

Research Article

Evaluation of selected promising land races of small cardamom (*Elettaria cardamomum* (L.) Maton) in South India

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Abstract

Small cardamom (*Elettaria cardamomum* (L.) Maton.), often referred to as the 'queen of spices' is believed to have originated in the moist evergreen forests of the Western Ghats of South India. The present study was conducted at the Indian Cardamom Research Institute, Myladumpara, Idukki Dt. of Kerala. Different farmer's varieties, nine landraces viz., *Njallani Green Gold*, *Thiruthali*, *Panikulangara Green Bold No.1*, *Wonder Cardamom*, *Elarajan*, *Arjun*, *Pappalu*, *PNS Vaigai*, *Pachaikkai* and ICRI-5 as control were evaluated in the cardamom tract of Idukki District. The selected genotypes were evaluated in the field for three consecutive years. The data on growth and yield were recorded, pooled and analyzed. From the analysis, it was found that the genotype *Njallani Green Gold* performed well compared to other varieties with respect to the yield (1271.80 kg/ha) followed by *Panikulangara Green Bold No.1* (1134.67 kg/ha) and more tillers (74.46) were found in the same clone also. The plant height was significantly higher in *Elarajan* (316.24 cm), followed by *Panikulangara Green Bold No.1* (312.45 cm). The number of leaves was greater in *Elarajan* (16.72), followed by *Panikulangara Green Bold No.1* (16.43). More vegetative buds were observed in *Pappalu* followed by *Wonder Cardamom*. Panicles per clump were more in *Thiruthali* (47.98), followed by *Njallani Green Gold* (46.59). Racemes per panicle were greater in *Pachaikkai* (26.57), followed by *Njallani Green Gold* (26.19). The number of capsules per racemes was more in *Njallani Green Gold* (9.59) followed by *Panikulangara Green Bold No.1* (8.59). The results pointed out that each clone in the trial differs from another with respect to the characters studied. The findings could be used for further breeding studies in small cardamom.

Keywords: Cardamom, Evaluation, Farmers' varieties, Landraces

INTRODUCTION

Elettaria cardamomum (L.) Maton. is one of the world's most ancient spices, and belongs to the family Zingiberaceae. Indian ayurvedic texts published approximately in 3000 BC mentioned the name *Ela*, which is the Sanskrit name of small cardamom commonly known as the 'Queen of Spices' (Ravindran and Madhusoodanan,

2002). It is a pseophytic monocot with a rhizomatous, herbaceous and perennial plant. This monotypic plant is native to the evergreen forests of Western Ghats of South India (Ravindran, 1999). This region lies within 8' and 30' N latitudes and 75' and 78'30' E longitudes (Anisha et al., 2020), at an elevation of 800-1300 m (Akhila et al., 2017). The small cardamom is cultivated under the canopy of evergreen forests, where it exhib-

its extensive variability (Nirmal Babu *et al.*, 2012, Murugan *et al.*, 2007). The wealth of genetic variability in small cardamom is due to the cross pollinating nature (Nadukeri *et al.*, 2020), so it is understood that the Western Ghats must be the key core of its genetic diversity. It is also grown in countries like Guatemala, Sri Lanka, Papua New Guinea, Laos, El Salvador, Cambodia, Vietnam and Tanzania (Murugan *et al.*, 2022; Aruna *et al.*, 2021).

. Several varieties of small cardamom are released by various Research Institutes and Universities. Besides, several superior clones are developed by farmers, known as *landraces*. Even though many research institutes working on small cardamom have developed many location-specific and improved varieties, the traditional farmers in the cardamom tract are popularizing the use of selected landraces for cultivation. Hence the importance of landraces is not questionable. During the past years, farmers developed more than twenty-five landraces, but only a few are registered (PPV & FRA, 2023). The present study aimed to evaluate the performance of nine small cardamom landraces, including the ruling variety *Njallani Green Gold*, with ICRI-5, the first man-made hybrid released by Indian Cardamom Research Institute as a local check, with respect to their growth and yield parameters.

MATERIALS AND METHODS

The present study was conducted at the Indian Cardamom Research Institute (ICRI) of Spices Board, Myladumpara, Idukki District of Kerala, during the period 2018-19 to 2020-21, to assess the performance of nine elite landraces of small cardamom, which were awarded by National Innovation Foundation (NIF), Govt. of India. Seven landraces viz., *Njallani Green Gold*, *Thiruthali*, *Panikulangara Green Bold No.1*, *Wonder Cardamom*, *Elarajan*, *Arjun* and *Pappalu* were selected from Idukki District and two varieties viz., *PNS Vaigai*, *Pachaikkai* from Theni District of Tamil Nadu and ICRI-5, was used as control.

