Journal of Crop and Weed 4(1) : 15-19 (2008)

Effect of spacing and seed corm size of elephant foot yam on economics of a coconut based cropping system

D. K. GHOSH, J. K. HORE, A. BANDOPADHYAY AND M. K. MAJI

All India Co-ordinated Research Project on Palms
Deptt of Spices and Plantation Crops, Faculty of Horticulture,Bidhan Chandra Krishi Viswavidyalaya

ABSTRACT

Field experiment was conducted at H. R. S. Mondouri, BCKV, WB during 1998-2000 to study the effect of spacing and seed corm size on yield of elephant foot yam, grown as inter crop in an 18 yrs old coconut (cv.-ECT) garden and to study the effect of inter crop on the economics of the cropping system . Among the five different spacings and two corm sizes, yield at 40 x 40 cm spacing with 500g corm size (71.45 kg/ 9.6m2) was the best for elephant foot yam, grown as intercrop in coconut. It was observed that P_1S_2 (40 x 40 cm, 500 g) adding the fixed cost for other component crop, recorded maximum cost of cultivation (Rs. 92,891/-), maximum gross return (Rs. 1,38,328/-) and net return (Rs. 45,367/-). Maximum benefit: cost ratio (0.85) was obsreved in P_4S_1 (70 x 70 cm, 300 g) combination.

Key Words : Coconut, elephant foot yam, intercrop, spacing, seed corm size, economics.

Elephant-foot yam (*Amorphophallus campanulates* Blume), has now become a very popular edible aroid in many tropical and sub-tropical countries. It plays an important role in vegetative diet. West Bengal is the prime consumer state in India. The corm has high carbohydrate content (about 18%) and rich in vitamin A, minerals and protein. The cultivar 'Kovur' is almost free from acrid an factor (raphides of calcium oxalate) that causes itchiness and swelling of tongue and throat. Ayurvedically, it is used against piles, jaundice, diabetes, dispepsia and appetite. Production potential of this crop is very much dependent on good management practices and both corm size and spacing being the important factors affecting the yield (Sethi *et al.*, 2002). There is enough scope to improve its economic cultivation through proper selection of spacing and size of planting material.

A high spacing of 7.5 m x 7.5 m in coconut is recommended mainly to accommodate the large crown of the palms, however, several studies revealed that natural resources *i.e.*, soil, water, air space and solar radiation are not fully utilized under this spacing schedule and much land space is generally left unproductive throughout the long life span of palms. In the recent past, economy of coconut farmers had weakened due to the fluctuation in the price of coconut, copra and coconut oil. So, adoption of coconut based multiple cropping system emerges as the viable way for improving the economic status of coconut farmers. Considering these the present investigation was undertaken to study the effect of different spacing and size of planting materials on the growth and yield of elephant foot yam when it is cultivated as intercrop in coconut garden and also to evaluate the effect of intercrop on the economics of coconut based cropping system.

MATERIALS AND METHODS

The experiment was carried out in a 17 years old coconut (cv. East Coast Tall) plantation at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia during 1998 to 2001.The coconut palms were spaced at 7.5x7.5 m. The study was based on a coconut based cropping model Coconut + guava + elephant-foot yam + colocasia, In this model 4 rows of coconut were alloted consisting of 6 palms in each row (total 24 palms) covering an area of 1350 m^2. Guava was planted in the centre of 4 palms, keeping altogether 15 fruit plants. Elephant-foot yam was planted in plots between two fruit plants. Colocasia was planted in between two coconut palms (along the row). The space utilisation for different crops in a model was 28% for coconut palm, 32% for EFYam, 19% for colocasia and 21% for Guava and irrigation channels, ridges etc.

