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Comparative analysis of marketable quality traits of Small Cardamom (*Elettaria cardamomum* L) from hilly and southern transitional zones of Hassan district

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Abstract

Traditionally small cardamom (*Elettaria cardamomum* L) cultivation was restricted only to areas receiving high to medium level of rainfall in Western Ghats tracts of Karnataka. With the changing scenarios, farmers from medium and lower rainfall areas as well as non-traditional areas also initiated to cultivate cardamom as an intercrop in the areca nut and coconut gardens. Cardamom being an important plantation crop of Hassan district has its own distinct variability for marketable quality traits grown within the district of Hassan. Even though crop establishment is ensured, information on quality traits of cardamom in non- traditional areas in comparison to traditional cardamom growing tracts is not available. Cardamom samples brought to cardamom drying facility center of Spices of Board's Regional Research Station, ICRI located at Sakleshpur, by various cardamom growers across five months (August to December) in a year are sampled for observations. For a period of three years observations were recorded and further data was segregated into four cardamom growing zones to analyze ecological influence on selected quality traits of cardamom. Out of three years of observations it is observed that, higher recovery percentage (21.2%), relative percentage of bold capsules (8mm and above 39.3%) liter weight (548 g/L) is significantly higher in traditional cardamom growing areas of Hassan district. Whereas, higher recovery percentage and bold capsules and liter weight was observed in the cardamom cured during the period of September to October. Higher incidence of thrips (34%) and capsule splitting (22.1%), lower liter weight (462g/L), smaller sized capsules were observed in cardamom grown in low rainfall area and harvest of August and November months. Hence to improve cardamom quality traits in low rainfall areas/ non- traditional areas capacity building programmes addressing productivity and quality improvement shall be intensified and encouraged.

Keywords: Cardamom, recovery percentage, thrips, bold capsule

Introduction

Cardamom (*Elettaria cardamomum* L) is popularly recognised as '*queen of spices*' and it has got its own priority in the ecological, and socio economic niche among cardamom growers of western ghats of Karnataka. Cardamom is cultivated in Hassan district over an area 1953 ha with the production of 83 MT of dry Cardamom capsules (Anon.2021). Traditionally small cardamom cultivation was restricted only to areas receiving high to medium level of rainfall in Western Ghats tracts. With the changing scenarios, farmers from medium and lower rainfall areas as well as non-traditional areas also initiated to cultivate cardamom as an intercrop in the areca nut and coconut gardens. Cardamom being an important plantation crop of Hassan district has its own distinct variability for marketable quality traits grown within the district of Hassan. Hassan district had spread across southern transition zone and hilly zone of Karnataka (Zone 7 and 9 respectively). Dominance of cardamom cultivation was restricted to hilly zone of Hassan district mainly Sakleshpur *taluk*. Because of encouraging price and consistent market demand attempts are made by the progressive farmers of Hassan district to grow cardamom in non-traditional area also (Southern transitional zones comprising Arakalagud, Holenarasipur,

Alur and Belur *taluks*). Success in establishing crop favouring micro environment through approximate agronomic interventions definitely helps in establishing a new crop in non-traditional area to the level of satisfaction.
Even though crop establishment is ensured, information on quality traits of dried cardamom capsules in comparison to traditional cardamom growing tracts are not available. Moreover, market preferred quality traits are influenced by ecological, edaphic and agronomic factors mainly and equally influenced by awareness of cardamom cultivation and post-harvest handling specifically harvesting and drying. To bridge this information gap primary data was collected from different cardamom growing tracts of Hassan district by Spices Board, Indian Cardamom Research Institute, Sakleshpur.

Materials and Methods

To assess the influence of ecological, agronomic and growers' awareness on quality traits of cardamom primary data was collected from the cardamom growers of Hassan district for period of three years (2021-2024). Entire cardamom growing traits of Hassan district was further categorised into four cardamom growing zones-based weather elements and intensity of cardamom cultivated. The traditional cardamom growing tracts fall under the zone 1 and 2. Whereas non-traditional cardamom growing tracts categorised under zone 3 and 4 (Table1). Pictorial representation of agro-climatic zones of Karnataka and sampling area details were furnished in fig.1 & 2. Freshly harvested cardamom capsule brought to Cardamom drying facility center of Spices of Board's Regional Research Station, ICRI located at Sakleshpur, by various cardamom growers across five months (August to December) in a year. Primary data for a period of three years were collected from the sampled lots on below furnished quality traits of cardamom capsules. Recorded observations were further segregated as per the cardamom growing zones classification criteria (Table 1).

