Original Research Article

Standardization of screen aperture size for grading of dhaincha

Abstract

An experiment was conducted to standardize the sieve size for seed grading in dhaincha during *Kharif*,2019-20 and 2020-21. The dhaincha local variety was processed using S_1 - 1.4 mm (S), S_2- 1.6 mm (S), S_3- 1.8 mm (S), S_4 - 2.0 mm (S) and S_5- 2.2 mm (S) of slotted perforatedmetal sieveswith CRD design. The study revealed that larger sized seeds are obtained from 2.0 mm and 2.2 mm sieves with maximum seed quality parameters. Seed recovery percentage in 1.4 mm sieve was higher than other sieves and also quality of seeds obtained in 2.2 mmsieves was higher than the Minimum Seed Certification Standards. The graded seeds obtained from the sieve 2.0 mm recorded the higher seed recovery (92.99 %), physical purity (98.46 %), pure live seed (90.37 %), test weight (26.16 g), germination (81.63 %), total seedling length (25.2 cm), seedling dry weight (14.4 mg), seedling vigour index-I (2103) and seedling vigour index-II (1174) in pooled mean data of both years. Hence, grading of dhaincha seeds with 2.0 mm sieve is more effective and economical than 2.2 mm sieve. Using the sieve of 2.0 mm (S), higher recovery of good seed with germination percentage and physicalpurity percentage above acceptable limits of Indian Minimum Seed Certification standard(IMSCS) can be obtained.

Keywords: Dhaincha, sieve size and grading

Introduction

Green manuring is a time-honored farming practice for maintaining soil fertility. The green revolution, on the other hand, has expanded the use of chemical fertilizers while marginalizing the usage of green manures in intensive crop production. This can be seen in the shrinking area beneath green manure crops over time. In India, green manure crops are reported to cover 1.23 million hectares (Anon., 2015).Increased fertilizer use with subsidized pricing has transformed India from a food-scarce region to one of food security, but organic manure use, especially green manure crops, has decreased significantly. Inorganic fertilizers have recently become more expensive, and soil productivity sustainability has become fashionable. Green manure crops are a low-cost and effective method of reducing fertilizer costs while also protecting soil health and productivity. Almost all green manure crops, whether utilized in-situ or ex-situ, contain all of the plant nutrients necessary for improving crop growth and maintaining soil health.

Among the green manure crops dhaincha (*Sesbania aculeata*) is one of the most important green manure crop. The ease of establishment, fast growth leading to accumulation of large quantity of biomass, rich in nutrients especially nitrogen in short period and quick decomposition upon incorporation in paddy (puddle rice lands) can release nutrients as per the need of rice crop made dhaincha the most widely grown green manure crop. Further, it is promising for cultivation in salt affected ill drained soils and areas with higher rainfall (Parlawar *et al*., 2003).

Seed processing is critical in scientific seed production because it preserves the physical integrity of seeds while also allowing for the recovery of ideal sized seeds for uniform crop establishment and growth.

Seed size is a key determinant of seed vigour because it affects seed performance in soil. Although the seed mass after harvest contains a wide range of seed sizes, not all of them are equally valuable for planting. Farmers have long recognized the importance of utilizing homogeneous, high-viability seeds to achieve high emergence and growth. There is no recommended sieve size for sorting dhaincha seed at this time. The current grading process attempts to exclude non-viable seeds so that sound, disease-free seed of uniform size is accessible for planting, resulting in optimal plant population and increased yields.

One of the requirements in the Minimum Seed Certification Standard (MSCS) for seed approval by the Indian government is the determination of the best sieve size and kind of screen. The sieve size recommended for processing various agricultural seeds under the minimum seed certification standard appears to be more general and unsuitable for all newer types, resulting in low seed recovery (Anon., 1998). There is a pressing need to standardize the sieve size for grading dhaincha seed, as it is frequently noted that seed growers are losing a significant amount of good seed that is classified as a rejection. Given the high demand from farmers for certified soybean seed, this is an essential necessity.

Comment [DR1]: Combine the paragraph

Comment [DR2]: Soybean?

