

Performance evaluation of some elite cardamom landraces from the Cardamom Hill Reserve of Kerala

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Abstract: Even though about twelve improved cardamom varieties have been released in India, many of the farmers of the traditional cardamom tracts of the country use farmer selected landraces as planting material and hence the importance of such landraces is not questionable. A study has been carried out to assess the performance of ten elite landraces of cardamom collected from Idukki district of Kerala state of India namely Panikulangara-1, Panikulangara-2, Njallani, Vali green gold, Palakkudi, PNS Vaigai, Vander cardamom, Ela Rani-1, Ela Rani-2 and Ela Rani-3 using ICRI-2, an improved variety released by Indian Cardamom Research Institute as control. Observations on seven growth characters, nine yield characters and four quality characters were made and compared. The present findings indicate the potential of selecting genotypes like Ela Rani- 2, Ela Rani- 3, Palakkudi and Vali green gold for further trials and evaluation protocols so that varieties with significantly superior characters could be developed.

Key words: *Elettaria cardamomum*, cardamom, landraces

INTRODUCTION

The small cardamom plant is botanically known as *Elettaria cardamomum* Maton and it belongs to the monocotyledonous family Zingiberaceae. It is believed to have originated in the moist evergreen forests of the Western Ghats of South India (Ravindran, 2002; 2005). The name of the genus is derived from the Tamil root *elettari*, meaning cardamom seed (Mabberley, 1987). Cardamom breeding in India has resulted in the release of 12 varieties suited for different agro climatic regions (Thomas *et al.*, 2006). Korikanthimath *et al.* (1997) conducted a comparative study of yield and yield components in cardamom and selected three superior clones for their higher number of panicles and capsules per plant, higher wet weight of capsules and higher dry capsule yield. Selection of superior genotypes based on variability and performance analysis has been carried out in cardamom by earlier workers (Radhakrishnan *et al.*, 2005; Kuruvilla *et al.*, 2006). Performance assessment of fourteen cardamom genotypes has been carried out by Radhakrishnan *et al.* (2005) and it has resulted in the selection of certain promising selections and hybrids. However, many of the farmers prefer local elite landraces due to their high productivity and adaptability. Hence A study has been carried out to assess the performance of ten elite landraces of cardamom collected from Idukki district of Kerala

MATERIALS AND METHOD

The experiment was carried out in the experimental farm of Indian Cardamom Research Institute (ICRI), Myladumpara, Idukki, Kerala, India during 2002-2006. The farm is located at an altitude of 1,068 m above MSL at 9° 53' N latitude and 77° 09' E longitude and it enjoys humid tropical climate. The soil is forest loam with pH of 5-6. The experiment was laid out in randomized block design with three replications and 12 plants per plot at a spacing of 3m x 3m. The experiments consisted of analysis of ten elite landraces such as Panikulangara-1, Panikulangara-2, Njallani, Vali green gold, Palakkudi, PNS Vaigai, Vander cardamom, Ela Rani-1, Ela Rani-2 and Ela Rani-3 along with the released variety ICRI-2 as control. Package of practices recommendation of the Spices Board (Anonymous 2001) was followed for cultivation. Observations on 32 characters including seven growth parameters, nine yield parameters and sixteen quality parameters have been presented and discussed. Overall performance of the landraces has been calculated based on performance index as suggested by Hrideek *et al.* (2002) by attributing grades to the accessions based on the performance and working out overall rank of performance (Tables 1, 2, 3 and 4).

RESULTS AND DISCUSSION

The study showed that majority of the characters showed statistically significant variation between the cultivars studied, indicating their genetic identity and the variation in growth and yield characters between them (Table 1). Based on the analysis of over all performance in relation to growth, yield and quality, Ela Rani-2 performed the best followed by Ela Rani-3, Palakkudi and Vali green gold in that order (Tables 2 and 3). Ela Rani- 2, the best performer produced around 100 tillers per clump on the average and 58 bearing tillers. Mean number of panicles per clump was 112.83 and panicle length 101.62cm. Dry yield per plant was 840g and recovery percentage was 20.98. Percentage of 7mm and above sized capsules was 72.03 and seed: husk ratio 57.87:1.

