Effect of seed size and incubation temperature on seed germination of cardamom (*Elettaria cardamomum* Maton)

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ABSTRACT

An experiment was conducted to find out the optimal incubation temperature and ideal season for sowing cardamom (*Elettaria cardamomum*) seeds to achieve better and uniform germination. Germination parameters were studied during September-October, December-January and February-March 1989-91. An incubation temperature of 30°C recorded good germination during all the three seasons. However, seeds kept at ambient temperature during September - October resulted in best germination compared to 30°C. There was no significant difference in germination between seed sizes used.

Key words : cardamom, *Elettaria cardamomum*, germination, seeds.

Introduction

Germination of cardamom seeds (*Elettaria cardamomum* Maton) is erratic, delayed and poor under traditional type of sowing (Pattanshetty & Prasad 1973). Attempts made in the past to improve germination percentage and also to attain uniform germination include scarification (both mechanical and chemical) (Kololgi, Pattanshetti & Prasad 1973), agronomic amendments with synthetic and natural mulch materials (Prasad, Pattanshetti & Kololgi 1974) etc. Variation in seed size due to differences in either endosperm or embryo size, or both, influences germination of seeds (Perry 1980). Although variation is seed germination under varied conditions has been established, finding a critical temperature for attaining higher germination has not been attempted. Hence, this experiment was undertaken to determine the optimal temperature required to get good, early and uniform germination and to find out the optimum season for sowing.

Materials and methods

Freshly harvested cardamom capsules were dehusked and the seeds were separated, washed throughly and dried under shade. Dried seeds were scarified

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with 25% HNO_3 for 10 min (Kololgi *et al.* 1973) and washed in copious amounts of water to remove traces of acid. The seeds were than soaked in water for 48h and treatments imposed.

The seeds were separated into two size classes viz., 2 mm and above and less than 2 mm dia using a 2 mm sieve and both the size groups were subjected to nine sub- treatments maintained under ambient conditions and in a B O D incubator, under the following temperature regimes: i) Control ii) 5°C iii) 10°C iv) 15°C v) 20°C vi) 25°C vii) 30°C viii) 35°C ix) 40°C. Each sub- treatment was replicated thrice with 25 acid scarified seeds sown in petridishes with blotters. The experiment was repeated thrice (seeds were sown in September, December and February) i.e., during September-October, December-January and February-March. The study was continued for two successive years viz., 1989-90 and 1990-91. Germination counts were recorded daily up to 60 days and the days taken for first germination, 50% germination and total germination were calculated. The germination rate (Edward 1932; Harrington 1962), co-efficient of velocity of germination (Kotowski 1926) and germination value (Czabator 1962) were also determined.

Results and discussion

The data obtained were initially analysed as per Split Plot Design with two main treatments and nine sub-treatments. There were no significant differences between the two main treatments, during any season indicating that seed size does not play a significant role in the germination process in cardamom.

Significant differences in days taken for first germination, 50% germination, total germination percentages, germination rate, co-efficient of velocity of germination and germination value were observed in different seasons and hence the data was analysed as per Randomized Block Design (Tables 1, 2 & 3).

The seeds failed to germinate at extreme low (5°,10° and 15°C) and high (35°C and 40°C) temperatures. The best germination under incubation conditions was recorded at 30°C during the entire period of the experiment. However , the performance of incubation at 30°C was inferior to that recorded under ambient condition during September-October season (Table 1), but was better during other seasons (Tables 2 & 3). Under ambient conditions the best germination parameters were recorded during September-October signifying that temperature regime prevailing during this season is conducive for germination of cardamom seeds. Under field conditions also better germination was reported during this period (Pattanshetti & Prasad 1973). The mean minimum and mean maximum ambient temperatures recorded during the three seasons were i) 18°C and 26°C, ii) 12°C and 29°C and iii) 14°C and 33°C, respectively (Table 4).

Borth Wick (1925) reported that seeds of *Asparagus officinalis* did not germinate when subjected to low temperatures. Solanki & Seth (1984) also reported similar results at low temperatures for seeds of winged bean and cucumber. In the present experiment also no germination was observed when the seeds were subjected to low temperatures. This could be due to lower rate of water absorption by the seeds. Vegis (1964) has put forward a general theory of dormancy in which it was postulated that higher temperature in association with restricted oxygen uptake due to presence of covering structures such as

Table 1. Parameters recorded during cardamom seed germination process at Ist season (Sep. - Oct.) (mean of 1989-90 & 1990-91)

Treatment	Days taken for Ist germination	Days taken for 50% germination	Germination % (at 60th day)	Germination rate (days)	Co-efficient of velocity	Germination value
Ambient*	16.3	19.8	90.7	42.5	2.3	3.5
5° C	60.0	60.0	00.0	60.0	1.7	0.0
10° C	60.0	60.0	00.0	60.0	1.7	0.0
15° C	60.0	60.0	00.0	60.0	1.7	0.0
20° C	45.5	60.0	28.2	50.3	1.8	0.2
25° C	34.2	60.0	24.3	41.2	2.2	0.1
30° C	26.8	48.7	73.0	40.8	2.2	1.5
35° C	48.0	60.0	02.7	44.3	1.8	0.0
40° C	60.0	60.0	00.0	60.0	1.7	0.0
C D at 5%	4.7	3.7	2.7	4.1	0.2	2.2

