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Influence of plant population and sett size on biomass accumulation and quality of white yam (*Dioscorea rotundata*) intercropped in coconut (*Cocos nucifera*) gardens

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ABSTRACT

A field experiment was conducted during 1998–99 and 1999–2000 (May–February) at College of Agriculture, Vellayani, Thiruvananthapuram, to investigate the effects of plant population and sett size on biomass accumulation and quality in white yam (*Dioscorea rotundata* Poir.) intercropped with coconut (*Cocos nucifera* L.). Heaviest sett (300 g) planted at the widest spacing (90 cm × 90 cm) promoted the canopy growth. Tuber dry biomass production and total plant dry biomass production were highest in the closest spacing, 60 cm × 60 cm, that accommodated 20,000 plants/ha. Efficient allocation of photo-assimilates for storage in tuber was favoured by the widest spacing, 90 cm × 90 cm, resulting in highest mean tuber weight and harvest index. Total biomass production, biomass accumulation in tubers as well as its partitioning ratio to tubers were notably higher with 300 g setts. Wider spacing (90 cm × 90 cm) also produced better quality tubers by accumulating more starch in tubers, while sett size did not alter tuber quality.

Key words : White yam, Intercropping, Coconut garden, Plant population, Sett size, Harvest index, Biomass, Starch, Crude protein

Among edible yams, Asiatic yams viz., greater yam (*Dioscorea alata*) and lesser yam (*Dioscorea esculenta*) are common intercrops in many coconut-growing regions of Asia. African white yam (*Dioscorea rotundata*) a recent introduction to India is gaining popularity due to its high yield potential, acceptable tuber quality especially high dry matter and starch contents, good taste and feasibility in diverse cropping systems (Nair *et al.,* 1987; Nayar and Suja, 1999). Tubers of white yam are less slimy and source of proteins, fats, minerals and vitamins particularly vitamin C and nutritionally comparable to potato.

The influence of cultural manipulations on biomass production and quality has been extensively researched in other tuber crops. Since, this aspect has not been studied in detail so far in *D. rotundata,* the present study was taken up to find out the effects of plant population and sett size on biomass accumulation and quality in white yam intercropped with coconut.

MATERIALS AND METHODS

A field study was undertaken during May–February in 1998–99 and 1999–2000 at the Instructional Farm, College of Agriculture, Vellayani, Thiruvananthapuram, Kerala, on red loam soils classed as Rhodic haplustox. Texturally the soil was a clay loam with acidic soil reaction (pH 5.6), with low contents of available N (264 kg/ha) and available K (138 kg/ha), medium content of organic carbon (0.532%) and high content of available phosphorus (59 kg/ha). The experimental site experiences a typical humid tropical climate with mean annual rainfall of 1899 mm. The experiment was laid out as a 3 × 3 factorial experiment in randomized block design (RBD) with 9 treatments, replicated thrice, involving various combinations of three spacings 60 cm × 60 cm (20,000 plants/ha); 75 cm × 75 cm (13,000 plants/ha) and 90 cm× 90 cm (9,000 plants/ha) and 3 sett sizes (100, 200 and 300 g). White yam variety 'Sree Priya' was planted in plots (7.2 m × 3.6 m) formed in the interspaces of coconut trees of 25–30 years of age spaced at 7.5 m, leaving an area of 2 m radius from the base of the palms. The plants were trailed 15 days after sprouting using coir ropes tied to G.I. Wires connecting coconut trees. Observation plants were staked individually. Fertilizers to provide 80 kg N, 60 kg P_2O_5 and 80 kg K_2O/ha were applied.

Observations on vine length and number of leaves were recorded 1 month prior to harvest (i.e., 8 MAP) before

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complete crop senescence. The plants were uprooted and separated into aerial biomass (leaves and vines) and the tuber (economic part), usually one. Tuber weight was recorded.

RESULTS AND DISCUSSION

Effect of spacing

The widest spacing (90 cm × 90 cm) significantly promoted the vine length, number of leaves and tuber weight. Singh *et al.* (1994) also reported similar results in *D. alata*. Efficient allocation of photo-assimilates for storage in tuber was favoured by the widest spacing, 90 cm × 90 cm resulting in highest mean tuber weight and harvest index. During both the years significantly highest aerial biomass, tuber biomass as well as total biomass per hectare was computed from the closest spacing (60 cm × 60 cm) (Table 1). This is solely due to the effect of high plant population. Plants spaced at 90 cm × 90 cm produced tubers with highest starch contents, which was on par with 75 cm × 75 cm (Table 2). Sufficient filling of the storage cells as a result of greater translocation of photo-assimilates to the tuber might have enhanced the starch content of tubers in widely spaced plants. Similar trends were observed in intercrops of cassava by Nayar and Sadanandan (1991) and in arrowroot by Maheswarappa *et al.* (1997) in coconut gardens at lower plant density.