Fig 1: Agroclimatic Zones of Karnataka

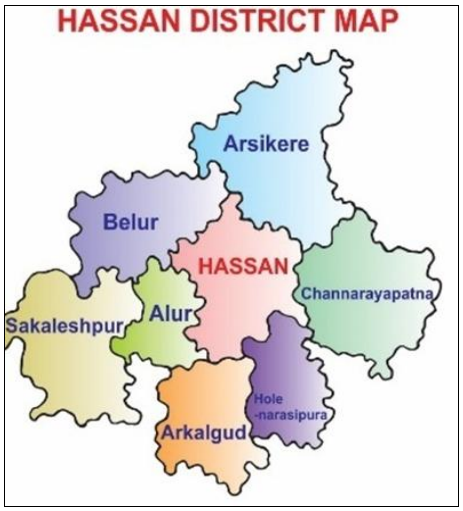

Fig 2: Cardamom Sampling area

1. Liter weight (g/L)
2. Dry recovery (%)
3. Capsule more than 8mm (%)
4. Capsule with splits (%)
5. Capsule infested with thrips and capsule borer damage (%).

Table 1: Metrological data and sampling details of Study area

Cardamom Growing Zones	Rainfall (mm)	Temperature (^{0}C)	No of Rainy days	No of cardamom samples
Zone-1:Hettur, Bisile & Vanagur	3800-3000	18-34	> 180	27
Zone-2 Sakleshpur (T)	3000-2000	21-38	> 150	32
Zone-3 Arakalgud, Alur (T)	2000-1200	21-39	120-140	22
Zone-4: Hole Narasipura & Belur (T)	<1200	24-41	< 90	08

Observation on these quality attributes were recorded across 5 months (August to December) from the cardamom lots which were brought into cardamom drying facility centre at Spices Boards' Indian Cardamom Research Institute, Sakleshpur. Tabulated data was subjected to assessment of standard deviation and t- test and p- value were calculated (Gomez & Gomez 1976) [2].

Results and Discussion

Cardamom samples brought to cardamom drying facility center ICRI, Sakleshpur by various cardamom growers across three years were subjected for recording observations and later data was segregated as per cardamom growing zones classification. It was observed that, dry recovery of cardamom capsules was found to be numerically higher in zone 1 and 2 (21.22 and 21.02% respectively) as compared to zone 3 and 4. Whereas cardamom capsules harvested during the month of September has recorded higher dry recovery in zone 2 followed by October and November months in zone 1 (table.2). On the contrary dry recovery of cardamom capsule was comparatively low by 5.51% in zone - 3 and 8.25% in case of zone - 4. Another important quality attributes of cardamom which dictates' the cardamom price in auction centre is liter weight or bulk density of cardamom

capsule (g/L). Traditional area of cardamom cultivation (zone 1 & 2) has recorded better liter weight (547.5 g/L) which was progressively higher by 4.7% and 15.7% respectively in comparison zone 3 and 7 (table.3). This variation in dry recovery and liter weight can be directly attributed to crop favouring natural ecological factors like ideal photo thermic dynamics during the growing seasons wide spread of rainfall as well as inherited skill of cardamom cultivation, harvesting skills and high level of awareness prevailing in zone 1 and 2 cardamom growers as compared to zone 3 and 4 growers. Due to ecological elements limitation and poor spread of rainfall coupled with higher thermal dynamics in zone 3 and 4 forces for early maturity of cardamom capsules. This forced maturation ends up with low dry recovery as well as lower liter weight of cardamom capsules. Apart from these factors cardamom being a cross-pollinated crop, role of pollinators and their activity starting from the month of March to September positively helps in enhancing dry recovery as well as liter weight of cardamom capsule. Zone 1 and 2 located in core area of western ghat eventually harbours various pollinators as compared to zone 3 and 4. Hence ecological attributes along with the pollinators had helped zone 1 and 2 cardamom growers to achieve superior quality traits in comparison to zone 3 and 4 (Murugan *et al*., 2009) [3]. Similarly harvesting cardamom is a skill associated science. This encapsulated skill of zone 1 and 2 cardamom growers helps in deciding maturation status of cardamom capsule based on phenotypic appearance of capsule.

Table 2: Dry recovery of cardamom capsules across different cardamom growing zones of Hassan

Cardamom Growing Zones	Dry recovery of cardamom capsule (%)					
	August	September	October	November	December	Mean
Zone-1:Hettur, Bisile & Vanagur	20.60 (2.63)	21.80 (0.84)	21.70 (2.41)	21.20 (1.66)	20.80 (2.15)	21.22
Zone-2 Sakleshpur (T)	20.45 (1.78)	22.05 (2.38)	21.50 (1.67)	21.00 (1.93)	20.10 (2.41)	21.02
Zone-3 Arakalgud, Alur (T)	20.05 (1.68)	20.30 (1.52)	20.38 (2.12)	19.85 (2.11)	19.65 (1.87)	20.05
Zone-4: Hole Narasipura & Belur (T)	19.28 (2.28)	20.08 (0.95)	21.02 (1.29)	19.98 (2.36)	19.00 (1.45)	19.87
Mean	20.10	21.06	21.15	20.51	19.89	