As a result, the current study on standardizing sieves for grading dhaincha seed was planned and undertaken.

Materials and methods

The field experiment was conducted to standardize the nipping technique for enhancement of seed yield and quality in dhaincha. Freshly harvested bulk seed of dhaincha harvested from National Seed Project (Crops), Seed Block, UAS, Raichur were used for conducting the experiment. The seeds were dried under shade to bring down the initial seed moisture content to around 9 per cent. A laboratory experiments was conducted to standardize of theseed aperture size for grading of dhaincha seeds at Seed Quality Assurance and Research Laboratory, Seed Unit, University of Agricultural Sciences, Raichur during2019-20 and 2020-21.The seeds were graded using five different sieve sizes.

Comment [DR3]: Where is it?

The experiment was laid out in Complete Randomized Design with four replications to impose treatments i.e., S_1- 1.4 mm (S), S_2- 1.6 mm (S), S_3- 1.8 mm (S), S_4- 2.0 mm (S) and S_5- 2.2 mm (S) screen aperture sizes. The seeds obtained from different sieves were assessed for various seed quality seed parameters.

Seed recovery

The seed recovery percentage was calculated as follows:

$$\text{Seed recovery (\%)} = \frac{\text{Total weight of graded seeds}}{\text{Total weight of bulk seeds}} \times 100$$

Physical purity

The physical purity (%) was calculated by using formula,

$$\text{Physical purity (\%)} = \frac{\text{Weight of pure seed fraction}}{\text{Weight of the components}} \times 100$$

Pure live seed

The percentage of pure live of seed was calculated by using the formula,

$$\text{Pure live of seed (\%)} = \frac{\text{Germination (\%) x Physical purity (\%)}}{100}$$

Test weight

From the seeds taken out from each replication treatment wise, one thousand seeds were drawn randomly from all the four replications and weighed. The mean weight of the sample was recorded as thousand seed weight and expressed in grams.

Germination

The germination test was conducted in the laboratory by using between paper method (Anon., 2014). One hundred seeds in four replicates were placed on germination paper and rolled towels were incubated in germination chamber maintained at 25 ± 1 °C and 90 per cent relative humidity. The germinated normal seedlings were evaluated on eighth day and the percentage germination was expressed in percentage.

$$\text{Germination (\%)} = \frac{\text{No. of normal seedlings}}{\text{Total no. of seeds}} \text{ X } 100$$

Total seedling length

Total seedling length was calculated by adding shoot and root length of ten normal seedlings which were randomly selected from each treatment and replication on the day of final count and the average was expressed in cm.

Seedling dry weight

From the seeds kept in laboratory for germination test, using between paper method, ten seedlings were selected for shoot and root length measurement were used for recording seedling dry weight. The seedlings were dried in a hot air oven maintained at 70± 1^{0}C for 24 hours and cooled in a desiccator. The mean seedling dry weight was recorded and expressed in mg per seedling (Evans and Bhatt, 1977).

Seedling vigour index (SVI)

Seedling vigour index-I

Seedling vigour index-I was recorded by multiplying standard seed germination percentage and mean seedling length. It was computed by adopting the formula given by Abdul Baki and Anderson (1973) and expressed as whole number.

$$\text{SVI} - \text{I} = \text{Germination (\%) x Mean seedling length (cm)}$$

Seedling vigour index-II

Seedling vigour index-II was recorded by multiplying standard germination percentage and seedling dry weight.

$$\text{SVI} - \text{II} = \text{Germination (\%) x Mean seedling dry weight (mg)}$$

The statistical analysis and the interpretation of the experimental data was done by using Fischer method of Analysis of Variance technique as outlined by Gomez and Gomez (1984). The level of significance used in F test was 1 per cent for laboratory experiment.

Results and discussion

The purpose of grading is to improve the homogeneity of the seed lot by removing seeds of the same species with low quality. During size grading, the small seeds are discarded which are believed to include empty, underdeveloped and low vigour seeds. Among the different sieve sizes, highly significant variation was observed for almost all the characters under study. The importance of seed size has been reported by Menaka and Balamurugan (2008).

