 47 |
| C 11 | 1243 | 2892 | 2067 | 57 |
| BDN 1 | 1871 | 2914 | 2393 | 36 |
| LRG 30 | 1299 | 2622 | 1960 | 50 |
| ICPH 2 | 1280 | 2434 | 1857 | 47 |
| ICPH 6 | 1801 | 2639 | 2220 | 32 |
| APAU 2208 | 1233 | 2496 | 1864 | 51 |
| ICPL 304 | 1371 | 2696 | 2034 | 49 |
| LRG 36 | 1456 | 3056 | 2256 | 52 |
| Mean | 1428 | 2691 | | 47 |

| SE± | |
|---|---|
| Irr | 188.7* |
| CV | 130.0 |
| Irri x CV | 256.2 (183.8) |

Table 9.3. Effect of moisture stress during the reproductive stage on TDM (kg ha-1) of medium-duration pigeonpea grown with and without irrigation, Alfisol, ICRISAT Center, rainy season, 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean | (A/B) |
|---|---|---|---|---|
| ICP 1-6 | 8087 | 12717 | 10402 | 0.64 |
| C 11 | 6862 | 11621 | 9241 | 0.59 |
| BDN 1 | 7227 | 10684 | 8956 | 0.67 |
| LRG 30 | 6993 | 11882 | 9437 | 0.59 |
| ICPH 2 | 7149 | 10764 | 8957 | 0.66 |
| ICPH 6 | 8523 | 11463 | 9993 | 0.74 |
| APAU 2208 | 7094 | 11090 | 9092 | 0.64 |
| ICPL 304 | 6894 | 11008 | 8951 | 0.63 |
| LRG 36 | 7557 | 13198 | 10377 | 0.57 |
| Mean | 7376 | 11603 | | |

| SE± | |
|---|---|
| Irr | 866.0 |
| CV | 432.1 |
| Irr x CV | 1040.2 |
| | (611.1) |

Table 9.4. Effect of moisture stress during the reproductive stage on HI of medium-duration pigeonpea grown with and without irrigation, Alfisol, ICRISAT Center, rainy season, 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean | (A/B) |
|---|---|---|---|---|
| ICP 1-6 | 0.15 | 0.19 | 0.17 | 0.79 |
| C 11 | 0.17 | 0.25 | 0.21 | 0.69 |
| BDN 1 | 0.25 | 0.28 | 0.27 | 0.91 |
| LRG 30 | 0.18 | 0.22 | 0.20 | 0.80 |
| ICPH 2 | 0.18 | 0.23 | 0.20 | 0.79 |
| ICPH 6 | 0.21 | 0.23 | 0.22 | 0.92 |
| APAU 2208 | 0.17 | 0.23 | 0.20 | 0.77 |
| ICPL 304 | 0.19 | 0.24 | 0.22 | 0.76 |
| LRG 36 | 0.19 | 0.23 | 0.21 | 0.82 |
| Mean | 0.19 | 0.23 | | |

| SE± | |
|---|---|
| Irr | 0.004* |
| CV | 0.010** |
| Irr x CV | 0.014 |

Table 9.5. Effect of moisture stress during the reproductive stage on pods plant-1 of medium-duration pigeonpea grown with and without irrigation, Alfisol, ICRISAT Center, rainy season, 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean |
|---|---|---|---|
| ICP 1-6 | 175.9 | 256.6 | 216.3 |
| C 11 | 124.5 | 245.9 | 185.2 |
| BDN 1 | 158.9 | 230.2 | 194.5 |
| LRG 30 | 127.2 | 252.0 | 189.6 |
| ICPH 2 | 159.5 | 242.6 | 201.0 |
| ICPH 6 | 183.5 | 247.1 | 215.3 |
| APAU 2208 | 176.7 | 279.5 | 228.1 |
| ICPL 304 | 136.7 | 280.4 | 208.5 |
| LRG 36 | 173.4 | 313.7 | 243.5 |
| Mean | 157.4 | 260.9 | |

| SE± | |
|---|---|
| Irr | 13.89* |
| CV | 18.26 |
| Irr x CV | 28.03 (25.83) |

Table 9.6. Effect of moisture stress during the reproductive stage on 100-seed weight (g) of medium-duration pigeonpea grown with and without irrigation, Alfisol, ICRISAT Center, rainy season, 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean |
|---|---|---|---|
| ICP 1-6 | 10.21 | 10.88 | 10.55 |
| C 11 | 10.13 | 10.18 | 10.15 |
| BDN 1 | 10.42 | 10.81 | 10.61 |
| LRG 30 | 7.97 | 8.84 | 8.40 |
| ICPH 2 | 8.62 | 8.20 | 8.41 |
| ICPH 6 | 8.48 | 9.17 | 8.82 |
| APAU 2208 | 8.81 | 9.51 | 9.16 |
| ICPL 304 | 9.17 | 9.86 | 9.51 |
| LRG 36 | 7.79 | 7.96 | 7.87 |
| Mean | 9.07 | 9.49 | |

| SE± | |
|---|---|
| Irr | 0.09 |
| CV | 0.19 |
| Irr x CV | 0.28 |

Table 9.7. Effect of moisture stress during the reproductive stage on number of seeds pod-1 of medium-duration pigeonpea grown with and without irrigation. Alfisol. ICRISAT Center. rainy season. 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean |
|---|---|---|---|
| ICP 1-6 | 1.79 | 2.13 | 1.96 |
| C 11 | 2.30 | 2.62 | 2.46 |
| BDN 1 | 2.65 | 2.82 | 2.73 |
| LRG 30 | 2.97 | 2.67 | 2.82 |
| ICPH 2 | 2.35 | 2.82 | 2.58 |
| ICPH 6 | 2.80 | 2.71 | 2.75 |
| APAU 2208 | 2.30 | 2.35 | 2.33 |
| ICPL 304 | 2.70 | 2.31 | 2.51 |
| LRG 36 | 2.90 | 2.92 | 2.91 |
| Mean | 2.53 | 2.60 | |

| SE± | |
|---|---|
| Irr | 0.09 |
| CV | 0.09 |
| Irri x CV | 0.13 |

Table 9.8. Effect of moisture stress during the reproductive stage on number of pods m-2 of medium-duration pigeonpea grown with and without irrigation. Alfisol. ICRISAT Center. rainy season. 1984/85.

| Cultivar | -Irr (A) | +Irr (B) | Mean |
|---|---|---|---|
| ICP 1-6 | 756 | 1098 | 927 |
| C 11 | 520 | 1077 | 799 |
| BDN 1 | 699 | 940 | 804 |
| LRG 30 | 545 | 1126 | 835 |
| ICPH 2 | 637 | 1002 | 820 |
| ICPH 6 | 762 | 1067 | 914 |
| APAU 2208 | 633 | 1113 | 873 |
| ICPL 304 | 561 | 1229 | 895 |
| LRG 36 | 638 | 1255 | 947 |
| Mean | 636 | 1101 | |

| SE± | |
|---|---|
| Irr | 61.2* |
| CV | 73.7 |
| Irr x CV | 104.3 |

**Table 9.9. Plant stand (m-2) of medium-duration cultivars grown with and without irrigation, Alfisol, ICRISAT Center, rainy season, 1984/85.**

| Cultivar | -Irr (A) | +Irr (B) | Mean |
|---|---|---|---|
| ICP 1-6 | 4.16 | 4.28 | 4.22 |
| C 11 | 4.06 | 4.42 | 4.24 |
| BDN 1 | 4.16 | 4.12 | 4.14 |
| LRG 30 | 4.26 | 4.48 | 4.37 |
| ICPH 2 | 3.98 | 4.14 | 4.06 |
| ICPH 6 | 4.14 | 4.34 | 4.24 |
| APAU 2208 | 3.60 | 3.98 | 3.79 |
| ICPL 304 | 4.16 | 4.38 | 4.27 |
| LRG 36 | 3.58 | 4.02 | 3.80 |
| Mean | 4.01 | 4.24 | |

| SE± | |
|---|---|
| Irr | 0.09 |
| CV | 0.12 |
| Irr x CV | 0.17 |

Table 9.10. Yield and yield components of medium-duration genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| Variable | ICP 1-6 | C 11 | ICPL BDN 1 | LRG 270 | ICPH 30 | ICPH 2 | APAU 6 | ICPL 2208 | 304 | Mean | SE± |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Yield (kg ha-1) | 2141 | 2407 | 2322 | 2342 | 2205 | 2190 | 2092 | 2154 | 2270 | 2236 | 116.1 |
| TDM (kg ha-1) | 8280 | 8679 | 7412 | 8196 | 8622 | 8215 | 7957 | 8539 | 8602 | 8278 | 403.6 |
| HI | 0.26 | 0.28 | 0.31 | 0.29 | 0.26 | 0.27 | 0.26 | 0.25 | 0.26 | 0.27 | 0.01** |
| Pods plant-1 | 225.6 | 252.7 | 228.3 | 192.9 | 291.1 | 237.4 | 218.4 | 259.2 | 226.3 | 236.9 | 19.44 |
| 100-seed weight (g) | 9.18 | 9.72 | 10.07 | 11.67 | 7.29 | 7.74 | 8.96 | 7.81 | 8.97 | 9.05 | 0.34** |
| Seeds pod-1 | 2.47 | 2.62 | 2.72 | 2.78 | 2.71 | 3.02 | 2.60 | 2.89 | 2.81 | 2.74 | 0.12 |
| Pods m-2 | 999 | 991 | 890 | 758 | 1194 | 997 | 915 | 1039 | 950 | 970 | 60.1** |
| Plants m-2 | 4.44 | 3.93 | 3.99 | 3.93 | 4.11 | 4.23 | 4.17 | 4.05 | 4.26 | 4.12 | 0.26 |

## 10. Screening of breeders' elite lines of pigeonpea for soil salinity tolerance

### Introduction

Soil salinity is widespread in the semi-arid regions of the world and is a major constraint to stabilized crop production. In order to improve adaptation of pigeonpea in saline soils, we have been screening advanced breeding lines developed for various traits for salinity tolerance in both field and pot tests. ICPL 227, a medium-duration line, has been identified to possess good tolerance. As more lines are in pipeline, it is our endeavor to see that lines which are supersusceptible or tolerant to salinity are identified. Lines with a high degree of tolerance may be useful in expanding pigeonpea cultivation to saline areas.

### Materials and Methods

Field screening:

ICRISAT Center: Field screening at ICRISAT Center was carried out in saline alkaline field BS8C according to the method described previously (PPR 1980/81, Chapter IV). Sowing was done on 18 September 1984. A row of tolerant check C 11 and susceptible check HY 3C was planted on either side of the test row which was 4 m long. The row-to-row spacing was 30 cm and plant-to-plant 10 cm. There were 2 replications. There were 72 test lines. These were arranged randomly so as to maximize the chances of screening in at least one of the replications.

Hisar: One hundred and eighty-nine pigeonpea lines, mostly belonging to the short-duration group, were planted in rows 30 cm apart. After 4 test rows, a combination of HY 3C (susceptible) and C 11 (tolerant) or HY 3C and ICP 1-6 (tolerant) was planted on 19 July 1984. These lines were sown in field No. 24, which had a high level of salinity. The lines were scored thrice for salinity tolerance on a 1-9 scale, one being resistant and 9 being most susceptible.

Pot experiment (ICRISAT Center):

The pot experiment was conducted in the greenhouse. Ninety test lines + two checks were grown in 13 cm diameter plastic pots filled with Vertisol with highly saline soil in a proportion to give EC of 6 dS/m. There were three replications. Five seeds of each line was sown on 25 September 1984. Counts of surviving plants and visual scoring for growth was done on 19 October 1984.

### Results and Discussion

Field screening (ICRISAT Center): Mean % mortality of 71 pigeonpea genotypes screened this year is given in Table 10.1-. Lines that showed less mortality than C 11 were MS9-1, ICP 1-6, ICPL 8304, BDN 2, ICPL 185 and ICPL 243 (Table 10.1).

Hisar: In the screening carried out at Hisar, out of 189 lines, lines that appeared promising were, ICPL 268, ICPL 154, ICPL 289, ICPL 312, ICPL 8308, ICPL 8310, ICPL 8315, ICPL 8324, ICPL 1, ICPL 161 ICPL 986, ICPL 8326, ICPL 84018, ICPL 84019, ICPL 84020, ICPL 84021 and ICPL 84023.

Pot screening: The performance of lines tested in pots in terms of % mortality and visual scoring is given in Table 10.2. The lines that were found tolerant were ICPL 286, ICPL 5, ICPL 8304, ICPL 84061, ICPL 8341, M59-1, HY 9, BDN 2 and ICPL 315 and ICPL 304, ICPL 329 and BWR 370 had moderate tolerance. Many of these lines were found to be tolerant in the field as well but there was no clear-cut relationship between the two screenings.

