Table 2. Influence of irrigation × nitrogen interaction on seed yield (t ha^{-1}) of chickpea grown at Gujarat Agricultural University, Devtaj, India, 1995/96 postrainy season.

	Nitrogen (kg ha^{-1})	
Irrigation	0	20
No irrigation	0.71	0.80
Two irrigations (at flowering and pod development stages)	0.76	0.89
SEm	± 0.10	
CD (0.05)	0.28	

number of pods plant^{-1}, and harvest index. The cultivar Phule G 5 was the tallest and the seed had the highest protein content. Dahod Yellow recorded the maximum net realization of Rs 4151 followed by ICCC 4 with Rs 3733 hg^{-1}.

Application of nitrogen had a significant effect on all growth and yield attributes. Seed yield increased by about 15% over no application of nitrogen (0.74 t ha^{-1}). A similar increase in yield with nitrogen application was reported by Sharma et al. (1989) in chickpea. Protein content of the seed also increased significantly with the application of nitrogen. Application of 20 kg N ha^{-1} resulted in an additional income of Rs 1092 ha^{-1}. Application of 40 kg P_2O_5 ha^{-1} enhanced the seed yield by 12%, and also increased protein content of the seed, which is in agreement with the results obtained by Patel and Patel (1991). The additional benefit of phosphorus application was only Rs 171 hg^{-1}.

The interaction between irrigation × nitrogen was significant, showing that irrigation at flowering and pod development stages together with 20 kg N ha^{-1} recorded significantly higher seed yield compared to rest of the treatment combinations (Table 2). The lowest seed yield was recorded with no irrigation and no nitrogen application.

References

Patel, R.S., and **Patel, Z.G.** 1991. Effect of FYM, N, P, and *Rhizobium* inoculation on the growth and yield of gram (*Cicer arietinum* L.). Annals of Agricultural Research 12(2):200–202.

Sharma, A.K., Singh, H., Singh, S., Singh, R., and **Namdeo, K.N.** 1989. Response of gram (*Cicer arietinum* L.) to rhizobial and N fertilization. Indian Journal of Agronomy 34(3):381–383.

Pigeonpea

Genetic Resources

Evaluation of Sri Lankan Pigeonpea Germplasm for Some Agronomic Traits

K B Saxena[1], H H D Fonseka[2], K Hettiarachchi[2], K D S M Joseph[2], L J Reddy[1], and **P J Bramel-Cox[1]**
(1. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India; and 2. Field Crops Research and Development Institute, Maha Illuppallama, Sri Lanka)

In Sri Lanka pigeonpea is not a commercial crop, but scattered plants around farmers' houses can be found in different parts of the Dry Zone. Farmers pick dry pods and eat whole boiled seeds. At ICRISAT, 60 germplasm accessions collected from different agroecological zones of Sri Lanka are being maintained. At the commencement of the Pigeonpea Varietal Adaptation and Production Studies Project supported by the Asian Development Bank and ICRISAT, the adaptation of this germplasm in Sri Lanka was studied in order to identify high-yielding genotypes.

All these accessions were procured from the Genetic Resources and Enhancement Program of ICRISAT for evaluation at the Field Crops Research and Development Institute, Maha Illuppallama (8°N latitude, 80°E longitude) during the 1990/91 main rainy (*maha*) season. Ten lines representing different maturity groups were used as the control. The entries were evaluated in 4-m long three-row plots with two replications. Interrow spacings were 60 cm and intrarow spacings were 20 cm. The trial was sown on 13 Oct 1990 in randomized complete block design (RCBD) under rainfed conditions. Three hand weedings were done and three sprays of recommended insecticides were given to control insect pests. Nine short-duration determinate lines, found promising in the 1990/91 *maha* season, were further evaluated in 1991/92 and 1992/93 *maha* seasons along with control cultivar ICPL 87. The trials were sown on 7 Nov 1991 and on 15 Oct 1992 in RCBD in 4-m long four-row plots. Interrow spacings were 60 cm and intrarow spacings were 10 cm. There were two replications in 1991/92 and three replications in 1992/93. The trials were given three hand weedings, and four insecticidal sprays were done to control *Maruca* and *Helicoverpa*

pod borers. The rainfall distribution in all three seasons was close to normal, resulting in good plant growth and canopy development.