The experiment on EFYam was laid out in split plot design with three replications assigning spacings to the main plots and seed corm size to the subplots. The treatments included five spacings (40 x 40, 55 x 50, 65 x 60, 70 x 70 and 90 x 85,cm x cm) with two corm size (300g and 500g).There were ten treatments with all possible combinations. Indofil-M 45 (0.3%) treated corm (cv. Kvour) of 300g and 500g were planted in the middle of March during both the years according to the spacing treatments . Fertilizers were applied @ 100: 60: 100 kg NPK ha^{-1}. Entire P with FYM @ 20 t ha^{-1} were given as basal application. N & K were applied in two splits 30 DAP and 60 DAP

followed by earthing up and irrigation. The corm was harvested at 210 DAP. The soil of the experimental site was gangetic alluvial with sandy loamtexture having medium NPK and soil pH 6. Scheduled agronomical management practices were followed in coconut EFYam and guava.

Economics of the cropping model has been studied in terms of cost of cultivation (only the paid out cost), gross return, net return and benefit : cost ratio. Here benefit means, extra earning per rupee of investment. There were 10 treatment combinations altogether comprising of 5 spacing and 2 size of planting material, in one of the component companion crops of the model *i.e.* elephant-foot yam in this Model. Statistical analysis have been done to identify the best treatment combination from data recorded over two years of experimentation.

RESULTS AND DISCUSSION

Yield of Elephant foot yam the major component crop

Data presented in Table 1, revealed that total corm yield per plot was higher with closest spacing in both the years as well as in pooled data. The highest yield per plot was 61.84 kg, 57.05 kg and 59.44 kg in the respective years and pooled data with closest spacing (40 x 40 cm) which were significantly superior to the yield (22.89 kg, 19.13 kg and 21.01 kg) from widest spacing 90 x 85 cm. Decreasing trend in yield per plot was noticed with the increase in spacing which was good in conformity with the findings of Sen *et al.* (1987). Higher yield per plot (42.91 kg in pooled data) was associated with the bigger corm size (500g). Although the weights of individual corm directly influence the final yield per plant but plant population per unit area is the major factor for determining the yield per plot. Hence the per plot yield was higher in closer spacing than the wider spacing (Table 1).

Interaction effects of spacing and corm size indicated that P_1S_2 (40 x 40 cm, 500g) combination produced maximum yield per plot of 74.52 kg, 68.37 kg and 71.45 kg during the respective years and pooled data as compared to minimum yield of 20.26 kg, 17.29 kg and 18.78 kg with P_5S_1 (90 x 85 cm, 300g) combination in the year 1999, 2000 and pooled data, respectively (Table 2).

Projected yield of Elephant foot yam per hectare

The data presented in Table 1, revealed that projected yield per hectare was higher with closest spacing in both the years of experiment. The highest yield was 18.55 t ha^{-1} and 17.11 t ha^{-1} in the year 1999 and 2000 with closest spacing (40 x 40 cm) which were significantly superior to the yield (6.85 t ha^{-1} and 5.73 t ha^{-1}) recorded from widest spacing 90 x 85 cm. Decreasing trend in yield per hectare was noticed with the increase in spacing which is in conformity with the findings of Sen *et al.* (1987). A significant response was also noticed with the size of seed corm. Higher projected yield per hectare (13.49 t and 12.24 t) was associated with the bigger corm size (500 g). Interaction effects due to spacing and seed corm sizes indicated that P_1S_2 (40 x 40 cm, 500g) combination produced maximum yield per hectare (22.35 t, 20.51 t and 21.43 t) during the respective years and pooled data in the year 1999, 2000 and pooled data (Table 2).