A comparative study of Ela Rani-2, Ela Rani-3, Palakkudi, Vali green gold and ICRI-2 has been provided in Table 4. It shows that Ela Rani-2, Ela Rani-3 and Palakkudi produced higher numbers of tillers per clump when compared to ICRI-2, the control. Tiller height, leaves per tiller and number of vegetative buds were higher in all the four landraces selected, when compared to the control. Number of bearing tillers was higher than the control in Ela Rani-2, Ela Rani-3 and Palakkudi. Panicles per clump, panicle length and fruit set percentage were the highest in Ela Rani-2. Dry yield per plant amounted to 840g in Ela Rani-2 which was considerably high when compared to ICRI-2. Recovery percentage and percentage of 7mm and above sized capsules were higher in all the four selected landraces when compared to ICRI-2, the control. Per litre weight of capsules was higher in Ela Rani-2, Ela Rani-3 and Palakkudi. Number of dry capsules per litre was the highest in ICRI-2 indicating that capsule size was higher in all the four landraces selected. Out of the 32 characters compared, 23 characters showed statistically significant variation among the genotypes and even in the case of other characters there was considerable variation among the landraces.

CONCLUSION

The present finding indicates the potential of selecting genotypes like Ela Rani-2, Ela Rani-3, Palakkudi and Vali green gold for further trials and evaluation protocols so that varieties with significantly superior characters could be developed.

Table 1. Performance evaluation of elite landraces of cardamom in the cardamom hill reserve of Kerala-character means

Characters	Paniulan gara-1	Panikulan gara-2	Njallani	Vali green gold	Palakkudi	PNS Vaigai	Vander cardamom	ICRI- 2	Ela Rani-1	Ela Rani-2	Ela Rani-3	CD (5%)
Tillers/clump**	88.94	90.39	70.28	77.83	81.56	66.06	62.06	80.39	95.22	99.67	93.01	11.16
Tiller height (cm)**	326.67	390.44	341.05	313.95	364.94	347.89	352.06	309.16	305.83	338.66	366.83	34.75
Leaves/tiller	19.22	20.94	21.00	19.82	21.49	20.45	21.44	18.28	20.61	20.72	20.89	NS
Leaf length (cm)**	61.06	69.00	64.94	69.60	61.83	63.72	52.27	61.17	53.61	62.39	59.61	3.19
Leaf breadth (cm)**	12.02	11.33	10.61	15.56	12.33	11.55	10.00	12.22	8.49	11.83	10.61	1.61
No. of veg. buds	4.94	4.50	4.06	3.5	4.56	3.50	4.22	2.72	3.28	3.67	3.28	NS
No. of bearing tillers	46.5	52.22	38.78	43.39	49.28	39.67	38.89	44.78	45.50	58.17	51.17	NS
Panicles/clump*	91.94	104.66	84.78	87.00	102.7	83.84	80.39	76.78	95.00	112.83	63.00	26.55
Panicle length (cm)*	78.17	81.45	69.83	76.78	97.39	95.39	83.83	69.33	60.66	101.62	70.55	21.66
Racemes/panicle**	26.61	24.39	25.89	25.72	28.94	28.21	27.77	18.95	21.44	26.89	25.89	3.04
Capsules/raceme**	8.44	8.34	7.89	9.06	7.05	8.44	7.89	7.00	8.17	7.66	8.55	0.11
Fruit set %**	73.29	71.30	72.86	63.06	69.93	59.30	61.78	65.67	81.94	75.37	67.85	10.75
Seeds/capsule	18.33	19.67	19.67	19.67	16.33	17.33	21.33	16.33	21.33	19.67	19.67	NS
Inter nodal length (cm)**	4.14	4.22	3.72	3.94	4.17	4.39	4.05	4.61	3.68	6.17	4.96	0.91
Yield/plant- fresh (kg)	4.05	4.82	3.96	4.81	4.48	5.04	3.51	3.19	4.08	4.00	4.17	NS
Yield/plant dry (kg)	0.850	0.940	0.806	1.030	1.043	1.078	0.737	0.639	0.856	0.840	0.879	NS