Table 10.1. Mortality (%) of various genotypes in field in naturally saline Vertisol, ICRISAT Center, 1984/85.

| S.No. | Cultivar | % mortality Rep I | Rep II | Mean |
|---|---|---|---|---|
| 1. | ICPL 84066 | 10 | 20 | 15 |
| 2. | C 11 | 10 | 9 | 10 |
| 3. | HY 3C | 35 | 28 | 32 |
| 4. | M59-1 | 13 | 0 | 7 |
| 5. | ICPL 306 | 13 | 11 | 12 |
| 6. | ICPL 302 | 9 | 19 | 14 |
| 7. | ICPL 265 | 5 | 33 | 19 |
| 8. | ICPH 2 | 14 | 48 | 31 |
| 9. | ICPL 8341 | 9 | 6 | 15 |
| 10. | ICPL 233 | 9 | 15 | 12 |
| 11. | ICPL 344 | 14 | 34 | 24 |
| 12. | ICPH 6 | 4 | 15 | 10 |
| 13. | ICP 1-6 | 9 | 8 | 9 |
| 14. | ICPL 161 | 12 | 91 | 52 |
| 15. | BDN 2 | 9 | 7 | 8 |
| 16. | ICPL 317 | 0 | 24 | 12 |
| 17. | ICPL 189 | 19 | 17 | 18 |
| 18. | ICPL 95 | 28 | 5 | 17 |
| 19. | ICPL 8304 | 9 | 6 | 7 |
| 20. | ICPL 270 | 29 | 7 | 18 |
| 21. | ICPL 81 | 35 | 17 | 26 |
| 22. | ICPL 267 | 29 | 32 | 31 |
| 23. | ICPL 150 | 46 | 19 | 33 |
| 24. | ICPL 142 | 41 | 12 | 26 |
| 25. | ICPL 329 | 51 | 15 | 33 |
| 26. | ICPL 186 | 58 | 17 | 37 |
| 27. | ICPL 315 | 54 | 17 | 36 |
| 28. | ICPL 296 | 51 | 5 | 28 |
| 29. | ICPL 295 | 51 | 10 | 31 |
| 30. | ICPL 332 | 44 | 19 | 32 |
| 31. | ICPL 138 | 51 | 8 | 30 |
| 32. | LRG 36 | 56 | 5 | 31 |
| 33. | LRG 30 | 26 | 6 | 16 |
| 34. | PDM 1 | 52 | 0 | 26 |
| 35. | ICPL 4 | 53 | 19 | 36 |
| 36. | HY 9 | 48 | 11 | 29 |
| 37. | HY 4 | 51 | 17 | 34 |
| 38. | ICPL 102 | 30 | 27 | 29 |
| 39. | ICPL 230 | 35 | 35 | 35 |
| 40. | MRG 67 | 41 | 32 | 37 |

Table 10.1. (contd..) 

| S.No. | Cultivar | % mortality Rep I | Rep II | Mean |
|---|---|---|---|---|
| 41. | ICPL 304 | 24 | 32 | 28 |
| 42. | MRG 53 | 29 | 19 | 24 |
| 43. | MRG 66 | 21 | 20 | 21 |
| 44. | ICPL 192 | 19 | 39 | 29 |
| 45. | ICP 7120 | 17 | 42 | 29 |
| 46. | ICP 7182 | 18 | 6 | 12 |
| 47. | K 64 | 12 | 42 | 27 |
| 48. | ICP 2624 | 13 | 26 | 20 |
| 49. | ICPL 185 | 4 | 0 | 2 |
| 50. | ICPL 243 | 14 | 1 | 8 |
| 51. | ICPL 42 | 31 | 28 | 30 |
| 52. | ICPL 5 | 19 | 36 | 27 |
| 53. | ICPL 250 | 14 | 9 | 12 |
| 54. | ICPL 8340 | 7 | 20 | 13 |
| 55. | ICPL 219 | 17 | 11 | 14 |
| 56. | ICPL 84060 | 22 | 32 | 27 |
| 57. | ICPL 84061 | 4 | 28 | 16 |
| 58. | ICPL 281 | 18 | 37 | 27 |
| 59. | ICPL 231 | 17 | 15 | 16 |
| 60. | ICPL 155 | 18 | 6 | 12 |
| 61. | ICPL 272 | 32 | 31 | 32 |
| 62. | ICPL 8339 | 48 | 29 | 38 |
| 63. | ICPL 84062 | 30 | 7 | 19 |
| 64. | ICPL 191 | 44 | 49 | 46 |
| 65. | BWR 370 | 48 | 10 | 29 |
| 66. | RRG 5 | 47 | 7 | 27 |
| 67. | ICPL 87 | 57 | 35 | 48 |
| 68. | ICPL 151 | 45 | 8 | 26 |
| 69. | ICPL 112 | 51 | 34 | 42 |
| 70. | MRG 5 | 45 | 18 | 32 |
| 71. | ICPL 286 | 46 | 11 | 29 |

Table 10.2. Survival (%) and scored for salinity tolerance of 100 pigeonpea lines grown in pots, greenhouse, ICRISAT Center, 1984/85. x (promising) ----->xxxx(highly promising).

| S.No. | Genotype | Mean x Survival (%) | Remarks | Score | Remarks |
|---|---|---|---|---|---|
| 1. | MRG 66 | 73.33 | | 8.000 | |
| 2. | ICPL 7120 | 60.00 | | 8.000 | |
| 3. | ICP 102 | 80.00 | | 8.333 | |
| 4. | ICPL 230 | 73.33 | | 9.000 | |
| 5. | ICPL 42 | 80.00 | | 9.000 | |
| 6. | ICPL 192 | 100.00 | XXX | 7.667 | |
| 7. | ICPL 185 | 80.00 | | 7.333 | |
| 8. | ICPL 243 | 86.67 | | 8.333 | |
| 9. | ICPL 250 | 80.00 | | 9.000 | |
| 10. | ICPL 286 | 93.33 | | 5.667 | XX |
| 11. | ST 1 | 80.00 | | 8.000 | |
| 12. | BDN 1 | 73.33 | | 7.000 | |
| 13. | MRG 67 | 86.67 | | 8.333 | |
| 14. | ICPL 304 | 93.33 | XX | 7.000 | |
| 15. | MRG 53 | 80.00 | | 7.333 | |
| 16. | K 64 | 53.33 | | 9.000 | |
| 17. | MRG 5 | 66.67 | | 8.000 | |
| 18. | ICPL 272 | 60.00 | | 7.667 | |
| 19. | ICPL 281 | 80.00 | | 8.000 | |
| 20. | ICPL 131 | 100.00 | XXX | 7.667 | |
| 21. | ICPL 219 | 100.00 | XXX | 8.000 | |
| 22. | ICPL 191 | 53.33 | | 9.000 | |
| 23. | ICPL 302 | 80.00 | | 8.667 | |
| 24. | ICPL 233 | 86.67 | | 7.000 | |
| 25. | ICPL 5 | 80.00 | | 5.333 | XX |
| 26. | ICPL 112 | 66.67 | | 7.333 | |
| 27. | ICPL 344 | 80.00 | | 7.333 | |
| 28. | ICPL 161 | 60.00 | | 8.333 | |
| 29. | ICPL 142 | 100.00 | XXX | 8.667 | |
| 30. | ICPL 151 | 93.33 | | 7.667 | |
| 31. | ICPL 87 | 66.67 | | 8.000 | |
| 32. | ICPL 81 | 86.67 | | 7.667 | |
| 33. | ICPL 8304 | 100.00 | XXX | 5.333 | |
| 34. | ICPL 317 | 86.67 | | 8.667 | |
| 35. | ICPL 267 | 73.33 | | 8.000 | |
| 36. | ICP 4 | 80.00 | | 8.000 | |
| 37. | ICPL 332 | 100.00 | XXX | 6.333 | X |
| 38. | ICPL 269 | 80.00 | | 8.333 | |
| 39. | ICPL 295 | 80.00 | | 8.333 | |
| 40. | ICPL 265 | 80.00 | | 9.000 | |
| 41. | ICPH 2 | 93.33 | | 7.333 | |
| 42. | ICPH 6 | 100.00 | XXX | 8.000 | |
| 43. | ICPL 84066 | 100.00 | XXX | 8.667 | |
| 44. | ICPL 84062 | 86.67 | | 7.333 | |
| 45. | ICPL 84061 | 100.00 | XXX | 6.000 | |
| 46. | ICPL 84060 | 100.00 | XXX | 9.000 | |
| 47. | ICPL 8341 | 100.00 | XXX | 5.000 | XX |
| 48. | ICPL 8340 | 100.00 | XXX | 7.000 | |
| 49. | ICPL 8339 | 100.00 | XXX | 6.333 | |
| 50. | ICPL 329 | 93.33 | | 5.667 | XXX |

| S.No. | Genotype | Mean x Survival (%) | Remarks | Score | Remarks |
|---|---|---|---|---|---|
| 51. | ICPL 306 | 100.00 | XXX | 6.333 | X |
| 52. | ICPL 186 | 100.00 | XXX | 6.667 | X |
| 53. | ICPL 189 | 86.67 | | 7.333 | |
| 54. | ICPL 150 | 93.33 | | 8.000 | |
| 55. | ICPL 3783 | 2.00 | | 9.000 | |
| 56. | ICPL 3782 | 2.00 | | 9.000 | |
| 57. | ICP 2630 | 33.33 | | 9.000 | |
| 58. | ICP 6997 | 8.00 | | 9.000 | |
| 59. | ICP 6630 | 46.67 | | 7.333 | |
| 60. | ICP 7349 | 33.33 | | 9.000 | |
| 61. | ICP 6986 | 40.00 | | 8.333 | |
| 62. | ICPL 138 | 93.33 | | 7.000 | |
| 63. | PDM 1 | 93.33 | | 6.667 | X |
| 64. | LRG 36 | 86.67 | | 6.667 | X |
| 65. | LRG 30 | 100.00 | XXX | 8.333 | |
| 66. | M59-1 | 100.00 | XXX | 4.333 | XXX |
| 67. | ICPL 270 | 93.33 | | 8.333 | |
| 68. | BVR 370 | 100.00 | | 5.667 | XX |
| 69. | HY 4 | 100.00 | XXX | 7.000 | |
| 70. | RRG 5 | 93.33 | | 6.333 | X |
| 71. | ICPL 95 | 100.00 | XXX | 7.667 | |
| 72. | HY 9 | 93.33 | | 5.667 | XX |
| 73. | BDN 2 | 100.00 | XXX | 4.333 | XXX |
| 74. | ICPL 315 | 86.67 | | 5.667 | |
| 75. | ICPL 155 | 100.00 | XXX | 7.667 | |
| 76. | C 11 | 93.33 | | 4.667 | XXX |
| 77. | C 11 | 93.33 | | 4.667 | XXX |
| 78. | C 11 | 86.67 | | 4.667 | XXX |
| 79. | C 11 | 100.00 | XXX | 3.333 | XXXX |
| 80. | ICP 4344 | 21.33 | | 9.000 | |
| 81. | ICP 4725 | 40.67 | | 9.000 | |
| 82. | ICP 7119 | 26.67 | | 9.000 | |
| 83. | ICP 7188 | 40.00 | | 8.333 | |
| 84. | ICP 7403 | 2.00 | | 9.000 | |
| 85. | ICP 7428 | 8.00 | | 9.000 | |
| 86. | ICP 7480 | 20.00 | | 9.000 | |
| 87. | ICP 7250 | 73.33 | | 8.333 | |
| 88. | ICP 7282 | 27.33 | | 9.000 | |
| 89. | ICP 7904 | 20.67 | | 9.000 | |
| 90. | ICP 7867 | 33.33 | | 9.000 | |
| 91. | ICP 7869 | 2.00 | | 9.000 | |
| 92. | ICP 7871 | 27.33 | | 9.000 | |
| 93. | ICP 7873 | 73.33 | | 9.000 | |
| 94. | ICP 7878 | 20.67 | | 9.000 | |
| 95. | ICP 7898 | 93.33 | | 8.333 | |
| 96. | HY 3C | 73.33 | | 7.333 | |
| 97. | HY 3C | 80.00 | | 7.667 | |
| 98. | HY 3C | 93.33 | | 7.667 | |
| 99. | HY 3C | 66.67 | | 7.333 | |
| 100. | HY 3C | 53.33 | | 8.000 | |

## 11. Screening for waterlogging tolerance

### Introduction

The objective of the screening elite lines of pigeonpea is to ensure that we do not develop lines which are supersusceptible to waterlogging as compared to standard, control genotypes or at least the deficiency of particular genotypes is known. The screening method used was essentially as described previously (PPR 1982/83, Chapter 11).

### Materials and Methods

Seventy two lines of pigeonpea received from Pigeonpea Breeding Unit of ICRISAT were planted in round plastic pots of 18 cm diameter. The pots were filled with powdered Vertisol to 2.5 cm below the rim. Sowing was done on 14 March 1985. Five seedlings were raised per pot. The plants were allowed to grow with adequate water until 23 April 1985. On 23 April, the pots were submerged in waterfilled plastic troughs and were removed on 1 May 1985, after 8 days of waterlogging. The lines were scored until 18 May.

### Results and Discussion

Of the 72 lines tested, only 15 lines showed less than 25% mortality under waterlogging conditions (Table 11.1). The lines with promising waterlogging tolerance included a few early as well as medium-duration lines. Long-duration lines were not included.

