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Effect of Nitrogen Levels on Growth Performance of Cardamom (*Elettaria cardamomum* M.) CV. Mudigere-1

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was carried out during the year 2023-24 at the Nursery No. 4, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India. The seven treatments replicated thrice comprising of various nitrogen levels (75, 100, 125, 150, 175

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and 200 kg/ha/year) with constant level of phosphorus (75 kg/ha/year) and potassium (200 kg/ha/year) and RDF of Kerala Agriculture University as control were tested under Randomized Block Design. The result obtained from the present experiment revealed that different nitrogen levels along with the constant phosphorus and potassium levels significantly affected the growth attributes of cardamom plants. At the end of the experiment (360 days after fertilizer application), the growth attributes *viz*., plant height (222.92 cm), plant spread (NS- 231.43 cm and EW- 215.44 cm), number of tillers (36.33) and number of leaves per tiller (16.00) were obtained maximum in treatment T_5 (N: P_2O_5:K_2O @ 150:75:200 kg/ha/year).

Keywords: Cardamom; fertilizer; nitrogen; growth.

1. INTRODUCTION

Cardamom is the dried capsule obtained from herbaceous perennial plant *Elettaria cardamomum* M. called as lesser cardamom or Chhota elaichi. The spices which entered the spice market of the West, cardamom is the one of them. Cardamom is popularly known as 'Queen of spices'. Cardamom principally is a sciophyte, means it requires lot of shade tree leaf litter that shed is helpful in enriching the soil atmosphere, still fertilizer application plays an important role. Inadequate application of manures or fertilizers is one of the reasons behind low yield in cardamom. Since cardamom is a surface feeder deep placement of fertilizer is not advisable.

In cardamom plants, nitrogen is involved in the protein synthesis mechanism. It is also important for production of new tillers, vegetative growth of young tillers. Nitrogen is responsible for the luxuriant green colour development of the capsule. General paling, chlorosis of new leaf, young tillers, poor green colour of capsules are the symptoms of nitrogen deficiency results into necrosis starting at the tips of older leaves. 'N' availability can be influenced by the soil pH [1]. To enhance the nutrient use efficiency of acidic cardamom soils ammonical forms of nitrogen sources are the best. Inadequate supply of nutrients, leaching losses of nutrients resulted in low yields of cardamom. Hence fertilizer application is become a standard practice for cardamom cultivation. As we know climatic conditions of Konkan region are suitable for cardamom cultivation. But there is no standard recommended dose of fertilizer for cardamom plants in this region. Fertilizers play crucial role in crop production by supplying essential elements responsible for various metabolic processes. So, keeping this view present investigation was undertaken.

2. MATERIALS AND METHODS

An experiment was conducted at Plot No. 14, Nursery No. 4, College of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India during the year 2023-24. The experiment was comprised of seven treatments replicated thrice and laid out in Randomized Block Design (RBD). The cardamom plantation was 2-year-old hence the 50 % of dose was applied in 2nd year of planting. Inorganic fertilizers were applied in the form of Urea, Single Super Phosphate and Muriate of Potash. Fertilizers were applied in two split doses by ring method. For assessing the growth performance of cardamom and effect of nitrogen on the growth performance of cardamom; all plants were selected for recording growth attributing characters. The observations were recorded throughout the growth period of plants up to 360 days at 60 days interval. The data were statistically analysed by method suggested by Panse and Sukhatme [2].

List 1. The treatment details

Treatments		Fertilizer Dose
T_1	:	N: P_2O_5: K_2O @ 75:75:150 kg/ha/year (KAU RDF)-Control
T_2	:	N: P_2O_5: K_2O @ 75:75:200 kg/ha/year
T_3	:	N: P_2O_5: K_2O @ 100:75:200 kg/ha/year
T_4	:	N: P_2O_5: K_2O @ 125:75:200 kg/ha/year
T_5	:	N: P_2O_5: K_2O @ 150:75:200 kg/ha/year
T_6	:	N: P_2O_5: K_2O @ 175:75:200 kg/ha/year
T_7	:	N: P_2O_5: K_2O @ 200:75:200 kg/ha/year