The experimental farm of (ICRI) is situated in the Idukki District of Kerala in the Cardamom Hill Reserve (CHR) with a longitude of 9°8'E and latitude of 77°2'N at an altitude 1050 msl. The location enjoys a humid tropical climate with a well-distributed rainfall of 2790 mm per annum and the soil is forest loam with a pH of 5-6.5 (Vijayan *et al.*, 2018).

The experiment was laid out in Randomized Block Design (RBD) with 3 replications and 12 plants per plot adopting 3 m x 3 m spacing. Cultural practices were followed as per the package of practices recommended by Spices Board. As per the cultivation practices for small cardamom, the ground was cleared for field planting and shade regulation, terracing, and preparation of pits were completed during the summer months (March

-May). Pits of 90 x 90 x 45 cm were prepared before monsoon and about 1/3 of the pit was filled with top soil and 1/3 filled with 1:3 mixture of top soil. Planting was done during the monsoon season in the opened pits and the plants were protected from wind staking. The plant base was mulched well with dry leaves to conserve soil moisture and prevent soil erosion.

Weeding and thrashing were done at regular intervals, and the plants were irrigated during summer. Forking was done during the North East monsoon to enhance root proliferation and the base of the plants was mulched, which is essential for reducing evaporation loss, suppressing weed growth and maintaining optimum soil temperature. Trashing and pruning were done to remove old tillers, dead rhizomes, dry leaves and leaf sheaths. Earthing-up of the plant base with top soil was carried out when the top soil covering of the plant base was washed away. Application of lime or dolomite was done to maintain the pH of the soil <5.5. Application of organic manures, NPK fertilizers, micronutrients was carried out as soil application or foliar application at regular intervals. Management of pests and diseases was done by both biological control and spraying of pesticides or insecticides. The capsules were harvested when they attained physiological maturity. After harvesting, the capsules were subjected to post-harvest operations such as washing, curing, cleaning, grading, packing and storage.

Data on morphological and yield parameters were recorded, pooled and analyzed for three consecutive years (2018-19 to 2020-21). Observations on parameters like total tillers, tiller height, number of leaves, length and width of leaves, number of vegetative buds, number of panicles, number of racemes per panicle, number of capsules per raceme and yield (kg/ha) (Hrideek *et al.*, 2011) were recorded and analyzed statistically by Microsoft excel spreadsheet.

RESULTS AND DISCUSSION

To assess the nine promising small cardamom landraces, the data recorded was subjected to statistical analysis and the results are presented in Tables 1- 4. The pooled analysis of three years of data (2018-19 to 2020-21) revealed that, among the 10 growth and yield parameters studied, 6 characters showed statistically significant (@ 5% level) variation between the landraces and control.

During the first and third years, *Njallani Green Gold* showed more yield than other varieties; in the second year, it was in the second position. The yield of *Njallani Green Gold* (1271.80 kg/ha) in pooled analysis was significantly higher than that of other varieties. Backiyarani *et al.* (2002) reported a highly significant and positive correlation between yield and the number of panicles, plant height and the number of tillers of small car-

Table 1. Performance of selected landraces of small cardamom during 2018-19

Genotypes	No. of Tillers / clump	Tiller height (cm)	No. of leaves of the tallest tiller	Leaf length (cm)	Leaf width (cm)	No. of veg. buds	No. of panicles	No. of cemes / panicles	No. of cap-sules / ra-ceme	Yield (Kg/ ha)
Wonder Cardamom	53.00	257.17	13.23	54.50	8.80	5.32	24.39	22.77	7.89	613.45
Pachaikkai	56.26	263.24	13.56	55.37	9.43	4.67	23.79	23.42	8.62	673.23
Thiruthali	48.54	249.27	13.67	53.17	8.70	5.53	28.55	24.72	9.06	895.81
Arjun	61.30	265.67	14.38	56.47	10.00	4.87	28.68	22.78	8.42	770.14
Panikulangara I	64.42	301.24	15.42	53.63	9.43	3.56	25.66	18.38	8.34	678.03
Elarajan	62.00	298.64	14.00	52.67	9.17	5.26	24.78	23.89	7.89	653.91
Pappalu	54.32	257.45	13.23	57.97	10.27	6.23	25.72	23.94	7.05	607.73
PNS Vaigai	57.00	249.32	13.00	51.90	9.43	4.68	22.84	24.21	8.44	653.37
Njallani Green Gold	59.65	273.23	13.82	53.50	10.17	4.00	24.94	23.61	9.42	776.55
ICRI 5 (Control)	58.00	268.34	12.54	51.80	9.63	5.00	26.78	24.95	7.00	654.79
CV	5.31	0.93	-	4.06	-	-	6.94	10.93	-	0.93
CD @ 5%	5.23	4.26	-	3.77	-	-	3.05	4.36	-	11.12