Grading is one of the important post harvest management techniques that homogenize the seed lot resulting in uniform germination with higher planting value (Suma et al., 2014).

Seed size exerted a significant influence on the seed recovery, test weight, physical purity, pure live seed, germination, total seedling length, seedling dry weight and seedling vigour index (Table 1, 2 and 3).

Seed recovery

Scrutiny of the data on seed recovery (%) presented in Table 1 shows that seed recovery (%) was significantly influenced by different screen size during 2019-20 and 2020-21 and pooled data of two years.

The pooled mean data for two years indicated that, seeds retained on S_1(1.4 mm slotted) showed maximum seed recovery (98.18 %) followed by S_2 (1.6 mm slotted) (97.91 %) and the lowest (87.95 %) was in S_5 (2.2 mm slotted). Similar trend was noticed in 2019-20 and 2020-21.

From the above results seed recovery was significantly influenced by different sieve sizes. The seeds graded with 1.4 mm slotted sieve size recorded higher seed recovery (%) compared to seeds graded with 1.6, 1.8, 2.0 and 2.2 mm slotted sieves. The reduction in seed recovery in 1.8, 2.0 and 2.2 mmslotted sievesis due to increase in screen aperture size which led to removal of small or undersized seeds and unwanted materials keeping good and bold seeds at top of the screen. As the screen size decreased from 2.2 to 1.4 mm, the per cent seed recovery increased. This is in conformity with the findings of Anuradha *et al*. (2009) in chickpea, Ganiger *et al*. (2016) in greengram and Kausal *et al*. (2008) in soybean.

Physical purity and pure live seed

The results on physical purity and pure live seed (%) exhibited a significant differences as influenced by different screen aperture sizes during 2019-20 and 2020-21 are presented in Table 1.

Seeds retained on S_5 (2.2 mm slotted) showed the highest physical purity (99.16 %) and pure live seed (83.78 %) followed by S_4 (2.0 mm slotted) (98.46 and 80.37 %) and the lowest was in S_1 (1.4 mm slotted) (95.47 and 68.69 %) in pooled mean data of two years. The similar trend was noticed in 2019-20 and 2020-21.

From the above results it was revealed that the physical purity differed significantly due to influence of different screen sizes. Significantly higher physical purity was recorded in, processed seeds i.e., seeds retained on sieves S_5 (2.2 mm slotted) and S_4(2.0 mm slotted) as compared to S_1 (1.4 mm slotted), S_2 (1.6 mm slotted) and S_3 (1.8 mm slotted) due to effective processing (Fig. 1). Further, all the impurities were removed and whereas the seeds retained on smaller screens had impurities so less physical purity was observed. Similar observations of improved physical purity have been reported by Ganiger *et al.* (2016) in greengram and soybean.

Test weight and germination

Test weight (g) and germination (%) as influenced by different screen sizes was found to be differ significantly (Table 2 and Fig. 2).

In pooled mean data of two years, highest test weight and germination (27.20 g and 84.47 %)was recorded in seeds retained on S_5 (2.2 mm slotted) and the lowest test weight was recorded in S_1 (1.4 mm slotted) (22.32 g and 71.94 %), respectively. Similar trend was recorded in 2019-20 and 2020-21.

From the above obtained results, the seeds retained on 2.2 mmslotted screen were larger in size and gave higher test weight and seed germination (Plate 1) which may be due to undesirable materials, low graded seedsare dropped through screens and retaining only goodgraded seeds which has better reserve food material available in the storage tissues. These results are in conformity with findings of Dharmalingam and Ramakrishnan (1978) in black gram, Kausal *et al.* (1993) in sorghum and greengram, Negi *et al*. (1988) in soybean, Paul *et al*. (1997) in mustard, Vishwanth*et al*. (2006) in french bean, Kausal *et al*. (1993) in sorghum and greengram and Raghavendra Rao *et al*. (1993) in sorghum.