Recovery % *	21.00	19.65	20.33	21.51	22.79	21.43	20.97	20.04	21.00	20.98	21.10	1.37
% of 7 mm & above capsules**	78.00	60.22	71.31	80.04	76.06	76.51	83.72	62.91	73.98	72.03	73.00	1.21
Seed wt.- fresh capsule (g)**	0.43	0.37	0.40	0.43	0.43	0.43	0.47	0.43	0.50	0.50	0.43	0.11
Seed wt dry-capsule (g)**	0.19	0.19	0.20	0.17	0.21	0.21	0.18	0.26	0.26	0.24	0.25	0.01
Husk wt-fresh (g)**	0.90	0.80	1.07	1.03	0.80	1.10	1.07	0.73	0.90	0.87	0.87	0.16
Husk wt-dry (g)	0.06	0.05	0.07	0.06	0.06	0.6	0.07	0.07	0.08	0.07	0.08	NS
Seed: husk ratio- fresh capsule	48:1	46.82:1	37.27:1	42.45:1	55.75:1	39.34:1	43.94:1	59.52:1	55.66:1	57.87:1	50.00:1	NS
Litre wt.- fresh capsules (g)*	546.67	566.67	566.67	533.33	573.33	560.00	556.67	566.67	555.00	575.00	568.67	14.87
No. of fresh capsules/ litre**	571.33	646.00	590.67	539	562.00	515.67	505.00	535.33	551.67	560.67	563.33	44.64
Litre wt of dry capsules (g)**	340	340	340	340	360	344.33	320	340	350	356.67	356.67	4.67
No of dry capsule/ litre**	2166.67	2505.33	2308.33	2104	2243.67	2281	2015	2041.33	1984.33	1984.67	2104	228.08
100 capsule wt.- fresh (g)**	133.86	116.98	126.09	137.76	117.9	132.23	134.35	121.92	133.33	139.49	137.86	6.69
100 capsule wt.-dry g)**	20.21	20.24	19.58	20.36	20.63	22.56	17.24	26.84	22.47	23.17	23.5	3.41
Volatile oil (%)	8.79	9.08	9.04	9.85	8.49	8.45	8.99	8.99	8.69	8.94	8.61	NS
Oleoresin (%)**	6.72	6.31	5.75	7.66	7.33	6.38	7.17	6.26	7.09	7.20	6.97	0.88
Moisture content-capsule (%)**	10.67	9.33	10.07	12.43	10.87	10.5	12.43	11.04	10.57	10.83	11.00	0.58

** Significant @ 1% *Significant @ 5%

Table 2. Performance evaluation of elite landraces of cardamom in the cardamom hill reserve of Kerala- value points attributed to genotypes in relation to characters

Characters	Panikulangara-1	Panikulangara-2	Njallani	Vali green gold	Palakkudi	PNS Vaigai	Vander cardamom	ICRI -2	Ela Rani-1	Ela Rani-2	Ela Rani-3
Tillers/clump	7	8	3	4	6	2	1	5	10	11	9
Tiller height	4	11	6	3	9	7	8	2	1	5	10

Leaves tiller	3	8	9	4	11	2	10	1	5	6	7
Leaf length	4	10	9	11	6	8	1	5	2	7	3
Leaf breadth	8	6	4	11	10	5	3	9	2	7	4
No. of veg. buds	11	9	7	5	10	5	8	3	4	6	4
No. of bearing tillers	7	10	1	4	8	3	2	5	6	11	9
Panicles/clump	7	10	5	6	9	4	3	2	8	11	1
Panicle length	6	7	3	5	10	9	8	2	1	11	4
Racemes/panicle	8	4	6	5	11	10	7	2	3	9	6
Capsules/raceme	9	8	6	11	2	9	6	3	7	4	10
Fruit set %	9	7	8	3	6	1	2	4	11	10	5
Seeds/capsule	9	10	10	10	6	8	11	7	11	10	10
Inter nodal length	5	7	2	3	6	8	4	9	1	11	10
Yield /plant-fresh	5	10	3	9	8	11	2	1	6	4	7
Yield / plant-dry	5	8	3	9	10	11	2	1	6	4	7
Recovery %	7	3	5	10	11	9	6	4	7	7	8
% of 7 mm & above capsules	9	1	3	10	7	8	11	2	6	4	5
Seed wt.-fresh capsule	9	7	8	9	9	9	10	9	11	114	9
Seed wt.-dry capsule	6	6	7	4	8	8	5	11	11	9	10
Husk wt.-fresh	8	6	10	9	6	11	10	5	8	7	7
Husk wt.-dry	8	7	9	8	8	11	9	9	10	9	10
Seed: husk ratio- fresh capsule	6	5	1	3	9	2	4	11	8	10	7
Litre wt.-fresh capsules	4	8	8	3	10	7	6	8	5	11	9
No. of fresh capsules/ litre	9	11	10	4	7	2	1	3	5	6	8
Litre wt of dry capsules	7	7	7	7	11	8	6	7	9	10	10
No. of dry	8	1	10	7	8	9	5	6	3	4	7

capsules/ litre		1									
100 capsule wt.- fresh	7	1	4	9	2	5	8	3	6	11	10
100 capsule wt.- dry	3	4	2	5	6	8	1	11	7	9	10
Volatile oil	6	1 0	9	1 1	3	2	8	8	5	7	4
Oleoresin	5	3	1	1 1	10	4	8	2	7	9	6
Moisture content- capsule	6	2	3	1 1	8	4	1 1	10	5	7	9

