

## Variation in the yield and quality characters of cardamom (*Elettaria cardamomum*) clones

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### Abstract

Twelve clones selected for high yield of capsules and a local check of cardamom were grown in a field in a randomized block design and evaluated for boldness, chlorophyll content of capsule husk, essential oil and its components, 1,8 cineole and  $\alpha$ -terpinyl acetate. Clones were not significantly superior to local check for boldness but, five clones had significantly high chlorophyll content of husk compared to the local check indicating their superiority with respect to green colour of capsules. All the clones yielded significantly higher essential oil per hectare compared to local check. Nine clones were superior to the local check for their per cent essential oil content of capsule, three of them significantly superior. Highest essential oil yield was obtained in Selection 7(190 kg/ha) and lowest in the local check (54 kg/ha). Seven clones including Selection 12 had higher ratio of  $\alpha$ -terpinyl acetate to 1,8 cineole compared to local check, which is a desirable quality attribute. The selections 2,11 and 12 yielded bold and green capsules superior to those of the other entries.

**Key words :** Cardamom, *Elettaria cardamomum*, essential oil, boldness, chlorophyll, 1,8-cineole,  $\alpha$ -terpinyl acetate, chromatograph.

### Introduction

*Elettaria cardamomum* Maton is a perennial herbaceous plant belonging to the family Zingiberaceae. It yields cardamom, of commerce, which is the seed containing capsule used as flavouring agent in culinary preparations and bakery products. Volatile oil of cardamom is used in the food preservation and perfumery [2]. The major chemical constituent which imparts the characteristic flavour to the oil is  $\alpha$ -terpinyl acetate. The other major component which imparts a harsh camphory note to the oil is 1,8-cineole [5]. Boldness and deep-green colour of capsule are two of the quality attributes of cardamom. High essential oil content and high proportion of sweet flavour imparting chemical constituents are the other important quality attributes in cardamom. Cardamom quality characters of several high yielding clones are reported here.

### Materials and methods

The study was carried out at the Indian Institute of Spices Research, Cardamom Research Centre, Appangala, Kodagu, Karnataka (850 m MSL). Twelve

cardamom selections and the local check were planted in July 1990 in randomized block design, with four replications by the trench method of planting. In each plot there were 12 plants at 1.8 m x 1.2 m spacing. Guard rows were also planted in each plot to reduce any border effects. The fertilizer dose of 120:120:240 kg NPK/ha was applied in four equal splits at a quarterly interval. During summer (first fortnight of January to 3rd week of May) the experimental plots were irrigated once in 15 days by resorting to over head (sprinkler) system to get 3.75 mm of rain in each round (shift) of irrigation. The yield performance was assessed during the 1992-93 and 1993-94 crop seasons. The chlorophyll content and quality analyses were carried out during the 1992-93 crop season. Samples were drawn from eight plants in each selection for estimation of chlorophyll and for quality analysis.

Boldness was determined by weighing 100 capsules. Chlorophyll-a, chlorophyll-b and total chlorophyll contents of the husks of the dried capsules were estimated. Chlorophyll was extracted in 80 per cent acetone and the absorption at 663 nm and 645 nm

Table-1. Yield of capsules in different clones of cardamom

Clone	Number of capsules/plant in the crop seasons		Mean
	1992-93 First crop	1993-94 Second crop	
Selection 1	1109.5	1746.5	1428.0
Selection 2	1786.0	2009.0	1897.5
Selection 3	1311.5	1922.5	1617.0
Selection 4	1243.0	1558.5	1401.0
Selection 5	1930.5	2037.0	1983.8
Selection 6	1432.0	1869.0	1650.5
Selection 7	2064.0	2336.5	2200.5
Selection 8	1612.0	859.0	1235.8
Selection 9	2346.0	2143.5	2244.8
Selection 10	1669.0	2016.0	1842.5
Selection 11	1407.0	1683.0	1545.0
Selection 12	1181.5	1610.0	1395.8
Local check	922.0	773.5	847.8
Mean	1539.6	1735.7	
CD at 5% for clone			513.2**
CD at 5% for season			NS
CD at 5% for interaction			NS

\*\* F test significant at P = 0.01  
NS, F test not significant

were read in a spectrophotometer. Using the absorption coefficients the amount of chlorophyll was calculated [4].

The seed moiety (30 g) of the capsule was commutated just prior to distillation and added water (1:4 ratio) for 4 hours and distilled using Clevengers apparatus [1]. The flask was heated in the temperature regulated silicon heating mantle at 90°C. Percentage oil yield of dry capsules was calculated on volume/weight basis.

