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Original Research Article

Standardization of Sieve Size for Seed Grading in Soybean

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A B S T R A C T

An experiment was conducted to standardize the sieve size for seed grading in soybean *cv.* JS-335 seeds using 3.75mm, 4.00mm, 4.25mm, 4.5mm and 4.75mm of slotted perforated metal sieves. The study revealed that larger sized seeds are obtained from 4.5mm and 4.75mm sieves with maximum germination and seedling vigour. Seed recovery percentage in 3.75mm sieve was higher than other sieves and also quality of seeds obtained in 3.75mm sieves was higher than the Minimum Seed Certification Standards. The graded seeds obtained from the sieve 3.75 mm recorded the highest recovery (83.90%), physical purity (98.49%), germination (75.00%), 100 seed weight (15.685 g), pure live seed (74.11%) and vigour index (2826). Hence, grading of soybean *cv.* JS-335 with 3.75mm sieve is more effective and economical than presently recommended 4.0 mm sieve. Using the proposed sieve of 3.75mm, higher recovery of good seed with germination percentage and physical purity percentage above acceptable limits of Indian Minimum Seed Certification standard (IMSCS) can be obtained.

Keywords

Soybean, JS-335, grading, sieve size, seed recovery (%)

Introduction

Seed as produced on the field may not be in a state to maintain its viability until the next sowing season. It is of critical to ensure that the seed at sowing time is as good as it was at harvest time. Many factors influence seed viability like seed moisture content and is dependent on the weather during after harvest. However, even if it is dry enough, seed in the condition in which it left the thresher or combine harvester is not fit for sowing and series of process needs to be fulfilled before supplying seeds to the end user. The most important operations are seed processing, seed treatment and packaging. These operations need to be combined with

drying and storage under integrated control and together they are known as seed processing. For seed quality control, the identity of seed must be retained all the way through from harvesting to sowing and this predominantly imperative during various stages of seed processing. Seed as it leave the thresher or combine-thresher includes undesirable material which has to be removed. This can be achieved by adopting proper seed grading sieve without affecting seed quality and avoiding excess seed rejections.

Soybean is a rich source of protein and oil content together account for 56% of dry soybeans weight (36% protein and 20% fat). Globally, area under soybean cultivation is around 121 million hectares and five major producing countries (USA, Brazil, Argentina, India and China) account for more than 85% of global soybean area and 88.5% of production (Purushottam Sharma and Ram Manohar Patel, 2017). The total soybean production in India is 11.000 In Million Metric Tons during 2018-19 (http://www.sopa.org). The average national productivity in India is 738 kg/ha [*Anon*., 2015].

One of the major problems encountered in soybean production is lack of good quality seeds. Although seed quality is governed by their genetic make-up, the quality of seeds however, is deteriorated during storage period (Barua *et al.*, 2009). Seed size is an important parameter of seed vigour as it influences the performance of seed in soil. The poor quality seeds may be due to poor handling of seed during postharvest time lead to poor and erratic field emergence and failure of seedling establishment in the field which subsequently results into low productivity. Use of proper sieves for obtaining maximum seed recovery with higher seed quality is an important objective of seed processing. Though, sieve sizes for soybean processing recommended, many times it needs to be changed with release of new varieties. Sometimes, the production conditions are such that, the seed produced will have varying sizes. If such seeds are processed with recommended sieves, it may lead to rejection of lot of seeds, which may otherwise be of good quality and vice-versa. Therefore, it is desirable to determine the optimum size of seed that promote better germination, growth, vigour and yield. At present the sieve size of 4.0 mm has been suggested by Seed Certification Agency to process the soybean seeds and it is based on old varieties. It is often observed that the seed growers are loosing considerable quantity of good seed which is treated as a rejection. Hence the present research on standardisation of optimum sieve size for grading of soybean seeds was undertaken.

Materials and Methods

The experiment was conducted at National Seed Project (Crops) Seed Unit, University of Agricultural Sciences, Raichur. The unconditioned seeds of soybean cv. JS-335 harvested from the crop raised at Seed Unit, Agricultural Research Station, Bidar constituted the material for study. For grading the seeds "Cleaner cum grader" having two screens and one fan were used. The Seeds retained over each sieve size were collected separately and tested for quality parameters *i.e.* recovery percentage and physical purity percentage (ISTA, 1993), 100 seed weight (ISTA, 1999) was expressed in gram. The graded seeds were tested for seed recovery percentage, germination percentage, physical purity percentage, 100 seed weight (g). The unprocessed seeds of soybean cv. JS-335 were graded with slotted hole sieve of 3.75 mm, 4.00 mm, 4.25 mm, 4.50 mm and 4.75 mm size. A sieve of 8.0 mm (r) were used as a top screen.

Size grading

The seeds were graded with slotted sieves of size *viz*., 3.75 mm, 4.00 mm, 4.25 mm, 4.50 mm and 4.75 mm.

