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Relative performance of long-duration pigeonpea (*Cajanus cajan*) of different growth habits as sole crop and in intercrop

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ABSTRACT

An experiment was conducted during 1985–86 and 1986–87 to study the relative performance of long-duration pigeonpea [*Cajanus cajan* (L.) Millsp.] genotypes of different canopy habits in sole crops and intercrops with pearl millet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz]. In both the seasons no interaction between grain yield of pigeonpea genotypes in sole crops and intercrops was observed, suggesting the validity of selecting progeny of long-duration pigeonpea in sole crops for eventual use in intercropping systems. These results are attributed to the long period, after the harvest of the intercropped pearl millet, over which long-duration pigeonpea can compensate for any differential competitive effects at early growth stages. The major factor determining yield appeared to be length of growing period, which was in turn determined by genotype and the environmental conditions following pearl millet harvest.

Long-duration pigeonpea [*Cajanus cajan* (L.) Millsp.] is commonly grown as an intercrop. Although it would be ideal to improve the crop in conditions it is to be grown, conducting a breeding programme for this crop in an intercrop situation is difficult because of large resources of land and labour required for evaluating progeny in an intercrop. Hence breeders prefer to evaluate progenies and advanced breeding materials in a sole crop situation, with the assumption that the selections found superior as sole crop will perform well in intercrop situations as well. This assumption, however, remains to be validated. A few studies presented at the first International Pigeonpea Workshop held at Patancheru in 1980 reported conflicting results, without any clear conclusions (Byth 1981). Therefore it is necessary to examine the efficacy of selections under sole cropping for ultimate and exclusive use in intercropping, using long-duration pigeonpea genotypes of different growth habits. The genotypes were compared for their performance as sole crop and when intercropped with pearl millet [*Pennisetum glaucum* (L.) R. Br. emend. Stuntz] —a common intercropping system in the Gwalior region, where the study was conducted.

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MATERIALS AND METHODS

The trials were conducted during the cropping seasons of 1985–86 and 1986–87 on an

Inceptisol at the ICRISAT-JNKVV Co-Operative Station, Gwalior. Split-plot design was adopted, with 4 replications, keeping cropping system in main plots and long duration pigeonpea genotypes in subplots. During 1985–86 the main-plot treatment comprised sole crop of pigeonpea and intercrop with pearl millet ('GV 1'). During 1986–87 the main plots were sole pigeonpea, sole pearl millet ('BJ 104') and the pigeonpea–pearl millet intercrop. Six pigeonpea genotypes were used in subplots in both the seasons, viz 'Gwalior 3' (spreading type), 'Bahar' and 'PDA 10' (semi-spreading types) and 'T 7', 'ICPL 360' and 'ICPL 366' (the compact types). The subplot size was 5.0 m x 5.4 m. The crops were sown on 18 July 1985 and 10 July 1986. The spacing for sole crop of pigeonpea was 45 cm x 45 cm (4.9 plants/m^2) and of pearl millet 45 cm x 20 cm (11 plants/m^2). A 2 : 2 arrangement was adopted for the intercrop with pigeonpea spaced at 45.0 cm x 22.5 cm (4.9 plants/m^2) and pearl millet at 45 cm x 10 cm (11 plants/m^2). The population of pigeonpea chosen was that commonly used in the breeding programme at this site. For intercropping the recommendations for the region were followed (Baldev 1988).

During 1985–86 N, P and K were applied basal to pigeonpea @ 20, 20 and 33 kg/ha respectively, and to pearl millet @ 100, 20 and 33 kg/ha placed in bands between rows. During 1986–87 both the crops received a basal application of 20 kg P/ha; pearl millet in addition received a basal application of 100 kg N/ha During 1985–86 the rainfall in rainy season (June–October) was 873 mm, which was 4 % more than the long-term average and was well distributed. The crops therefore could easily be raised rainfed. However, during 1986–87 the rainfall in the rainy season was only 498 mm. Two irrigations were given at 53 and 147 days after sowing to obviate the symptoms of drought. The crop was hand-weeded.

Pearl millet was harvested on 28 September 1985 and 7 October 1986. Extensive bird damage to heads of pearl millet prevented estimates of its grain yield in both the years. Each pigeonpea genotype was harvested at its date of maturity (Table 1).

RESULTS AND DISCUSSION

During 1986–87 total aerial dry matter of pearl millet was 5.3–7.5 tonnes/ha when intercropped with the different pigeonpea

Table 1 Time to maturity (days) of pigeonpea genotypes as sole crop and in intercrop with pearl millet

Genotype	1985–86			1986–87		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
'Gwalior 3'	271	272	272	240	241	241
'Bahar'	268	267	268	227	228	228
'PDA 10'	276	275	275	241	241	241
'T 7'	270	272	271	240	239	240
'ICPL 360'	271	273	272	241	242	243
'ICPL 366'	276	277	276	262	263	263
Mean	272	273		243	243	
SEm± for comparing						
Genotypes (G)		0 5			0 5	
Cropping systems (CS)		0 2			0 4	
G x CS		0 7			0 7	
(except when comparing same levels of CS)		0 8			0 7	

genotypes. But these differences were not significant. The dry-matter yield of the sole crop of pearl millet was 13.6 tonnes/ha. Growth of pearl millet was not determined during 1985–86.

