



Effect of spacing and seed rhizome size on growth and yield of ginger grown as intercrop in coconut plantation in West Bengal

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Ginger (*Zingiber officinale* Rosc) is one of the major spice crops grown in India. India is the largest producer, consumer and exporter of this crop in the world. Growing ginger in coconut plantation proves profitable without hampering the performance of the main crop. (Sharma *et al.*, 1996; Sairam *et al.*, 1997; Nath, 2002). The size of planting material and spacing are the major factors influencing growth and yield of ginger, although not much work on standardisation of these factors has so far been done in West Bengal, particularly when grown as intercrop in coconut garden. Ginger in West Bengal is generally planted in rows 25 cm apart at distances of 20 cm within the row and size of seed 30 g.

The experiment was carried out in a 18 years old coconut (cv. E C T) plantation at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, Nadia during 1999 and 2000. The soil of the experimental site was gangetic alluvial with sandy loam texture having medium NPK and soil pH 6. The coconut palms were spaced at 7.5 x 7.5 m. The experiment was laid out in split plot design with five spacings *i.e.*, P₁ (20 x 15 cm), P₂ (20 x 20 cm), P₃ (25 x 20 cm), P₄ (25 x

25 cm) and P₅ (30 x 25 cm) as main plot and two size of planting material *i.e.* S₁ (15-20 g) and S₂ (25-30 g) as subplot treatments, with three replications. Thus, there were ten treatments with all possible combinations. Indofil-M 45 (0.3 %) treated rhizomes (cv. Gorubathan) of required size were planted in the middle of March during both the years according to the spacing treatments. Fertilizers were applied @ 125 : 100 : 100 kg NPK / ha. The entire P with ½ K and 1/3 N along with FYM @ 20 t / ha were given as basal application. 1/3N at 45 DAP and 1/3N & 1/2 K were applied at 90 DAP followed by earthing up and mulching. The rhizome was harvested at 210 DAP. Scheduled agronomical management practices with fertilizer dose @ 500 : 250 : 750 g NPK / palm /year were followed in coconut under both intercropped and monocrop plots. Irrigation was given after planting of intercrops. Further need based irrigation was given for intercrops and main crop. Plant protection measures were taken as and when required. The observation on different growth parameters were recorded from five randomly selected plants per replication. Yield was taken on net plot basis at harvest.

Table 1. Effect of spacing and rhizome size on growth parameters of ginger

Treatment	Plant height (cm)			Number of tillers per clump		
	1999	2000	Pooled	1999	2000	Pooled
Spacing						
P ₁ (20 x 15cm)	124.36	110.13	117.25	14.26	10.58	12.42
P ₂ (20 x 20cm)	120.40	107.31	113.85	15.60	12.31	13.95
P ₃ (25 x 20cm)	115.56	108.13	111.85	15.40	14.13	14.76
P ₄ (25 x 25cm)	112.50	102.20	107.35	16.56	15.16	15.86
P ₅ (30 x 25cm)	104.43	96.85	100.64	17.00	17.80	17.40
S.Em.(±)	4.091	3.688	1.687	0.528	0.902	0.583
CD (P=0.05)	13.34	12.026	5.501	3.789	2.941	1.901
Rhizome size						
S ₁ (15-20 g)	112.14	101.28	106.71	15.37	13.24	14.31
S ₂ (25-30 g)	118.76	108.57	113.66	16.16	14.75	15.45
S.Em. (±)	1.288	1.325	1.0851	0.254	0.387	0.219
CD (P=0.05)	4.05	4.173	3.417	0.800	1.219	0.689

Table 2. Interaction effect of spacing and rhizome size on growth parameters of ginger

Treatment	Plant height (cm)			Number of tillers per clump		
	1999	2000	Pooled	1999	2000	Pooled
P ₁ S ₁	119.80	111.00	115.40	13.73	9.40	11.56
P ₁ S ₂	128.93	109.26	119.10	14.80	11.76	13.28
P ₂ S ₁	119.00	102.36	110.68	15.46	10.86	13.16
P ₂ S ₂	121.80	112.26	117.03	15.73	13.76	14.75
P ₃ S ₁	113.80	103.40	108.60	15.00	13.70	14.35
P ₃ S ₂	117.33	112.86	115.10	15.80	14.56	15.18
P ₄ S ₁	107.66	97.80	102.73	16.20	14.73	15.46
P ₄ S ₂	117.33	106.60	111.96	16.93	15.60	16.26
P ₅ S ₁	100.46	91.83	96.15	16.46	17.53	17.00
P ₅ S ₂	108.40	101.86	105.13	17.53	18.06	17.80
P x S						
S.Em.(±)	2.881	2.96	2.426	0.568	0.865	0.491
CD (P=0.05)	9.075	9.32	7.641	1.789	2.724	1.546

