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Standardization of screen sizes and density grades for chilli (*Capsicum annuum*) seed processing

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ABSTRACT Seeds of chilli (*Capsicum annuum* L.) cv *Byadagi* were size graded by using different screen sizes, *viz.* 2.50mm(R) (S_1), 2.80mm(R) (S_2), 3.10mm(R) (S_3), 3.25mm(R) (S_4) and density grades D_1(1.00 gcc-1) to D_4 (1.06 gcc-1), and evaluated for seed quality parameters. The results showed that seed size grades were found to influence seed recovery, test weight, germination and other seed quality parameters such as root length, shoot length, seedling dry weight, vigour index, field emergence, speed of emergence and germination after accelerated ageing. Though S_4 (3.25mm(R)) seeds showed higher seed quality parameters, they recorded poor seed recovery (68%). Seed size 2.50mm(R) (S_1) could be employed with least reduction in seed quality and with high recovery (92%). In seed density grades, despite improvement in D_3 (1.04 gcc-1) and D_4 (1.06 gcc-1) density grades, seed recovery was as low as 75 and 66%, respectively. Thus, D_2 (1.02gcc-1) density grade seed which accounted for seed recovery of 83% was identified as ideal for upgrading seeds.

Key words: Chilli, seed processing, screen size, density grades

Seed vigour is a major component of seed quality along with viability, health and structural soundness in chilli (*Capsicum annuum* L.). Seed size has been found to significantly influence the vigour and storability of seed and thereby determine the seed quality, in many crops. The effect of seed size on seedling vigour, crop productivity and storability has drawn attention of researchers since long time [1]. The plum seeds can be stored for a long period [2, 3, 1 and 4] and found to perform better in terms of germination and seedling vigour, whereas contradictory results were reported by some researchers [1 and 4]. Proper selection of seed size is essential to achieve better seed quality and long period storability. Information on storability of chilli seed to preserve viability and vigour from harvesting to next planting season and also for carry over or transport purpose is of prime importance for any successful seed production programme. Therefore, this study was undertaken to evaluate seed size and effect of density on seed quality in chilli.

MATERIALS AND METHODS

Seeds of chilli cv. *Byadagi* were size graded by using different screen sizes *viz.* 2.50mm(R) (S_1), 2.80mm(R) (S_2), 3.10mm(R) (S_3), 3.25mm(R) (S_4) and ungraded seeds were taken as control (S_0). The seeds retained over these screens were taken as graded seeds and were placed in polyethylene covers separately and stored in an incubator at 10°C until they were tested for seed quality parameters. The seeds that passed through the screens were rejected. The seed recovery of graded seeds to that of bulk seeds was recorded on weight basis and expressed as percentage.

Bulk seeds of chilli cv *Byadagi* were obtained and separated for density grades using sodium chloride solution at different densities based on floatation technique. Different density solutions were created by dissolving sodium chloride salt at different concentrations. Seeds were put into aqueous solution for 2 minutes and stirred. The

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seeds that floated were removed and seeds that sank were taken and washed with water three times to avoid the accumulation of salt on seeds. Then the seeds were dried under shade for two days.

Density grade	Density of salt solution (gcc-1)	Quantity of salt dissolved in 100 ml of water (g)
D_0	Ungraded	-
D_1	1.00	0.0
D_2	1.02	2.5
D_3	1.04	5.0
D_4	1.06	7.5

All size and density grades were subjected to seed quality evaluation and observations. Four replications of 1,000 seeds were counted in each treatment and weighed using an electronic balance with 0.001g sensitivity. The seeds were tested by standard germination test by following between paper method as per ISTA [5]. 100-seeds each of four replications were tested for germination. The germination counts were recorded on 14th day and per cent germination was expressed on the basis of normal seedling.

The seedlings in each replication were selected randomly for measuring root length on 14th day. The distance between collar and tip of primary root was measured in centimeters and the mean root length was calculated. The seedlings used for root measurement were considered for measurement of shoot length also. The distance between collar and tip of shoot was measured. The mean shoot length was recorded and expressed in centimeters. Ten seedlings form each replication which were used for length measurement, were kept in butter paper covers and dried in hot air oven maintained at 85°C for 24 hr. Then seedlings were cooled in silica gel desiccators for 30 min. The dry weight of seedlings was measured with the help of an electronic balance and mean dry weight (mg) per seedling was calculated.

The vigour index was calculated by multiplying per cent seed germination and length of seedlings (in centimeters) using formula given by Abdul-Baki and Anderson [6].