All the long- and medium-duration accessions evaluated in 1990/91 were indeterminate in growth habit and grew over 3 m in height, making insect management very difficult and ineffective. Almost all the pods on such plants were destroyed by pod fly and *Helicoverpa* pod borer. In the short-duration group, sown in the 1990/91 season, the insecticidal sprays also were not very effective and in some lines up to 60% pod damage was recorded. However, due to good soil-moisture status

Table 1. Some agronomic traits of short-duration Sri Lankan pigeonpea germplasm evaluated at Maha Illuppallama during the 1991/92 and 1992/93 *maha* seasons.

	Days to flower		Days to mature		Plant height (cm)		100-seed mass (g)		Yield (t ha^{-1})[1]		
Accession	1991/92	1992/93	1991/92	1992/93	1991/92	1992/93	1991/92	1992/93	1991/92	1992/93	Mean
ICP 7135	64	75	115	121	81	89	09.3	09.5	1.36	1.37	1.37
ICP 7153	63	76	115	122	73	88	09.8	09.7	1.31	1.04	1.18
ICP 7136	61	74	115	121	79	84	10.2	10.0	1.25	1.20	1.23
ICP 7152	60	73	116	118	75	87	10.0	10.3	1.24	1.38	1.31
ICP 7127	60	71	117	116	74	84	10.2	09.6	0.94	1.26	1.10
ICP 7125	60	69	115	116	69	81	10.0	09.3	0.90	1.21	1.06
ICP 7122	62	72	115	116	70	80	09.5	09.0	0.75	1.36	1.06
ICP 7128	61	71	116	116	68	91	09.8	10.1	0.55	1.39	0.97
ICP 7134	60	73	117	118	74	84	10.2	09.2	0.53	1.32	0.93
Control (ICPL 87)[1]	61	76	116	122	78	94	09.6	10.2	0.99	1.13	1.06
Mean	61	73	115	119	74	86	09.9	09.7	0.98	1.26	1.12
SE	± 0	± 1.4	± 0	± 2.2	± 0	± 5.9	± 0	± 0.5	± 0	± 0.21	
CV (%)	3.5	2.4	1.1	2.3	5.9	8.4	5.6	6.7	30.2	20.7	

1. First flush yield.

Table 2. Comparative expression of some traits of Sri Lankan germplasm of pigeonpea at Maha Illuppallama in Sri Lanka and at ICRISAT-Patancheru.

	Days to flower		Days to mature		Plant height (cm)		100-seed mass (g)	
Accession	Sri Lanka	Patancheru	Sri Lanka	Patancheru	Sri Lanka	Patancheru	Sri Lanka	Patancheru
ICP 7135	69.5	92	118.0	150	85.0	85.0	9.4	7.7
ICP 7153	69.5	101	118.5	150	80.5	85.0	9.8	9.1
ICP 7136	67.5	101	118.0	150	81.5	70.0	10.1	7.4
ICP 7152	66.5	101	117.0	150	81.0	80.0	10.2	9.3
ICP 7127	65.5	92	116.5	148	79.0	85.0	9.9	8.0
ICP 7125	64.5	92	115.5	150	75.0	85.0	9.7	8.8
ICP 7122	56.0	101	115.5	150	75.0	80.0	9.3	7.7
ICP 7128	66.0	98	116.0	148	79.5	85.0	9.6	9.8
ICP 7134	66.5	101	117.5	150	79.0	80.0	9.7	7.4
Mean	66.9	97.7	116.9	149.6	79.5	81.7	9.7	8.4

a heavy second flush of flowers was observed, and it was protected from pod borer damage with two additional insecticidal sprays. This resulted in delayed maturity in several lines. Therefore, data from these lines were not considered for statistical analysis. In the sown crop, days to flowering in this collection ranged between 62 and 125. ICPs 7122, 7130, 7135, and the control ICPL 81 were earliest to flower. Plant height among the accessions ranged from 66 to 325 cm.

