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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.

Table 2. Yield (t ha^{-1}) of pigeonpea and groundnut in various intercropping combinations at Maha Illuppallama, Sri Lanka, during 1990/91 *maha* and 1991 *yala* seasons.

Combination (%)		*Maha* season			*Yala* season	
Pigeonpea	Groundnut	Pigeonpea	Groundnut	LER	Pigeonpea[1]	Gingelly
100	0	1.74	–	–	0.45	-
75	25	1.12	0.11	0.73	0.31	0.0
50	50	1.37	0.42	1.12	0.34	0.0
25	75	1.27	0.69	1.27	0.29	0.0
0	100	–	1.24	–	–	0.0
SE		± 0.18	± 0.22	–	–	–
CV (%)		16.7	12.1	–	–	–

1. As a ratoon crop.

while spacing for maize was 60 × 50 cm and for groundnut, 60 × 20 cm. The maize crop was fertilized according to commercial recommendations (120 kg N, 45 kg P, and 35 kg K ha^{-1}) and no fertilizer was applied to pigeonpea and groundnut. Pigeonpea was sprayed three times for protection against pod-boring insects. The varieties used in these experiments were ICPL 2 (pigeonpea), Bhadra (maize), and MI-1 (groundnut). Both the trials were sown under rainfed conditions in randomized complete block design with four replications. The sowing was done on 13 Oct 1990 (pigeonpea/maize) and 26 Oct 1990 (pigeonpea/groundnut). Gingelly was sown on 11 Apr 1991.

Pigeonpea/maize intercropping

The maize crop was harvested for dry grain after 105 days while pigeonpea matured in 130 days. In the *maha* season, the sole crop of pigeonpea yielded 1.73 t ha^{-1}, and maize yielded 5.03 t ha^{-1} (Table 1). Land equivalent ratio (LER) values suggested that the combination of 75% maize and 25% pigeonpea resulted in an 8% advantage in the land use. In this combination maize yielded 3.5 t ha^{-1} (69.6% of the sole crop) while the yield of pigeonpea was 0.45 t ha^{-1} (26% of the sole stand). With the onset of *yala* rains, pigeonpea was ratooned and gingelly was planted in between the rows of ratooned pigeonpea stumps. In this season the amount and distribution of rains were inadequate (data not available) and the crop of gingelly germinated well but failed to survive due to drought, and no yield was recorded (Table 1). Under such harsh drought conditions pigeonpea did fairly well by producing 0.54 t ha^{-1} grain yield under pure stands.

Pigeonpea/groundnut intercropping

The sole crop of pigeonpea yielded 1.74 t ha^{-1} and groundnut yielded 1.24 t ha^{-1}. Unlike pigeonpea/maize intercropping, the yield of pigeonpea in various groundnut combinations did not vary much (Table 2). However, the reduction in groundnut yields were significant. A crop combination of 25% pigeonpea and 75% groundnut resulted in the highest LER of 1.27. In this combination pigeonpea yielded 1.27 t ha^{-1} (72.9 % of the pure stand) and groundnut yielded 0.69 t ha^{-1} (55.1% of the pure stand). Again, in this experiment gingelly did not survive up to maturity due to drought and data were not analysed. In various crop combinations the ratooned pigeonpea produced 0.29–0.45 t ha^{-1} (Table 2) grain yield with sole cropping out-yielding the intercropping treatments.

From the above studies it can be concluded that:

- an introduction of 25% pigeonpea in the maize or groundnut crop on a replacement basis may be beneficial in terms of higher LER values.
- maize is a relatively more competitive companion crop to pigeonpea than is groundnut.
- in the *yala* season under moisture stress conditions, ratooning pigeonpea is more beneficial than growing other such field crops as gingelly.

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Molybdenum Response of Pigeonpea on Ferruginous Latosols in Fiji

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Vegetable pigeonpea is cultivated as a cash crop by farmers in the western division of Fiji on land not used for sugarcane production. Since sugarcane is the main income source, income from opportunistic crops, such as pigeonpea with minimal input, is a bonus. Because pigeonpea has traditionally demanded a high price in the local market, farmers have accepted low yields in return for high income. The demand, however, for vegetable pigeonpea is increasing because of a growing export market created by the émigré populations in Australia, New Zealand, and Canada.

Because pigeonpea has traditionally been an opportunistic crop for farmers, little work has been done to assess crop response to nutrient application under the agroclimatological conditions in Fiji. Many farmers use their own seed. Pigeonpea is mostly cultivated in areas of Fiji with a distinct dry season, where the soils are predominantly ferruginous Latosols (Laffan 1988). These soils are characterized by a low pH, with crops frequently showing nutrient deficiency symptoms. Chemical analysis of these soils in Fiji confirms the low pH (3.8–4.4), and show them to have low extractable Olsen-P levels (<6 mg kg^{-1}), low CEC (<6.0 me kg^{-1}), and low SO_4-S (90–302 mg kg^{-1}).

Using traditional farming methods, a pigeonpea varietal trial conducted on Legalega Research Station (LRS) resulted in low yields, which upon investigation were attributed to poor nodulation. Inadequate nodulation of legumes on acid soils can be associated with low-plant-available molybdenum (Reyes and Jurinak 1967, Barrow 1974). The results reported below are from a completely randomized block design (CRBD), with three replicates, and two rates of foliar applied molybdenum (Mo) (0 and 2 kg ha^{-1}) as sodium molybdate in solution (Na_2MoO_4). Each plot had a basal application of P (20 kg ha^{-1}) and K (40 kg ha^{-1}). Pigeonpea in Fiji, after flowering, is prone to attack by the caterpillar *Maruca testulalis*, which bores into the young pod. Control of the caterpillar is obtained by spraying weekly with methomyl in water (4 ml L^{-1}) using a mist blower once flower buds appear. In the trial at LRS on ferruginous Latosol (Nadi soil series) with the pigeonpea cultivar QPL 511 (Pragati), a significant response was recorded to foliar applications of Mo in terms of increasing flower numbers, improving pod set, and reducing days to flowering (Table 1). This response to Mo was carried over to the ratoon crop.

On-farm trials (Table 2) confirmed the LRS results obtained with Mo, applied at a rate of 1 kg ha^{-1} of Mo as Na_2MoO_4 in solution, 2 weeks after emergence and again 3 weeks later. In the absence of Mo plant vigor was poor, the incidence of yellow deformed necrotic leaves was high, and physiological maturity was delayed. Application of Mo improved plant vigor, plant height and overall performance.

Table 1. Response of pigeonpea cultivar QPL 511 to foliar application of molybdenum at Legalega Research Station, Fiji.

Foliar treatment with Mo	Plant height at flowering (cm)	Days to first green pod harvest	Height at first green pod harvest (cm)	First flush green pod yield (t ha^{-1})	Ratoon green pod yield (t ha^{-1})	Total green pod yield (t ha^{-1})
0	95	157	96	0.2	0.3	0.5
2 kg ha^{-1}	118	107	119	4.9	6.4	11.3
LSD (0.05)	8.4	12.2	9.1	0.6	0.8	1.2