**Table 11.1 Screening for waterlogging tolerance (Screenhouse) 1984/85**

A. **Lines showing less than 25% mortality (tolerant)**

1. ICPL 8304
2. ICPH 2
3. ICPL 265
4. ICPL 304
5. ICPL 84060
6. ICPL 268
7. C 11
8. ICPL 192
9. ICP 7182
10. ICP 2624
11. ICPL 42
12. ICPL 8340
13. ICPL 8339
14. ICPL 281
15. ICP 138

B. **Lines showing more than 25% mortality (susceptible)**

1. LRG 30
2. ICPL 4
3. M59-1
4. ICPL 84066
5. ICPL 267
6. ICPL 81
7. ICPL 270
8. ICPL 95
9. ICPL 189
10. ICPL 317
11. BDN 2
12. ICPL 161
13. HY 4
14. ICPL 102
15. ICPH 6
16. ICPL 344
17. ICPL 233
18. ICPL 8341
19. ICPL 302
20. ICPL 306
21. HY 9
22. ICPL 230
23. MRG 67
24. MRG 53
25. ICP 1-6
26. ICPL 219
27. ICPL 84062
28. ICPL 191
29. BWR 370
30. RRG 5
31. ICPL 87
32. ICPL 151
33. ICPL 112
34. MRG 5
35. BDN 1
36. HY 3C
37. MRG 66
38. ICP 7120
39. ICPL 185
40. ICPL 243
41. ICPL 5
42. ICPL 250
43. PDM 1
44. ICPL 84061
45. ICPL 272
46. ICPL 142
47. ICPL 155
48. ICPL 231
49. ICPL 186
50. ICPL 150
51. ICPL 239
52. ICPL 315
53. ICPL 296
54. ICPL 295
55. ICPL 332
56. LRG 36

## 12. Effects of soil collected from good and bad patches of the fields at Gwalior on the performance of ICPL 87.

### Introduction

The soil at the ICRISAT Cooperative Center at Gwalior is sandy loam (Inceptisols) which generally supports good growth. Over the years it has, however, been observed that in some parts of the fields of the farm growth of pigeonpea is very poor. In these parts pigeonpea plants show acute water stress soon after monsoon rains are over. Attempts to relate these growth differences with hard pan in soil or micronutrient deficiencies have not led to any conclusion. It was felt that if the poor growth problem of these patches is related to nutrient deficiency or biotic factors, it should be possible to reproduce these in pots where physical conditions could be held as constant as possible. To test this a pot experiment was conducted using soil collected from good and bad patches.

### Materials and Methods

Soil for the experiment was collected from the depths of 0-25 and 25-50 cm from the good and bad patches of two problem fields # 305 and #321 at ICRISAT Cooperative Center at Gwalior. This soil was transported to ICRISAT Center for the pot experiment in the greenhouse. Pigeonpea genotype ICPL 87 was sown in 23 cm square plastic pots containing 8 kg finely sieved soil from each treatment. The treatments constituted 2 fields (#305 and 321) of soil patches (good and bad) and 2 soil depths (0-25 and 25-50 cm). There were three replications (pots). Six seeds per pot were sown which upon emergence were thinned to 3 $pot^{-1}$. Seeds were inoculated with *Rhizobium* strain IC 3195 by pouring slurry on to the sown seeds. Pots were irrigated to field capacity 3 times a week. Observations on days to flowering, maturity, and at maturity on plant height, branch no., no. of leaves, and area, dry weight of shoots and seeds, harvest index, and yield components were recorded. Analysis of these variables was done in a randomized block design with three treatment factors.

### Results and Discussion

Plants in the good patch soil flowered and matured significantly earlier than in the bad patch soil in both the field soils (Table 12.1). The effect of soil depth was also significant with flowering and maturity occurring significantly later in deeper, 25-50 cm, layers of both the fields. The interaction between soil depth and soil patch was also significant with effect of soil depth being particularly conspicuous in the bad patch soil.

The effect of soil patch was significant on plant height at maturity (Table 12.2). The differences in plant height in good and bad patch soil became apparent from the early stages. The effect of soil depth was also significant on plant height but its interaction was not significant with soil patch. The effect of soil patch was not significant on number of branches and number of leaves at maturity, but was significant on no. of leaf scars at maturity. No. of leaf scars was significantly more in good patch soil but its interaction with soil depth was not significant. The effect of soil depth was highly significant on number of branches, number of leaves and leaf scars. The soil from deeper layers had fewer branches and leaves but significantly more scars due to increased senescence.

The trends in leaf area reflected a similar pattern to the number of leaves (Table 12.3). The effect of soil patch was not significant on the leaf area but the effect of soil depth was highly significant. Also the effect of field was significant with greater leaf area being obtained from plants grown in field # 321 than in field# 305. The effect of soil patch was highly significant on dry matter and seed weights. Both dry matter and seed weight were significantly more in the good patch soil. Also both dry matter and seed yield were significantly more in the 0-25 cm layer and in the field # 305 than in the # 321. Interactions between field and soil patch and field x depth were also highly significant. For seed yield, interaction between soil patch and depth was also significant.

The effect of soil patch was significant for harvest index (HI), seeds per pod, and pods per plant, with higher values of each of these parameters observed in good patch soil (Table 12.4). The effect of soil depth was significant for 100-seed weight, HI and pods per plant. The interaction of field x depth was significant for HI and field x depth and field x soil patch were significant for pods per plant. Greater number of pods per plant were obtained in field # 305 which could be the reason for significantly higher seed yield and HI in this soil.

The results of the study clearly indicate that soil from the bad patches supported poor growth and the soil from good patches good growth in pots also where the physical effects of soil could have been uniform. Therefore these results suggest that the factors related to poor or good growth may be nutritional or biotic. The possibility of nutrients playing role in bad patch formation is high as is evident from soil chemical analysis (Table 12.5). In the analysis it was apparent that there was lower P content in the soil in the bad patches and the lower depths, where the crop growth was poor. In fact the delayed flowering effect of bad patch soil was a typical effect of P deficiency observed in Phosphorus experiments conducted this year (See chapter 6). In addition to P, the bad patches had significantly lower Zn content, whereas the sodium content was higher in the bad patches. The correlation matrix of various chemical parameters with total dry matter and seed yield given in Table 12.6 clearly provides evidence of the role played by low P and Zn in the bad patch formation in Gwalior soil. We have not explored the possibility of biotic factors such as nematodes being involved in bad patch formation. Therefore their involvement has not been ruled out in this experiment.

Table 12.1. Effect of soil collected from different depths of good and bad patches in two fields at Gwalior on days to flowering (DF) and maturity (DM).

| Soil patch | Soil depth (cm) | Field No. 305 | 321 | 305 | 321 |
|---|---|---|---|---|---|
| | | DF | | DM | |
| Bad | 0-25 | 89 | 88 | 133 | 136 |
| | 25-50 | 129 | 92 | 207 | 120 |
| Good | 0-25 | 80 | 79 | 129 | 128 |
| | 25-50 | 80 | 93 | 126 | 126 |
| SE | Field | 2.3 | | 2.9* | |
| | Soil | 2.3** | | 2.9** | |
| | Depth | 2.3** | | 2.9** | |
| | Field x Soil | 3.2** | | 4.2 | |
| | Field x Depth | 3.2 | | 4.2* | |
| | Soil x Depth | 3.2* | | 4.2** | |
| | Field x Soil x Depth | 4.6** | | 5.9* | |

Table 12.2. Effect of soil collected from different depths of good and bad patches in two fields at Gwalior on plant height (cm), number of branches, number of leaves and number of leaf scars at maturity of ICPL 87 grown in pots at ICRISAT Center, 1984/85.

| Soil | Soil depth (cm) 0-25 | 25-50 | Mean | Soil depth (cm) 0-25 | 25-50 | Mean |
|---|---|---|---|---|---|---|
| | Plant height (cm) | | | No. of branches | | |
| Bad patch | 63 | 57 | 60 | 3.4 | 0.4 | 1.9 |
| Good patch | 69 | 66 | 67 | 3.9 | 1.4 | 2.7 |
| | ±1.6 | | ±1.1** | ±0.47 | | ±0.33 |
| Mean | 66 | 61 | | 3.7 | 0.9 | |
| | ±1.1* | | | ±0.33** | | |
| | No. of leaves | | | No. of leaf scars | | |
| Bad patch | 19.3 | 7.2 | 13.5 | 13.4 | 15.5 | 14.5 |
| Good patch | 21.9 | 5.1 | 13.5 | 14.4 | 21.4 | 17.9 |
| | ±1.99 | | ±1.41 | ±1.16 | | ±0.82** |
| Mean | 20.6 | 6.4 | | 13.9 | 18.5 | |
| | ±1.41** | | | ±0.82** | | |

**Table 12.3. Effect of soil collected from different depths of good and bad patches in two fields at Gwalior on the leaf area, total dry matter and seed yield of ICPL 87 grown in pots, ICRISAT Center, 1984/85.**

| Soil patch | Soil depth (cm) | Field No. 305 | 321 | 305 | 321 | 305 | 321 |
|---|---|---|---|---|---|---|---|
| | | Leaf area (cm)2 plant-1 | | Dry weight g plant-1 | | Seed weight g plant-1 | |
| Bad | 0-25 | 175.5 | 291.8 | 11.04 | 9.84 | 4.23 | 2.39 |
| | 25-50 | 12.2 | 65.5 | 1.86 | 3.30 | 0.31 | 0.62 |
| Good | 0-25 | 193.3 | 256.5 | 15.04 | 10.86 | 6.74 | 3.34 |
| | 25-50 | 36.1 | 49.1 | 5.27 | 4.56 | 1.57 | 0.94 |
| SE | Field | 16.8* | | 0.240** | | 0.121** | |
| | Soil | 16.8 | | 0.240** | | 0.121** | |
| | Depth | 16.8** | | 0.240** | | 0.121** | |
| | Field x Soil | 23.75 | | 0.339** | | 0.171** | |
| | Field x Depth | 23.75 | | 0.339** | | 0.171** | |
| | Soil x Depth | 23.75 | | 0.339 | | 0.171* | |
| | Field x Soil x Depth | 33.59 | | 0.480 | | 0.243 | |

Table 12.4. Effect of soil collected from different depths of good and bad patches in two fields at Gwalior on HI(%), 100-seed weight, seeds pod-1 and pods plant-1 of ICPL 87 grown in pots, ICRISAT Center, 1984/85.

| Soil patch | Soil depth (cm) | Field No. 305 | 321 | 305 | 321 | 305 | 321 | 305 | 321 |
|---|---|---|---|---|---|---|---|---|---|
| | | HI (%) | | 100-seed mass g | | Seeds pod-1 | | Pods plant-1 | |
| Bad | 0-25 | 38.5 | 24.3 | 9.6 | 10.4 | 2.8 | 2.0 | 15.9 | 11.9 |
| | 25-50 | 16.8 | 19.5 | 6.4 | 7.6 | 2.0 | 2.2 | 3.1 | 3.9 |
| Good | 0-25 | 44.9 | 30.6 | 9.8 | 8.4 | 3.1 | 3.1 | 22.2 | 13.1 |
| | 25-50 | 30.1 | 19.7 | 7.6 | 7.7 | 2.7 | 2.7 | 7.7 | 4.3 |
| SE | Field | 1.51 | | 0.30 | | 0.14 | | 0.72** | |
| | Soil | 1.51** | | 0.30 | | 0.14 | | 0.72** | |
| | Depth | 1.51** | | 0.30 | | 0.14** | | 0.72** | |
| | Field x Soil | 2.13 | | 0.42 | | 0.20 | | 1.01* | |
| | Field x Depth | 2.13* | | 0.42 | | 0.20 | | 1.01* | |
| | Soil x Depth | 2.13 | | 0.42 | | 0.20 | | 1.01 | |
| | Field x Soil x Depth | 3.01 | | 0.59 | | 0.28 | | 1.43 | |

Table 12.5. Soil chemical analysis of soil collected from good and bad patches in two different fields at Gwalior and used in the pot experiments conducted at ICRISAT Center, 1984/85.

| Field No. | Soil patch | Depth (cm) | EC | pH | P (mg $Kg^{-1}$ Soil) | Na | K | Zn |
|---|---|---|---|---|---|---|---|---|
| 305 | Bad | 0-25 | 0.15 | 8.1 | 7.0 | 132 | 113 | 0.44 |
| | | 25-50 | 0.17 | 8.0 | 1.7 | 170 | 144 | 0.40 |
| | Good | 0-25 | 0.20 | 8.1 | 16.3 | 107 | 161 | 0.76 |
| | | 25-50 | 0.17 | 8.3 | 5.5 | 157 | 158 | 0.43 |
| 321 | Bad | 0-25 | 0.18 | 8.1 | 6.7 | 156 | 128 | 0.54 |
| | | 25-50 | 0.18 | 8.0 | 2.3 | 274 | 187 | 0.36 |
| | Good | 0-25 | 0.17 | 7.9 | 12.8 | 156 | 138 | 0.76 |
| | | 25-50 | 0.18 | 7.9 | 3.7 | 125 | 131 | 0.47 |
| SE | | | | | | | | |
| Field | | | 0.010 | 0.06 | 0.48 | 11.1* | 7.0 | 0.014 |
| Soil | | | 0.010 | 0.06 | 0.48** | 11.1** | 7.0 | 0.014** |
| Depth | | | 0.010 | 0.06 | 0.48** | 11.1* | 7.0 | 0.014** |
| Field x Soil | | | 0.014 | 0.08 | 0.68 | 15.7 | 9.9* | 0.020 |
| Field x Depth | | | 0.014 | 0.08 | 0.68 | 15.7 | 9.9 | 0.020 |
| Soil x Depth | | | 0.014 | 0.08 | 0.68** | 15.7 | 9.9* | 0.020** |
| Field x Soil x Depth | | | 0.020 | 0.12 | 0.96 | 22.2* | 14.0 | 0.028 |

Table 12.6. Correlation coefficients of various chemical parameters with total dry matter and seed yield.

| | Total dry matter | Seed weight |
|---|---|---|
| EC | 0.216 | 0.261 |
| pH | 0.128 | 0.186 |
| P | 0.917** | 0.912** |
| Na | -0.582 | -0.590 |
| K | -0.287 | -0.166 |
| Zn | 0.824* | 0.773* |

## 13. Solarization studies with pigeonpea (YSC, YLN, CJ, MPH, S. Singh, SBS, JVDKK, SS, KLS, JRB)

### Introduction

Soil solarization is a method of heating soil by using solar energy to control soil-borne pathogens, plant parasitic nematodes and soil dwelling insects. In May 1983, a preliminary experiment was carried out by our pathologists to see if wilt disease caused by *Fusarium* could be controlled by this method. The results indicated that the method has promise in our conditions but it was also clear that meaningful results could be obtained if a multidisciplinary team of scientists worked together on various aspects of soil solarization. In order to investigate the effects of soil solarization on plant growth and biological N fixation in pigeonpea and chickpea, we joined the group. In this section results of plant growth, phenology, nodulation and N fixation parameters of pigeonpea are presented.

