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Economics of a coconut-based inter-cropping system as influenced by spacing and seed rhizome size of ginger

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ABSTRACT

A field experiment was conducted to study the effect of spacing and seed rhizome size on yield of ginger cv. Garubathan, grown as inter-crop in bearing coconut cv. East Coast Tall garden and to study the effect of inter-crop on the economics of the cropping system model (coconut + lime + ginger + okra). Among the five different spacings (20 × 15 cm, 20 × 20 cm, 25 × 20 cm, 25 × 25 cm and 30 × 25 cm) and two rhizome size (15-20 and 25-30 g) of ginger, the closest spacing (20 × 15 cm) in combination with bigger seed rhizome (25-30 g) produced highest yield (15.39 kg/3 m^2) . In case of okra and coconut the yield was 2.1 t/ha and 12,750 nuts/ha, respectively. The lime was in initial stage of bearing. Higher yield was recorded with 20 x 15 cm spacing due to increased plant population per unit area. Yield was proportionate to the size of the planting material. The maximum (Rs. 1,03,727/-) and minimum (Rs. 57,746/-) cost of cultivation were recorded in spacing 20 x 15 cm with rhizome size 25-30 g and spacing 30 x 25 cm with rhizome size 15-20 g, respectively. The maximum net return (Rs. 78,421/-) was realised from closest spacing with smaller seed rhizome. Planting with 25-30 g seed rhizome in 20 x 15 cm spacing may be recommended for ginger as inter-crop in coconut plantation for maximizing the yield.

Key words: Coconut, ginger, intercrop, seed, rhizome, spacing.

INTRODUCTION

Coconut (*Cocos nucifera* L.) is one of the most beautiful and useful palms in the world. The coconut palm rightly eulogised as *Kalpavriksha* or 'Tree of Heaven', yields more products of use to the human race than any other tree of God's creations. It provides not only edible products but also fuel, shelter, medicine and employment to the millions of people in the tropics, playing vital role in the socio-economic condition of India.

Ginger (*Zingiber officinale* Rosc.) is one of the major spice crop grown in India. India is the largest producer, consumer and exporter of this crop in the world. Ginger is widely used in food, beverage, confectionery and medicine. Growing of ginger in coconut plantation proves profitable without hampering the performance of the main crop (Roy and Hore, 8; Maity and Hore, 3). The size of planting materials and spacing are the major factors influencing growth and yield of ginger. Okra is a very popular vegetable in West Bengal rich in vitamins and minerals and has a good demand in the market. Lime is a suitable crop for growing as a filler crop in the centre of four coconut palms and it has also good demand in the market.

Several studies revealed that natural resources *i.e.*, soil, water, air space and solar radiation are not fully utilized under mono-cropping in coconut (Girijadevi and Nair, 2; Sairam *et al.*, 9). Presently the income derived from coconut, essentially a crop of small and marginal farmers is not sufficient to sustain the dependent families. One of the feasible ways of increasing the farm level income is intercropping. Considering these, the present investigation was undertaken to study the effect of different spacings and size of planting materials on yield of ginger and to evaluate the effect of inter-crop on the economics of coconut-based cropping system.

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MATERIALS AND METHODS

The experiment was carried out in 18-year-old coconut (cv. East Coast Tall) plantation at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia. The coconut palms were spaced at 7.5 m x 7.5 m. The study was based on a coconut based cropping model, *i.e.*, coconut + lime + ginger + okra. In this model 4 rows of coconut, consisting of 6 palms in each row were alloted (total 24 palms) covering an area of 1,350 m^2. Lime was planted in the centre of 4 palms, keeping altogether 15 fruit plants. Ginger was planted in plots between two fruit plants. Okra was planted in between two coconut palms (along the row). The space utilisation for different crops in the model was 28% for coconut 32% for ginger, 19% for okra and 21% for lime and irrigation channels, ridges etc.

The experiment on ginger was laid out in split plot design with three replications, assigning spacing to the main plots and seed corm size to the sub-plots. The treatments included five spacings, *i.e.* P_1 (20 × 15 cm), P_2 (20 × 20 cm), P_3 (25 × 20 cm), P_4 (25 × 25 cm) and P_5 (30 × 25 cm) as main plot and two size of planting material, *i.e.*, S_1 (15-20 g) and S_2 (25-30 g) as sub-plot treatments, with three replications. There were ten treatments with all possible combinations. The plots of ginger and okra were prepared 2.0 m away from either side of the palms. Indofil M-45 (0.3%) treated ginger rhizomes (cv. Gorubathan) were planted in the middle of April during both the years. Fertilizers were applied @ 125: 100: 100 kg NPK / ha. Entire P with ½ K and 1/3 N along with FYM @ 20 t / ha were given as basal application. Remaining 1/3 N at 45 DAP and 1/3 N and 1/2 K were applied at 90 DAP followed by earthing up and mulching. The rhizome was harvested at 210 DAP. Economics of the cropping model was studied in terms of cost of cultivation, gross return, net return and benefit : cost ratio. Statistical analysis has been done to identify the best treatment combination from data recorded over two years of experimentation.