The seeds retained on the sieves were analyzed for seed recovery percentage and for the other seed quality parameters.

Seed recovery (%)

The weight of seeds retained in each sieve was recorded and seed recovery was calculated in percentage using the following formula

$$\text{Seed recovery (\%)} = \frac{\text{wight of seeds retained in each sieve}}{\text{Total wight of seeds}} \text{ X } 100$$

Test weight (100 seed weight in gram)

Four replicates of hundred seeds were drawn from each treatment, weighed in sensitive electronic balance and expressed in grams (ISTA, 1999).

Germination (%)

In the standard germination test four replicates of hundred seeds were placed within two sheets of standard weight of germination paper moistened with deionized water.

The germination paper was rolled and placed upright in a walk in germinator at 25° ± 1°C and 95° ± 3 per cent relative humidity maintained in a germination room. After the test period of seven days, the normal seedlings were counted and the mean values expressed as percentage (ISTA, 2013) to the total number of seeds placed for germination.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds placed for germination}} \text{X } 100$$

Seedling vigour index

The seedling vigour index values were computed, adopting the procedure of Abdul Baski and Anderson (1973) as given below and expressed as whole number.

Seedling Vigour Index (SVI) = Germination (%) x Total seedling length (cm)

Pure live seed percentage

Was calculated using following formula:

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

The experiment was laid out in a completely randomized design with four replications. The results were subject to analysis of variance and expressed at 1% level of probability. The data in percentage were analysed using data transformed Arcsine square root. Statistical analysis was done based on the procedure prescribed by Panse and Sukhatme (1978).

Results and Discussion

Quality seed is major input in increasing the productivity of agricultural crops. Seed after harvesting contains many undesirable materials like seeds of other crops, weed seeds, immature seeds, damaged seeds, seeds which are too small or too large, plant materials and other inert matters. Some of this material is not positively harmful, but tends to hold moisture and adds to the bulk of material that has to be handled and supplied. Moreover, if the farmer is to be persuaded to pay for high quality seed, the seed he buys must be undeniably be pure and flow without difficulty through planter or drill. To separate these different kinds of material, many equipments have been developed which

exploit the differences between the physical characteristics of the various components of the seed mixture. The most important differences are in size, shape and density. Separations based on these characteristics are made by perforated screens and by modifiable air blasts. The screens are made of sheet metal or of woven wire mesh, and the holes may be rectangular, round, or triangular in shape. Seed cleaning usually requires a succession of operations and these can be regarded as proceeding in three stages viz. pre-cleaning, basic cleaning and separation and grading.

Seed grading is an integral part of seed production for enhanced planting value. In addition to obtain uniform seed size within a variety, size grading is essential. Seed size exerted a significant influence on the seed recovery, 100 seed weight, germination (%), seedling vigour index, pure live seed and physical purity (%) (Table 1). The seed recovery ranged from 70.85 per cent to 83.90 per cent among the size grades. The recovery of larger size seeds (seeds retained on 4.75mm sieve) was 70.85 per cent while the recovery of medium sized seeds retained in 3.75mm sieve was 83.90 per cent. As the screen size decreased from 4.75 to 3.75 mm, the per cent seed recovery was increased (67.35 to 88.90) (Fig. 1). This is in conformity with the findings of Anuradha *et al.,* (2009), Kumar *et al.,* (2014) and B. S. Ganiger *et al.,* (2016) in green gram.

Physical purity exhibited non-significant difference between different sieve size. However, highest physical purity percentage was recorded in sieve size 4.75mm (98.68) followed by 4.5mm (98.58).

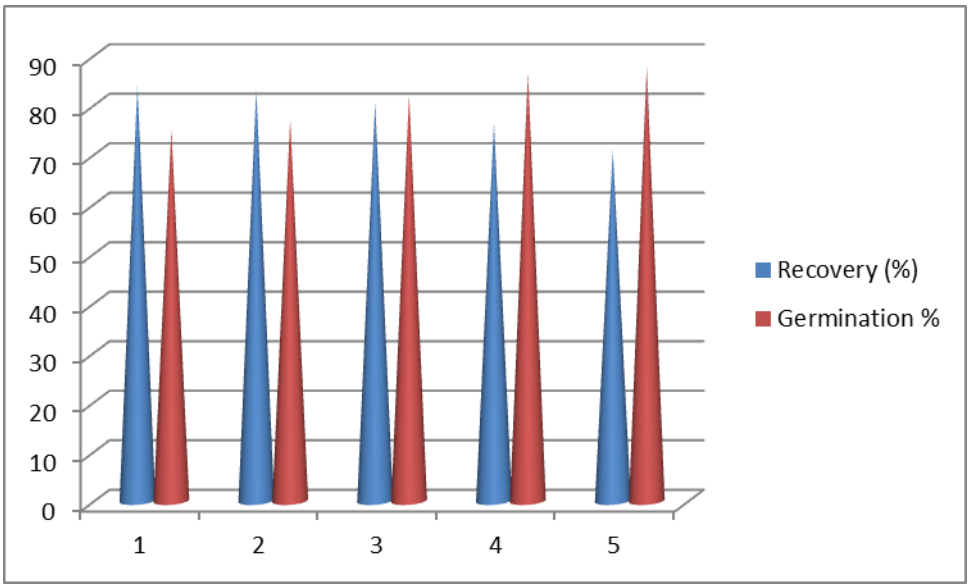
Pure live seed percentage displayed non-significant difference but highest pure live seed percentage was recorded in 4.75mm (86.59) followed by 4.5mm (85.27). Similar observations of improved seed recovery and quality have been reported by many workers (Hanumantharaya, 1991; Ramaiah, 1994 and Ganiger *et al.,* 2016).