Total seedling length and seedling dry weight

The data on total seedling length (cm) and seedling dry weight (mg) as influenced by different screen aperture sizes during 2019-20 and 2020-21 and pooled data of two years are presented in Table 3.

The total seedling length and seedling dry weight differed significantly among different screen sizes and maximum total seedling length and seedling dry weight (26.3 cmand 15.3 mgmg) was recorded in S_5 (2.2 mm slotted). Whereas the S_1 (1.4 mm slotted) recorded the lower shoot length (21.3 cmand 11.1 mg) in pooled data of two years. Similar trend was noticed in 2019-20 and 2020-21.

Total seedling length and seedling dry weight was recorded highest in seeds which were retained on large screen size i.e. 2.2 mm slotted (Plate 2). While, the lowest was recorded in small screen size of 1.4 mm slotted. This may be due to adequate quantity of reserve food material in the small to medium sized seeds endosperm and better supply of food to the embryo for a long period of time which helped for higher mobilization efficiency of reserve food material during germination leading to more number of cells per cotyledon in the form of reserve food resulting in increased root, shoot length (Guldan and Brun, 1985). As there has been better seedling growth, which might have led to an increase in mean seedling dry weight and similar results were also documented by Sudeep Kumar *et al.* (2010) in fieldbean.

Seedling vigour index

The data on seedling vigour indexas influenced by different screen aperture sizes during 2019-20 and 2020-21 and pooled data of two years are presented in Table 4 which differed significantly among the treatments.

Seedling vigour index I

Seedling vigour index I as influenced by different screen aperture size was found to be differed significantly in 2019-20 and 2020-21 and pooled data of two years.

Screen sizes influenced seedling vigour index I and significant difference was observed between the treatments. Significantly higher (2225) seedling vigour index-I was recorded in S_5 (2.2 mm slotted). Whereas the S_1 (1.4 mm slotted) recorded least seedling vigour index-I (1561) in pooled mean data of two years. Similar trend was noticed in 2019-20 and 2020-21.

Seedling vigour index II

In pooled mean data of two years. The higher seedling vigour index II (1292) was recorded in S_5 (2.2 mm slotted). Whereas the S_1 (1.4 mm slotted) recorded the significantly lowest seedling vigour index II (795). Similar trend was noticed in 2019-20 and 2020-21.

Conclusion

The study inferred that, a sieve size of 2.0 (S) mm registered seed recovery of (92.99 %), physical purity (98.48 %), germination (81.63 %), test weight (26.16 g), pure live seed (90.37 %), total seedling length (25.2 cm), seedling dry weight (14.4 mg) and seedling vigour index-I and II (2103 and 1174) which is above the minimum seed certification standards. Hence the dhaincha can be processed using 2.0 mm (S) grading sieve for better seed recovery and quality.

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Table 1. Seed recovery, physical purity and pure live seed as influenced by different screen sizes in dhaincha

Treatments	Seed recovery (%)			Physical purity (%)			Pure live seed (%)		
	2019	2020	Pooled	2019	2020	Pooled	2019	2020	Pooled
S_1 (1.4 mm)	98.92	98.28	**98.18**	95.77	95.18	**95.47**	67.61	69.76	**68.69**
S_2 (1.6 mm)	98.44	97.92	**97.91**	96.48	96.43	**96.46**	71.63	72.87	**72.25**
S_3 (1.8 mm)	96.05	96.33	**95.33**	97.49	97.48	**97.49**	74.34	75.55	**74.94**
S_4 (2.0 mm)	94.08	94.03	**92.99**	98.47	98.46	**98.46**	79.50	81.25	**80.37**
S_5 (2.2 mm)	86.35	87.66	**87.95**	99.21	99.11	**99.16**	83.65	83.91	**83.78**
Mean	**94.77**	**94.84**	**94.47**	**97.48**	**97.33**	**97.41**	**75.35**	**76.67**	**78.01**
S.Em±	0.59	0.66	0.31	0.37	0.28	0.39	1.34	1.19	0.94
CD at 1 %	2.24	2.51	1.16	1.55	1.18	1.62	5.60	4.97	3.90