Table 1. Effect of spacing and corm size on yield of elephant-foot yam

Treatment	Yield per plot (kg/9.6 m^2)			Projected yield (t/ha)		
	1999	2000	Pooled	1999	2000	Pooled
Spacing						
P_1 (40 x 40cm)	61.84	57.05	59.44	18.55	17.11	17.83
P_2 (55 x 50cm)	40.71	41.27	40.99	12.21	12.37	12.29
P_3 (65 x 60cm)	36.94	29.93	33.44	11.08	8.98	10.03
P_4 (70 x 70cm)	30.14	34.16	32.15	8.54	10.24	9.39
P_5 (90 x 85cm)	22.89	19.13	21.01	6.85	5.73	6.29
S.Em.(±)	2.134	1.551	1.563	0.796	0.635	0.422
C.D. (P=0.05)	6.961	5.058	5.098	2.596	2.073	1.376
Corm size						
S_1 (300 g)	32.03	31.78	31.90	9.40	9.53	9.47
S_2 (500 g)	44.98	40.83	42.91	13.49	12.24	12.87
S.Em.(±)	0.559	0.514	0.397	0.168	0.424	0.199
C.D. (P=0.05)	1.761	1.619	1.252	0.532	1.338	0.628

Table 2. Interaction effect of spacing and corm size on yield of elephant-foot yam

Treatment	Yield per plot (kg/9.6 m²)			Projected yield (t/ha)		
	1999	2000	Pooled	1999	2000	Pooled
P_1S_1	49.16	45.72	47.44	14.75	13.71	14.23
P_1S_2	74.52	68.37	71.45	22.35	20.51	21.43
P_2S_1	32.77	37.25	35.01	9.83	11.17	10.50
P_2S_2	48.65	45.29	46.97	14.59	13.58	14.08
P_3S_1	30.52	26.20	28.36	9.15	7.86	8.51
P_3S_2	43.37	33.67	35.82	13.01	10.10	11.55
P_4S_1	27.44	32.46	29.95	7.23	9.73	8.48
P_4S_2	32.84	35.86	34.35	9.85	10.75	10.30
P_5S_1	20.26	17.29	18.78	6.06	5.18	5.62
P_5S_2	25.52	20.97	23.25	7.65	6.29	6.97
P x S						
S.Em.(±)	1.250	1.149	0.888	0.377	0.950	0.445
C.D. (P=0.05)	3.939	3.619	2.799	1.189	2.993	1.404

Table 3. Cost of cultivation and returns from coconut and intercrops except EFYam under the model.
(*Economic yield yet to obtain)

Crop	Cost of cultivation (Rs. / ha)		Gross return (Rs. / ha)		Net return (Rs. / ha)	
	1999	2000	1999	2000	1999	2000
Guava*	6,120	2,572	-	-	-	-
Colocasia	7,030	6,210	12,330	11,730	5,300	5,520
Coconut	18,800	17,750	39,648	41,506	20,848	23,756
Total	31950	26532	51978	53236	26148	29276

Yield per plot was maximum at closer spacing (40 x 40 cm) and decreased with every increase in the spacing. Increased yield under closer spacing might be due to more number of plants per unit area. The reduction in yield attributes under narrow spacing might be ascribed to comparatively poor growth and development of individual plants due to competition for growth resources like space, sunlight, nutrients, moisture etc. The improvement in yield attributes at widest spacing was not reflected by total corm yield because higher productivity per plant at lowest plant density could not compensate for increased number of plants per unit area under 40 x 40 cm spacing. Similar findings on spacing (Singh *et al.*, 1997), planting material (Verma *et al.*, 1994) and spacing cum planting material (Sethi *et al.*, 2002) support the findings under the present investigation.

Economic assessment of the model Coconut + Guava + Elephant-foot yam + Colocasia

The model consisted of coconut, guava, elephant-foot yam and colocasia. For calculation of cost of cultivation ,fixed cost towards maintenance of coconut, planting and maintenance of guava and cultivation of colocasia were added to the treatment combinations of elephant-foot yam in both the years and it was Rs. 18,800/- and Rs. 17,750/- for coconut, Rs. 6,120/- and Rs. 2,572/- for guava and Rs. 7,030/- and Rs. 6,210/- for colocasia in 1999 and 2000, respectively. Similarly for calculation of gross return from Model-I, the fixed return from coconut and colocasia were added which were Rs. 39,648/- and 41,506/- for coconut and Rs. 12,330/- and Rs. 11,730/- for colocasia in 1999 and 2000 respectively (Table 3).It was clear from the pooled data (Table 4) that with the increase in planting distance in elephant-foot yam, the cost of cultivation, gross return and net return of the model as a whole decreased significantly. Maximum cost (Rs. 82,091/-) has been incurred in P_1 (40 x 40 cm) spacing, mainly because of the cost of planting materials of EFYam. Maximum gross return (Rs. 1,23,917/-) was realised with (40 x 40 cm) spacing followed