### Materials and Methods

The experiment was laid out on a Vertisol wilt sick (BIL 2B) plot. On this field inocula of *Fusarium udum* had been previously enhanced by intensive and repeated incorporation of wilt infected plant material for the purpose of creating a uniformly wilt sick plot to screen for resistance.

The field design of the experiment was split-plot with irrigation (+irrigation), no irrigation (-irrigation) prior to solarization as main plots and the sub-plots were a factorial combination of a wilt susceptible genotype LRG 30 and wilt-resistant genotype ICP 8863 with and without solarization. There were six replications. Plot size was 6 x 6 m (four 1.5 m-wide broadbeds). A 3 m-wide buffer zone was maintained between plots. Clear polythene sheeting of 100 um thickness (94 g m-2) of 6 x 6.5 m size was laid over the appropriate plots 2-3 days after irrigation of the main plots. Soil was placed around edges of the polythene sheet to secure it.

Solarization began on 13 April and was terminated on 4 June, after 52 days of solarization. Pigeonpea was sown on 25 June after a uniform weeding. Sowing was done at 75 cm row-to-row spacing and 30 cm plant-to-plant spacing.

Observations on plant height, phenology, plant stand, seed yield, total above-ground dry matter at mortality, pods per plant, number of seeds per pod and 100-seed weight were recorded. The sampling area for yield and plant dry matter for each plot at maturity was 15 m2.

In addition, during the crop growth period observations of nitrogen fixation were recorded.

A composite soil sample comprising 2 subsamples was collected from 0-15 cm depth of each of the plots on 10 April 1984 (before solarization) and 5 June 1984 (after solarization). The soil samples were analyzed for pigeonpea *Rhizobium* population by serial dilution-plant infection most-probable number (MPN) method (Kumar Rao and Dart, 1981, International Pigeonpea Workshop Proc. Vol. II, ICRISAT, pp. 367-372). At 30 and 60 DAS, 10 and 5 plants per plot were sampled for nodulation, ARA and plant dry matter. At sampling, the plants were carefully dug out to recover as much root system with nodules as possible. ARA of the nodulated roots and loose nodules was conducted. The shoot, root and nodules were dried at 70 C and weighed.

Details on the effects of solarization on fungal diseases, nematodes, soil moisture and temperature are available in the reports of the respective collaborators.

## Results and Discussion

Weed growth: Weed growth was significantly reduced by polythene application (Table 13.1). Irrigation prior to solarization did not seem to enhance the effectiveness of solarization although the solarization x irrigation treatment interaction was significant. This was because irrigation increased the weed growth substantially in the non-solarised treatments.

Plant growth and branching: Plant height and number of primary branches was consistently more in the polythene mulch treatment of both wilt-resistant and the susceptible genotypes (Table 13.2) at all samplings. Plant height at maturity was 45% more and branch no. 70% more in the solarized treatment than the non-solarized treatment. The irrigation x solarization treatment interacting was also significant for plant height and no. of primary branches. The effect of solarization in the resistant genotype could be attributed to the increased growth responses.

Phenology: Flowering and maturity was enhanced by solarization (Table 13.3). A greater effect of solarization on flowering and maturity was observed in the case of the wilt susceptible genotype than the wilt resistant genotype; the genotype x solarization interaction was highly significant.

Total dry matter (TDM): TDM was significantly more in the solarized treatments for both genotypes (Table 13.4). Increase in the TDM due to irrigation in the susceptible genotype was nearly 6 fold and in the resistant genotype nearly two fold. The interactions of solarization with irrigation and genotype were significant.

Seed yield: Solarization significantly increased seed yield but interaction of solarization was not-significant with irrigation or genotype (Table 13.4). Yield of LRG 30 increased by about 10 fold and that of ICP 8863 1.65 fold over the non solarized control. The increase in seed yield of the wilt-susceptible genotype came mainly from reduced wilt incidence but that of wilt-resistant genotype from increased growth response as it was virtually free of disease.

Increase in seed yield due to solarization was due the significant improvement in the number of pods plant-1 and number of seeds pod-1 (Table 13.5). Hundred seed weight was not affected by solarization. There was a significant increase in the harvest index of LRG 30 as a result of solarization, but not in ICP 8863 due to a strong genotype x solarization interaction.

Solarization of the soil resulted in a 4-fold reduction of soil populations of pigeonpea *Rhizobium* compared to the non-solarized treatment

(Table 13.6). At 30 DAS, pigeonpea nodulation [nodule number (Table 13.7) and dry weight (Table 13.8)], specific ARA (Table 13.10) were all significantly reduced by solarization. The adverse effect of solarization was particularly greater in irrigated plots than non-irrigated plots. This may be attributed to the fact that the moist heat is more deleterious to soil flora than dry heat. The wilt-resistant genotype had significantly greater nodulation and ARA than the susceptible genotype although there were no differences in shoot dry matter between the two. The interaction of solarization and genotype was significant as the nodulation and ARA of LRG 30 was more affected by solarization than ICP 8863. Solarization had increased shoot dry matter of both genotypes (Table 13.11). The increase in shoot weight due to solarization was, however, significantly less in irrigated plots than nonirrigated plots. Similar interactions were observed with root and total plant dry matter (Tables 13.12 and 13.8).

At 60 DAS, pigeonpea nodulation (Tables 13.14 and 13.15) and ARA (Tables 13.16 and 13.17) were low compared to the observations made at 30 DAS. This was probably because of a prolonged drought spell during the interacting period. However, the shoot, root and TDM were increased by solarization (Tables 13.18, 13.19 and 13.20). Although solarization had reduced Rhizobium population and plant nodulation, the increased plant growth might be attributed to availability of more plant nutrients, particularly nitrogen released through mineralization.

Table 13.1. Effect of soil solarization as weed growth in a wilt-sick Vertisol field, ICRISAT Center, 1984/85.

| Treatment | -Sol | +Sol | Mean | -Sol | +Sol | Mean |
|---|---|---|---|---|---|---|
| | I weeding (25/6/84) | | | II weeding (20/7/84) | | |
| - irrigation | 3.39 | 0.28 | 1.83 | 143.9 | 28.6 | 86.3 |
| + irrigation | 15.14 | 1.02 | 8.08 | 58.1 | 25.0 | 41.5 |
| | ±0.987 | | ±0.840** | ±6.53 | | ±2.54** |
| | (0.732) | | | (8.51)** | | |
| Mean | 9.26 | 0.65 | | 101.0 | 26.8 | |
| | ±0.518** | | | ±6.01** | | |
| | III weeding (3/10/84) | | | IV weeding (27/11/84) | | |
| - irrigation | 149.8 | 37.5 | 93.7 | 10.1 | 17.5 | 13.8 |
| + irrigation | 172.4 | 28.6 | 100.5 | 8.7 | 33.9 | 21.3 |
| | ±10.01 | | ±6.18 | ±4.21 | | ±2.79 |
| | (11.13) | | | (4.47) | | |
| Mean | 161.1 | 33.1 | | 9.4 | 25.7 | |
| | ±7.87** | | | ±3.16** | | |

SE values in the parenthesis are for comparing means at the same level of irrigation.

Table 13.2. Effect of solarization on plant height (cm) and number of primary branches of LRG 30 and ICP 8863 grown on wilt sick Vertisol, ICRISAT Center 1984/85.

| Genotype | Treatment | Days after sowing 67 | 114 | 144 | 226 |
|---|---|---|---|---|---|
| | | Plant height (cm) | | | |
| LRG 30 | -Sol | 28.2 | 50.5 | 76.1 | 79.7 |
| | +Sol | 48.6 | 103.0 | 128.8 | 129.9 |
| ICP 8863 | -Sol | 31.5 | 64.4 | 90.6 | 91.5 |
| | +Sol | 41.2 | 94.1 | 121.6 | 118.5 |
| SE | | ±2.76 | ±5.10 | ±5.44 | ±4.75 |
| | | No. of primary branches plant-1 | | | |
| LRG 30 | -Sol | 0.8 | 3.1 | 5.9 | 6.0 |
| | +Sol | 3.78 | 10.8 | 13.0 | 12.3 |
| ICP 8863 | -Sol | 2.3 | 5.7 | 7.1 | 7.0 |
| | +Sol | 3.6 | 9.9 | 10.1 | 9.8 |
| SE | | ±0.49 | ±0.85 | ±0.85 | ±0.78 |

Table 13.3. Effect of solarization on time to 50% flowering and maturity of LRG 30 and ICP 8863 grown on wilt sick Vertisol, ICRISAT Center 1984/85.

| Genotype | -Sol | +Sol | Mean |
|---|---|---|---|
| | Time to 50% flowering (days) | | |
| LRG 30 | 153 | 143 | 148 |
| ICP 8863 | 138 | 125 | 132 |
| SE | ±1.59 | | ±1.13** |
| Mean | 145 | 134 | |
| SE | ±1.13** | | |
| | Time to maturity | | |
| LRG 30 | 247 | 187 | 217 |
| ICP 8863 | 200 | 181 | 190 |
| SE | ±3.05** | | ±2.16** |
| Mean | 224 | 184 | |
| SE | ±2.16** | | |

Table 13.4. Effect of solarization on total dry matter and seed yield of LRG 30 and ICP 8863 grown on wilt sick Vertisol, ICRISAT Center, rainy season 1984/85.

| | Genotype | | | | |
|---|---|---|---|---|---|
| | LRG 30 | .7) | (10.7) | | |
| Mean | 2.0 | 2.6 | | 2.7 | 2.9 |
| | (4.0) | (8.5) | | (8.8) | (11.5) |
| Mean | 2.3 | | | 2.8 | |
| | (6.3) | | | (10.2) | |
| Sol x CV | | | | | |
| +Sol | 2.2 | 2.5 | 2.3 | | |
| | (5.5) | (9.2) | (7.3) | | |
| -Sol | 2.5 | 3.0 | 2.7 | | |
| | (7.3) | (10.8) | (9.1) | | |
| Mean | 2.3 | 2.7 | | | |
| | (6.4) | (10.0) | | | |
| SE | | | | | |
| Irri | ±0.22 NS | | | | |
| Sol | ±0.22 NS | | | | |
| CV | ±0.22 NS | | | | |
| Irri x Sol | ±0.31 NS | | | | |
| Irri x CV | ±0.31 NS | | | | |
| Sol x CV | ±0.31 NS | | | | |
| Irri x Solar x CV | ±0.44 NS | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.5. Effect of solarization on yield components of LRG 30 and ICP 8863 grown on wilt sick Vertisol, ICRISAT Center, 1984/85.

| | Genotype | | | | |
|---|---|---|---|---|---|
| | LRG 30 | | ICP 8863 | | |
| Components | -Sol | +Sol | -Sol | +Sol | SE |
| 100-seed weight (g) | 6.63 | 6.06 | 8.90 | 8.31 | 0.187 |
| Seeds pod-1 | 2.17 | 2.89 | 2.20 | 2.71 | 0.067** |
| Pods plant-1 | 23.4 | 1009.8 | 64.0 | 124.3 | 7.16** |
| Harvest index (%) | 10.0 | 16.1 | 31.0 | 27.8 | 1.46 |

Table 13.6. Effect of solarization on pigeonpea - Rhizobium populations [most probable number (MPN)] of a Vertisol field[a] - after solarization.

| | MPN pigeonpea rhizobia/g[-1] dry wt. soil | | |
|---|---|---|---|
| Treatment | +Irrig | -Irrig | Mean |
| +Sol | 4.07 | 4.09 | 4.08 |
| -Sol | 4.77 | 4.73 | 4.75 |
| SE | ±0.132[b] ±0.220 | | ±0.094** |
| Mean | 4.42 | 4.41 | |
| SE | ±0.199(NS) | | |

a - before solarization the field had 5.15 MPN pigeonpea rhizobia (log10) g-1 dry soil.

b - the standard error for comparing irrigated at a given level is ±0.132 and comparing levels within the irrigated and unirrigated is ±0.220.