Table 2. Test weight and germination as influenced by different screen sizes in dhaincha

Treatments	Test weight (g)			Germination (%)		
	2019	2020	Pooled	2019	2020	Pooled
S_1 (1.4 mm)	21.99	22.45	**22.22**	70.58	73.30	**71.94**
S_2 (1.6 mm)	23.93	24.34	**24.13**	74.20	75.59	**74.89**
S_3 (1.8 mm)	25.30	25.37	**25.34**	76.27	77.51	**76.89**
S_4 (2.0 mm)	26.28	26.04	**26.16**	80.72	82.54	**81.63**
S_5 (2.2 mm)	27.21	27.19	**27.20**	84.28	84.66	**84.47**
Mean	**24.94**	**25.08**	**25.01**	**77.21**	**78.72**	**77.96**
S.Em±	0.33	0.40	0.36	1.02	1.14	0.30
CD at 1 %	1.39	1.69	1.51	4.26	4.76	1.24

Table 3. Total seedling length and seedling dry weight as influenced by different screen sizes in dhaincha

Treatments	Total seedling length (cm)			Seedling dry weight (mg)		
	2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
S_1 (1.4 mm)	21.3	21.3	**21.3**	10.9	11.2	**11.1**
S_2 (1.6 mm)	24.1	23.4	**23.8**	11.8	12.2	**12.0**
S_3 (1.8 mm)	24.6	23.7	**24.1**	13.3	13.7	**13.5**
S_4 (2.0 mm)	25.5	24.9	**25.2**	14.4	14.3	**14.4**
S_5 (2.2 mm)	27.7	26.2	**27.0**	15.3	15.2	**15.3**
Mean	**24.6**	**23.9**	**24.3**	**13.1**	**13.3**	**13.2**
S.Em±	0.3	0.2	0.2	0.2	0.3	0.2
CD at 5 %	1.2	0.7	0.8	0.7	1.2	0.9

Table 4. Seedling vigour index as influenced by different screen sizes in dhaincha

Treatments	Seedling vigour index-I			Seedling vigour index-II		
	2019	**2020**	**Pooled**	**2019**	**2020**	**Pooled**
S_1 (1.4 mm)	1550	1572	**1561**	769	821	**795**
S_2 (1.6 mm)	1732	1778	**1755**	877	923	**900**
S_3 (1.8 mm)	1855	1848	**1851**	1013	1029	**1021**
S_4 (2.0 mm)	2131	2075	**2103**	1166	1181	**1174**
S_5 (2.2 mm)	2211	2239	**2225**	1294	1290	**1292**
Mean	**1896**	**1902**	**1899**	**1024**	**1049**	**1036**
S.Em±	32	30	21	27	8	15
CD at 5 %	132	126	63	115	34	61

Plate 1. Germination (%) as influenced by different screen sizes in dhaincha

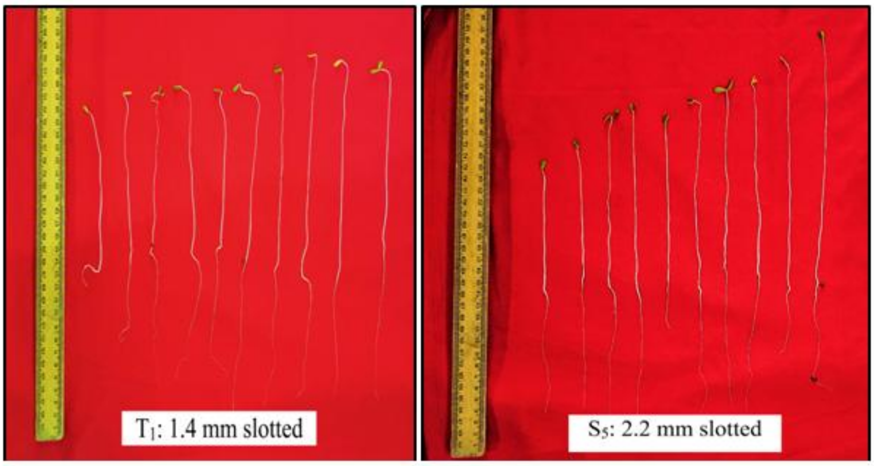

Plate 2. Total seedling length(cm) as influenced by different screen sizes in dhaincha