3. RESULTS AND DISCUSSION

3.1 Plant Height

According to the results of present investigation, the height of plant was significantly influenced by different nitrogen levels. In present study application of nitrogen up to 150 kg/ha with constant P_2O_5 and K_2O recorded the maximum plant height over other treatments. The highest plant height (222.92 cm) was recorded in treatment T_5 (N: P_2O_5:K_2O @ 150:75:200 kg/ha/year) and it was significantly superior over rest of the treatments including control. The minimum plant height (155.45 cm) was found in control treatment T_1 (N: P_2O_5:K_2O @ 75:75:150 kg/ha/year). This might be due to increased availability of nitrogen up to optimum level to the plants. Plants tend to grow taller to capture more of sunlight. Similar results were obtained by Korikanthimath et al. [3], Chidambara [4] in cardamom and Leua et al. [5] in turmeric. Also, the results are accordance with Awan et al. [6] in rice and Nguyen et al. [7] in red turmeric. Further, it was noticed that the higher level of nitrogen (175 and 200 kg N/ha) did not produce maximum height over 150 kg N/ha. This showed that increased dose of nitrogen beyond certain level does not respond well to plant growth because plant absorb the N up to optimum level required for their growth and development.

3.2 Plant Spread (NS) and (EW)

In present study, significantly the maximum NS and EW plant spread was recorded with application of nitrogen up to 150 kg/ha with constant P_2O_5 and K_2O. Nautiyal [8] recorded the maximum plant spread with 150 kg N/ha in turmeric. Similar findings were reported by Shahi et al. [9] in brinjal with 150 kg N/ha, Rajan et al. [1] in chrysanthemum and Mahantesh et al. [9] in Japanese mint and Mandhare et al. [10] in calendula.

3.3 Number of Tillers per Plant

The maximum number of tillers per plant (36.33) was recorded in T_5 (N: P_2O_5:K_2O @ 150:75:200 kg/ha/year) which was significantly superior over rest of treatments including control. The minimum number of tillers (13.83) obtained in control treatment. This might be due to nitrogen supply increases the number of meristematic cells and their growth leads to formation of tillers. In case of spice crops, more the number of tillers, more will be the reproductive growth. Similar results were observed by Shinde et al. [11] in turmeric, Chidambara [4] in cardamom, Seyie et al. [12] in ginger, Mekonen and Garedew [13] and Tiwari et al. [14] in turmeric.

Table 1. Effect of nitrogen levels on height (cm) of cardamom

Treatments	Height of plant (cm)					
	Days after fertilizer application					
	60	120	180	240	300	360
T_1: N: P_2O_5:K_2O @ 75:75:150 kg/ha/year (Control)	85.07	103.49	120.55	138.03	149.02	155.45
T_2: N: P_2O_5:K_2O @ 75:75:200 kg/ha/year	98.80	117.71	128.81	145.41	161.11	171.00
T_3: N: P_2O_5:K_2O @ 100:75:200 kg/ha/year	133.63	144.42	156.74	170.81	183.80	193.67
T_4: N: P_2O_5:K_2O @ 125:75:200 kg/ha/year	143.23	164.65	180.42	194.82	206.50	213.60
T_5: N: P_2O_5:K_2O @ 150:75:200 kg/ha/year	150.77	166.96	182.27	195.62	211.67	222.92
T_6: N: P_2O_5:K_2O @ 175:75:200 kg/ha/year	135.75	148.62	168.82	181.01	193.97	204.00
T_7: N: P_2O_5:K_2O @ 200:75:200 kg/ha/year	109.10	127.12	138.84	156.86	170.68	179.45
Mean	**122.34**	**139.00**	**153.78**	**168.94**	**182.39**	**191.44**
S. Em (±)	**1.46**	**1.42**	**0.82**	**0.91**	**0.90**	**0.93**
CD @5%	**4.50**	**4.39**	**2.55**	**2.80**	**2.77**	**2.86**
'F' test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**

