Preliminary Evaluation of Short- and Medium-duration Pigeonpea Genotypes in the Dry Season in Indonesia

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In Indonesia, pigeonpea is predominantly grown in Java and in the drier eastern islands, especially Bali, West Nusa Tenggara, East Nusa Tenggara, East Timor, and South Sulawesi. Traditionally medium- to long-duration (150–240 days maturity) local cultivars are grown as a minor crop mixed with maize (*Zea mays*) and cassava (*Manihot esculenta*). Pigeonpea is generally sown in the rainy season (Nov–Mar) with about 1400 mm mean rainfall. At present the crop is utilized as a vegetable in the form of green pods, mainly in rural areas. It has been recently shown that it can substitute for soybean (*Glycine max*) in preparing 'tempeh' and 'kecap' (Damardjati and Widowati 1991). Efforts are being made to encourage rural agroindustry to utilize pigeonpea (Rukmani 1995). This may trigger an increase in demand for pigeonpea and eventually its organized marketing, which is nonexistent at present. While there is limited scope to further popularize its cultivation in the wet season due to competition with major crops such as rice (*Oryza sativa*), maize, and soybean, this crop could be grown in the dry season (Apr–Oct), especially in the semi-arid regions, which receive about 200 mm rainfall; this would enhance pigeonpea cultivation and diversify the cropping systems. However, the potential of the crop in such environments has not been examined. The purpose of this research was to examine the potential of short- and medium-duration pigeonpea genotypes in the dry season in Indonesia.

Eighteen determinate and 14 indeterminate short-duration (SD) genotypes along with control cultivar Mega (determinate) and 16 medium-duration (MD) genotypes along with a local cultivar were evaluated during the 1994 dry season at four locations, Muneng, Mojosari, Jambegede, and Kendalpayak. Mega, a selection from lines developed by ICRISAT, was introduced in Indonesia in 1987 by the University of Queensland, Australia, as the cultivar Hunt. However, because of its very small seeds (7–8 g 100 seeds^{-1}) it has not been extensively adopted. Short-duration genotypes were sown on 26 Mar 1994 at Muneng, Experimental Farm in East Java Province. Medium-duration genotypes were sown at four locations in East Java Province: at Muneng on 11 May 1994, at Mojosari on 28 Apr 1994, at Jambegede on 23 Apr 1994 and at Kendalpayak on 20 Apr 1994. A basal application of urea to give 23 kg N ha^{-1}, triple superphosphate to give 10 kg P ha^{-1}, and potassium chloride to give 30 kg K ha^{-1} was given at each location. For each group of genotypes, a separate randomized block design was used with three replications. Sowing arrangement for SD genotypes was 30 × 10 cm and for MD genotypes 75 × 20 cm. To allow estimation of potential yield, SD genotypes were irrigated at 23, 46, 62, and 83 days after sowing (DAS). In addition to irrigation given at sowing at each location, MD genotypes were irrigated at, 23, 41, and 64 DAS at Muneng, at 36 and 86 DAS at Mojosari, at 22 and 46 DAS at Jambegede, and at 29 and 83 DAS at Kendalpayak. The SD genotypes needed more irrigation, apparently due to their greater susceptibility to intermittent drought than the MD genotypes. However, this requirement would be reduced drastically if sowing were to be advanced towards the end of the rainy season in March. The crops were protected with about three sprays during the vegetative stage to protect against white flies (*Bemisia tabaci*) and three to five sprays during the reproductive stage, alternating monocrotophos, endosulfan, methomyl, deltamethrin, phenthoate, and

Table 1. Grain yield of some high yielding determinate and indeterminate short-duration pigeonpea genotypes at Muneng, Indonesia, dry season 1994[1].

Genotype	Grain yield (t ha^{-1})	Genotype	Grain yield (t ha^{-1})
Determinate		**Indeterminate**	
ICPL 87	2.70	ICPL 91048	2.42
ICPL 84031	2.28	ICPL 92050	2.37
ICPL 88027	2.22	ICPL 88034	2.18
ICPL 89030	2.16	UPAS 120	1.71
Mega (C)	2.18	Mega (C)	2.10
SE	±0.418		±0.354
Trial mean	1.74		1.95
CV (%)	30.2		19.3

1. The grain yield of determinate pigeonpea genotypes ranged from 0.47 to 2.70 t ha^{-1}, while that of indeterminate genotypes ranged from 1.43 to 2.42 t ha^{-1}.

Table 2. Grain yield of some high yielding medium-duration pigeonpea genotypes at four locations, Muneng, Mojosari, Jambegede, and Kendalpayak, Indonesia, dry season 1994.

Genotype	Grain yield (t ha^{-1}) Muneng	Mojosari	Jambegede	Kendalpayak	Mean
ICPL 92066	2.62	2.09	3.60	2.97	2.82
ICPL 87119	2.92	1.51	3.50	2.48	2.60
ICPL 92069	2.99	1.63	2.99	2.56	2.54
ICPL 92057	1.72	2.16	3.73	1.57	2.30
Local (control)	1.14	1.40	1.73	0.81	1.27
SE	±0.402	±0.329	±0.450	±0.418	
Trial mean	2.33	1.58	2.77	2.01	
Range[1]	1.14–2.99	1.22–2.16	1.73–3.73	0.81–2.97	
CV (%)	20.8	20.5	21.9	26.1	

1. For grain yields of all medium-duration genotypes at respective locations.

diazinon to protect against pod-boring insects. Dry matter and grain yield were recorded from a net plot size of 2.16 m^2 for SD and 5.4 m^2 for MD genotypes.