All the pigeonpea genotypes flowered and matured earlier in 1986–87 than in 1985–86 (Table 1). The time to 50% flowering was 140–144 days in 1986–87 and 150–163 days in 1985–86. Below-average temperature during December 1985–April 1986 might have caused seasonal differences. The intercropping treatment did not affect the phenology, but there were differences among genotypes in time taken to flowering and maturity. 'ICPL 366' had the longest duration and 'Bahar' the shortest in both the seasons

The longer growth duration during 1985–87 allowed taller growth (234–254 cm) compared with that during 1986–87 (218–235 cm) Aerial biomass could not be compared directly in different years, but the use of stick yield as an estimate of biomass indicated that intercropping reduced the biomass during 1985–86 (Table 2). During 1986–87 aerial biomass was marginally (not significant) reduced by intercropping. There was no interaction between cropping system and genotype, but a significant difference was observed among genotypes in biomass produced in this season.

Grain yield of pigeonpea was generally higher during 1985–86 than during 1986–87 (Table 3), corresponding with the longer growth duration (Table 1). Mean yield was significantly lower in the intercrop than in the sole crop in both the seasons, although the reduction was greater during 1985–86. There was no significant interaction between cropping system and genotype for grain yield, indicating that intercropping reduced the yield of each genotype similarly.

The genotypes differed significantly in yield in both the seasons; 'ICPL 366' giving the highest yield (Table 3). The combined data of all the seasons showed good correlation between yield and crop duration ($r = 0.76^{**}$).

The data indicate that the differences in genotypic rankings between sole crops and intercrops are likely to be less with increase in differences between maturity of the cereal and the legume. After the harvest of the cereal intercrop, there is a period of up to 6 months for the long-duration pigeonpea to compensate for any differential genotype effects of intercrop competition. Further, the different

Table 2 Air-dried weight of sticks (tonnes/ha) during 1985–86 and aerial dry matter (tonnes/ha) during 1986–87 of pigeonpea genotypes as sole crop and in intercrop with pearl millet

Genotype	1985–86			1986–87		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
'Gwalior 3'	15 9	7 9	11 9	18 4	16 3	17 4
'Bahar'	13 3	7 3	10 3	19 1	15 7	17 4
'PDA 10'	12 3	8 4	10 4	15 8	11 9	13 8
'T 7'	15 6	9 1	12 4	19 3	18 1	18 7
'ICPL 360'	9 8	8 7	9 3	17 9	16 2	17 1
'ICPL 366'	12 9	11 2	12.1	17 6	15 5	16 6
Mean	13 8	8 8		18 0	15 6	
SEm± for comparing						
Genotypes (G)		1 21			0 86	
Cropping systems (CS)		0 78			0 61	
G x CS		1 75			1 26	
(except when comparing same levels of CS)		1 72			1 21	

Table 3 Grain yield (tonnes/ha) of pigeonpea genotypes as affected by cropping system

Genotype	1985–86			1986–87		
	Sole	Intercrop	Mean	Sole	Intercrop	Mean
'Gwalior 3'	2 26	1 74	2 00	2 13	1 80	1.96
'Bahar'	3 16	2 10	2 63	1.75	1 50	1 62
'PDA 10'	2 52	1.92	2.22	1.53	1 51	1 52
'T 7'	3 08	1 87	2.47	2.13	1 78	1 96
'ICPL 360'	3 15	2 14	2 65	2 13	1 80	1 96
'ICPL 366'	3 73	3 07	3 40	2 44	2 40	2 42
Mean	2 99	2 14		2.02	1 82	
SEm± for comparing						
Genotypes (G)		0 186			0 107	
Cropping systems (CS)		0 102			0 042	
G x CS		0 261			0 145	
(except when comparing same levels of CS)		0 263		0 152		

spatial arrangement between sole crop and intercrop did not contribute to any genotypic differences related to canopy type, ie the compact or spreading habits conferred no particular advantage in intercropping of long-duration pigeonpea. Nevertheless, the overall effect of cereal competition in reducing the pigeonpea biomass at early stages is partly reflected in the final yield. In medium-duration pigeonpea (150–180 days) there is less time for such a compensation, and thus competitive effects of the intercropped cereal, and genotypic differences in this regard, are more likely to influence the final grain yield (Tiwari *et al.* 1977, Green *et al.* 1981, Rao *et al.* 1981).

The present results support the conduct of a breeding programme for long-duration pigeonpea in a sole crop situation, even though the products are intended for intercropping systems. Its spacings should however be kept the same as in the intercrop to avoid the possible effect of self competition at later growth stages, as under terminal drought stress. However, our conclusions at this stage definitively apply to selection of progeny in sole crops only for alternate paired rows of pearl millet and pigeonpea in this environment. The wider applicability of these conclusions would depend on testing of long-duration pigeonpea in alternative cropping systems and environments.

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