Table.1 Effect of sieve size on seed quality of Soyabean cv. JS-335

Treatments	Recovery (%)	Physical purity (%)	Germination (%)	100 seed weight (g)	Vigour index	Pure live seed (%)
(S_1) 3.75mm	**83.90 (66.34)**	**98.49 (82.94)**	**75.00 (60.18)**	**15.685**	**2826**	**74.11 (59.43)**
(S_2) 4.0 mm	82.95 (65.61)	98.52 (83.01)	77.00 (61.53)	15.776	3033	76.10 (60.75)
(S_3) 4.3 mm	80.55 (63.85)	98.55 (83.08)	82.00 (64.83)	15.840	3226	80.69 (63.95)
(S_4) 4.5 mm	76.35 (60.92)	98.58 (83.16)	86.50 (68.54)	15.904	3546	85.27 (67.51)
(S_5) 4.75 mm	70.85 (57.32)	98.68 (83.40)	87.75 (69.55)	16.869	3732	86.59 (68.55)
	S	S	S	S	S	S
SeM	0.48	0.06	0.87	0.12	94.62	0.83
CD @ 1%	1.99	0.23	3.61	0.49	394.29	3.44

*Values in parenthesis indicates the arc sine values

Fig.1 Influence of size grading on seed recovery (%) and seed germination (%) in soybean cv. JS-335



The evaluated seed quality characters of the present study revealed that seed size had positive association with seed weight, the hundred seed weight observed with different sieve size exhibited a reduction with decrease in size of sieve. The highest hundred seed weight was recorded in 4.75mm (16.869g) and least in 3.75mm (15.685g) sieve size seeds. The positive association of seed size and seed weight was reported by B. S. Ganiger *et al.,* (2016) in greengram, Kumar *et al.,* (2005) in Indian mustard and Suma *et al.,* (2014) in sesame where in seed size and seed weight was positively related.

Germination percentage

Germination percentage in all different sieve sizes was greater than 80 and Germination values increase by increase in seed size and they were in the range of 75-87.75%. Significant differences were unveiled in standard germination test (Fig. 1). The seeds retained on 4.75mm sieve recorded highest germination (87.75%) followed by 4.5mm (86.50%) and least in 3.75mm sieve (75.00%), germination percentage which is above the minimum seed certification standards. Jerlin *et al.,* (2004) in pongamia reported a non-significant difference in germination between the larger and medium sized seeds. This is in confirmatory with research findings of Gunaga *et al.,* (2007) in white dammer. The higher potential of larger and medium sized seeds might due to the initial capital and more amount of nutrients available for germination as stated by Ashby (1936). The higher germination in large seeds may due to higher amount of food reserves and increased activity of redox enzymes in the seeds helping in breaking down the complex food reserves into simple soluble sugars (Gurbanov and Berth, 1970).

Seedling vigour index recorded meagre difference between different sieve size seeds and seedling vigour index was highest in 4.75mm and least in 3.75mm sieve size seeds. But Nachimuthu (1997) in gingelly and Ganiger *et al.,* (2016) in greengram reported that seed size, seed weight and seed quality characters are positively related to each other. All the evaluated vigour

parameters exhibited a significant reduction with large, medium, smaller sized seeds. Pollock and Roos (1972) reported that larger seeds possessed more vigour than smaller seeds due to the presence of more of food material. Rajesekaran (2001) in niger also observed that seedling vigour characteristics were positively correlated with seed size and seed weight.

Thus, the study inferred that, a sieve size of 3.75 (S) mm registered recovery of 83.90%, Physical purity (98.49%), germination (75.00%), 100 seed weight (15685 gm), pure live seed (74.11%) and vigour index (2826) which is above the minimum seed certification standards. Hence the Soybean cv. JS-335 can be processed using 3.75 mm (S) grading sieve for better seed recovery and quality.

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