Gas chromatography of the hydrodistilled essential oil was conducted in a Hewlett Packard 5730. A gas chromatograph interfaced with various Tectron recorder. The oven of the gas chromatograph was fitted with 6' x 1/4" stainless steel column containing 3 per cent carbowax. Flame ionization gas mixture contained hydrogen and air at 20 and 220 ml/min respectively. Flame ionisation detector was attenuated in 1-100 range

Table-2. Size and chlorophyll contents of the capsules of cardamom clones

Clone	Boldness (/capsule)	Chlorophyll content of husk (mg/g)		
		Chl-a	Chl-b	Total
Selection 1	1.002	0.049	0.038	0.088
Selection 2	0.857	0.070	0.044	0.115
Selection 3	0.907	0.057	0.034	0.092
Selection 4	0.945	0.047	0.029	0.076
Selection 5	0.954	0.039	0.038	0.061
Selection 6	0.967	0.056	0.047	0.103
Selection 7	0.936	0.050	0.036	0.085
Selection 8	0.928	0.035	0.025	0.060
Selection 9	0.870	0.052	0.043	0.095
Selection 10	0.879	0.042	0.034	0.076
Selection 11	0.917	0.068	0.059	0.127
Selection 12	0.906	0.061	0.064	0.126
Local check	0.973	0.047	0.037	0.084
± SE	0.022	0.003	0.003	0.004
CD at 5%	0.063	0.010	0.010	0.011

NS, P test not significant

and peaks were reduced by 8 times for getting optimum resolution of the essential oil components.

$\alpha$ -terpinyl acetate and 1,8 - cineole peaks were identified by injecting the authentic compounds and recording the relative retention times of individual compounds and standard mixture. Percentage of 1,8-cineole and  $\alpha$ -terpinyl acetate were calculated as per cent of the total available constituents in 0.5 microlitres of oil.

### Results and discussion

#### Number of capsules per plant

Number of capsules per plant in selected clones was assessed for two seasons (1992-93 and 1993-94). Clones differed significantly among themselves for number of capsules per plant (at P=0.01) All the clones were significantly superior to the local check (Table-1). The clones Selection-9 had maximum number of capsules (2244.80 followed by Selection 7 (2200.3) and Selection 5 (1983.8). The lowest was recorded with local check

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**Table-3. Essential oil content and quality in the cardamom clones**

Clone	Essential oil (%)	Essential oil yield (kg/ha)	1,8-cineole (%)	$\alpha$ -terpinyl acetate(%)	$\alpha$ -terpinyl acetate : 1,8-cineole ratio
Selection 1	7.6	154	34	49	1.44
Selection 2	7.1	141	36	46	1.28
Selection 3	8.0	162	35	49	1.40
Selection 4	8.5	149	37	45	1.22
Selection 5	8.4	189	35	46	1.31
Selection 6	8.3	174	37	46	1.24
Selection 7	7.5	190	38	43	1.13
Selection 8	7.0	65	36	47	1.31
Selection 9	7.1	154	35	45	1.29
Selection 10	7.8	160	38	42	1.11
Selection 11	8.0	143	37	43	1.16
Selection 12	7.3	123	33	44	1.33
Local check	7.2	54	37	46	1.24
$\pm$ SE	0.0259	6.37	1.513	2.175	-
CD at 5%	0.8	20	NS	NS	-

NS, F test not significant

(847.8). Interaction between clones and years for number of capsules per plant was not significant.

#### Boldness

Boldness in terms of size or weight of capsule is commercially very important trait in cardamom. Significant variability was observed among the clones for boldness (Table-2). Selection 1 was the only clone superior (1.002 g/capsule) to local check (0.973 g/capsule) for boldness.

#### Chlorophyll content of husk

Total chlorophyll content of husk varied significantly among the clones (Table-2). Eight clones were superior to local check for the total chlorophyll content. Highest chlorophyll content of husk was observed in Selection 11 (0.127 mg/g) followed by Selection 12 (0.126 mg/g), Selection 2 (0.115 mg/g) and Selection 6 (0.103 mg/g) and in local check it was only 0.084 mg/g of capsule. Clones also differed significantly among themselves for chlorophyll-a and -b contents (Table-2). Except in Selection 12, the chlorophyll-a content was higher than chlorophyll-b content of husk in all the clones. Most of

the clones were superior to local check for green capsule colour which is advantageous in fetching a better price in market.

#### Essential oil

Significant variability was observed among the clones for essential oil percentage of dry capsule and oil yield per hectare (Table- 3). Variability for essential oil content was observed among the germplasm accessions in the earlier studies also [3]. Nine clones has high percentage of oil content compared to local check. Highest oil percentage was observed in Selection 4 (8.5%), followed by Selection 5 (8.4%), and Selection 6 (8.3%), while the local check had 7.3% of oil. Essential oil yield per hectare was highest in Selection 7 (190 kg/ha), followed by Selection 5 (189 kg/ha), Selection 6 (174 kg/ha) and Selection 10 (160 kg/ha), and was lowest in the local check (54 kg/ha). Almost all the clones were superior to local check.

#### Constituents of essential oil

Among the entries, there was no significant difference for  $\alpha$ -terpinyl acetate and 1,8-cineole contents (Table-3).

The percent composition of the sweet flavoured  $\alpha$ -terpinyl acetate, was higher compared to that of less flavoured 1,8 cineole in all the clones. The ratio of  $\alpha$ -terpinyl acetate : 1,8-cineole which determines the quality of essential oil [6] was highest in Selection 1 (1.44), followed by Selection 3 (1.40), Selection 12 (1.33), Selection 5 (1.31), Selection 9 (1.29) and Selection 2 (1.28), as compared to the much lower value in the local check (1.24).

This study has shown that the Selections 2, 11 and 12 bear bold green capsules. The Selection 12 is also pleasantly flavoured. The essential oil and capsules yields are highest in the Selection 7. It appears that a breeding programme will be required to combine the attribute in a cultivar. A promising cross may be the one between Selections 7 and 12.

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