Table 4. Effect of spacing and corm size of elephant-foot yam on economics of the Model

Treatment	Cost of cultivation (Rs. /ha)			Gross return (Rs. /ha)			Net return (Rs. /ha)			Benefit : Cost		
	1999	2000	Pooled	1999	2000	Pooled	1999	2000	Pooled	1999	2000	Pooled
P_1 + A	85,140	79,042	82,091	126,158	121,676	123,917	41,018	42,634	41,826	0.48	0.54	0.51
P_2 + A	65,994	59,836	62,915	100,818	102,736	101,775	34,824	42,900	38,862	0.52	0.72	0.62
P_3 + A	58,284	52,066	55,175	96,298	89,157	92,727	38,014	37,092	37,552	0.65	0.71	0.68
P_4 + A	54,426	52,066	53,246	88,138	94,196	91,168	33,712	42,134	37,921	0.62	0.81	0.71
P_5 + A	47,013	43,175	45,094	79,418	76,175	77,796	32,405	33,001	32,703	0.68	0.76	0.72
S.Em(±)	8.981	2.803	4.654	15.037	1.991	6.693	9.431	2.417	3.798	0.0001	0.0001	0.0001
C.D. (P=0.05)	29.287	9.141	15.176	49.045	6.495	21.829	30.754	7.882	12.387	0.0003	0.0003	0.0003
S_1 + A	57,132	52,338	54,735	90,394	91,356	90,875	33,262	39,017	36,139	0.59	0.75	0.67
S_2 + A	67,210	61,992	64,601	105,938	102,220	104,079	38,727	40,227	39,478	0.59	0.64	0.61
S.Em(±)	3.597	0.973	1.694	3.752	1.275	1.585	6.199	1.595	2.899	0.0001	0.0001	0.0001
C.D. (P=0.05)	2.337	3.065	5.337	11.819	4.018	4.993	19.528	5.027	9.132	0.0003	0.0003	0.0003

Spacing : P_1 = 40 x 40 cm, P_2 = 55 x 50 cm, P_3 = 65 x 60 cm, P_4 = 70 x 70 cm, P_5 = 90 x 85 cm
Corm size : S_1 = 300 g, S_2 = 500 g, A = Coconut + Guava + Colocasia

Table 4. Interaction effect of spacing and corm size of elephant-foot yam on economics of the Model

Treatment	Cost of cultivation (Rs. /ha)			Gross return (Rs. /ha)			Net return (Rs. /ha)			Benefit : Cost		
	1999	2000	Pooled	1999	2000	Pooled	1999	2000	Pooled	1999	2000	Pooled
P_1S_1 + A	74,341	68,242	71,291	110,098	108,076	109,507	36,597	39,834	38,216	0.49	0.58	0.53
P_1S_2 + A	95,940	89,842	92,891	141,375	135,276	138,328	45,435	45,434	45,367	0.47	0.50	0.48
P_2S_1 + A	59,712	53,554	56,633	91,298	97,917	94,607	31,586	44,363	37,974	0.52	0.82	0.67
P_2S_2 + A	72,276	66,118	69,197	110,337	107,556	108,945	38,061	41,438	39,758	0.52	0.62	0.57
P_3S_1 + A	53,856	47,638	50,747	88,579	84,677	86,627	34,723	37,039	35,880	0.64	0.77	0.70
P_3S_2 + A	62,712	56,494	59,603	104,018	93,636	98,828	41,306	37,142	39,225	0.65	0.65	0.65
P_4S_1 + A	50,898	44,620	47,759	84,899	92,155	88,527	34,001	47,535	40,778	0.66	1.06	0.85
P_4S_2 + A	57,954	51,676	54,815	91,378	96,236	93,809	33,424	44,560	38,994	0.57	0.86	0.71
P_5S_1 + A	46,854	40,516	43,685	76,256	73,954	75,105	29,402	33,448	31,420	0.62	0.82	0.72
P_5S_2 + A	47,172	45,834	46,503	82,578	78,396	80,487	35,406	32,562	33,984	0.75	0.71	0.73
P x S												
S.Em.(±)	8.043	2.175	3.788	8.390	2.851	3.545	13.862	3.568	6.482	0.0003	0.0002	0.0001
C.D. (P=0.05)	25.337	6.853	11.934	26.430	8.983	11.166	43.667	11.241	20.419	0.0009	0.0006	0.0003