Table 2. Effect of nitrogen levels on North-South plant spread (cm) of cardamom

Treatments	Plant spread North-south (cm)					
	Days after fertilizer application					
	60	120	180	240	300	360
T_1: N: P_2O_5:K_2O @ 75:75:150 kg/ha/year (Control)	45.67	65.63	85.90	94.82	105.31	110.77
T_2: N: P_2O_5:K_2O @ 75:75:200 kg/ha/year	55.62	75.73	89.75	101.96	115.05	123.97
T_3: N: P_2O_5:K_2O @ 100:75:200 kg/ha/year	82.63	99.44	118.55	134.46	144.47	153.60
T_4: N: P_2O_5:K_2O @ 125:75:200 kg/ha/year	85.92	127.70	145.00	168.17	175.18	193.90
T_5: N: P_2O_5:K_2O @ 150:75:200 kg/ha/year	151.63	163.09	191.69	207.87	223.67	231.43
T_6: N: P_2O_5:K_2O @ 175:75:200 kg/ha/year	93.60	110.13	138.30	150.32	165.02	173.15
T_7: N: P_2O_5:K_2O @ 200:75:200 kg/ha/year	66.33	83.67	109.50	122.39	129.58	136.69
Mean	**83.06**	**103.63**	**125.53**	**140.00**	**151.18**	**160.50**
S. Em (±)	**0.78**	**1.15**	**0.85**	**0.93**	**0.90**	**0.73**
CD @5%	**2.41**	**3.53**	**2.62**	**2.85**	**2.79**	**2.24**
'F' test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**

Table 3. Effect of nitrogen levels on East-West plant spread (cm) of cardamom

Treatments	Plant spread East-West (cm)					
	Days after fertilizer application					
	60	120	180	240	300	360
T_1: N: P_2O_5:K_2O @ 75:75:150 kg/ha/year (Control)	40.00	56.60	67.64	78.24	88.66	98.00
T_2: N: P_2O_5:K_2O @ 75:75:200 kg/ha/year	58.00	66.98	76.56	93.55	109.33	119.34
T_3: N: P_2O_5:K_2O @ 100:75:200 kg/ha/year	87.75	95.25	104.75	120.30	133.73	143.35
T_4: N: P_2O_5:K_2O @ 125:75:200 kg/ha/year	104.50	134.29	152.35	167.17	182.02	195.26
T_5: N: P_2O_5:K_2O @ 150:75:200 kg/ha/year	123.84	144.78	164.07	186.63	202.50	215.44
T_6: N: P_2O_5:K_2O @ 175:75:200 kg/ha/year	73.29	100.05	116.68	130.68	142.98	154.59
T_7: N: P_2O_5:K_2O @ 200:75:200 kg/ha/year	66.83	82.51	93.57	107.52	116.85	124.94
Mean	**79.17**	**97.21**	**110.80**	**126.30**	**139.44**	**150.13**
S. Em (±)	**0.94**	**0.94**	**0.80**	**0.89**	**0.75**	**1.21**
CD @5%	**2.89**	**2.91**	**2.45**	**2.75**	**2.31**	**3.72**
'F' test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**

3.4 Number of Leaves Per Tiller

In present experiment, the maximum number of leaves per tiller (16.00) were obtained with application of nitrogen up to 150 kg/ha with constant P_2O_5 and K_2O in treatment T_5 (N: P_2O_5:K_2O @ 150:75:200 kg/ha/year) which was followed by T_4 - N: P_2O_5:K_2O @ 125:75:200 kg/ha/year (14.50). Nitrogen directly or indirectly responsible for enlargement and division of new cells and production of new tissues which in turn resulted in increase in growth in terms of number of leaves per tiller. The increased number of leaves would synthesize more carbohydrates