The calculated t *(4.48)* exceeds the p value (1.98) df-126
Figure in parenthesis is standard deviation values-Pooled data of three years

Harvesting Cardamom capsule at physiological maturity (fresh capsules, green in colour seeds turning brown to black) gives green coloured dried capsules if dried in cardamom driers or else pale green to light yellow coloured capsule if sun dried. On the contrary harvesting cardamom capsules after attaining complete maturity (fresh capsule with pale green colour or yellow colour with all seeds having black colour) results in higher dry recovery as well as liter weight. But, this habit of harvesting has a greater limitation of capsule splitting during the process of drying. Relative percentage of capsules splitting was found to be higher when capsules were sun dried in comparison to drying cardamom in driers. It is evident from the available data that, higher percentage of splitting in capsule was observed in zone 4 (20.54%) followed by zone 3 (15.36%) as compared to zone 1 and 2 (11.4%) (table.4). Inherited knowledge and skill of cardamom cultivation harvesting and drying noticed among the cardamom growers of zone 1 & 2 has helped to realize better quality attributes *viz*., higher dry recovery, liter weight and lower capsule splitting of cardamom in comparison to non-traditional cardamom growing areas.

Table 3: Liter weight (g/L) of cardamom capsules across different cardamom growing zones of Hassan

Cardamom Growing Zones	Liter weight of cardamom capsule (g/L)					
	August	September	October	November	December	Mean
Zone-1:Hettur, Bisile & Vanagur	543.0 (55.60)	554.0 (56.90)	572.0 (68.61)	538.0 (24.82)	530.0 (38.43)	547.4
Zone-2 Sakleshpur (T)	541.0 (37.58)	551.0 (29.99)	558.0 (44.05)	552.0 (60.36)	537.0 (48.07)	547.8
Zone-3 Arakalgud, Alur (T)	520.0 (26.29)	522.0 (31.11)	525.0 (47.55)	520.0 (65.18)	519.0 (61.53)	521.2
Zone-4: Hole Narasipura & Belur (T)	464.0 (37.62)	467.0 (47.16)	474.0 (42.83)	458.0 (45.85)	448.0 (47.84)	462.2
Mean	517.0	523.5	532.3	517.0	508.5	

The calculated t *(10.62) exceeds the p value (1.98) df-126*
Figure in parenthesis is standard deviation values-Pooled data of three years

Table 4: Cardamom capsule splitting (%) across different cardamom growing zones of Hassan

Cardamom Growing Zones	Splitting of cardamom capsule (%)					
	August	September	October	November	December	Mean
Zone-1:Hettur, Bisile & Vanagur	20.60 (2.63)	21.80 (0.84)	21.70 (2.41)	21.20 (1.66)	20.80 (2.15)	21.22
Zone-2 Sakleshpur (T)	20.45 (1.78)	22.05 (2.38)	21.50 (1.67)	21.00 (1.93)	20.10 (2.41)	21.02
Zone-3 Arakalgud, Alur (T)	20.05 (1.68)	20.30 (1.52)	20.38 (2.12)	19.85 (2.11)	19.65 (1.87)	20.05
Zone-4: Hole Narasipura & Belur (T)	19.28 (2.28)	20.08 (0.95)	21.02 (1.29)	19.98 (2.36)	19.00 (1.45)	19.87
Mean	20.10	21.06	21.15	20.51	19.89	

The calculated t *(4.48)* exceeds the p value (1.98) df-126
Figure in parenthesis is standard deviation values-Pooled data of three years

Graded bold capsules (more than 8mm) is an important market requirement in the cardamom trade. This attribute is largely governed by genetic and appropriate ecological interventions. Approximately 18% higher bold capsules (> 8mm) were recorded in zone 1 & 2 as compared to zone 3 & 4 (table. 4). Higher the number of days taken for flowering to harvesting assists for higher biomass accumulation from source to sink. This indubitably favoured by cool and humid weather observed during capsule development stage. Assurance of relatively higher percentage of bold capsule in zone 1 and 2 can be justifiable due to existence of favourable weather elements and higher visit of pollinator.

Table 5: Bold cardamom capsules (>8 mm) (%) across different cardamom growing zones of Hassan.

