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A perennial cropping system from pigeonpea grown in post-rainy season

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ABSTRACT

The feasibility of growing pigeonpea [*Cajanus cajan* (Linn.) Millsp.] as a perennial crop was investigated during 1980–82. The medium-duration pigeonpea genotype 'ICP 1-6', sown in the post-rainy season at a population of 30 plants/m², was allowed to perennate for 18 months, during which it produced 3 flushes of pods at 5, 15 and 18 months after sowing. There was a substantial plant mortality after the first-flush harvest, but due to the high-sowing rate many plants survived and regenerated to form a closed canopy in the following rainy season. The mean yield of 2 seasons was 0.5 tonne/ha in the first flush, 1 tonne/ha in the second and 0.05 tonne/ha in the third. The yield from the second flush was obtained without weeding or insecticide spray and was comparable to that of the rainfed crop of medium-duration genotypes. Considerable leaf fall also occurred, which contributed 40 kg N/ha to the soil. The yield from the third flush was very low to warrant continuation of the crop for another 3–4 months after the second-flush crop. At this harvest the mean firewood (air-dried stem) yield was 3.5 tonnes/ha. The system has good potential in the wet rainy season fallows in peninsular India, as it enables pigeonpea after the rainy season with little efforts and few inputs.

Pigeonpea [*Cajanus cajan* (Linn.) Millsp.] is intrinsically a perennial plant, although it is generally grown as an annual crop. Due to its deep roots and drought-tolerant nature, it is grown extensively on drylands (Singh and Das, 1986). One problem in growing it as a perennial crop is its general susceptibility to diseases, such as fusarium wilt (*Fusarium udum* Butler) and sterility mosaic.

With the availability of cultivars combining resistance to several diseases (Nene *et al.*, 1981), it should be possible to overcome some of the limitations to the perennial cropping of pigeonpea. Further, cropping systems in which high initial plant stands are established could be utilized; so that even if some plants die for various reasons after the first-flush crop, there should still be enough surviving plants to exploit the resources of light and water in the next season. One such system is pigeonpea sown in the post-rainy season. Owing to the reduced growth of plants due to cool whether and short days, a high plant population has been recommended in the post-rainy season, which is 5–9 times more than required in normal sowings around the longest day (Narayanan and Sheldrake, 1979).

Hence an experiment was conducted to find out the possibility of raising a perennial crop of pigeonpea from a crop sown at the beginning of the post-rainy season. The system envisaged planting pigeonpea at a high density in September-November, when post-rainy season crops are usually established, harvesting it by ratooning in late February or March, and leaving plants in the field during the dry

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period of April–May. Owing to the droughttolerant nature of pigeonpea, many plants would be expected to survive this dry period, and with the onset of the rainy season quickly establish a closed canopy. Thus a crop similar to a normal crop established around the longest day was expected to be harvested by December or January. This could be further ratooned to give another harvest by March, when it would be removed from the field.

MATERIALS AND METHODS

Three trials were set up on Vertisol (Typic Pellustert) during 1980–82 at Sangareddy Fruit Research Station (70 km north-west of Hyderabad, 17 °N, 78 °E, 545 m above mean sea-level) and an observation plot during 1982–84 at Patancheru (30 km north-west of Hyderabad). A genotype ('ICP 1-6') tolerant to wilt and sterility mosaic (SM) was used. Basal dressing of fertilizer was not done. In 1980–82 the seeds were sown on 9 November 1980 on a flat seed-bed at 30 cm × 10 cm spacing and a light irrigation was given to germinate the seeds, since the surface soil was dry at the time of sowing. During the post-rainy season the plots were weeded once and 1 spray of endosulfan (EC 35%) was given to control the infestation of pod-borer (*Heliothis armigera* Hübn.).