Effect of sett size

The growth attributes, tuber weight, total biomass production, biomass accumulation in tubers as well as its partitioning ratio to tubers were notably higher with 300 g setts (Table 1). It seems that vigorous initial plant growth, especially greater leaf area, produced by a large sett gives the plant an advantage that lasts throughout the growing season (Nwoke *et al.*, 1984), which results in greater carbon assimilation in the plant as well as assimilate translocation to the tubers. The higher mean tuber bulking rates in plants established from large setts might have contributed to higher weight and dry-matter yield. The heavy investment by the plant in the tuber at the expense of vines, leaves and roots resulted in higher harvest index in the largest sett size. However, sett size had no impact on starch or crude protein contents in the present investigation as stated by Nair (1985) in *D. esculenta* and Maheswarappa *et al.* (1997) in arrowroot (Table 2).

Spacing × sett size interaction

Heaviest sett (300 g) planted at the widest spacing (90 cm × 90 cm) promoted canopy size and harvest index. Largest sett planted at the closest spacing (60 cm × 60 cm and 300 g) resulted in significantly higher total dry biomass yield due to the integration of the growth and yield

Table 1. Effect of spacing and sett size on growth attributes, yield, biomass production and harvest index of white yam

Treatment	Vine length (cm)		Number of leaves		Mean tuber weight (kg)		Biomass production (dry biomass tonnes/ha)						Harvest index	
							Aerial		Tuber		Total			
	1998–99	1999–2000	1998–99	1999–2000	1998–99	1999–2000	1998–99	1999–2000	1998–99	1999–2000	1998–99	1999–2000	1998–99	1999–2000
Spacing														
S_1, 60 cm × 60 cm	581	589	453	457	1.23	1.11	7.34	7.23	6.72	6.00	14.06	13.23	0.47	0.45
S_2, 75 cm × 75 cm	660	670	493	501	1.39	1.39	5.22	5.34	5.13	4.96	10.35	10.29	0.49	0.48
S_3, 90 cm × 90 cm	738	748	614	653	1.71	1.74	3.49	3.37	4.42	4.46	7.92	7.82	0.56	0.57
CD (P=0.05)	21	21	11	13	0.10	0.16	0.54	0.61	0.53	0.56	0.78	0.56	0.03	0.04
Sett size														
W_1, 100 g	481	491	394	438	1.15	1.11	5.22	5.24	3.94	3.83	9.16	9.07	0.43	0.43
W_2, 200 g	687	693	531	534	1.53	1.49	5.53	5.35	5.79	5.34	11.32	10.69	0.52	0.51
W_3, 300 g	812	823	635	639	1.66	1.65	5.31	5.35	6.53	6.24	11.85	11.59	0.57	0.55
CD (P=0.05)	21	21	11	13	0.10	1.16	NS	NS	0.53	0.56	0.78	0.56	0.03	0.04

Table 2. Effect of spacing and sett size on tuber quality of white yam

Treatment	Starch (%) fresh weight basis		Crude protein (%) fresh weight basis	
	1998–99	1999–2000	1998–99	1999–2000
Spacing				
S_1, 60 cm × 60 cm	22.05	22.13	1.79	1.77
S_2, 75 cm × 75 cm	23.52	23.20	1.79	1.77
S_3, 90 cm × 90 cm	24.12	23.28	1.79	1.78
CD (P=0.05)	0.70	0.82	NS	NS
Sett size				
W_1, 100 g	22.81	22.49	1.78	1.77
W_2, 200 g	23.44	22.71	1.79	1.77
W_3, 300 g	23.44	23.41	1.79	1.77
CD (P=0.05)	NS	NS	NS	NS

promoting effects of the large sett size on the dense stand.

REFERENCES

Maheswarappa, H.P., Nanjappa, H.V. and Hedge, M.R. 1997. Influence of sett size, plant population and organic manures on yield components, yield and qualitative characters of arrowroot grown as intercrop in coconut garden. *Journal of Root Crops* **23**(2) : 131–137.

Nair, S.G., Abraham, K. and Nayar, G.G. 1987. Two high yielding selections of white yam (*Dioscorea rotundata* Poir.). *Journal of Root Crops* **13**(2) : 103–109.

Nair, S.R.C. 1985. 'Effect of seed size and fertility levels on the yield and quality of *Dioscorea esculenta* (Lour) Burk.' M.Sc (Agriculture) Thesis, Kerala Agricultural University, Thrissur.

Nayar, T.V.R. and Sadanandan, N. 1991. Effect of plant population and growth regulators on cassava intercropped in coconut gardens. II. Yield components, yield and tuber quality. *Journal of Root Crops* **17**(1) : 39–43.

Nayar, T.V.R. and Suja, G. 1999. Plant density for intercropping *Dioscorea* in coconut gardens. (In) *Tropical Tuber Crops : In Food Security and Nutrition,* pp. 351–356. Balagopalan, C. *et al.* (Eds). Oxford & IBH Publishing Co., Pvt. Ltd, New Delhi.

Nwoke, F.I.O., Njoku, E. and Okonkwo, S.N.C. 1984. Effect of sett size on yield of individual plants of *Dioscorea rotundata* Poir. *Tropical Agriculture* **61**(2) : 99–101.

Singh, D.N., Tripathy, P., Sahu, A. and Nandi, A. 1994. Effect of spacing and planting material size on growth and yield of *Dioscorea alata*. *Journal of Root Crops* **20**(2) : 81–84.