Vigour index = germination (%) x seedlings length (cm)

Four replications of 100 seeds from each treatment were collected randomly and were sown on finely prepared nursery beds. The spacing followed was 10 cm x 5 cm between rows and seedlings. The number of seedlings emerged was counted daily from the day of first emergence and was computed adopting the following formula given below. The total number of seedlings that emerged up to 16th day in each replication were counted and expressed as per cent field emergence.

$$\text{Speed of emergence} = \frac{X1}{Y1} + \frac{X2 - X1}{Y2} + \frac{Xn - (Xn - 1)}{Yn}$$

Xn = number of seeds germinated at nth count

Yn = number of days of days from sowing on nth count.

Seeds from each treatment were subjected to accelerated ageing at 42°±1°C and 100% relative humidity for 4 days. The aged seeds were removed from ageing chamber and air dried under shade for 24 hr. Then seeds were subjected to germination test with four replications of 100 seeds each. Normal seedlings were counted on 14th day and expressed as per cent germination after accelerated ageing.

RESULTS AND DISCUSSION

Seed size grades were found to influence seed recovery, test weight, germination and other seed quality parameters such as root length, shoot length, seedling dry weight, vigour index, field emergence, speed of emergence and germination after accelerated ageing (GAA). The seed recovery increases with decrease in screen size from 3.25 mm(R) to 2.50 mm(R). The recommended screen size for chilli [7] was 2.10mm, irrespective of varieties. But in present study all the seeds of Byadagi were retained on 2.10mm which was considered to be the control (S_0). Among graded seeds, seeds retained on 2.50mm(R) (S_1) have

Table 1. Effect of seed size grades on seed quality parameters in chilli cv. Byadagi

Seed size grade	Seed recovery (%)	Test weight (g)	Germination (%)	Field emergence (%)	Speed of emergence (%)	Root length (cm)	Shoot length (cm)	Seedling dry weight (mg)	Vigour index	GAA (%)
S_1: 2.50mm(R)	92	6.44	81	75	7.90	4.36	8.70	3.20	1061	65
S_2: 2.80mm(R)	85	6.50	84	77	8.10	4.43	9.63	3.43	1179	66
S_3: 3.10mm(R)	78	6.58	85	79	8.41	4.65	9.85	3.56	1232	68
S_4: 3.25mm(R)	68	6.63	88	82	8.61	4.86	10.20	3.75	1320	72
S_0: 2.10mm(R)/ control	100	6.28	78	72	7.39	3.60	6.75	3.01	805	60
Mean	85	6.49	83	77	8.08	4.38	9.03	3.39	1220	66
SEm±	2.14	0.03	1.10	1.08	0.12	0.14	0.14	0.05	20.88	1.27
CD (0.05)	6.0	0.09	3.0	3.0	0.36	0.44	0.43	0.16	63.0	4.0

GAA, Germination after 4 days accelerated ageing (%)

maximum recovery (per cent) and it decreased with increase in screen size from 2.50mm to 3.25mm(R) (S_4). Seeds retained on 3.25 mm(R) (S_4) had the lowest seed recovery (68%), followed by S_3, seeds retained on 3.10 mm(R) (78%), whereas test weight increased with increase in screen size and maximum test weight was recorded with seeds retained on 3.25mm(R) (S_4) (Table 1). Germination and field emergence percentage was maximum with S_4 {3.25mm(R)} grade seeds which did not differ with S_3 {3.10mm(R)}. Jacobson and Globerson [8] reported that larger seeds of carrot germinated better than smaller seeds. Similar results had been reported by Dharmalingam and Basu [9], Shashidhar *et al.* [10] and Verma and Singh [11].

Significant improvement in root length, shoot length, seedling dry weight, vigour index and speed of emergence were observed in S_4 {3.25mm(R)} seeds, followed by S_3 (3.10mm(R)) seeds and tend to decrease with decrease in size grades. Palaniswamy and Ramaswamy [12] found higher seedling vigour root and shoot length with larger seeds and was found to decrease in smaller seeds. Similar results were reported by Verma and Singh [11]. Germination after accelerated ageing (GAA) also decreased with decrease in seed size grades. Maximum GAA was recorded with S_4 {3.25mm(R)} and it did not differ for S_3 (3.10 mm(R)) seeds. The results of GAA indicated that higher grade seeds retained on 3.25mm(R) (S_4) and 3.10mm(R) (S_3) screen size showing higher GAA and have better storability than the seeds retained on low screen size and ungraded control (S_1, S_2 and S_0)