Table 3. Performance index of genotypes of cardamom in high ranges-
value points attributed to genotypes in relation to characters

Characters	Panikula ngara-1	Panikul angara- 2	Njallani	Vali green gold	Palakkudi	PNS Vaigai	Vander cardamom	ICRI -2	Ela Rani-1	Ela Rani-2	Ela Rani-3
Tillers/ clump	0.64	0.73	0.27	0.36	0.55	0.18	0.09	0.45	0.91	1.00	0.82
Tiller height	0.36	1.00	0.55	0.27	0.82	0.64	0.73	0.18	0.09	0.45	0.91
Leaves/ tiller	0.27	0.73	0.82	0.36	1.00	0.18	0.91	0.09	0.45	0.55	0.64
Leaf length	0.36	0.91	0.82	1.00	0.55	0.73	0.09	0.45	0.18	0.64	0.27
Leaf breadth	0.73	0.55	0.36	1.00	0.91	0.45	0.27	0.82	0.18	0.64	0.27
No. of veg. buds	1.0	0.82	0.64	0.45	0.91	0.45	0.73	0.27	0.36	0.55	0.36
No. of bearing tillers	0.64	1.00	0.09	0.36	0.73	0.27	0.18	0.45	0.55	1.00	0.82
Panicles/ clump	0.64	1.00	0.45	0.55	0.82	0.36	0.27	0.18	0.73	1.00	0.09
Panicle length	0.55	0.64	0.27	0.45	0.91	0.82	0.73	0.18	0.09	1.00	0.36
Racemes/ panicle	0.73	0.36	0.55	0.45	1.00	0.91	0.64	0.18	0.27	0.82	0.55
Capsules/ raceme	0.82	0.73	0.55	1.00	0.18	0.82	0.55	0.27	0.64	0.36	0.91
Fruit set %	0.82	0.50	0.73	0.27	0.55	0.09	0.18	0.36	1.00	0.91	0.45
Seeds/ capsule	0.82	0.91	0.91	0.91	0.55	0.73	1.00	0.94	1.00	0.91	0.91
Inter nodal length	0.45	0.64	0.18	0.27	0.55	0.73	0.36	0.82	0.09	1.00	0.91
Yield/plant - fresh	0.45	0.91	0.27	0.64	0.91	1.00	0.18	0.09	0.55	0.36	0.64
Yield/ plant- dry	0.45	0.73	0.27	0.64	0.91	1.00	0.18	0.09	0.55	0.36	0.64
Recovery %	0.64	0.27	0.45	0.91	1.00	0.82	0.55	0.36	0.64	0.64	0.73
% of 7 mm & above	0.82	0.9	0.27	0.914	0.64	0.73	1.00	0.18	0.55	0.36	0.45

capsules											
Seed wt.- fresh capsule	0.82	0.64	0.73	0.82	0.82	0.82	0.91	0.82	1.00	1.00	0.82
Seed wt.- dry capsule	0.55	0.55	0.64	0.36	0.73	0.73	0.45	1.00	1.00	0.82	0.91
Husk wt.- fresh	0.73	0.55	0.91	0.82	0.55	1.00	0.91	0.45	0.73	0.64	0.64
Husk wt.- dry	0.73	0.55	0.91	0.82	0.55	1.00	0.91	0.45	0.73	0.64	0.64
Seed: husk ratio- fresh capsule	0.55	0.45	0.09	0.27	0.82	0.18	0.36	1.00	0.73	0.91	0.64
Litre wt.- fresh capsule	0.36	0.73	0.73	0.27	0.91	0.64	0.55	0.73	0.45	1.00	0.82
No. of fresh capsules/ litre	0.82	1.00	0.91	0.37	0.64	0.18	0.9	0.27	0.45	0.55	0.73
Litre wt. of dry capsules	0.64	0.64	0.64	0.64	1.00	0.73	0.55	0.64	0.82	0.91	0.91
No of dry capsules/ litre	0.73	1.00	0.91	0.64	0.73	0.82	0.45	0.55	0.27	0.36	0.64
100 capsule wt.- fresh	0.64	0.09	0.36	0.82	0.18	0.45	0.73	0.27	0.55	1.00	0.91
100 capsule wt.- dry	0.27	0.36	0.18	0.45	0.55	0.73	0.09	1.00	0.64	0.82	0.91
Volatile oil	0.55	0.91	0.82	1.00	0.27	0.18	0.73	0.73	0.45	0.64	0.36
Oleoresin	0.45	0.27	0.09	1.00	0.91	0.36	0.73	0.18	0.64	0.82	0.55
Moisture content- capsule	0.55	0.18	0.27	1.00	0.73	0.36	1.00	0.91	0.45	0.64	0.82
Total value points	5.56	5.63	5.00	6.46	6.74	4.63	6.09	6.28	5.45	7.65	7.29
Rank of performance	8	7	10	4	3	11	6	5	9	1	2