Table 3. Effect of spacing and rhizome size on weight and dimension of clump of ginger

Treatment	Fresh weight of clump (g)			Length of clump (cm)			Breadth of clump (cm)		
	1999	2000	Pooled	1999	2000	Pooled	1999	2000	Pooled
Spacing									
P ₁ (20 x 15cm)	225.33	188.50	206.91	18.92	17.98	18.45	11.71	11.50	11.60
P ₂ (20 x 20cm)	229.83	210.16	220.00	19.21	18.30	18.76	13.11	11.88	12.50
P ₃ (25 x 20cm)	252.16	230.50	241.33	21.20	19.13	20.17	12.85	11.93	12.39
P ₄ (25 x 25cm)	280.00	250.33	265.16	21.23	19.85	20.54	13.65	12.68	13.16
P ₅ (30 x 25cm)	321.66	267.50	294.58	21.71	20.53	21.12	14.03	12.66	13.35
S.Em.(±)	9.708	21.890	8.427	1.214	0.745	0.706	0.464	0.346	0.309
CD (P=0.05)	31.657	NS	27.480	NS	NS	NS	1.513	NS	1.007
Rhizome size									
S ₁ (15-20 g)	247.46	217.00	232.23	19.69	18.42	19.06	12.44	11.72	12.08
S ₂ (25-30 g)	276.13	241.80	258.96	21.22	19.90	20.56	13.70	12.54	13.12
S.Em. (±)	7.879	4.825	4.980	0.402	0.590	0.313	0.251	0.348	0.186
CD (P=0.05)	24.81	15.198	15.715	1.301	NS	0.985	NS	NS	0.585

NS = Not significant

Different growth parameters like plant height, tiller number, leaf number recorded at 180 days after planting (DAP) in both the years showed variation with the treatments. Plant height decreased with the increase in spacing but number of tillers per clump increased with increase in spacing (Table 1). Maximum plant height (117.25 cm) was observed under 20 x 15 cm spacing as compared to minimum height (100.64 cm) with 30 x 25 cm spacing. Maximum tillers (17.40) were observed in widest spacing (30 x 25 cm) as compared to minimum tillers (12.45) in closest spacing of 20 x 15 cm. Considering size of the planting materials, maximum height (113.66 cm) and tiller number (15.45) were recorded in the plants raised from bigger seed rhizomes (25-30 g) as compared to plants (106.71 cm and 14.31) raised from smaller ones (15-20 g). Combination of closest spacing with bigger seed rhizome (20 x 15 cm, 25-30 g) recorded maximum plant height but number of tillers per clump was maximum in widest spacing (30 x 25 cm) combined with bigger seed rhizome (25-30 g) (Table 2).

Weight of clump is an important yield-contributing trait and it was observed that the highest clump weight (319.50 g) with maximum length (21.83 cm) and breadth (13.71 cm) (Tables 3 and 4) were obtained from the plants grown under widest spacing (30 x 25 cm) with bigger size of seed rhizome (25-30 g). However, the increase in spacing from 20 x 15 cm to 30 x 25 cm showed a decreasing trend in yield per plot. The highest yield per plot (15.62 kg/3m²) were obtained from P₁S₂ (20 x 15 cm, 25-30 g) treatment as compared to the lowest yield (10.49 kg/3 m² and 8.39 t/ha) under P₅S₁ (30 x 25 cm, 15-20 g) treatment (Tables 5 and 6). Yield was proportionate to the size of the planting material. Planting with 25–30 g seed rhizome in 20 x 15 cm spacing may be recommended for ginger as intercrop in coconut plantation for maximising the yield. The increase in yield under closer spacing may be 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

Table 4. Interaction effect of spacing and rhizome size on weight and dimension of clump of ginger