All the determinate SD genotypes took less than 100 days to mature and grew to a height of about 1 m. ICPL 87 gave maximum yield of 2.7 t ha^{-1} (Table 1). The control genotype Mega yielded 2.18 t ha^{-1}. Most of the indeterminate genotypes matured in less than 100 days and attained plant height of about 1.15 m. ICPL 91048 gave maximum yield of 2.42 t ha^{-1} compared to 2.10 t ha^{-1} of the control cultivar Mega (Table 1). UPAS 120, a popular cultivar in India, yielded only 1.71 t ha^{-1}. Yield variation was significantly associated with total dry matter production among both determinate (r = 0.888) and indeterminate (r = 0.789) genotypes, suggesting that the ability to produce more dry matter was an important determinant of yield. No relationship between time to maturity and yield, however, was observed for genotypes of either growth habit.

The mean yield of MD genotypes ICPL 92066, ICPL 92069, and ICPL 87119 in four locations was more than 2.5 t ha^{-1}, whereas the local control gave only 1.2 t ha^{-1} (Table 2). The genotype × location interaction was not significant. Most of the genotypes introduced from ICRISAT gave more than 2 t ha^{-1}. The maximum yield of 3.73 t ha^{-1} was obtained at Jambegede, although pest damage caused by pod borer (*Helicoverpa armigera*) was around 20–30% at this location in spite of insecticide application. At Muneng, Jambegede, and Kendalpayak pod borer infestation was <15%. Although there was no relationship between time to maturity and yield it is possible that late-maturing MD genotypes could get caught in early rainy season rains during the reproductive period.

The preliminary evaluation of pigeonpea in these trials showed that both SD and MD genotypes have a good yield potential for sowing in the dry season. The yield potential of some SD and MD genotypes was comparable to irrigated yields of soybean in farmers' fields, which was around 2 t ha^{-1} (Adisarwanto et al. 1993). Pigeonpea yields in this study were obtained with irrigation and it would be interesting to see if high yields of pigeonpea can also be realized (vis-à-vis soybean) under rainfed conditions. Further studies are in progress to examine the yield performance of pigeonpea under rainfed conditions. Pigeonpea could be introduced as the initial crop in upland areas with a dry climate where annual rainfall is less than 2000 mm and the growing period is less than 180 days (Virmani et al. 1991); and as a second and third crop after rice under residual moisture. Such areas exist in East Java, Bali, Nusa Tenggara, and South Sulawesi islands. Quantification of the moisture requirement of pigeonpea in these environments and soil moisture balance from historic weather data would enable effective mapping of potential pigeonpea areas at a minimal cost.

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Studies on Intercropping Short-duration Pigeonpea with Maize and Groundnut

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Traditionally, medium- (180 days) and long-duration (>250 days) cultivars of pigeonpea are intercropped with various rainy season crops such as maize (*Zea mays*) and sorghum (*Sorghum bicolor*), which mature in about 120 days. In Sri Lanka, short-duration pigeonpea has been successfully introduced in dry and intermediate zones for sole cropping under rainfed conditions (Joseph and Saxena 1996). Considering the potential for pigeonpea cultivation in the diverse agroecological zones of Sri Lanka, a study was conducted at the Field Crops Research and Development Institute to assess the adaptability of short-duration cultivars in intercropping with maize and groundnut (*Arachis hypogaea*), the two established crops of the zone.

In Sri Lanka rainfall is bimodal and in the main rainy (*maha*) season (Oct–Mar), which receives about 1200 mm rainfall, traditionally crops of 140–150 days crops are cultivated and in the short rainy (*yala*) season (Apri–Jul), receiving about 400 mm rainfall, extra-early crops maturing in 80–90 days are grown. A new production system integrating main and ratoon cropping in the two seasons was evolved by Jayasekera et al. (1992). The objective of the current study was to evaluate pigeonpea/maize/groundnut intercropping in *maha* and subsequent *yala* seasons with pigeonpea as a ratoon crop and gingelly (*Sesamum indicum*), the most common *Yala* season crop, be grown in the space vacated by maize or groundnut.

Two separate trials for pigeonpea/maize and pigeonpea/groundnut were conducted on red-brown soil. The component crops were planted in various combinations, including 75% pigeonpea + 25% maize/groundnut (two pigeonpea rows followed by one maize/groundnut); 50% pigeonpea + 50% maize/groundnut (one row of pigeonpea followed by one row of maize/groundnut); and 25% pigeonpea + 75% maize/groundnut (two rows of maize/groundnut followed by one row of pigeonpea); sole crops of pigeonpea and maize/groundnut were used as the control. Each plot had eight 4-m rows at a spacing of 60 cm. Pigeonpea was sown at a spacing of 60 × 10 cm

Table 1. Yield (t ha^{-1}) of pigeonpea and maize in various intercrop combinations at Maha Illuppallama, Sri Lanka, during 1990/91 *maha* and 1991 *yala* seasons.

Combination (%)		*Maha* season			*Yala* season	
Pigeonpea	Maize	Pigeonpea	Maize	LER	Pigeonpea[1]	Gingelly
100	0	1.73	–	–	0.54	–
75	25	1.36	1.44	0.95	0.28	0.0
50	50	0.95	2.29	1.01	0.15	0.0
25	75	0.45	3.50	1.08	0.13	0.0
0	100	–	5.03	–	–	0.0
SE		± 0.20	± 0.28	–	–	–
CV (%)		15.4	9.2	–	–	–

1. As a ratoon crop.