Presence of immature seeds and reduced quality of food reserves could be the probable cause for poor performance of smaller seeds [13]. Despite S_4 {3.25mm(R)} seeds giving higher test weight, germination and vigour, it recorded poor seed recovery. It was observed that, recommended screen size for chilli was 2.10mm(R) in which all the seeds of chilli cv. *Byadagi* got retained. Screen sizes recommended for grading of some crops under minimum seed certification standards may not be appropriate for all the varieties [14] and its needs to be reviewed for every variety. Thus, it can be concluded that screen size 2.50mm(R) (S_1) could be employed for grading of chilli cv. *Byadagi* which recorded higher seed recovery (92%) with better seed quality.

Due to continuous breeding programme using elite lines, there is great advancement in development of chilli varieties and hybrids. Hence,

it is essential to recommend screen sizes based on varieties rather than crop as a whole.

Density grading is one of the important processing operations for upgrading the quality of seeds. Specific gravity and density of seeds govern germination and vigour [15]. In the present study chilli cv. *Byadagi* seeds were subjected to density grading by water floatation technique using sodium chloride solution of different concentrations (1.00, 1.02, 1.04 and 1.06 (gcc-1). Seed recovery, test weight, germination percentage and other seed quality parameters such as field emergence, speed of emergence, root length, shoot length, seedling dry weight, vigour index and germination after accelerated ageing (GAA) were found to differ among seed density grades (Table 2). Seed recovery was maximum (90%) in D_1 (1.00gcc-1) and decreased with increase in density of solution. The D_4 (1.06gcc-1) yielded poor seed recovery of 66%, whereas D_3 (1.04gcc-1) and D_2 (1.02gcc-1) recorded 75 and 83%, respectively. The test weight was maximum (7.44g) in D_4 (1.06gcc-1) which did not differ with D_3 (7.36g). Maximum germination (90%) and field emergence (83%) were produced by high-density seeds (D_4). The D_2 grade seed did not differ with D_3 grade seed for germination and other seed quality parameters except shoot length and vigour index.

Seed density grades differ significantly for root length, shoot length, seedling dry weight vigour index and speed of emergence. Maximum improvement in seed quality parameters was recorded with D_4 (1.06gcc-1) grade seeds, followed by D_3 (1.04gcc-1) and D_2 (1.02gcc-1) grade seeds. Selvaraj [16], Patil *et al.* [17] and Leffler & Williams [18] have made similar correlation studies between physical traits and seed quality. Similar results were reported in peas by Gorecki *et al.* [19]. Accelerated ageing results showed that the high (D_4) and medium density grades (D_3 and D_4) recorded higher accelerated ageing germination which indicated better storability. Better performance of dense seed has been reported in cabbage [20]. The presence or even absence of embryo may make little difference on total seed density. Better performance of heavier seeds was due to better availability and mobilization of food reserves.

Despite, better improvement in D_3 (1.04gcc-1) and D_4 (1.06gcc-1) density grades the seed recovery was as low as 75 and 66%, respectively. Thus, D_2 (1.02gcc-1) density grade seed which accounted for seed recovery of 83% is found to be ideal in upgrading *Byadagi* seeds by discarding low density fractions.

Table 2. Effect of seed density grades on seed quality parameters in chilli cv. *Byadagi*

Seed size grade	Seed recovery (%)	Test weight (g)	Germination (%)	Field emergence (%)	Speed of emergence (%)	Root length (cm)	Shoot length (cm)	Seedling dry weight (mg)	Vigour index	GAA (%)
D_1: 1.00gcc-1	90	7.08	84	78	7.97	4.78	9.55	3.16	1197	67
D_2: 1.02gcc-1	83	7.23	86	80	8.29	5.23	9.82	3.35	1291	70
D_3: 1.04gcc-1	75	7.36	88	81	8.64	5.47	10.36	3.52	1386	72
D_4: 1.06gcc-1	66	7.44	90	83	9.43	5.71	10.76	3.66	1487	73
D_0: Control	100	6.28	78	72	7.39	3.60	6.75	3.02	805	60
Mean	83	7.08	85	79	8.34	4.96	9.45	3.34	1233	68
S.Em±	1.92	0.05	1.03	1.11	0.14	0.13	0.14	0.49	17.54	1.41
CD (0.05p)	6.0	0.15	3.0	3.0	0.44	0.38	0.43	0.15	53.0	4.0

GAA, Germination after 4 days accelerated ageing (%)

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