Table 4. Comparative performance of the four elite genotypes selected presently and the control-character means

Characters	Ela Rani-2	Ela Rani-3	Palakkudi	Vali green gold	ICRI -2	CD (5%)
Tillers/ clump**	99.67	93.01	81.56	77.83	80.39	11.16
Tiller height (cm) **	338.66	366.83	364.94	313.95	309.16	34.75
Leaves/ tiller NS	20.72	20.89	21.49	19.82	18.28	NS
No. of veg. buds . NS	3.67	3.28	4.56	3.5	2.72	NS
No. of bearing tiller . NS	58.17	51.17	49.28	43.39	44.78	NS
Panicles per clump *	112.83	63.00	102.7	87.00	76.78	26.55
Panicle length (cm)*	101.62	70.55	97.39	76.78	69.33	21.66
Racemes per panicle**	26.89	25.89	28.94	25.72	18.95	3.04
Capsules per raceme **	7.66	8.55	7.05	9.06	7.00	0.91

Fruit set % **	75.37	67.85	69.93	63.06	65.67	10.75
Yield per plant- dry (kg) NS	0.840	0.879	1.043	1.030	0.639	NS
Recovery % *	20.98	21.10	22.79	21.51	20.04	1.37
% of 7 mm & above capsules **	72.03	73.00	76.06	80.04	62.91	1.21
Seed: husk ratio- fresh capsule NS	57.87:1	50.00:1	55.75:1	42.45:1	59.52:1	NS
Litre wt. of dry capsules *	356.67	356.67	360	340	340	3.13
No of dry capsules per litre**	1984.67	2104	2243.67	2104	2041.33	44.64
Volatile oil (%) NS	8.94.	8.61	8.49	9.85	8.99	NS
Oleoresin (%) **	7.20	6.97	7.33	7.66	6.26	0.88
Moisture content- capsule (%)**	10.83	11.00	10.87	12.43	11.04	0.58

** Significant @1% *Significant @ 5%

REFERENCES

- Anonymous 2001. Package of Practices for Cardamom. Spices Board, Cochin, Kerala, India.
- Hrideek T.K., Sureshkumar V.B., Reddy A.G.S and Mohanan K.V., 2002. A study of initial performance of CxR (*C.congensis* x *C. canephora* var. robusta) coffee grafted on tree coffee seedlings at cotyledon stage. Proc. PLACROXYM XV: 161-164.
- Korikanthimath V.S., Ravindra-Mulge. and Hosmani M. M. 1997. Preliminary evaluation of elite clones of cardamom (*Elettaria cardamomum* Maton) for yield and yield parameters in clonal nursery. *J. Spices and Aromatic Crops*. 6(1): 37-41.
- Kuruville K.M., Madhusoodanan K.J., Vadivel V., Radhakrishnan V.V., Patil D.V. and Thomas J. 2006. Hybrid cardamom MHC-26 with high yield and quality capsule traits. *J. Plantation Crops* 34: 208-211.
- Radhakrishnan V.V., Mohanan K.V. and Priya P.M. 2005. Comparative performance of certain promising genotypes of cardamom. *J. Non-Timber Forest Products* 12(1): 38-41.
- Thomas J. 2006. Re-crowning the queen of spices- Cardamom. In: 'J.Thomas, T.K. Hrideek, Joseph Thomas and K.M. Kuruville (eds), Plantation Crops Research- an overview'. Indian Cardamom Research Institute, Myladumpara, Kerala, India: 1-21.
- Mabberley T.J., 1987. The Plant Book. Cambridge University Press, Cambridge.
- Ravindran P.N., 2002. Introduction. In: 'P.N.Ravendran and K.J.Madhusoodanan (eds), Cardamom- the genus *Elettaria*'. Taylor and Francis Inc., London: 1-10.
- Ravindran P.N., 2005. Cardamom – the queen that cures-2. *Spice India* 18(12): 5-15.