* Mean minimum temperature = 18° & 19°C
* Mean maximum temperature = 26° & 29°C

Table 2. Parameters recorded during cardamom seed germination process at IInd season (Dec. - Jan.) (mean of 1990-91)

Treatment	Days taken for Ist germination	Days taken for 50% germination	Germination % (at 60th day)	Germination rate (days)	Co-efficient of velocity	Germination value
Ambient*	38.5	60.0	42.0	51.9	1.9	0.5
5° C	60.0	60.0	00.0	60.0	1.7	0.0
10° C	60.0	60.0	00.0	60.0	1.7	0.0
15° C	60.0	60.0	00.0	60.0	1.7	0.0
20° C	53.2	60.0	19.1	54.9	1.8	0.1
25° C	37.7	60.0	13.4	51.0	2.2	0.1
30° C	30.2	51.5	70.9	45.6	2.2	1.4
35° C	52.0	60.0	02.6	60.0	1.9	0.0
40° C	60.0	60.0	00.0	60.0	1.7	0.0
C D at 5%	6.0	0.5	1.9	5.0	0.2	0.1

* Mean minimum temperature = 12° & 13°C
* Mean maximum temperature = 28° & 29°C

Table 3. Parameters recorded during cardamom seed germination process at IIIrd season (Feb. - Mar.) (mean of 1990 - 91)

Treatment	Days taken for Ist germination	Days taken for 50% germination	Germination % (at 60th day)	Germination rate (days)	Co-efficient of velocity	Germination value
Ambient*	28.3	50.8	58.7	42.5	2.3	1.0
5° C	60.0	60.0	00.0	60.0	1.7	0.0
10° C	60.0	60.0	00.0	60.0	1.7	0.0
15° C	60.0	60.0	00.0	60.0	1.7	0.0
20° C	49.5	60.0	20.6	54.7	1.8	0.2
25° C	35.0	60.0	13.6	46.0	2.2	0.1
30° C	38.5	51.0	72.0	44.8	2.2	1.4
35° C	50.0	60.0	02.6	52.2	1.9	0.0
40° C	60.0	60.0	00.0	60.0	1.7	0.0
C D at 5%	8.8	2.2	2.4	6.5	0.3	0.1

* Mean minimum temperature = 14° & 16°C
* Mean maximum temperature = 30° & 33°C

Table 4. Mean minimum and maximum temperature during experimental season (mean of 1989 - 91)

Month	Mean min. temp. (°C)	Mean max. temp. (°C)
September	18	26
October	19	29
November	18	28
December	12	28
January	13	29
February	14	30
March	16	33

seed coat was the primary cause of dormancy. Since cardamom seeds also possess a hard seed coat, the results obtained during the present study subscribes to the general theory of dormancy mentioned above.

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References

Borth Wick HA 1925 Factor influencing the rate of germination of seeds of *Asparagus officinalis*. Coli Tech., Paper 18.

Czabator F 1962 Germination value and index combining speed and completeness of pine seed germination. For. Sci. 8 : 386-396.

Edward T J 1932 Temperature relations of seed germination. Quart. Rev. Biol. 7 : 428-443.

Harrington J E 1962 The effect of temperature on the germination on the several kinds of vegetable seeds. XIth Int. Hort. Conf. Vol-II. pp. 435-441.

Kololgi S B, Pattanshetti H V & Prasad A B N 1973 Germination of cardamom can be improved by treatment with nitric acid and sowing in plastic house. Curr. Res. 1(1) : 3.

Kotowski F 1926 Temperature relations to germination of vegetable seeds. Proc. Amer. Soc. Hort. Sci. 23 : 176-184.

Pattanshetti H V & Prasad A B N 1973 September is most suitable month for sowing cardamon seeds. Curr. Res. 2(5) : 26.

Perry D A 1980 Seed vigour and seedling establishment .In:Advances in Research Technology of Seed. Part-5. Thompson J R (Ed.) (p.25) Centre for Agricultural Publishing and Documentation, Wageningen.

Prasad A B N, Pattanshetty H V & Kololgi S B 1974 Seed treatment to improve and hasten the germination of cardamom seeds sown during winter. Cardamom 6(8) : 5-12.

Solanki S S & Seth J N 1984 Studies on co-efficient of germination of winged bean (*Sophocarpus tetragonolobus* L.) and cucumber (*Cucumis sativus* L.) seeds. Haryana J. Hort. Sci. 13(3-4) : 143-146.

Vegas A 1964 Dormancy in higher plants. Ann. Rev. Plant. Phy. 15 : 185-224.