Table 13.7. Effect of solarization on nodule number plant-1 of pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1 | CV-2 | Mean |
| +Sol | 9 | 12 | 11 | 13 | 18 | 16 |
| -Sol | 36 | 23 | 29 | 28 | 22 | 25 |
| Mean | 22 | 17 | | 21 | 20 | |
| Mean | 20 | | | 20 | | |
| <u>Sol x CV</u> | | | | | | |
| +Sol | 11 | 15 | 13 | | | |
| -Sol | 32 | 23 | 27 | | | |
| Mean | 22 | 19 | | | | |
| <u>SE</u> | | | | | | |
| Irri | ±1.9 NS | | | | | |
| Sol | ±0.9 ** | | | | | |
| CV | ±0.9 NS | | | | | |
| Irri x Sol | ±2.1 ** | | | | | |
| Irri x CV | ±2.1 NS | | | | | |
| Sol x CV | ±1.3 ** | | | | | |
| Irri x Solar x CV | ±2.5 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.8. Effect of solarization on nodule dry wt. mg plant-1 of pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 0.1 | 0.5 | 0.2 | 0.6 | 1.2 | 0.9 |
| | (1.2)b | (3.6) | (2.4) | (4.0) | (14.7) | (9.3) |
| -Sol | 1.1 | 1.2 | 1.1 | 0.9 | 1.1 | 1.0 |
| | (13.5) | (15.3) | (14.3) | (9.2) | (13.5) | (11.3) |
| Mean | 0.5 | 0.8 | | 0.8 | 1.1 | |
| | (7.4) | (9.4) | | (6.6) | (14.1) | |
| Mean | 0.7 | | | 1.0 | | |
| | (8.4) | | | (10.3) | | |
| <u>Sol x CV</u> | | | | | | |
| +Sol | 0.3 | 0.8 | 0.6 | | | |
| | (2.6) | (9.2) | (5.9) | | | |
| -Sol | 1.0 | 1.1 | 1.1 | | | |
| | (11.4) | (14.4) | (12.9) | | | |
| Mean | 0.7 | 1.0 | | | | |
| | (7.0) | (11.8) | | | | |
| <u>SE</u> | | | | | | |
| Irri | | ±0.05 * (1.13) | | | | |
| Sol | | ±0.04 ** (0.64) | | | | |
| CV | | ±0.04 ** (0.64) | | | | |
| Irri x Sol | | ±0.06 ** (1.30) | | | | |
| Irri x CV | | ±0.06 NS (1.30) | | | | |
| Sol x CV | | ±0.05 ** (0.91) | | | | |
| Irri x Solar x CV | | ±0.08 NS (1.59) | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

**Table 13.9. Effect of solarization on ARA (u moles $C_2H_4$/plant/h) pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.**

| Treatment | +Irri CV-1a | +Irri CV-2 | +Irri Mean | -Irri CV-1a | -Irri CV-2 | -Irri Mean |
|---|---|---|---|---|---|---|
| +Sol | 0.2 (0.1)b | 0.4 (0.2) | 0.3 (0.1) | 0.6 (0.4) | 1.2 (1.5) | 0.9 (0.9) |
| -Sol | 1.1 (1.1) | 1.3 (1.8) | 1.2 (1.5) | 0.9 (0.8) | 1.1 (1.2) | 1.0 (1.0) |
| Mean | 0.6 (0.6) | 0.8 (1.0) | | 0.7 (0.6) | 1.2 (1.4) | |
| Mean | 0.7 (0.8) | | | 0.9 (1.0) | | |
| <u>Sol x CV</u> | | | | | | |
| +Sol | 0.4 (0.2) | 0.8 (0.8) | 0.6 (0.5) | | | |
| -Sol | 1.0 (1.0) | 1.2 (1.5) | 1.1 (1.2) | | | |
| Mean | 0.7 (0.6) | 1.0 (1.2) | | | | |
| <u>SE</u> | | | | | | |
| Irri | | ±0.05 * | | | | |
| Sol | | ±0.03 ** | | | | |
| CV | | ±0.03 ** | | | | |
| Irri x Sol | | ±0.06 ** | | | | |
| Irri x CV | | ±0.06 NS | | | | |
| Sol x CV | | ±0.05 * | | | | |
| Irri x Solar x CV | | ±0.07 * | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.10. Effect of solarisation on specific ARA (umC2H4/g dry nod./h) pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.

| Treatment | +Irri CV-1a | +Irri CV-2 | +Irri Mean | -Irri CV-1a | -Irri CV-2 | -Irri Mean |
|---|---|---|---|---|---|---|
| +Sol | 32.5 | 44.2 | 38.4 | 85.8 | 105.0 | 95.4 |
| -Sol | 83.2 | 117.0 | 100.1 | 89.4 | 92.8 | 91.1 |
| Mean | 57.9 | 80.6 | | 87.6 | 98.9 | |
| Mean | 69.2 | | | 93.2 | | |
| Sol x CV | | | | | | |
| +Sol | 59.2 | 74.6 | 66.9 | | | |
| -Sol | 86.3 | 1'04.9 | 95.6 | | | |
| Mean | 72.7 | 89.7 | | | | |
| SE | | | | | | |
| Irri | | ±3.76 ** | | | | |
| Sol | | ±5.08 ** | | | | |
| CV | | ±5.08 * | | | | |
| Irri x Sol | | ±6.32 ** | | | | |
| Irri x CV | | ±6.32 NS | | | | |
| Sol x CV | | ±7.19 NS | | | | |
| Irri x Solar x CV | | ±9.57 NS | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863

b = Figures in parentheses are values before log10 transformation.

** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.11. Effect of solarization shoot dry weight (g/plant) pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.

| | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| Treatment | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 0.50 | 0.45 | 0.47 | 0.61 | 0.60 | 0.61 |
| | (0.25) | (0.20) | (0.23) | (0.38) | (0.37) | (0.37) |
| -Sol | 0.50 | 0.48 | 0.49 | 0.45 | 0.49 | 0.47 |
| | (0.25) | (0.24) | (0.24) | (0.20) | (0.24) | (0.22) |
| Mean | 0.50 | 0.47 | | 0.53 | 0.55 | |
| | (0.25) | (0.22) | | (0.29) | (0.31) | |
| Mean | 0.48 | | | 0.54 | | |
| | (0.24) | | | (0.30) | | |
| <u>Sol x CV</u> | | | | | | |
| +Sol | 0.56 | 0.53 | 0.54 | | | |
| | (0.32) | (0.29) | (0.30) | | | |
| -Sol | 0.47 | 0.49 | 0.48 | | | |
| | (0.23) | (0.24) | (0.23) | | | |
| Mean | 0.51 | 0.51 | | | | |
| | (0.27) | (0.26) | | | | |
| <u>SE</u> | | | | | | |
| Irri | | ±0.01 ** | | | | |
| Sol | | ±0.01 ** | | | | |
| CV | | ±0.01 NS | | | | |
| Irri x Sol | | ±0.02 ** | | | | |
| Irri x CV | | ±0.02 NS | | | | |
| Sol x CV | | ±0.02 NS | | | | |
| Irri x Solar x CV | | ±0.03 NS | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.12. Effect of solarization on root dry weight (mg/plant) pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.

| Treatment | +Irri CV-1a | +Irri CV-2 | +Irri Mean | -Irri CV-1a | -Irri CV-2 | -Irri Mean |
|---|---|---|---|---|---|---|
| +Sol | 1.56 | 1.60 | 1.58 | 1.70 | 1.76 | 1.72 |
| | (36.9)b | (40.2) | (38.6) | (50.7) | (57.2) | (54.0) |
| -Sol | 1.64 | 1.67 | 1.65 | 1.58 | 1.64 | 1.61 |
| | (43.5) | (47.5) | (45.5) | (38.2) | (45.0) | (41.6) |
| Mean | 1.60 | 1.63 | | 1.64 | 1.70 | |
| | (40.2) | (43.8) | | (44.4) | (51.1) | |
| Mean | 1.61 | | | 1.67 | | |
| | (42.0) | | | (47.8) | | |
| Sol x CV | | | | | | |
| +Sol | 1.63 | 1.68 | 1.65 | | | |
| | (43.8) | (48.7) | (46.3) | | | |
| -Sol | 1.61 | 1.65 | 1.63 | | | |
| | (40.8) | (46.2) | (43.5) | | | |
| Mean | 1.62 | 1.66 | | | | |
| | (42.3) | (47.3) | | | | |
| SE | | | | | | |
| Irri | | ±0.02 * | | | | |
| Sol | | ±0.02 NS | | | | |
| CV | | ±0.02 NS | | | | |
| Irri x Sol | | ±0.03 ** | | | | |
| Irri x CV | | ±0.03 NS | | | | |
| Sol x CV | | ±0.03 NS | | | | |
| Irri x Solar x CV | | ±0.04 NS | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.13. Effect of solarization total plant dry matter (g/plant) pigeonpea grown on a Vertisol in Kharif 1984, 30 DAS.

| Treatment | +Irri CV-1a | +Irri CV-2 | +Irri Mean | -Irri CV-1a | -Irri CV-2 | -Irri Mean |
|---|---|---|---|---|---|---|
| +Sol | 0.54<br>(0.29)b | 0.50<br>(0.25) | 0.52<br>(0.27) | 0.66<br>(0.43) | 0.66<br>(0.44) | 0.66<br>(0.44) |
| -Sol | 0.55<br>(0.31) | 0.54<br>(0.30) | 0.55<br>(0.30) | 0.50<br>(0.25) | 0.55<br>(0.30) | 0.52<br>(0.28) |
| Mean | 0.54<br>(0.30) | 0.52<br>(0.27) | | 0.58<br>(0.34) | 0.60<br>(0.37) | |
| Mean | 0.53<br>(0.29) | | | 0.59<br>(0.36) | | |
| Sol x CV | | | | | | |
| +Sol | 0.60<br>(0.36) | 0.58<br>(0.35) | 0.59<br>(0.35) | | | |
| -Sol | 0.53<br>(0.28) | 0.54<br>(0.30) | 0.54<br>(0.29) | | | |
| Mean | 0.56<br>(0.32) | 0.56<br>(0.32) | | | | |
| SE | | | | | | |
| Irri | ±0.01 ** | | | | | |
| Sol | ±0.01 * | | | | | |
| CV | ±0.01 NS | | | | | |
| Irri x Sol | ±0.02 ** | | | | | |
| Irri x CV | ±0.02 NS | | | | | |
| Sol x CV | ±0.02 NS | | | | | |
| Irri x Solar x CV | ±0.03 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.14. Effect of solarization on nodule no. plant-1 pigeonpea grown on a Vertisol in Kharif 1984, 60 DAS.

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 5 | 4 | 4.4 | 7 | 8 | 7.5 |
| -Sol | 3 | 6 | 4.7 | 7 | 5 | 6 |
| Mean | 4 | 5 | | 7 | 7 | |
| Mean | 5 | | | 7 | | |
| <u>Sol x CV</u> | | | | | | |
| +Sol | 6 | 6 | 6 | | | |
| -Sol | 5 | 6 | 5.5 | | | |
| Mean | 5.5 | 6 | | | | |
| **SE** | | | | | | |
| Irri | ±0.9 NS | | | | | |
| Sol | ±0.6 NS | | | | | |
| CV | ±0.6 NS | | | | | |
| Irri x Sol | ±1.0 NS | | | | | |
| Irri x CV | ±1.0 NS | | | | | |
| Sol x CV | ±0.9 NS | | | | | |
| Irri x Solar x CV | ±1.4 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.15. Effect of solarization on nodule dry wt. mg plant-1 pigeonpea grown on a Vertisol in Kharif 1984, 60 DAS.

| | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| Treatment | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 2.0<br>(4.0)b | 2.3<br>(6.0) | 2.2<br>(5.0) | 2.4<br>(7.0) | 2.7<br>(12.3) | 2.5<br>(9.7) |
| -Sol | 2.0<br>(4.0) | 2.9<br>(11.0) | 2.4<br>(7.5) | 3.1<br>(10.7) | 3.04<br>(10.7) | 3.1<br>(10.7) |
| Mean | 2.0<br>(4.0) | 2.6<br>(8.5) | | 2.7<br>(8.8) | 2.9<br>(11.5) | |
| Mean | 2.3<br>(6.3) | | | 2.8<br>(10.2) | | |
| Sol x CV | | | | | | |
| +Sol | 2.2<br>(5.5) | 2.5<br>(9.2) | 2.3<br>(7.3) | | | |
| -Sol | 2.5<br>(7.3) | 3.0<br>(10.8) | 2.7<br>(9.1) | | | |
| Mean | 2.3<br>(6.4) | 2.7<br>(10.0) | | | | |
| SE | | | | | | |
| Irri | ±0.22 NS | | | | | |
| Sol | ±0.22 NS | | | | | |
| CV | ±0.22 NS | | | | | |
| Irri x Sol | ±0.31 NS | | | | | |
| Irri x CV | ±0.31 NS | | | | | |
| Sol x CV | ±0.31 NS | | | | | |
| Irri x Solar x CV | ±0.44 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

**Table 13.16. Effect of solarization on ARA (umoles C2H4 plant/h) pigeonpea grown on a Vertisol in Kharif 1984, 60 DAS.**

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 0.1 (0.03) | 0.1 (0.02) | 0.1 (0.02) | 0.1 (0.0[illegible] | 0.1 (0.04) | 0.1 (0.04) |
| -Sol | 0.1 (0.03) | 0.1 (0.02 | 0.1 (0.02) | 0.1 (0.0[illegible] | 0.2 (0.1) | 0.1 (0.10) |
| Mean | 0.1 (0.03) | 0.1 (0.02 | | 0.1 (0.0[illegible] | 0.1 (0.1) | |
| Mean | 0.1 (0.02) | | | 0.1 (0.04) | | |
| **Sol x CV** | | | | | | |
| +Sol | 0.1 (0.03) | 0.1 (0.03) | 0.1 (0.03) | | | |
| -Sol | 0.1 (0.02) | 0.2 (0.[illegible]) | 0.1 (0.04) | | | |
| Mean | 0.1 (0.03) | 0.1 (0.04) | | | | |
| **SE** | | | | | | |
| Irri | ±0.02 NS | | | | | |
| Sol | ±0.02 NS | | | | | |
| CV | ±0.02 NS | | | | | |
| Irri x Sol | ±0.03 NS | | | | | |
| Irri x CV | ±0.03 NS | | | | | |
| Sol x CV | ±0.03 NS | | | | | |
| Irri x Solar x CV | ±0.04 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.17. Effect of solarization on specific ARA (umoles C2H4/g dry nod/h) of pigeonpea grown on a Vertisol in Kharif 1984, 60 DAS.

| Treatment | +Irri CV-1a | +Irri CV-2 | +Irri Mean | -Irri CV-1a | -Irri CV-2 | -Irri Mean |
|---|---|---|---|---|---|---|
| +Sol | 2.1 (7.5)b | 1.5 (3.2) | 1.8 (5.4) | 1.0 (2.2) | 1.5 (2.9) | 1.3 (2.6) |
| -Sol | 2.2 (4.8) | 1.6 (16.5) | 1.9 (10.6) | 1.8 (4.6) | 2.1 (8.4) | 1.9 (6.5) |
| Mean | 2.1 (6.2) | 1.5 (9.8) | | 1.4 (3.4) | 1.8 (5.6) | |
| Mean | 1.8 (8.0) | | | 1.6 (4.5) | | |
| <u>Sol x CV</u> | | | | | | |
| +Sol | 1.6 (4.9) | 1.5 (3.1) | 1.5 (4.0) | | | |
| -Sol | 2.0 (4.7) | 1.8 (12.4) | 1.9 (8.6) | | | |
| Mean | 1.8 (4.8) | 1.7 (7.7) | | | | |
| <u>SE</u> | | | | | | |
| Irri | ±0.26 NS | | | | | |
| Sol | ±0.28 NS | | | | | |
| CV | ±0.28 NS | | | | | |
| Irri x Sol | ±0.38 NS | | | | | |
| Irri x CV | ±0.38 NS | | | | | |
| Sol x CV | ±0.39 NS | | | | | |
| Irri x Solar x CV | ±0.55 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.18. Effect of solarization on shoot dry weight (g/plant) of pigeonpea grown on a Vertisol in Kharif 1984, 60 DAS.

