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Growth and yield parameters of cardamom (*Elettaria cardamomum* Maton) as influenced by nutrition and planting density

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Abstract

Investigations carried out on cardamom (*Elettaria cardamomum*) at Appangala (Karnataka, India) to assess the effect of NPK nutrient combinations and planting densities on growth and yield parameters indicated that, increasing nutrient levels as well as planting density resulted in increased plant height at early stages of plant growth. Increased fertilizer levels increased number of leaves and panicles, but increased planting density had adverse effect on these characters. A fertilizer combination of 150:75:300 kg NPK/ha and 5000 plants/ha planted at 2 m x 1 m spacing was comparatively optimum for satisfactory growth of cardamom.

Key words : cardamom, *Elettaria cardamomum,* nutrition, plant density.

Application of little or no fertilizer is one of the main reasons for the low productivity of cardamom (*Elettaria cardamomum* Maton) in India. Leaching and run-off of nutrients are also common due to heavy rainfall and undulating to-pography of cardamom areas. Moreover, continuous cultivation on the same land leads to depletion of nutrients resulting in poor growth and yield, thus necessitating the application of balanced dose of nutrients (Korikanthimath 1994). In any crop, maximum yield is obtained at densities where competition between plants is less. However, the reduction in growth and yield in a crop community is compensated by the overall production from a large number of plants growing in an unit area (Donald 1962). Therefore, the adoption of an optimum plant density per unit area is vital to increase productivity and reduce cost of production. The present investigation was conducted to assess the influence of nutrient levels and plant density on growth and yield parameters of cardamom.

The field experiment was carried out at the Indian Institute of Spices Research,

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Cardamom Research Centre, Appangala (Karnataka, India) where the soil is clayey, kaolinitic, having a pH of 5.3 and organic carbon content of 3.86% in the top 0-17 cm layer. The total phosphorus content of soil is low and medium in potassium. The experiment was carried out in a split plot design with three levels of fertilizers (50:25:100, 100:50:200 and 150:75:300 kg NPK/ha) as main plots and five levels of planting density (2.0 m x 2.0 m = 2500 plants/ha, 2.0 m x 1.5 m = 3333 plants/ha, 2.0 m x 1.0 m = 5000 plants/ha, 2.0 m x 0.75 m = 6666 plants/ha and 2.0 m x 0.5 m = 10,000 plants/ha) as sub plots. The treatment combinations were replicated twice in a gross plot size of 12 m x 8 m (96.59 m^2). Well grown cardamom seedlings of PV type (Malabar prostrate type) having a minimum of three tillers in each unit were planted on 28 September 1993 on a sloping land (5-8 per cent slope in North-South direction). Fertilizer application as per treatments (through urea, single super phosphate and muriate of potash) and other cultural operations were also carried out. The growth characters studied were plant height and number of green leaves and panicles per plant at 22 and 45 months after planting. The crop was irrigated once in 10 days during summer months from February onwards.

Various fertilizer levels resulted in significant differences in plant height during early stages of plant growth (22 months after planting); the differences were not statiscally significant as the plants grew (45 months after planting) (Table 1). Cardamom, being perennial and rhizomatous in nature, nutrient supply helped in early vigorous growth and accumulation of stored food in rhizomes. Once the nutrient needs are met, the plants tend to grow taller to capture more of sunlight and increased length of pseudostem helps in better distribution of leaves in the canopy for efficient harnessing of sunlight. The number of green leaves and panicles showed significant increase at 45 month after planting with increased fertilizer levels. The present study corroborated the earlier studies of Kumar & Hegde (1983) and Venkatesh *et al* (1992).

There were significant interactions between fertilizer levels and planting density on number of panicles (Table 2). Fresh capsule yield per plant increased significantly with increased fertilizer level up to the second level, whereas dry capsule yield per hectare increased significantly up to the highest level tried. The yield realised at the highest level (540.6 kg/ha) was 49.9 per cent higher than the yield at lowest level of treatment. With every increase in plant density, fresh capsule yield per plant decreased significantly whereas dry capsule yield per hectare increased significantly up to third level of plant density only (5000/ha). The interaction effect was not significant.