Table 4. Effect of nitrogen levels on number of tillers per plant of cardamom

Treatments	Number of tillers per plant					
	Days after fertilizer application					
	60	**120**	**180**	**240**	**300**	**360**
T_1: N: P_2O_5:K_2O @ 75:75:150 kg/ha/year (Control)	9.17	10.00	11.33	12.33	13.50	13.83
T_2: N: P_2O_5:K_2O @ 75:75:200 kg/ha/year	10.50	12.00	14.50	16.33	17.17	17.83
T_3: N: P_2O_5:K_2O @ 100:75:200 kg/ha/year	10.50	12.50	15.50	17.83	19.17	20.67
T_4: N: P_2O_5:K_2O @ 125:75:200 kg/ha/year	20.00	23.17	26.00	28.50	32.00	31.17
T_5: N: P_2O_5:K_2O @ 150:75:200 kg/ha/year	22.67	25.83	29.33	32.33	34.83	36.33
T_6: N: P_2O_5:K_2O @ 175:75:200 kg/ha/year	14.67	17.00	20.00	19.50	24.17	25.83
T_7: N: P_2O_5:K_2O @ 200:75:200 kg/ha/year	14.67	16.17	17.17	17.67	18.50	19.17
Mean	**14.60**	**16.67**	**19.12**	**20.64**	**22.48**	**23.55**
S. Em (±)	**0.68**	**0.77**	**0.48**	**0.60**	**0.63**	**0.73**
CD @5%	**2.10**	**2.37**	**1.48**	**1.86**	**1.95**	**2.24**
'F' test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**

Table 5. Effect of nitrogen levels on number of leaves per tiller of cardamom

Treatments	Number of leaves per tiller					
	Days after fertilizer application					
	60	**120**	**180**	**240**	**300**	**360**
T_1: N: P_2O_5:K_2O @ 75:75:150 kg/ha/year (Control)	7.00	8.83	10.50	11.17	12.00	13.00
T_2: N: P_2O_5:K_2O @ 75:75:200 kg/ha/year	7.17	9.17	10.17	11.33	12.17	13.17
T_3: N: P_2O_5:K_2O @ 100:75:200 kg/ha/year	8.17	10.17	11.33	12.17	13.17	14.17
T_4: N: P_2O_5:K_2O @ 125:75:200 kg/ha/year	9.83	10.83	11.83	12.67	13.50	14.50
T_5: N: P_2O_5:K_2O @ 150:75:200 kg/ha/year	10.83	12.17	13.50	14.33	15.17	16.00
T_6: N: P_2O_5:K_2O @ 175:75:200 kg/ha/year	8.33	10.00	11.17	12.17	13.33	14.33
T_7: N: P_2O_5:K_2O @ 200:75:200 kg/ha/year	7.00	9.17	10.67	11.33	12.33	13.33
Mean	**8.33**	**10.05**	**11.31**	**12.17**	**13.10**	**14.07**
S. Em (±)	**0.24**	**0.44**	**0.51**	**0.61**	**0.62**	**0.55**
CD @5%	**0.73**	**1.36**	**1.58**	**1.89**	**1.90**	**1.68**
'F' test	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**	**Sig.**

and act as a substrate for the growth and development of rhizomes. Results are in accordance with Korikanthimath et al. [3] in cardamom, Leua et al. [5], Shinde et al. [11] in turmeric and Verma et al. [15] in turmeric [16,17].

4. CONCLUSION

According to the results of present investigation, application of N: P_2O_5:K_2O @ 150:75:200 kg/ha/year (T_5) recorded highest values for plant