Table 2. Performance of selected land races of small cardamom during 2019-20

Genotypes	No. of Tillers / clump	Tiller height (cm)	No. of leaves of the tallest tiller	Leaf length (cm)	Leaf width (cm)	No. of veg. buds	No. of panicles	No. of cemes / panicles	No. of cap-sules / ra-ceme	Yield (Kg/ ha)
Wonder Cardamom	62.67	266.63	13.33	60.57	9.40	5.67	40.00	30.67	7.67	1317.34
Pachaikkai	62.00	273.60	13.67	57.30	9.10	4.67	36.00	27.33	7.67	1056.49
Thiruthali	55.33	258.30	14.33	56.03	9.63	5.33	35.00	26.67	8.67	1133.02
Arjun	68.00	275.77	14.00	57.67	10.47	4.33	33.33	25.00	8.33	971.74
Panikulangara I	70.00	309.43	14.67	58.80	9.47	3.33	37.00	22.67	9.00	1056.88
Elarajan	67.00	307.07	14.67	57.13	11.10	5.33	35.00	26.33	8.33	1074.71
Pappalu	57.67	269.53	12.67	59.53	9.90	5.67	27.00	26.67	7.67	773.23
PNS Vaigai	63.00	262.73	13.33	55.50	9.57	4.33	29.00	29.33	7.67	913.34
Njallani Green Gold	65.00	288.90	13.33	60.93	9.60	3.67	31.00	31.33	9.67	1314.85
ICRI 5 (Control)	64.33	280.33	12.67	57.43	11.10	5.00	32.33	29.33	8.00	1062.03
CV	35.68	-	-	3.44	6.18	-	6.36	5.40	-	13.25
CD @ 5%	39.68	-	-	3.43	1.05	-	3.74	2.61	-	242.57

Table 3. Performance of selected landraces of small cardamom during 2020 - 21

Genotypes	No. of Tillers / clump	Tiller height (cm)	No. of leaves of the tallest tiller	Leaf length (cm)	Leaf width (cm)	No. of veg. buds	No. of panicles	No. of racemes / panicles	No. of capsules / raceme	Yield (Kg/ha)
Wonder Cardamom	71.83	362.06	21.44	59.23	11.17	6.33	69.39	19.77	7.33	1407.78
Pachaikkai	65.67	319.24	19.28	65.33	11.00	6.52	60.66	28.94	6.00	1474.62
Thiruthali	62.06	313.95	18.82	54.70	10.07	5.67	80.39	18.24	7.33	1504.73
Arjun	66.33	310.44	18.22	59.87	10.50	5.33	62.78	18.33	7.44	1198.63
Panikulangara I	88.94	326.67	19.22	61.27	11.40	4.52	70.63	20.00	8.44	1669.11
Elarajan	81.56	343.00	21.49	58.27	11.10	5.00	69.33	21.72	6.34	1336.59
Pappalu	84.39	346.05	20.94	62.23	10.30	6.33	69.66	20.33	7.34	1455.28
PNS Vaigai	66.06	347.89	20.45	57.13	9.27	5.67	66.44	20.34	7.33	1386.80
Njallani Green Gold	70.28	341.05	21.00	63.33	10.80	6.33	83.84	23.62	9.67	1724.00
ICRI 5 (Control)	70.06	309.06	19.28	59.60	10.35	5.67	70.78	18.95	7.89	1481.60
CV	5.81	2.09	-	1.65	-	-	4.66	9.49	-	1.94
CD @ 5%	7.25	11.91	-	1.70	-	-	5.63	3.42	-	48.77

Table 4. Three Years Pooled Data (2018-2021) of small cardamom land races

Genotypes	No. of Tillers / clump	Tiller height (cm)	No. of leaves of the tallest tiller	Leaf length (cm)	Leaf width (cm)	No. of veg. buds	No. of panicles	No. of racemes / panicles	No. of capsules / raceme	Yield (Kg/ha)
Wonder Cardamom	62.50	295.29	16.00	58.10	9.79	5.77	44.59	24.40	7.63	1112.86
Pachaikkai	61.31	285.36	15.50	59.33	9.84	5.29	40.15	26.57	7.43	1068.12
Thiruthali	55.31	273.84	15.61	54.63	9.46	5.51	47.98	23.21	8.35	1177.85
Arjun	65.21	283.96	15.53	58.00	10.32	4.85	41.60	22.04	8.07	980.17
Panikulangara I	74.46	312.45	16.43	57.90	10.10	3.81	44.43	20.35	8.59	1134.67
Elarajan	70.19	316.24	16.72	56.02	10.45	5.20	43.04	24.20	7.52	1021.74
Pappalu	65.46	291.01	15.61	59.91	10.16	6.07	40.79	23.65	7.35	945.41
PNS Vaigai	62.02	286.65	15.60	54.84	9.42	4.89	39.42	24.63	7.81	984.50
Njallani Green Gold	64.98	301.06	16.05	59.26	10.19	4.67	46.59	26.19	9.59	1271.80
ICRI 5 (Control)	64.13	285.91	14.83	56.28	10.49	5.22	43.30	24.41	7.63	1066.14
CV	8.04	2.49	31.47	2.22	4.59	15.55	3.71	5.51	15.51	4.32
CD @ 5%	8.90	12.55	8.52	2.19	0.79	1.37	2.75	2.26	2.13	79.67