Cardamom Growing Zones	Bold capsules (>8 mm) (%)					
	August	September	October	November	December	Mean
Zone-1:Hettur, Bisile & Vanagur	38.6 (4.4)	39.7 (2.41)	39.9 (2.91)	39.2 (4.24)	39.0 (3.88)	39.3
Zone-2 Sakleshpur (T)	38.6 (4.71)	40.2 (5.94)	39.4 (4.67)	38.4 (4.14)	38.7 (4.79)	39.1
Zone-3 Arakalgud, Alur (T)	30.6 (1.42)	35.2 (6.18)	34.9 (6.24)	30.8 (5.18)	31.2 (4.63)	32.5
Zone-4: Hole Narasipura & Belur (T)	32.3 (7.22)	34.8 (6.16)	31.8 (4.63)	30.7 (4.76)	30.9 (6.04)	32.1
Mean	35.0	37.5	36.5	34.8	34.9	

The calculated t *(4.48)* exceeds the p value (1.98) df-126
Figure in parenthesis is standard deviation values-Pooled data of three years
It is more evident that, in depth awareness for managing micro climate requirement of

Table 6: Incidence of cardamom capsule borer damage (%) across different cardamom growing zones of Hassan.

Cardamom Growing Zones	Cardamom capsule borer damage (%)					
	August	September	October	November	December	Mean
Zone-1:Hettur, Bisile & Vanagur	9.84	9.67	9.68	10.18	10.04	9.88
Zone-2 Sakleshpur (T)	9.77	9.59	9.58	10.48	10.53	9.99
Zone-3 Arakalgud, Alur (T)	16.38	10.80	10.60	14.70	18.30	14.16
Zone-4: Hole Narasipura & Belur (T)	20.50	19.30	22.20	17.50	18.20	19.54
Mean	14.12	12.34	13.01	13.22	14.27	

Any physical damage on capsule *viz*., scabby appearance and holes occurred due to insect damage largely impacts on cardamom price during the trade. Generally higher incidence of cardamom capsule borer and thrips damage were more in zone 3 and 4 as compared to zone 1 and 2. This higher incidence of pest is mainly due to ecological, agronomical and poor plant protection measures employed by sampled cardamom growers of zone3 & 4 Virender Kaul Kesar (2003) [4]. As evident in zone 1 & 2 of cardamom growing areas relatively better spread of rainfall during April to October months helps in wiping away thrips hibernated in cardamom leaf sheath as well as floral bracts. This kind of natural managerial benefit is absent in zone 3 & 4.

Table 7: Incidence of thrips damage on cardamom capsule (%) across different cardamom growing zones of Hassan

Cardamom Growing Zones	Thrips damage on cardamom capsule (%)					
	August	September	October	November	December	Mean
Zone-1:Hettur, Bisile & Vanagur	25.77 (5.09)	26.53 (2.80)	19.93 (3.31)	25.57 (3.40)	23.55 (2.14)	24.27
Zone-2 Sakleshpur (T)	20.62 (3.11)	20.72 (4.67)	17.32 (6.77)	26.92 (4.71)	26.74 (2.68)	22.46
Zone-3 Arakalgud, Alur (T)	34.10 (5.61)	26.20 (8.43)	30.10 (5.96)	30.90 (5.74)	32.30 (3.91)	30.72
Zone-4: Hole Narasipura & Belur (T)	39.00 (4.07)	27.30 (9.96)	30.20 (7.65)	32.00 (7.60)	38.20 (4.63)	33.34
Mean	29.87	25.19	24.39	28.85	30.20	

The calculated *t (7.22)* exceeds the p value (1.99) df-80
Figure in parenthesis is standard deviation values-Pooled data of three years

In addition, agronomic interventions like de thrashing of dried cardamom leaves followed in the month of March to April helps in exposing the various castes of cardamom thrips to sunshine, indirectly helps in reducing its damage on capsule. Moreover, awareness of timely prophylactic spray schedule of insecticide adds up to lower incidence of pest and diseases which is widely evident in traditional cardamom growing traits as compared to non-traditional cardamom growing tracts.

Conclusion

It is evident from the pooled observations of three years data that, better market preferred quality attributes were noticeable in the traditional cardamom growing tracts as compared to non-traditional cardamom growing areas. Prevalence of ideal agroclimatic elements combined with timely cultural operations and plant protective measures along with inherited experience and expertise for harvesting and post-harvest handling of cardamom capsules in zone 1 and 2 clearly overwrites quality attributes of cardamom capsules grown in non-traditional areas. It is also important to mention that, among the sampled formers from zone 3 and 4 a lower frequency of farmers (12-16%) had superior quality attributes as good as zone 1 and 2. Hence observed lower frequency of superior quality traits of cardamom capsules observed in zone 3 & 4 cardamom farmers can be attributed to lack of awareness and experience in handling crop primarily followed by challenges in modifying weather elements or micro climate required for cardamom. It can be concluded that providing ideal weather during crop growth and awareness about cardamom crop requirement among zone 1 and 2 farmers has helped to take an edge over zone 3 and 4 farmers with respect to market preferred quality attributes. Its also affirmed that, with appropriate capacity building interventions in zone 3 and 4 for quality improvement in cardamom, definitely improves the market driven quality traits of cardamom even in zone and 4 also.

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