Spacing : P_1 = 40 x 40 cm, P_2 = 55 x 50 cm, P_3 = 65 x 60 cm, P_4 = 70 x 70 cm, P_5 = 90 x 85 cm
Corm size : S_1 = 300 g, S_2 = 500 g, A = Coconut + Guava + Colocasia

by 55 x 50 cm (Rs. 1,01,775/-) and minimum rentrun (Rs. 77,796/-) was observed in widest spacing *i.e.*, 90 x 85 cm. Closest spacing (40 x 40 cm) also ensured the maximum net renturn. However, highest B : C ratio was observed in P_4 (70 x 70 cm) spacing mainly because of significant reduction in cost of cultivation due to lower requirement of planting materials.

Cost of cultivation as well as returns were higher when elephant-foot yam was grown with bigger size of planting material. However, maximum benefit : cost ratio was associated with small size planting material *i.e.*, 300 g. Considering the spacing and corm size together, it was observed that P_1S_2 + A(40 x 40 cm, 500 g) treatment recorded maximum cost of cultivation (Rs. 92,891/-), maximum gross return (Rs. 1,38,328/-) and net return (Rs. 45,367/-). Maximum benefit: cost ratio (0.85) was obsreved in P_4S_1 (70 x 70 cm, 300 g) +A combination followed by P_5S_{1+A} (0.72) and P_4S_{2+A} (0.71). The cost of cultivation and net return in P_4S_{1+A} combination were Rs. 47,759/- and Rs. 40,778/- respectively, emerging as the best combination for growing elephant-foot yam as an intercrop with coconut. Elephant-foot yam at 70 x 70 cm spacing with 300 g planting material in combination with guava and colocasia formed the best set of intercrop in the coconut plantation (Table 3). These findings are in good agreement with Singh *et al.* (2002) and Sairam *et al.*, 1997.

REFERENCES

Nath, J. C. 2002. Prospects of coconut based high density multistoreyed cropping in Assam. *Indian Coconut J.*, **33**(3) : 10-11.

Sen, H., Roychowdhury, N. and Mukhopadhyay, S. 1987. Effect of set size and spacing on the production of seed corm in A*morphophallus*. *J. Root Crops*, **13**(2) : 121-123.

Sethi, K., Mohanty, A., Naskar, S. K., Byju, G. and Mukherjee, A. 2002. Effect of set size, spacing and NPK fertilizer on yield of *Amorphophallus* in hilly areas of Orissa. *Orrisa J. Hort.*, **30**(2) : 72-75.

Singh, S., Singh, S. B., Verma, R. B. and Singh, T. 1997. Growth, yield and quality of elephant foot yam as affected by various levels of nitrogen, potassium and spacing. *Prog. Hort.*, **29**(1-2) : 41-47

Sairam, C. V., Gopalasundaram, P. Umamaheswari, L. 1997. Capital requirements for adoption of coconut based intercropping system in Kerala. *Indian Coconut J.*, **27**(10) : 2-4.

Singh,S. P., Manjunath, B. L., Khan, H. H.and Shalini Bhanu 2002.Coconut based high density cropping system in Goa. *Indian Coconut J.*, **33**(7) : 9-12.