In the 1991/92 *maha* season, the selected accessions flowered during 60–64 days and pod maturity was observed at 115–117 days (Table 1). Plant height varied from 68 cm (ICP 7128) to 81 cm (ICP 7135). This material showed narrow variability for flowering, maturity, and plant height, but the differences in main crop yield were large. Four accessions gave higher yield than the control cultivar ICPL 87 (0.99 t ha^{-1}). ICP 7135 recorded the highest yield (1.36 t ha^{-1}) followed by ICP 7153 (1.31 t ha^{-1}), ICP 7136 (1.25 t ha^{-1}), and ICP 7152 (1.24 t ha^{-1}). Various parameters recorded in the 1992/93 *maha* season were comparable with those recorded in 1991/92 (Table 1). ICPs 7135, 7128, 7122, and 7134 were among the high yielders. From the data from both seasons it was concluded that the short-duration Sri Lankan germplasm were similar for flowering, maturity, height, and seed size. For yield, such accessions as ICP 7135, 7136, and 7152 performed better in both seasons. ICP 7128 and 7132 showed high variation in yield over the two seasons.

Comparison of the data recorded in Sri Lanka with that of characterization data of the germplasm bank at ICRISAT-Patancheru (18°N latitude, 78°E longitude) showed that the Sri Lankan accessions in general took about 30 days longer to flower and mature at Patancheru (Table 2). However, for plant height and seed size the variation between the two sites was not large.

The results of this study show that the germplasm available in Sri Lanka contains considerable variation for important agronomic traits. The long-duration types often found in backyards in Sri Lanka are not suitable for commercial production there due to their excessive height and susceptibility to pod borers and pod fly. The short-duration group appears to have a narrow variability for flowering, maturity, and height, and some are superior in yield to the control cultivar ICPL 87, the most popular cultivar in Sri Lanka. The major insect pests can be managed in the short-duration types, and when sown under high density with good management practices they can produce yields of 1.0 to 1.5 t ha^{-1}. Breeders, therefore, can utilize such accessions in pigeonpea breeding programs for direct use or as parents in hybridization programs.

Breeding/Genetics

Studies on Genetic Variability in Pigeonpea

K N Patel and **D R Patel** (Department of Plant Breeding, Gujarat Agricultural University, Anand 388 110, Gujarat, India)

The presence of genetic variation in plant breeding materials is of importance for selecting superior genotypes. Therefore, the present study was undertaken to assess the extent of variability and genetic gain for yield and its components in pigeonpea.

The experimental materials consisted of six generations (P_1, P_2, F_1, F_2, B_1, and B_2) of four crosses of pigeonpea as indicated in Table 1. The materials were grown in compact family block design with three replications during the 1993/94 rainy season at the Vegetable Research Station, Gujarat Agricultural University, Anand. The parents and F_1 of each cross were sown in single row plots of 3-m length, while the F_2 generation was sown in 4-row plots of 3-m length and the backcross generations were sown in 2-row plots of 3-m length. Interrow spacings of 60 cm and intrarow spacings of 30 cm were adopted.

Recommended agronomic practices were followed to raise the crop. Observations for nine characters were recorded on five randomly selected plants in the parents and F_1 and on all individual plants in the backcross and F_2 populations. Genotypic and phenotypic coefficients of variability were estimated following Burton (1951), whereas heritability and expected genetic advance were estimated as suggested by Allard (1960). Methionine and total soluble sugar content were estimated using a colorimetric method (Anonymous 1956).

High genotypic (GCV) and phenotypic (PCV) coefficients of variation were observed for number of clusters $plant^{-1}$, number of pods $plant^{-1}$, and seed yield in all crosses; plant height and number of primary branches $plant^{-1}$ in crosses Anand-1 × Pusa 851 and GAUT 82-90 × ICPL 84023; pod thickness and methionine content in crosses Anand-1 × Pusa 851 and GAUT 82-92 × AF 100; and days to flower in cross GAUT 82-90 × ICPL 84023, indicating high variability present in these characters (Table 1). Hence, selection for better plant type based on these characters could be a suitable proposition for improving the productivity of genotypes. Awatade et al. (1980) observed significant differences for seven yield components and reported higher PCV than GCV