Fig. 1. Comparison of leaves of small cardamom landraces and control (A. Wonder Cardamom, B. Pachaikkai, C. Thiruthaly, D. Arjun, E. Panikulangara Green Bold No. 1, F. Elarajan, G. Pappalu, H. PNS Vaigai, I. Njallani Green Gold & J. ICRI 5 as Control)



Fig. 2. Comparison of dry capsules of small cardamom landraces and control (A. Wonder Cardamom, B. Pachaikkai, C. Thiruthaly, D. Arjun, E. Panikulangara Green Bold No. 1, F. Elarajan, G. Pappalu, H. PNS Vaigai, I. Njallani Green Gold & J. ICRI 5 as Control)

damom plants in cardamom growing tracts of Western Ghats.

Kuriakose *et al.* (2008) reported that the domestication cardamom in cardamom hills of Kerala had increased the number of tillers and the number of panicles per clump, which resulted in a significant increase in the total number of flowers per clump. These features have resulted in a considerable increase in capsule formation in the genotypes. Analysis of pooled data showed that the number of tillers per clump was significantly greater in *Panikulangara Green Bold No.1* (74.46), followed by *Elarajan* (70.19). The height of the tallest tiller was significantly more in *Panikulangara Green Bold No. 1* (316.24 cm) followed by *Elarajan* (312.45 cm). The number of leaves in the tallest tiller was more in *Elarajan* (16.72), followed by *Panikulangara Green Bold No.1* (16.43). The length of the third leaf

(Fig. 1) was more in *Pappalu* (59.91 cm) followed by *Pachaikkai* (59.33 cm) and the width of the leaf was found more in *Elarajan* (10.45 cm) followed by *Arjun* (10.32 cm). More vegetative buds were found in the clone *Pappalu* (6.07) followed by *Wonder Cardamom* (5.77). Variations in leaf length, leaf width and the number of vegetative buds per clump between the genotypes might be because of the genetic pattern of each genotype (Nadukeri *et al.*, 2020). If the leaf length and width are more, the photosynthetic efficiency will be increased and the more vegetative buds, the capsule yield will increase in the succeeding year.

The number of panicles per clump was significantly higher in *Thiruthali* (47.98), followed by *Njallani Green Gold* (46.59). Racemes per panicle were significantly more in *Pachaikkai* (26.57) followed by *Njallani Green Gold* (26.19). The number of capsules (Fig. 2) per ra-

cemes was more in *Njallani Green Gold* (9.59) followed by *Panikulangara Green Bold No.1* (8.59). The number of capsules per plant significantly positively correlated with panicles per plant and the total number of tillers (Korikanthimath *et al.*, 2000). Hrideek *et al.* (2008) reported that the number of tillers per plant, length of the leaf, number of panicles per plant, length of the panicle and number of capsules per panicle had a higher association with yield than other parameters. Data pooled over three years showed that *Njallani Green Gold* was superior in yield and yield contributing characters (Table 4). A highly significant and positive correlation was observed between the number of panicles and the yield of small cardamom in cardamom tracts of Western Ghats (Backiyarani *et al.*, 2002; Avadhani *et al.*, 1993; Patil *et al.*, 1998). Murugan *et al.* (2022) reported that the yield of small cardamom was affected by climatic and non-climatic factors. Soil fertility, insect pests and diseases, weed pressures etc., are the non-climatic factors. Several non-climatic factors act in concert with climatic factors, such as alternate hot and dry, humid and wet weather conditions that can favour root grubs and white flies and may affect the yield of small cardamom.

Conclusion

The present findings indicated significant variability in cardamom concerning various morphological characters, viz., plant height, number of tillers, length of leaf, number of panicles, number of capsules and yield. As the yield has a highly significant and positive correlation with the number of capsules per racemes, number of panicles, and number of tillers, these varieties can be selected and utilized for further breeding. In order to develop high-yielding varieties suitable for cardamom hill reserve, the clones with superior traits can be utilized for the improvement of cardamom. All the genotypes, which showed superiority in different traits and genotypes like *Njallani Green Gold* and *Panikulangara Green Bold No.1* about yield, can be used for crop improvement programmes so that the varieties with significantly superior characteristics could be developed.

Conflict of interest

The authors declare that they have no conflict of interest.

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