RESULTS AND DISCUSSION

The data presented in Table 2 revealed that yield per plot (3 m^2) of ginger was maximum with closer spacing. The increase in spacing from 20 × 15 to 30 × 25 cm showed a decreasing trend in total yield. However, yield was increased with the increase of seed rhizome size. Maximum yield of 15.39 kg was obtained under closest spacing P_1 (20 × 15 cm) but plant raised from bigger seed rhizome S_2 (25-30 g) recorded the higher yield of 13.63 kg per plot as compared to 12.54 kg from smaller seed rhizome S_1 (15-20 g).

In case of interaction effect, the closest spacing (20 × 15 cm) in combination with bigger seed rhizome (25-30 g), *i.e.* P_1S_2 produced highest plot yield (15.62 kg /3 m^2) and projected yield (12.50 t/ha) as compared to minimum plot yield (10.49 kg/3 m^2 and projected yield 8.39 t/ha) with widest (30 × 25 cm) spacing in combination with small seed rhizome (15-20 g), *i.e.* P_5S_1 (Table 3). The increase in yield under higher population was attributed due to more population per hectare. Even though some growth and yield components were superior with medium and wider spacing but plant population level could not compensate the total yield that was realised in 20 × 15 cm spacing level. Similarly, Ahmed *et al*. (1) recorded the highest yield of 13.42 t/ha with close spacing (50 cm in row). Pandey (5) also reported that closer spacing was optimum for getting maximum yield in mango-ginger and kacholam, respectively. The reduction in yield attributes under narrower spacing might be ascribed due to comparatively poor growth and development of individual plants owing to competition for growth resource like space, sun-light, nutrients, moisture etc., which was supported by the earlier findings (Singh *et al*.,10; Mohanty *et al*., 4).

In this intercropping system (Table 1) fixed cost towards maintenance of coconut (Rs. 18,275/-), planting of lime (Rs. 3,778/-) and cultivation of okra (Rs. 5,030/-) in available space were included with all the ten treatment combinations having ginger. Gross return from coconut and okra were Rs. 44,604/- and Rs. 8,420/- were added with the gross returns from the treatment combinations of ginger for calculating the total return from the system as a whole.

Data presented in Table 2 clearly revealed that the cost cultivation, gross return and net return of the system decreased significantly with the increase in spacing of ginger. Maximum (Rs. 93,727/-) and minimum (Rs. 64,247/-) cost of cultivation were recorded in closest (20 × 15 cm) and widest (30 × 25 cm) spacing, respectively. Maximum gross return (Rs. 1,63,814/-) was realised from closest spacing (20 × 15 cm) followed by 20 × 20 cm spacing (Rs. 1,50,133/-) and minimum (Rs. 1,35,666/-) with widest spacing (30 × 25 cm) as highest yield obtained due to maximum population, however, maximum net return (Rs. 74,171/-) was obtained from medium spacing (25 × 20 cm) followed by 25 × 25 cm spacing (Rs. 73,879/-). These findings are in agreement with Singh *et al*. (11), and Sairam *et al.* (9).

Cost of cultivation and gross return varied due to change of rhizome size of ginger from S_1 (15-20 g) to S_2 (25-30 g). Maximum cost of cultivation (Rs. 81,365/-) and gross return (Rs. 1,51,177/-) were recorded with bigger seed rhizome but maximum net return (Rs. 74,884/-) and benefit : cost ratio (1.10) were recorded with smaller seed rhizome, indicating that the return was not proportionate with the cost involved for the planting materials.

The combination of both spacing and rhizome size revealed that maximum (Rs. 1,03,727/-) and minimum (Rs. 57,746/-) cost of cultivation was recorded in P_1S_2 (20 × 15 cm, 25-30 g) and P_5S_1 (30 × 25 cm, 15-20 g), respectively. The maximum gross return was realised from P_1S_2 (Rs. 1,65,479/-) combination followed by P_1S_1 (Rs. 1,62,149/-) and P_2S_2 (Rs. 1,52,203/-) but maximum net return was observed in P_1S_1 (Rs. 78,421/-). The benefit : cost ratio was highest in P_5S_1 (1.22) indicating the need of judicious selection of both planting material and plant population in such cropping model. From yield maximisation point of view 20 × 15 cm spacing with 25-30 g seed rhizome size was the best for ginger, grown as intercrop in coconut plantation giving the maximum gross return of Rs. 1,65,479/- from the model (Table 3). The present findings corroborate to the findings of Sairam *et al.* (9) who obtained a net

Table 1. Cost of cultivation of inter-crop and main crop.