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 3.64 | 4.02 | 3.83 | 4.79 | 4.01 | 4.40 |
| -Sol | 2.00 | 2.26 | 2.13 | 1.74 | 1.75 | 1.74 |
| Mean | 2.82 | 3.14 | | 3.26 | 2.88 | |
| Mean | 2.98 | | | 3.07 | | |
| Sol x CV | | | | | | |
| +Sol | 4.21 | 4.02 | 4.11 | | | |
| -Sol | 1.87 | 2.00 | 1.94 | | | |
| Mean | 3.04 | 3.01 | | | | |
| SE | | | | | | |
| Irri | ±0.18 NS | | | | | |
| Sol | ±0.28 ** | | | | | |
| CV | ±0.28 NS | | | | | |
| Irri x Sol | ±0.33 NS | | | | | |
| Irri x CV | ±0.33 NS | | | | | |
| Sol x CV | ±0.39 NS | | | | | |
| Irri x Solar x CV | ±0.51 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863
b = Figures in parentheses are values before log10 transformation.
** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.19. Effect of solarisation root dry weight (g/plant) pigeonpea grown on a Vertisol in Kharif 1984.

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 0.46 | 0.37 | 0.42 | 0.60 | 0.45 | 0.53 |
| -Sol | 0.26 | 0.32 | 0.29 | 0.33 | 0.24 | 0.29 |
| Mean | 0.36 | 0.34 | | 0.47 | 0.355 | |
| Mean | 0.35 | | | 0.41 | | |
| Sol x CV | | | | | | |
| +Sol | 0.53 | 0.41 | 0.47 | | | |
| -Sol | 0.30 | 0.28 | 0.29 | | | |
| Mean | 0.41 | 0.35 | | | | |
| SE | | | | | | |
| Irri | ±0.01 * | | | | | |
| Sol | ±0.04 ** | | | | | |
| CV | ±0.04 NS | | | | | |
| Irri x Sol | ±0.04 NS | | | | | |
| Irri x CV | ±0.04 NS | | | | | |
| Sol x CV | ±0.05 NS | | | | | |
| Irri x Solar x CV | ±0.07 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863

b = Figures in parentheses are values before log10 transformation.

** Significant at 1%; * Significant at 5%; NS = Non-significant

Table 13.20. Effect of solarization total plant dry matter (g/plant) pigeonpea grown on a Vertisol in Kharif 1984, 60 DAS.

| Treatment | +Irri | | | -Irri | | |
|---|---|---|---|---|---|---|
| | CV-1a | CV-2 | Mean | CV-1a | CV-2 | Mean |
| +Sol | 1.98 | 2.05 | 2.02 | 2.30 | 1.97 | 2.14 |
| | (4.1)b | (4.4) | (4.25) | (5.4) | (4.48) | (4.94) |
| -Sol | 1.49 | 1.57 | 1.53 | 1.44 | 1.40 | 1.42 |
| | (2.26) | (2.59) | (2.42) | (2.08) | (2.00) | (2.04) |
| Mean | 1.74 | 1.81 | | 1.87 | 1.69 | |
| | (3.18) | (3.49) | | (3.74) | (3.24) | |
| Mean | 1.78 | | | 1.78 | | |
| | (3.34) | | | (3.49) | | |
| Sol x CV | | | | | | |
| +Sol | 2.14 | 2.01 | 2.08 | | | |
| | (4.75) | (4.44) | (4.59) | | | |
| -Sol | 1.47 | 1.49 | 1.48 | | | |
| | (2.17) | (2.29) | (2.23) | | | |
| Mean | 1.80 | 1.75 | | | | |
| | (3.46) | (3.37) | | | | |
| SE | | | | | | |
| Irri | ±0.05 NS | | | | | |
| Sol | ±0.08 ** | | | | | |
| CV | ±0.08 NS | | | | | |
| Irri x Sol | ±0.09 NS | | | | | |
| Irri x CV | ±0.09 NS | | | | | |
| Sol x CV | ±0.11 NS | | | | | |
| Irri x Solar x CV | ±0.14 NS | | | | | |

a = CV-1 - LRG 30; CV-2 - ICP 8863

b = Figures in parentheses are values before log10 transformation.

** Significant at 1%; * Significant at 5%; NS = Non-significant

## 14. Weed management in pigeonpea

### Introduction

Pigeonpea genotypes have slow initial growth rates. In intercropping, this characteristic offers an advantage to companion crops. However, for the sole cropping of pigeonpea, which is becoming increasingly popular, this results in susceptibility to weed competition. Weeds in pigeonpea, if not controlled, can substantially reduce yields. It was therefore felt desirable to develop weed management practices that would economically reduce weed incidence in pigeonpea. This may, in the first instance, reduce the costs of weeding in our experiments. In this section we report the results of an experiment with different hand weeding and herbicide treatments carried out on a Vertisol field.

### Materials and Methods

The experiment was conducted on a Vertisol field BP11C. Six genotypes of pigeonpea, ICPL 81 and ICPL 87 (short-duration), C 11 and ICPL 270 (medium-duration), GW 3 and ICPL 358 (long-duration) were sown on 60 cm ridges on 26 June 1984.

The Six weed-control treatments were:

(1) hand weeding at 15 days after sowing (HW 15D);
(2) hand weeding 15 and 35 days after sowing (HW 15-35D);
(3) prometryne (pre-emergence) at 1.25 kg a.i. ha-1;
(4) basalin (pre-emergence) at 0.75 kg a.i. ha-1;
(5) weed-free; and
(6) weedy check.

These treatments were arranged in a RBD with two treatment factors. There were 3 replications. The plot size was 3 x 4 m. The plant density for the short-duration genotypes (ICPL 81 and ICPL 87) was 30 x 10 cm whereas for the medium- and long-duration genotypes it was 60 x 30 cm.

The pre-emergence herbicides were sprayed on 28 June, after sowing. A post-sowing irrigation was given on 29 June and another irrigation was given on 1 September 1984. Hand weeding in the first two treatments was done at 15 and 35 DAS. Weeding in the weed-free treatments was done 3 times. Weed weights at each time of weeding were recorded. Also, a final sample of weed weight was taken at maturity in ICPL 81 and ICPL 87 only.

Days to 50% flowering and maturity were noted. At maturity, the center six rows of the short-duration pigeonpea and center two rows of the medium- and long-duration pigeonpea were harvested; the net plot area harvested for all the genotypes was similar, 4.2 to 4.4 m2. At maturity, observations on plant stand, wilt incidence, yield, TDM and yield components were recorded.

## Results and Discussion

The weed management treatments did not affect time to flowering and maturity of the genotypes (Table 14.1).

The effect of different weed management treatments on overall weed weight kg/ha given in Table 14.2 indicates that in the weed-free situation, where weeds were removed periodically, weed biomass was least, followed by the two weeding and one weedings treatments. The difference in weed weight in these treatments was significant from weedy check, in which treatment the weed weight was highest. In the Prometryne treated plots, mean weed weight was 17% less and in the Basalin treatment it was 26% less than the weedy check. The reduction was significant. Weed weight in these treatments was not recorded for other genotypes. Within the two genotypes ICPL 81 and ICPL 87, the differences were not significant, although the plant stand of ICPL 81 was poorer than ICPL 87. The interaction of genotype with treatment was also not significant for weed weights. It appears therefore that both genotypes have similar weeding requirements. Hand weeding appeared best for controlling weeds, but herbicide could also be used for this. Although herbicides may not completely suppress weeds, these apparently give better ability to pigeonpea to compete with weeds (Table 14.3).

The effects of weed management treatments and genotypes were highly significant on seed yield (Table 14.3). Hand weeding at 15-35 DAS gave comparable yields to the completely weed-free check. Of the two herbicide treatments, the Basalin treatment did not differ significantly from the weed-free check. Hand weeding at 15 DAS and Prometryn application gave significantly lower yield than the weed-free checks. The lowest yield was obtained in the weedy check.

ICPL 87 gave the maximum mean yield and GW 3 the lowest. Yield of ICPL 81 was low due to lower plant stand but low yield of long-duration genotypes were mainly due to high wilt incidence (Table 14.4).

The genotype x weed management interaction was significant (Table 14.3). Significantly lower yield of two long-duration genotypes was obtained in the weedy check than some of the weed management treatments and even weed-free check. This was rather surprising. However, this anomaly is easily explicable on this basis of mean wilt incidence in different treatments (Table 14.4). Somehow, weedy check had a lower wilt incidence whereas weeding or herbicide treatments had a higher wilt incidence. This aspect is interesting and merits further investigation.

The comparison of weedy and weed-free checks suggested that short-duration pigeonpea was more prone to harmful effects of weed competition than the medium- and long-duration pigeonpea.

The effect of the weed management treatments was highly significant for TDM (Table 14.5), but not for HI, pods m2, 100-seed mass (Table 14.6, 14.7 and 14.8). The effect of the weed management treatments was, however, significant for number of seeds pod-1 (Table 14.9). Interaction of the weed management treatments and genotype was also significant for pods m2, number of seeds pod-1 (Tables 14.7 and 14.9).

Table 14.1. Time to 50% flowering and maturity of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| Weeding treatment | Genotype | | | | | |
|---|---|---|---|---|---|---|
| | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 |
| | | | Days to 50% flowering | | | |
| HW 15D | 74 | 76 | 129 | 115 | 150 | 147 |
| HW 15-35D | 76 | 77 | 129 | 115 | 154 | 154 |
| Prometryne | 76 | 76 | 129 | 118 | 158 | 155 |
| Basalin | 74 | 76 | 131 | 118 | 150 | 149 |
| Weed-free | 74 | 74 | 129 | 118 | 149 | 150 |
| Weedy | 74 | 77 | 132 | 116 | 157 | 157 |
| | | | Days to maturity | | | |
| HW 15D | 114 | 129 | 185 | 174 | 219 | 222 |
| HW 15-35D | 113 | 129 | 180 | 174 | 214 | 214 |
| Prometryne | 116 | 129 | 185 | 175 | 226 | 220 |
| Basalin | 116 | 129 | 185 | 177 | 219 | 225 |
| Weed-free | 115 | 129 | 181 | 174 | 216 | 216 |
| Weedy | 113 | 129 | 185 | 176 | 219 | 219 |

Table 14.2. Effect of weed management on weed weight kg ha-1 in the plots of ICPL 81 and ICPL 87 grown on a Vertisol, ICRISAT Center, rainy season 1984/85.

| Genotype | Weed treatment | | | | | | |
|---|---|---|---|---|---|---|---|
| | HW 15D | HW 15-35D | Prome-tryne | Basalin | Weed-free | Weedy | Mean |
| ICPL 81 | 803 | 391 | 3313 | 2700 | 280 | 3706 | 1866 |
| ICPL 87 | 666 | 334 | 3536 | 3347 | 782 | 4507 | 2095 |
| SE | | | ±268.1 | | | | ±109.5 |
| Mean | 734 | 362 | 3425 | 3024 | 231 | 4107 | |
| SE | | | ±189.6** | | | | |

Table 14.3 Effect of weed management o yield (kg/ha) of six pigeonpea genotypes grown on Vertisol. ICRISAT Center, rainy season 1984/85.

| GENO | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | Mean |
|---|---|---|---|---|---|---|---|
| HW 15 D | 584 | 2051 | 1300 | 1397 | 700 | 318 | 1117 |
| HW15-35D | 738 | 2272 | 1864 | 2160 | 812 | 470 | 1389 |
| PROMYTRI | 495 | 1566 | 1743 | 1527 | 931 | 602 | 1161 |
| BASALIN | 597 | 1913 | 1761 | 2120 | 708 | 390 | 1281 |
| WEEDFREE | 1069 | 2374 | 2007 | 2018 | 320 | 281 | 1378 |
| WEEDY | 339 | 1397 | 1435 | 1398 | 964 | 651 | 1064 |
| MEAN | 637 | 1929 | 1699 | 1838 | 797 | 380 | 1233 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM GENO |
|---|---|---|---|
| ESE | 70.33* | 70.3** | 172.3* |
| CV% | | | 24.2 |