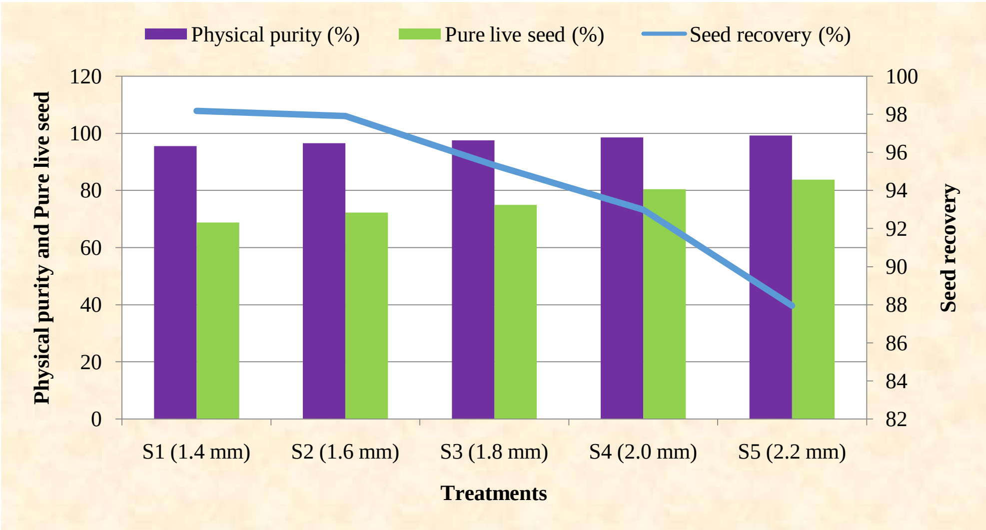

Fig. 1. Seed recovery, physical purity and pure live seed as influenced by different screen sizes in dhaincha

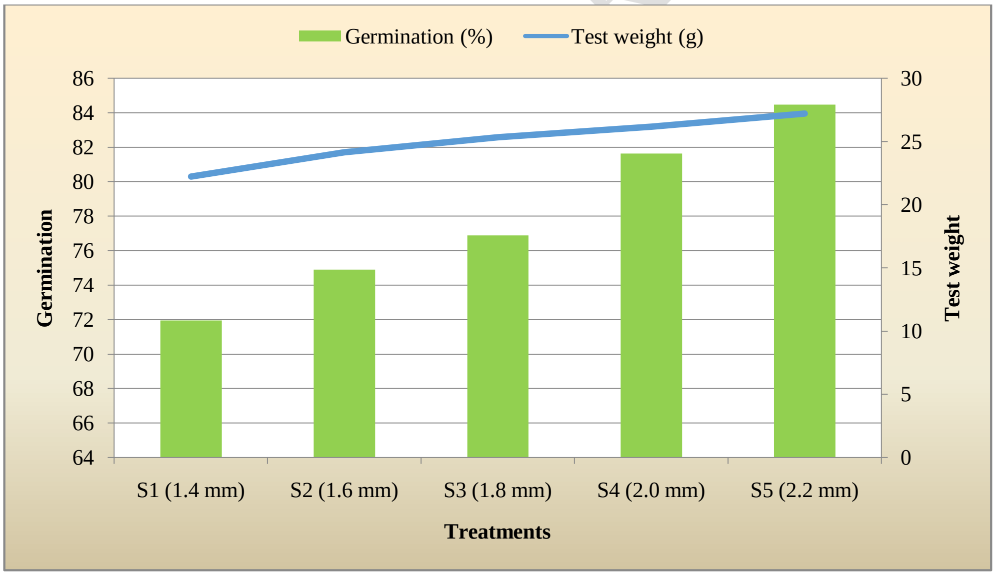

Fig. 2. Germination and test weight as influenced by different screen sizes in dhaincha