Treatment	Fresh Weight of clump (g)			Length of clump (cm)			Breadth of clump (cm)		
	1999	2000	Pooled	1999	2000	Pooled	1999	2000	Pooled
P ₁ S ₁	220.00	184.00	202.00	17.85	17.24	17.55	10.86	10.56	10.71
P ₁ S ₂	230.66	193.00	211.83	19.99	18.72	19.36	12.56	12.43	12.50
P ₂ S ₁	221.33	204.00	212.66	18.86	18.28	18.57	13.03	11.26	12.15
P ₂ S ₂	238.33	216.33	227.33	19.56	18.33	18.95	13.20	12.50	12.85
P ₃ S ₁	244.33	217.66	231.00	20.66	18.13	19.40	11.96	11.66	11.81
P ₃ S ₂	260.00	243.33	251.66	21.73	20.14	20.94	13.73	12.20	12.96
P ₄ S ₁	259.00	232.66	245.83	20.05	18.66	19.35	13.10	12.40	12.75
P ₄ S ₂	301.00	268.00	284.50	22.42	21.05	21.74	14.20	12.96	13.58
P ₅ S ₁	292.66	246.66	269.66	21.03	19.80	20.42	13.26	12.70	12.98
P ₅ S ₂	350.66	288.33	319.50	22.40	21.25	21.83	14.80	12.63	13.71
P x S									
S.Em. (±)	17.619	10.790	11.157	0.899	1.319	0.700	0.562	0.778	0.416
CD (P = 0.05)	NS	NS	NS	2.831	NS	2.205	1.770	NS	1.310

NS = Not significant

Table 5. Effect of spacing and rhizome size on yield of ginger

Treatment	Yield per plot (kg/3 m ²)			Projected yield (t/ha)		
	1999	2000	Pooled	1999	2000	Pooled
Spacing						
P ₁ (20 x 15cm)	17.18	13.60	15.39	37.22	29.47	33.34
P ₂ (20 x 20cm)	14.23	12.76	13.49	30.81	27.66	29.24
P ₃ (25 x 20cm)	13.79	12.22	13.01	29.88	26.48	28.18
P ₄ (25 x 25cm)	12.83	11.31	12.07	27.81	24.51	26.16
P ₅ (30 x 25cm)	12.48	10.48	11.48	27.04	22.71	24.88
S.Em.(±)	0.523	1.189	0.546	1.133	2.577	1.184
CD (P=0.05)	1.705	NS	1.780	3.698	NS	3.861
Rhizome size						
S ₁ (15-20 g)	13.45	11.63	12.54	29.15	25.21	27.18
S ₂ (25-30 g)	14.75	12.52	13.63	31.96	27.13	29.55
S.Em. (±)	0.202	0.225	0.144	0.437	0.488	0.312
CD (P=0.05)	0.636	0.708	0.453	1.376	1.532	0.982

the total yield that was realised in 20 x 15 cm spacing level. Ahmed *et al.* (1988) recorded the highest yield of 13.42 t/ha with closer spacing (50 cm in row). Pandey (1999) and Maheswarappa *et al.* (2000) also reported that closer spacing was optimum for getting maximum yield in mango-ginger and kacholam (Family – Zingiberaceae) 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 find support from the earlier findings (Mohanti *et al.*, 1993; Singh *et al.*, 2000).

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Table 6. Interaction effect of spacing and rhizome size on yield of ginger

Treatment	Yield per plot (kg/3 m ²)			Projected yield (t/ha)		
	1999	2000	Pooled	1999	2000	Pooled
P ₁ S ₁	16.92	13.40	15.16	36.66	29.03	32.85
P ₁ S ₂	17.44	13.80	15.62	37.78	29.91	33.84
P ₂ S ₁	13.86	12.56	13.21	30.02	27.22	28.62
P ₂ S ₂	14.60	12.96	13.78	31.61	28.09	29.86
P ₃ S ₁	13.28	11.75	12.51	28.76	25.44	27.11
P ₃ S ₂	14.31	12.70	13.51	31.01	27.52	29.26
P ₄ S ₁	11.97	10.75	11.35	25.92	23.25	24.59
P ₄ S ₂	13.70	11.90	12.80	29.69	25.78	27.74
P ₅ S ₁	11.25	9.73	10.49	24.37	21.08	22.73
P ₅ S ₂	13.72	11.23	12.47	29.72	24.34	27.03
P x S						
S.Em.(±)	0.452	0.503	0.323	0.977	1.092	0.698
CD (P=0.05)	NS	1.584	NS	3.077	3.439	2.173

NS = Not significant

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