Table 14.4. Effect of weed management on plants/m2 of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| GENO WM | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | MEAN |
|---|---|---|---|---|---|---|---|
| HW15D | 28.7 | 39.6 | 5.0(7)a | 5.1(16) | 5.0(45) | 5.5(66) | 14.8 |
| HW15-35D | 31.3 | 38.0 | 4.8(0) | 5.3 (1) | 4.7(53) | 5.2(86) | 14.9 |
| PROMYTRI | 22.6 | 33.9 | 4.7(5) | 5.0 (9) | 5.0(36) | 5.0(30) | 12.7 |
| BASALIN | 19.8 | 38.1 | 5.1(4) | 5.0 (3) | 4.4(47) | 5.5(51) | 13.0 |
| WEEDFREE | 41.0 | 40.0 | 4.8(6) | 5.3(21) | 4.7(83) | 5.4(83) | 16.8 |
| WEEDY | 18.6 | 32.5 | 5.0(3) | 5.1 (1) | 5.2(32) | 5.0(30) | 11.9 |
| MEAN | 27.0 | 37.0 | 4.9 | 5.1 | 4.8 | 5.2 | 14.0 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM GENO |
|---|---|---|---|
| ESE | 0.66** | 0.66** | 1.61** |
| CV% | | | 10.9 |

Table 14.5. Effect of weed management on TDM (kg/ha) of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| GENO / WM | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | MEAN |
|---|---|---|---|---|---|---|---|
| HW15D | 1517 | 4605 | 4167 | 6149 | 4761 | 4019 | 4203 |
| HW15-35D | 2022 | 5300 | 7544 | 7005 | 7467 | 5516 | 5809 |
| PROMYTRI | 1255 | 3871 | 5772 | 5463 | 8896 | 4118 | 4896 |
| BASALIN | 1203 | 4596 | 7059 | 8059 | 5327 | 4070 | 5052 |
| WEEDFREE | 2178 | 5291 | 8110 | 7143 | 7972 | 5290 | 5997 |
| WEEDY | 1037 | 3573 | 5424 | 6410 | 7887 | 5953 | 5047 |
| MEAN | 1535 | 4540 | 6346 | 6705 | 7052 | 4828 | 5168 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM GENO |
|---|---|---|---|
| ESE | 311.9** | 311.9** | 763.9 |
| CV% | | | 25.6 |

Table 14.6. Effect of weed management on HI (%) of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| GENO / WM | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | MEAN |
|---|---|---|---|---|---|---|---|
| HW15D | 39.4 | 44.4 | 34.3 | 26.4 | 15.7 | 7.8 | 28.0 |
| HW15-35D | 35.7 | 42.9 | 24.8 | 31.9 | 10.8 | 8.4 | 25.7 |
| PROMYTRI | 39.9 | 40.8 | 31.1 | 27.8 | 11.2 | 17.0 | 28.0 |
| BASALIN | 52.8 | 41.8 | 25.0 | 26.8 | 14.2 | 12.0 | 28.8 |
| WEEDFREE | 49.6 | 45.5 | 25.4 | 28.3 | 6.2 | 5.1 | 26.7 |
| WEEDY | 32.7 | 38.5 | 27.2 | 24.7 | 12.2 | 11.3 | 24.4 |
| MEAN | 41.7 | 42.3 | 28.0 | 27.6 | 11.7 | 10.3 | 26.9 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM GENO |
|---|---|---|---|
| ESE | 1.70 | 1.70** | 4.16 |
| CV% | | | 26.8 |

Table 14.7. Effect of weed management on pod m-2 of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| GENO / WM | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | MEAN |
|---|---|---|---|---|---|---|---|
| HW15D | 516 | 759 | 648 | 545 | 498 | 256 | 537 |
| HW15-35D | 431 | 824 | 867 | 737 | 556 | 306 | 620 |
| PROMYTRI | 363 | 574 | 828 | 547 | 671 | 443 | 571 |
| BASALIN | 340 | 736 | 879 | 810 | 512 | 391 | 611 |
| WEEDFREE | 625 | 1034 | 970 | 710 | 373 | 272 | 664 |
| WEEDY | 296 | 563 | 735 | 644 | 668 | 441 | 558 |
| MEAN | 428 | 748 | 821 | 665 | 547 | 351 | 594 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM GENO |
|---|---|---|---|
| REP | 18 | 18 | 3 |
| ESE | 37.2 | 37.2** | 91.2* |
| CV% | | | 26.6 |

Table 14.8. Effect of weed management on 100-seed mass (g) of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| GENO / WM | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | MEAN |
|---|---|---|---|---|---|---|---|
| HW15D | 5.9 | 8.4 | 9.3 | 10.7 | 7.5 | 6.2 | 8.0 |
| HW15-35D | 5.9 | 8.5 | 9.2 | 10.7 | 7.4 | 8.8 | 8.4 |
| PROMYTRI | 5.8 | 8.8 | 9.1 | 9.7 | 7.1 | 7.7 | 8.0 |
| BASALIN | 6.5 | 8.0 | 9.3 | 10.6 | 8.3 | 7.6 | 8.4 |
| WEEDFREE | 6.1 | 8.0 | 8.8 | 10.8 | 8.5 | 6.5 | 8.1 |
| WEEDY | 5.9 | 8.3 | 8.4 | 10.2 | 7.4 | 8.2 | 8.1 |
| MEAN | 6.0 | 8.3 | 9.0 | 10.4 | 7.7 | 7.5 | 8.2 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM GENO |
|---|---|---|---|
| ESE | 0.18 | 0.18** | 0.45 |
| CV% | | | 9.5 |

Table 14.9. Effect of weed management on seeds/pod of six pigeonpea genotypes grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| GENO<br>WM | ICPL 81 | ICPL 87 | C 11 | ICPL 270 | ICPL 358 | GW 3 | MEAN |
|---|---|---|---|---|---|---|---|
| HW15D | 1.9 | 3.3 | 2.3 | 2.8 | 2.0 | 1.8 | 2.3 |
| HW15-35D | 2.9 | 3.2 | 2.4 | 2.8 | 2.0 | 1.8 | 2.5 |
| PROMYTRI | 2.4 | 3.1 | 2.3 | 2.9 | 1.9 | 2.0 | 2.4 |
| BASALIN | 2.7 | 3.3 | 2.2 | 2.5 | 1.8 | 1.9 | 2.4 |
| WEEDFREE | 2.9 | 2.9 | 2.4 | 2.6 | 1.6 | 1.6 | 2.3 |
| WEEDY | 2.0 | 3.0 | 2.3 | 2.5 | 2.0 | 1.8 | 2.3 |
| MEAN | 2.5 | 3.1 | 2.3 | 2.7 | 1.9 | 1.8 | 2.4 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | WM | GENO | WM<br>GENO |
|---|---|---|---|
| ESE | 0.06* | 0.06** | 0.14* |
| CV % | | | 10.2 |

## 15. Effect of different insecticide spray regimes on the productivity of ICPL 1 and ICPL 87

### Introduction

There is an increasing interest in growing short-duration pigeonpeas as sole crops and taking more than one harvest from these. It is already known that such genotypes are prone to very heavy pest damage in most locations, but very good yields from them can be realised if adequate protection by pesticide is provided. Determination of the approximate spray requirements for adequate control is as essential as the other cultural practices. In order to fully realise the potential of short-duration pigeonpea, we investigated the effect of different spray regimes on the performance of 2 short-duration pigeonpea genotypes in collaboration with entomologists. In this section we report the yield data only. The effect of different spray regimes on % damage by different insects is reported elsewhere (Pulse Entomology Progress Report No.16, Pages 68-73).

### Materials and Methods

The experiment was conducted on a Vertisol field BP11C. Two pigeonpea genotypes ICPL 1 (indeterminate) and ICPL 87 (determinate) were sown at 30 x 10 cm spacing on 26 June 1984 on 60 cm ridges.

The trial was laid out in a split plot design with genotypes as main treatments and six differing spray regimes in the sub-plots. There were four replications. The sub-plot size was 2.4 x 4 m. Sprays were of monocrotophos at 0.6 kg a.i. ha-1 in 1000 L of water, using knapsack sprayers. Each sub-plot was surrounded by buffer plots of 2.4 x 4 m on all the four sides in which ICPL 1 was grown unsprayed and the spray drift was minimized by using a portable polythene screen. The spray treatments were given as follows:

5 sprays given at 0, 10, 20, 30 and 40 days after 50% flowering.
4 sprays given at 0, 10, 20 and 30 days after 50% flowering.
3 sprays given at 0, 10 and 20 days after 50% flowering.
2 sprays given at 0 and 10 days after 50% flowering.
1 spray given at 50% flowering only.

No spray was given during the second flush as the incidence of the insects was very low. The first harvest was made by picking the pods. The crop was cut at ground level at the second flush maturity.

### Results and Discussion

The effect of spray treatments on the first flush yields was highly significant (Tables 15.1 and Fig. 15.1). One or two sprays gave very little or no benefit in yield but advantages were evident from the three to five spray treatments. The difference between genotypes was significant and its interaction with spray treatment was also highly significant. The determinate genotype ICPL 87 gave lower first flush yield, with one or two sprays or in control, but its yields were higher than the indeterminate genotype ICPL 1 with three to five sprays. This supports the general thinking that for unsprayed conditions the indeterminate genotypes may be desirable, but for the sprayed conditions, the determinate genotypes may be desirable.

The insecticide sprays appeared to have little effect on the second flush yield from the indeterminate genotype (Table 15.1, Fig. 15.1). The yields from the second flush from the determinate genotype decreased linearly with increasing spray regimes. It was clearly due to greater compensatory flush being formed in the lower spray regimes where first flush was heavily attacked by insects. There may have been greater nutritional reserves in plants receiving fewer sprays resulting in a greater second flush. Owing to the greater second-flush, in the determinate genotype, the overall yield was significantly greater except at one and two levels of sprays (Table 15.1). Both first flush yield and the total yield was lower in the one and two sprays than the control in ICPL 87. This could be due to the inhibitory effect of some partially, damaged pods on the formation of more pods.

Table 15.1. Effect of different spray regimes on the yield (kg/ha) of different flushes of ICPL 1 and ICPL 87 grown on Vertisol, ICRISAT Center, rainy season 1984/85.

| | Spray treatments | | | | | | |
|---|---|---|---|---|---|---|---|
| Genotype | 5 | 4 | 3 | 2 | 1 | Control | Mean |
| | | | Yield (kg/ha) of the first-flush | | | | |
| ICPL 1 | 1567 | 1519 | 1305 | 836 | 781 | 868 | 1146 |
| ICPL 87 | 1754 | 1772 | 1402 | 329 | 48 | 208 | 919 |
| SE | | | ±84.2** (86.6)a | | | | ±29.0* |
| Mean | 1660 | 1646 | 1353 | 583 | 415 | 538 | |
| SE | | | ±61.3** | | | | |
| | | | Yield (kg/ha) of the second-flush | | | | |
| ICPL 1 | 579 | 751 | 618 | 615 | 526 | 420 | 585 |
| ICPL 87 | 683 | 775 | 958 | 1141 | 1282 | 1365 | 1034 |
| SE | | | ±123.6** (116.4) | | | | ±63.1 |
| Mean | 631 | 763 | 788 | 878 | 904 | 893 | |
| SE | | | ±82.3 | | | | |
| | | | Total yield (kg/ha) of the two flushes | | | | |
| ICPL 1 | 2146 | 2271 | 1923 | 1451 | 1307 | 1288 | 1731 |
| ICPL 87 | 2437 | 2548 | 2361 | 1470 | 1330 | 1573 | 1953 |
| SE | | | ±138.0 (125.0) | | | | ±77.5 |
| Mean | 2291 | 2409 | 2142 | 1461 | 1319 | 1431 | |
| SE | | | ±88.4* | | | | |

a SE values in parentheses are comparing means with same level of genotype.

## 16. Testing of the direct effects of insecticides on plant growth and grain yield of pigeonpea (YSC, SS)

### Introduction

In comparison of pesticide-protected and pesticide-free crops of pigeonpea for estimating the loses caused by the pests, we often encounter variations in yields, which are not explicable on the basis of reduction in pest damage. In some cases a growth regulatory effect has also been envisaged which could be responsible for such variations. In order to see to what extent the commonly used insecticide directly affect the growth and yield of pigeonpea, a pot culture study was planned in collaboration with pulse entomologists.

### Materials and Methods

The experiment was conducted in the greenhouse to prevent the confounding effect of insect damage. ICPL 87 was sown on 2 May 1984 in 23 cm round plastic pots each containing 10 kg Vertisol treated with diammonium phosphate at 0.25 g kg-1 soil. Sowing was done in five hills per pot with two seeds per hill. Plants were not given any treatment until flowering. Pots were irrigated to field capacity three times a week using tap water.

At 50% flowering 7 insecticide spray treatments were imposed. They were:

T 1: Endosulfan (0.07%) 35% EC.
T 2: Monocrotophos (0.04%) 40% EC.
T 3: DDT (0.1%) 25% EC.
T 4: Cypermethrin (0.009%) cymbush 25% EC.
T 5: Water sprays.
T 6: Mixtalol 5 mg L-1.
T 7: Control.

The treatments were imposed by our entomologists. These treatments were arranged in a RBD with four replications.

At maturity observations on plant growth, TDM, yield and yield components were recorded.

### Results and Discussion

The effect of different spray treatments was significant only in number of leaves and plant height (Table 16.1). In spite of number of leaves being affected, there was no difference in leaf area plant-1 among different treatments. Most of the chemicals reduced the number of leaves significantly. Chemicals such as mixtalol and water sprays significantly reduced the plant height, which is rather surprising. The results of the study indicate that insecticides used in the study did not have masked stimulatory or harmful effects on seed yield, TDM and yield components.