In the first trial, designed to study the effect of method of first-flush harvesting on subsequent harvests, 3 harvest methods of the first flush were tested: (*i*) hand-picking of pods, (*ii*) ratooning by cutting the plants at 30 cm above-ground level, and (*iii*) ratooning by cutting the plants at 10 cm above-ground level. The second trial was designed to study the effect of plant population on the second-flush yield. Plant population was varied using 3 thinning treatments during August 1981 : (*i*) no thinning, (*ii*) thinning of alternate rows, and (*iii*) thinning of 2 out of 3 rows. In the third trial the effect of method of harvesting the second flush on the third-flush yield was studied. The 3 treatments of this experiment on the second flush were: (*i*) hand-picking of pods, (*ii*) ratooning by cutting the plants at 110 cm above-ground level, and (*iii*) ratooning by cutting the plants at 180 cm above-ground level. There were 3 replications in each experiment, laid out in a randomized block design. Plot size in trial 1 was 55 m × 55 m and in trials 2 and 3 it was 44.6 m × 44.6 m. The first flush of the 1980–82 crop matured in March 1981. In trials 2 and 3 the first-flush crop harvested from different plots was bulked as treatments had not been imposed by then. The second-flush crop matured by December 1981. In trials 1 and 2 the second flush was harvested at 110 cm above-ground level. In all the trials the third flush was harvested in April 1982 at the ground level.

In 1982–84, for observation plot seeds were sown on 17 September 1982 in 0.25 ha on 150 cm broad beds and furrows at a spacing of 30 cm row-to-row and 8 cm plant-to-plant, with 4 rows/bed. The first-flush crop was weeded once and 1 spray of endosulfan (EC 35%) was given to control the infestation of pod-borer. The first flush of the 1982–84 crop matured in February 1983. This crop was harvested by ratooning at 30 cm above-ground level, which was nearly half of the total plant height. The second flush commenced in November and was ready for harvest by January 1984. The second flush was harvested by cutting the stems at 150 cm above-ground level. The third-flush crop was harvested in April 1984 by cutting the stems at the ground level.

Observations were recorded on seed yield, dry matter, fallen leaves and plant survival at each harvest in 1980–82. In 1982–84, only seed yield, stem dry matter and plant survival were recorded.

RESULTS AND DISCUSSION

The average first-flush yield in 1980–82 was 0.40 tonne/ha and in 1982–84 was 0.66 tonne/ha (Table 1). The low yield from the first flush in 1980–82 was due to delayed sowing in November (Venkataratnam *et al.*, 1984). In 1982–84 it was

Table 1. Yield (tonnes/ha) of different flushes of medium-duration pigeonpea genotype 'ICP 1-6' grown as a perennial in 1980–82 at Sangareddy and in 1982–84 at Patancheru

Treatment	First flush	Second flush	Third flush	Total
1980–82				
Experiment 1				
Hand-picking	0.35 ± 0.053*	1.45 ± 0.051	0.13 ± 0.010	1.93 ± 0.106
Ratooning at 30 cm	0.40 ± 0.042	1.44 ± 0.143	0.11 ± 0.017	1.95 ± 0.188
Ratooning at 10 cm	0.42 ± 0.042	1.21 ± 0.140	0.11 ± 0.013	1.74 ± 0.191
Experiment 2				
No thinning		1.26 ± 0.081	0.11 ± 0.011	1.77 ± 0.085
Thinning alternate rows	0.40	1.10 ± 0.082	0.08 ± 0.006	1.59 ± 0.083
Thinning of 2 out of 3 rows		0.93 ± 0.116	0.08 ± 0.014	1.41 ± 0.121
Experiment 3				
Hand-picking		1.25 ± 0.076	0.11 ± 0.029	1.76 ± 0.073
Ratooning at 180 cm	0.40	1.02 ± 0.082	0.09 ± 0.014	1.51 ± 0.076
Ratooning at 110 cm		1.10 ± 0.038	0.07 ± 0.010	1.57 ± 0.035
Mean	0.40	1.20	0.10	1.70
1982–84	0.66	0.91	0.003	1.57

*Standard error

slightly lower than normal, because of pod-borer damage (about one-third pods).