Crop	Yield / ha	Cost of cultivation (Rs. / ha)	Gross return (Rs. / ha)	Net return (Rs. / ha)
Okra (t)	2.11 t	5,030	8,420	3,390
Coconut (No.)	12,750	18,275	44,604	26,329
Total	-	23,305	53,024	29,719

Table 2. Effect of spacing and rhizome size on yield of ginger and economics of cropping system.

Treatment	Yield/ plot (kg/3 m^2)	Cost of cultivation (Rs. /ha)	Gross return (Rs. /ha)	Net return (Rs. /ha)	Benefit : cost
P_1 + B	15.39	93,727	163,814	70,086	0.76
P_2 + B	13.49	80,448	150,133	69,685	0.88
P_3 + B	13.01	72,497	146,668	74,171	1.03
P_4 + B	12.07	66,106	139,986	73,879	1.12
P_5 + B	11.48	61,747	135,666	71,418	1.13
$CD_{(0.05)}$	1.780	14.684	6.087	18.011	0.0011
S_1 + B	12.54	68,446	143,329	74,884	1.10
S_2 + B	13.63	81,365	151,177	69,812	0.86
$CD_{(0.05)}$	0.453	10.471	2.992	9.494	0.0006

Spacing : P_1 = 20 × 15 cm, P_2 = 20 × 20 cm, P_3 = 25 × 20 cm, P_4 = 25 × 25 cm, P_5 = 30 × 25 cm

Rhizome size: S_1 = 15-20 g, S_2 = 25-30 g, B = Coconut + lime + okra, NS = Not significant

Table 3. Interaction effect of spacing and rhizome size on yield of ginger and economics of intercropping system.

Treatment	Yield per plot (kg/3 m^2)	Cost of cultivation (Rs. /ha)	Gross return (Rs. /ha)	Net return (Rs. /ha)	Benefit : cost
P_1S_1 + B	15.16	83,727	162,149	78,421	0.93
P_1S_2 + B	15.62	103,727	165,479	61,751	0.59
P_2S_1 + B	13.21	72,949	148,064	75,115	1.03
P_2S_2 + B	13.78	87,947	152,203	64,256	0.73
P_3S_1 + B	12.51	66,496	143,113	76,615	1.15
P_3S_2 + B	13.51	78,497	150,224	71,726	0.91
P_4S_1 + B	11.35	61,305	134,789	73,481	1.19
P_4S_2 + B	12.80	70,907	145,184	74,277	1.04
P_5S_1 + B	10.49	57,746	128,534	70,788	1.22
P_5S_2 + B	12.47	65,747	142,799	77,052	1.17
P x S					
$CD_{(0.05)}$	NS	23.407	6.690	21.331	0.0013

Spacing : P1 = 20 × 15 cm, P2 = 20 × 20 cm, P3 = 25 × 20 cm, P4 = 25 × 25 cm, P5 = 30 × 25 cm

Rhizome size: S1 = 15-20 g, S2 = 25-30 g, B = Coconut + lime + okra, NS = Not significant

Cost of input: Seed rhizome of Rs. 25.00 kg^{-1} okra seed-Rs. 300.00 kg-1, FYM Rs. 400.00 t^{-1}, Urea Rs. 4.70 kg^{-1}, SSP- 3.30 kg^{-1}, MOP-Rs. 4.50 kg^{-1}, Labour Rs. 60.00 day^{-1}

Selling price of produce: Ginger = Rs. 9.00 kg^{-1}, Coconut = Rs. 3.50 nut^{-1}, okra = Rs. 4.00 kg^{-1}

profit of Rs. 24,000/- from ginger grown as intercrop in coconut plantation. In an other system studied by Girijadevi and Nair (2), the net return of Rs. 2,74,808/- was realized from coconut + banana + elephant foot yam per year in one hectare plantation. Intercropping of ginger gave an additional return of Rs. 29,428 from 0.05 ha land under coconut + ginger cropping system. An additional employment of 40 mandays was also generated under intercropping system compared to monocrops (Ravishankar *et al*., 7). These returns clearly indicated the economic viability of companion cropping system with coconut under alluvial plains of West Bengal.

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