Table 16.1. Effect of different insecticide treatments on TDM, seed yield, yield components, leaf number and area, plant height and no. of primary branches of ICPL 87 grown in pots using Vertisol, ICRISAT Center, 1984/85.

| Treat-ment | TDM (g/pl) | Seed wt (g/pl) | HI (%) | 100-seed mass (g) | Seeds pod-1 | Pods/pl | Leaf No. | Leaf Area (cm2) | Pl ht cm | Br no./pl |
|---|---|---|---|---|---|---|---|---|---|---|
| T 1 | 20.51 | 4.30 | 5.0 | 9.6 | 3.0 | 14.8 | 24.3 | 914.2 | 102 | 3.5 |
| T 2 | 19.92 | 4.42 | 4.6 | 9.5 | 2.8 | 16.9 | 23.9 | 954.7 | 94 | 3.0 |
| T 3 | 20.16 | 4.77 | 4.3 | 10.0 | 2.8 | 16.8 | 25.0 | 912.7 | 94 | 3.3 |
| T 4 | 20.82 | 4.43 | 4.7 | 9.9 | 2.8 | 16.5 | 22.3 | 744.8 | 100 | 2.8 |
| T 5 | 20.24 | 4.11 | 5.0 | 9.7 | 3.0 | 14.3 | 29.1 | 943.0 | 93 | 3.1 |
| T 6 | 19.17 | 4.32 | 4.5 | 9.6 | 2.9 | 15.6 | 25.3 | 890.5 | 93 | 3.2 |
| T 7 | 19.94 | 3.78 | 5.4 | 9.8 | 2.8 | 13.8 | 29.9 | 951.6 | 99 | 3.8 |
| SE | 1.308 | 0.51 | 0.31 | 0.23 | 0.12 | 1.36 | 1.42* | 128.6 | 2.1* | 0.36 |
| Mean | 20.11 | 4.33 | 4.8 | 9.7 | 2.8 | 15.3 | 25.7 | 90.13 | 96 | 3.2 |
| CV % | 13.9 | 23.5 | 13.2 | 4.7 | 8.4 | 17.5 | 11.1 | 28.5 | 4.4 | 22.1 |

## 17. Effect of depodding on the performance of medium-duration pigeonpea

### Introduction

The flowers and pods of pigeonpea are subjected to heavy attack by insect pests such as pod borer (*Helicoverpa armigera*). The ability of plants to compensate for the loss of flowers and pods has been investigated over the past several years (PPR 1975/76, Chapter II, PPR 1976/77, Chapter II, PPR 1982/83 Chapter VIII and PPR 1983/84, Chapter 2). We have earlier reported that plants were capable of compensating for the removal of flowers more or less completely, but the ability to compensate developing pods was not fully resolved. In the last two seasons' experiments we have found that some genotypes have a capacity to compensate for the loss of pods or part of the pods. Our entomologists have also identified a few lines that have a good compensatory ability by comparisons under heavy pest attack. This method is simple and direct; but an alternative method which could be used to confirm the entomologists findings, or even to screen cultivars or breeding material, would be to remove all the pods from the plants and look for the better lines in terms of compensation. The feasibility for screening for compensatory ability by pod removal method was tested in this year.

### Materials and Methods

The experiment was conducted on an Alfisol field RP1A. Ten medium-duration pigeonpea genotypes, HY 3A, APAU 2208, ICP 10466, ICP 4070, ICP 3009, ICP 1-6, C 11, ICP 1, ICP 2223 and ICP 810 were grown on 60 cm ridges at 60 x 30 cm spacing. Some of the genotypes were included at the suggestion of pulse entomologists. These were planted in a RBD with 3 replications on 11 July 1984. The plot size was two 60 cm rows 4 m long. No irrigation was given at any stage, but the crop was intensively protected from insect-pests.

Days to 50% flowering were noted. On 19 November 1984, which was about 15-20 days after 50% flowering of the different genotypes, pods from one of the rows were completely removed. Days to maturity, and at maturity, yield (from 2.77 m2), yield components and TDM were recorded. The data were analyzed in a split plot analysis treating genotypes as the main plots and depodding treatment as sub-plots.

### Results and Discussion

All the genotypes flowered within ten days except ICP 1-6 which flowered in 117 days (Table 17.1). A similar difference was noted for days to maturity. Days to maturity was delayed by about a month due to depodding in all the genotypes.

Depodding reduced the yield by 25% which was highly significant (Table 17.2). Percent reduction in yield due to depodding varied from 6 to 52%. In APAU 2208, there was 16% increase in the seed yield due to depodding. In the past experiments this genotype was found to have a high compensatory ability (PPR 1982/83, Chapter VIII). The high compensatory ability of this genotype is therefore confirmed.

Depodding significantly decreased the TDM (Table 17.3). The decrease in dry matter, however, was less than that for seed yield. It could be that depodding may have led to some compensatory vegetative growth also. A 13-14% decrease was noted in HI and pods m2 (Table 17.4 and 17.5). Hundred seed weight was not affected due to depodding but the no. of seeds in the depodding treatment was significantly less (Tables 17.6 and 17.7). There may be a greater locule abortion in pods set from the later formed flowers. In some genotypes such as APAU 2208 and C 11, no. of seeds/pod was more in the depodding treatment. The genotype x pod treatment interactions were not significant for any of the traits measured. Plant stand was marginally more in the depodding treatment (Table 17.8).

Using the depodding method, some inferences in compensatory ability of the genotypes could be drawn. For example on the basis of % yield increase or lesser reduction, APAU 2208 appears most promising, followed by ICP 1-6 and C 11. Genotypes ICP 2223, ICP 1, ICP 810, ICP 3309, ICP 4070; and HY 3A are adversely affected by pod removal and showed a relatively large reduction in yield.

**Table 17.1. Days to 50% flowering and maturity 10 medium-duration genotypes of pigeonpea. Alfisol, ICRISAT Center, rainy season 1984/85.**

| Genotype | Days to 50% flowering | Days to maturity: Control | Days to maturity: 100% pod removal |
|---|---|---|---|
| HY 3A | 104 | 172 | 200 |
| APAU 2208 | 110 | 164 | 198 |
| ICP 10466 | 107 | 164 | 201 |
| ICP 4070 | 102 | 162 | 205 |
| ICP 3009 | 105 | 164 | 205 |
| ICP 1-6 | 117 | 182 | 206 |
| C 11 | 112 | 164 | 198 |
| ICP 1 | 104 | 164 | 199 |
| ICP 2223 | 105 | 164 | 208 |
| ICP 810 | 101 | 164 | 203 |

Table 17.2. Effect of pod removal treatment (PDRTRT) on yield (kg/ha) of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT GENO | CONTROL | 100%PDR | MEAN | % YIELD REDUCTION/ INCREASE |
|---|---|---|---|---|
| HY 3A | 1306 | 1031 | 1168 | -21 |
| APAU 2208 | 1390 | 1531 | 1460 | +16 |
| ICP 10466 | 1250 | 1082 | 1166 | -13 |
| ICP 4070 | 1555 | 1066 | 1310 | -31 |
| ICP 3009 | 1467 | 930 | 1199 | -37 |
| ICP 1-6 | 1214 | 1148 | 1181 | -6 |
| C 11 | 1179 | 1064 | 1122 | -10 |
| ICP 1 | 1655 | 919 | 1287 | -45 |
| ICP 2223 | 1549 | 744 | 1146 | -52 |
| ICP 810 | 1599 | 1078 | 1339 | -33 |
| **MEAN** | 1416 | 1059 | 1238 | -25 |

**EFFECTIVE STANDARD ERRORS OF MEANS**

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 126.2 | 52.0** | 171.6 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 164.3 |
| CV % | 17.7 | | 23.0 |

Table 17.3. Effect of pod removal treatment (PDRTRT) on TDM (kg/ha) of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT / GENO | CONTROL | 100%PDR | MEAN |
|---|---|---|---|
| HY 3A | 5354 | 5091 | 5223 |
| APAU 2208 | 6027 | 6430 | 6228 |
| ICP 10466 | 5870 | 5402 | 5636 |
| ICP 4070 | 7008 | 5620 | 6314 |
| ICP 3009 | 6382 | 5662 | 6022 |
| ICP 1-6 | 7369 | 6540 | 6954 |
| C 11 | 5901 | 5300 | 5600 |
| ICP 1 | 7214 | 4844 | 6029 |
| ICP 2223 | 6324 | 5168 | 5746 |
| ICP 810 | 7181 | 5549 | 6365 |
| MEAN | 6463 | 5561 | 6012 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 394.1 | 211.2** | 615.0 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 667.8 |
| CV % | 11.4 | | 19.2 |

Table 17.4. Effect of pod removal treatment (PDRTRT) on harvest index (%) of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT / GENO | CONTROL | 100%PDR | MEAN |
|---|---|---|---|
| HY 3A | 25.3 | 20.7 | 23.0 |
| APAU 2208 | 23.1 | 23.8 | 23.5 |
| ICP 10466 | 22.4 | 20.0 | 21.2 |
| ICP 4070 | 22.1 | 19.2 | 20.6 |
| ICP 3009 | 23.1 | 16.0 | 19.6 |
| ICP 1-6 | 16.7 | 17.7 | 17.2 |
| C 11 | 20.2 | 19.9 | 20.0 |
| ICP 1 | 23.1 | 19.0 | 21.0 |
| ICP 2223 | 24.3 | 14.8 | 19.6 |
| ICP 810 | 22.2 | 19.7 | 20.9 |
| MEAN | 22.2 | 19.1 | 20.7 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 1.65 | 0.49** | 1.99 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 1.56 |
| CV % | 13.9 | | 13.1 |

Table 17.5. Effect of pod removal treatment (PDRTRT) on pod m-2 of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT<br>GENO | CONTROL | 100%PDR | MEAN |
|---|---|---|---|
| HY 3A | 365 | 299 | 332 |
| APAU 2208 | 747 | 762 | 755 |
| ICP 10466 | 676 | 711 | 694 |
| ICP 4070 | 783 | 722 | 753 |
| ICP 3009 | 738 | 622 | 680 |
| ICP 1-6 | 595 | 628 | 612 |
| C 11 | 607 | 485 | 546 |
| ICP 1 | 746 | 505 | 626 |
| ICP 2223 | 1008 | 643 | 826 |
| ICP 810 | 754 | 642 | 698 |
| MEAN | 702 | 602 | 652 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 64.0** | 29.2* | 91.5 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 92.4 |
| CV % | 17.0 | | 24.5 |

Table 17.6. Effect of pod removal treatment (PDRTRT) on 100-seed mass (g) of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT<br>GENO | CONTROL | 100%PDR | MEAN |
|---|---|---|---|
| HY 3A | 11.1 | 13.4 | 12.3 |
| APAU 2208 | 7.8 | 8.2 | 8.0 |
| ICP 10466 | 6.8 | 7.0 | 6.9 |
| ICP 4070 | 7.8 | 7.1 | 7.4 |
| ICP 3009 | 8.0 | 7.5 | 7.8 |
| ICP 1-6 | 10.8 | 10.0 | 10.4 |
| C 11 | 10.3 | 8.1 | 9.2 |
| ICP 1 | 9.0 | 8.6 | 8.8 |
| ICP 2223 | 6.5 | 6.4 | 6.5 |
| ICP 810 | 8.5 | 8.3 | 8.4 |
| MEAN | 8.7 | 8.5 | 8.6 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 0.34** | 0.17 | 0.50 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 0.53 |
| CV % | 6.8 | | 10.7 |

Table 17.7. Effect of pod removal treatment (PDRTRT) on seeds/pod of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT / GENO | CONTROL | 100%PDR | MEAN |
|---|---|---|---|
| HY 3A | 3.4 | 2.6 | 3.0 |
| APAU 2208 | 2.4 | 2.5 | 2.4 |
| ICP 10466 | 2.7 | 2.2 | 2.4 |
| ICP 4070 | 2.6 | 2.1 | 2.3 |
| ICP 3009 | 2.5 | 2.0 | 2.2 |
| ICP 1-6 | 1.9 | 1.8 | 1.9 |
| C 11 | 2.0 | 2.8 | 2.4 |
| ICP 1 | 2.5 | 2.1 | 2.3 |
| ICP 2223 | 2.3 | 1.8 | 2.1 |
| ICP 810 | 2.5 | 2.0 | 2.3 |
| MEAN | 2.5 | 2.2 | 2.3 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 0.16* | 0.07* | 0.23 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 0.23 |
| CV % | 11.9 | | 17.2 |

Table 17.8. Effect of pod removal treatment (PDRTRT) on plants/m2 of 10 medium-duration genotypes grown on Alfisol, ICRISAT Center, rainy season 1984/85.

| PDRTRT / GENO | CONTROL | 100%PDR | MEAN |
|---|---|---|---|
| HY 3A | 3.2 | 3.6 | 3.4 |
| APAU 2208 | 3.6 | 4.3 | 4.0 |
| ICP 10466 | 3.2 | 4.2 | 3.7 |
| ICP 4070 | 4.0 | 4.2 | 4.1 |
| ICP 3009 | 3.9 | 4.2 | 4.0 |
| ICP 1-6 | 3.7 | 4.3 | 4.0 |
| C 11 | 4.0 | 4.2 | 4.1 |
| ICP 1 | 4.2 | 4.0 | 4.1 |
| ICP 2223 | 4.0 | 4.2 | 4.1 |
| ICP 810 | 4.1 | 4.1 | 4.1 |
| MEAN | 3.8 | 4.1 | 4.0 |

EFFECTIVE STANDARD ERRORS OF MEANS

| TABLE | GENO | PDRTRT | GENO PDRTRT |
|---|---|---|---|
| ESE | 0.23 | 0.10* | 0.33 |
| EXCEPT WHEN COMPARING MEANS WITH SAME LEVEL(S) OF: | | | |
| GENO | | | 0.33 |
| CV % | 10.1 | | 14.4 |