The plant population at the harvest of the first flush was about 30 plants/m^2. Afterwards, substantial plant mortality occurred in both the 1980–82 and 1982–84 crops. More than 50% plants died after the first-flush harvest in 1980–82 on the onset of the rainy season, irrespective of the mode of harvest. In the 1982–84 observation plot, maximum mortality occurred between harvest of the first flush in February and the onset of the rainy season in June; thereafter plant population tended to stabilize. The mortality was mainly due to the infection by *Rhizoctonia bataticola* (Taub.) Butler and drought stress. However, the surviving plant population, 14 plants/m^2, was still more than is generally required for the crop sown in the rainy season. These plants formed a satisfactory canopy in the rainy season, effectively suppressing the growth of weeds.

The second flush of pods of the plants grown in 1980–81 reached maturity at the same time to medium-duration pigeonpea sown at the beginning of the rainy season (the normal sowing time). In 1980–82 the mean yield of the second-flush crop was 1.20 tonnes/ha and in 1982–84 it was 0.91 tonne/ha (Table 1). These yields were obtained without further land cultivation, interculture and insecticide application. In 1980–82 the attack of pod-boring caterpillers of *H. armigera* was modest compared with that in an adjacent farmer's field, probably due to a build-up of predators. The yields obtained were comparable with those of medium-duration pigeonpea grown under rainfed conditions (Sharma *et al.*, 1978). In 1980–82 the first flush of pods could be harvested by ratooning without adversely affecting the subsequent crop yield (Table 1). This is useful, since ratooning is much quicker and cheaper

Table 2. Fallen leaves (tonnes/ha) at the second-flush harvest and dry matter (tonnes/ha) at the third-flush harvest of medium-duration genotype 'ICP 1-6' grown as a perennial crop during 1980–82 at Sangareddy

	Fallen leaves	Total dry matter	Firewood
Experiment 1	3.1 ± 0.30*	5.6 ± 0.34	4.7 ± 0.29
Experiment 2			
No thinning	2.1 ± 0.08	5.3 ± 0.20	4.5 ± 0.21
Thinning of alternate rows	1.5 ± 0.12	4.0 ± 0.16	3.0 ± 0.20
Thinning of 2 out of 3 rows	0.9 ± 0.19	3.0 ± 0.34	2.4 ± 0.23

*Standard error

than hand-picking the pods. Similarly, in the second trial the surviving plants may form an optimum canopy and there may be no advantage to thin out an apparently excessive population (Table 1).

In 1980–82 and 1982–84 the yield from the third flush was very small, 0.10 tonne/ha and 0.003 tonne/ha (Table 1). This may be due to severe drought stress and soil cracking during the formation of the third flush (Venkataratnam and Sheldrake, 1985). Hand-picking of the second flush did not improve the yield of the third flush (Table 1). The low yield potential of the third flush is very uneconomical.

In 1980–82, the weight of fallen leaves was 3.1 tonnes/ha in trial 1 (Table 2), which at 1.3% N content could have been 40 kg N/ha. This is similar to a crop of medium-duration pigeonpea sown at the usual time which can leave as much as 30-40 kg N/ha in the form of fallen leaves, senesced nodules etc. (Kumar Rao *et al.*, 1983). The quantity of fallen leaves declined with an increase in the degree of thinning (Table 2). This indicates that weight of air-dried stem left after threshing the third-flush crop in Experiment 1 in 1980–82 was 4.7 tonnes/ha and in 1982–84 it was 2.2 tonnes/ha. For fallen leaves the amount of stem material was reduced with thinning (Table 2). However, in Table 2 the biomass of the plants thinned was not included as it was more suitable as a forage than as firewood. The fresh weight of the stems was 3,122 kg/ha in the alternate row-thinning treatment and 4,494 kg/ha in the 2 out of 3 row-thinning treatments. The respective dry weights were 812 and 1,211 kg/ha.

Thus in field it is possible to grow a perennial cropping system with a crop of pigeonpea grown in the post-rainy season. The cropping system may have an advantage in areas of peninsular India. Vertisols are normally left fallow during the rainy season, because of the difficulty in working the soil while wet.

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