height (222.92 cm), plant spread (NS- 231.43 cm and EW- 215.44 cm), number of tillers per plant (36.33) and number of leaves per tiller (16.00). Hence, it can be concluded that application of 150:75:200 kg/ha/year N: P_2O_5: K_2O is suggested for overall growth performance of cardamom. However, the experiment conducted first time in this region, it will be worthwhile to explore these possibilities again for 2-3 years to arrive at specific recommendation.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOYT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Rajan Kitty, Bhatt Dipal S, Chawla SL, Bhatt ST, Sangeetha Priya S. Effect of nitrogen and phosphorus on growth, flowering and yield of cut chrysanthemum cv. Thai Chen Queen. Current Agriculture Research J. 2019;7(3):337-342.
2. Mandhare, Kunda S, Dharmik YB, Nagdeve NS, Pote Monali D, Thakre SA, Bhomale, Dhanashri D. Effect of nitrogen and phosphorus on growth and flowering of calendula. J. Pharmacognosy and Phytochemistry. 2021;10(3):193-196.
3. Korikanthimath VS, Hegde R, Mulge R, Hosmani MM. Growth and yield parameters of cardamom (*Elettaria cardamomum* Maton) as influenced by nutrition and planting density. J. Spices and Aromatic Crops. 1998;7(1):39-42.
4. Chidambara KP. Effect of different levels of shade and nitrogen, phosphorus and potassium on growth of cardamom (*Elettaria cardamomum* Maton.) at primary nursery stage. M. Sc. (Hort.) Thesis submitted to the University of Agricultural Sciences, Bangalore; 1989.
5. Leua HN, Patel MM, Satodia BN, Parmar RS, Patel BJ. Effect of different levels of nitrogen and phosphorus on growth and yield of turmeric (*Curcuma longa* L.) cv. Kesar under north Gujarat condition. The Asian J. Horticulture. 2012;7(1):98-100.
6. Awan TH, Ali RI, Manzoor Z, Ahmad, M, Akhtar,M. Effect of different nitrogen levels and row spacing on the performance of newly evolved medium grain rice variety, KSK-133. The J. Animal and Plant Sciences. 2011;21(2):231-234.
7. Nguyen TTH, Tran BV, Phan TDQ, Dinh LD, Le STT, Nguyen TX, Le QT, Nguyen TV, Tran TV. Effects of nitrogen and potassium rates on growth and yield of red turmeric (*Curcuma longa* L.) on the gray soil in Ho Chi Minh City. The J. Agriculture and Development. 2022;21(6):1-9.
8. Nautiyal, Nikki. Effect of nitrogen levels and plant spacing on growth and yield of turmeric (*Curcuma longa* L.). M. Sc. (Hort.) Thesis submitted to the VCSG Uttarakhand University of Horticulture and Forestry, Bharsar-246 123 (Pauri Garhwal), Uttarakhand, India; 2015.
9. Mahantesh PS, Gangadharappa PM, Hiremath JS, Shivakumar KM, Ravi Y, Bhat DS. Influence of row spacing and nitrogen levels on growth rate and nitrogen uptake in japanese mint (*Mentha arvensis* L.). International J. Current Microbiology Applied Science. 2018;7(6):1297-1302.
10. Shahi R, Yadav A, Shekhar C, Kumar S. Effect of different doses of nitrogen on growth and yield of brinjal (*Solanum melongena* L.) cv. Pusa purple long Kanpur, India. The Pharma Innovation J. 2021;10(9):1228-1230.
11. Shinde VV, Gavade RT, Dubale JJ, Chavan SS. Influence of fertilizer management to turmeric (*Curcuma longa* L.) cv. Salem under Konkan condition. International J. Current Research. 2016;8(2):26548-26550.
12. Seyie A, Naruka IS, Singh PP, Kushwah, SS. Nutrient management and its effect on growth, yield and quality of ginger cultivars. Indian J. Horticulture. 2013;70(1):65-70.
13. Mekonnen B, Garedew W. Growth, yield and quality responses of turmeric (*Curcuma longa* L.) to nitrogen fertilizer

rate and timing of its application. *Acta agrobotanica*. 2019;72(3):1-11.

14. Tiwari SK, Tiwari JK, Pathak MK. Growth, yield and quality of turmeric (*Curcuma longa* L.) as influenced by planting time and fertility levels. J. Spices and Aromatic Crops. 2014;23(1):64-70.
15. Verma PP, Padalia RC, Singh VR, Kumar A, Agri BK. Effect of nitrogen, phosphorus and potassium levels on growth and yield of turmeric (*Curcuma longa* L.) under the Katyur valley of Western Himalayan region of Uttarakhand. J. Medicinal Plant Studies. 2019;7(2):117-122.
16. Panse VG, Sukhatme PV. Statistical Methods for Agriculture Workers. ICAR, New Delhi; 1995.
17. Ranganathan V, Natesan S. Cardamom soils and manuring. Planters Chronicle. 1985;80(7):233-236.

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