Lower plant densities receiving higher levels of nutrients had higher number of panicles. Here the plants received adequate nutrients and the competition for other inputs like solar energy, water, etc. were also less, thus resulting in higher number of panicles. Increased planting density resulted in taller plants, but with fewer leaves and fewer number of panicles as well as weaker panicles with fewer capsules at various stages of growth. When the planting density is increased, root density increased, leading to mutual interference in the absorption of one or more growth factors (Donald 1962). The resulting over crowding also led to competition for light and

Table 1. Influence of fertilizer levels and plant density on growth and yield parameters of cardamom

Treatment	Plant height (cm) 22 MAP	Plant height (cm) 45 MAP	No. of green leaves 45 MAP	No. of panicles/ plant 45 MAP	Fresh capsule yield/ plant (g)	Pooled average yield(dry) (1985-87) (kg/ha)
Fertilizer level (kg NPK/ha)						
50:25:100	171.200	289.400	147.3	22.66	317.20	360.80
100:50:200	195.900	324.800	161.2	27.79	426.00	485.40
150:75:300	216.500	302.000	199.4	33.38	460.80	540.60
Spacing (m)						
2.0x2.0	157.667	257.667	256.8	41.08	594.60	371.60
2.0x1.5	181.833	291.333	196.6	33.78	492.50	410.30
2.0x1.0	204.833	302.167	150.5	26.53	391.20	468.20
2.00x0.75	212.167	331.667	144.5	22.85	311.90	519.60
2.0x0.5	216.167	344.167	98.0	15.46	216.60	541.60
For comparing means of: Fertilizer levels (FL)						
SE m±	6.60	14.39	5.61	0.75	19.46	4.61
CD (P=0.05)	28.41	NS	24.16	3.23	83.80	19.60
Plant population (PP)						
SE m±	4.52	14.48	20.04	1.36	27.74	26.80
CD (P=0.05)	9.87	31.56	43.67	2.96	60.50	58.50
PP at same FL						
SE m±	7.84	25.08	34.71	2.35	48.06	46.43
CD (P=0.05)	NS	NS	NS	5.13	NS	NS
FL at same or different PP						
SE m±	8.31	29.86	31.29	1.58	54.62	17.33
CD (P=0.05)	NS	NS	NS	1.23	NS	NS

MAP = Months after planting; NS = Not significant

the plants tend to increase in height to tap solar energy. The close proximity of neighbours causes sub-optimum absorption of growth factors and there is inequitable distribution of resources among the plants. Over crowding also resulted in shading of lower leaves which in turn reduced the photosynthetic efficiency, resulting in less number of panicles.

For optimum growth of cardamom, an

Table 2. Influence of plant density and fertilizer levels on production of panicles in cardamom

Spacing (m)	Fertlizer level (kg NPK/ha)			Spacing mean
	50:25:100	100:50:200	150:75:30	
2.0x2.0	30.65	43.50	49.10	41.08
2.0x1.5	26.65	33.20	41.50	33.78
2.0x1.0	23.35	26.15	30.10	26.53
2.00x0.75	19.65	21.40	27.50	22.85
2.0x0.5	13.00	14.70	18.70	15.47
Fertilizer mean	22.66	27.79	33.38	

For comparing means of :

Fertilizer level (FL)	SE m±	0.75
	CD (P=0.05)	3.23
Plant population (PP)	SE m±	1.36
	CD (P=0.05)	2.96
PP at same FL	SE m±	2.35
	CD (P=0.05)	5.13
FL at same or different PP	SE m±	1.58
	CD (P=0.05)	10.23

Values indicate no. of panicles produced per plant 45 months after planting

optimum planting density at which the drop in the individual plant performance is compensated by the additional number of plants needs to be arrived at. Thus, 5000 plants/ha planted at 2 mx1 m spacing could be considered as optimum, beyond which adverse interference sets in resulting in reduced growth and yield.

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