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Seed quality improvement in okra through specific gravity separation

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ABSTRACT

A study was conducted to assess the efficiency of specific gravity separator in removing partially filled/chaffy seeds of okra during 2007 and 2008. Bulk seed, after extraction, was first subjected to an air screen cleaner with three screens. Then, the good seed fraction obtained was subjected to specific gravity separation. Three fractions were obtained, viz., heavy, medium and light and they were assessed for quality, along with ungraded seed. Test weight, germination percentage, first count, seedling vigour indices I & II and field emergence were significantly higher in the heavy seed fraction than in ungraded seed. Black seed content in heavy seed fraction was significantly low, thereby improving seed quality. Rejection percentage in terms of light and medium seed fractions put together was 3.5% and 12% in 2007 and 2008, respectively. By removal of these fractions, percentage of field emergence improved from 63% to 82% in 2007, and 62.8 to 76.4% in 2008, respectively.

Key words: Okra, specific gravity separation, seed quality, black seed

INTRODUCTION

Good quality seed can be obtained consistently with efficient use of processing machines, irrespective of seed-quality of a harvested seed lot. Several seed-processing equipments are available to improve quality of the seed-lot, but, potential of these machines has not been exploited fully. In many of the seed processing plants, just an air-screen cleaner is operated owing to lack of information on other equipment as to how and to what extent seed quality can be upgraded using such equipment. Specific-gravity separator is one such equipment which separates seeds based on their density. Its potential has not been fully exploited by many involved in seed-processing. Many vegetable seed-lots consist of under-developed/chaffy seeds similar in size to normal, well-developed seeds. These are difficult to remove by an air-screen cleaner. During a survey conducted by the authors in Ranebennur, Karnataka - the hub of vegetable seed production activities in India, some seed companies expressed that light and black seeds present in okra seed-lots lead to poor germination percentage and these cannot be removed by air-screen cleaning. Hence, a study was taken up to assess the feasibility of using specific-gravity separator in okra for separating chaffy seeds from good seeds.

MATERIAL AND METHODS

Fresh seeds of okra cv. Arka Anamika were produced in *Kharif* season of 2007 and 2008 at IIHR, Bangalore. After threshing, bulked seeds were subjected to air-screen cleaning (with three screens, Westrup model). The good-seed fraction collected here was subjected to specific-gravity separation using Westrup gravity separator. Seeds were fed into the oscillating deck inclined to a side tilt of 2.5 degrees and rear-end tilt of 3.25 degrees, running on Eccentric Speed of 450 rpm. This set-up was found to be suitable for okra. The deck had four outlets from. The first outlet (present opposite the inlet) was adjusted such that the deck was completely covered with seeds, with a distinct density gradient. Seeds moving upstream of the deck were collected separately at the second outlet and these belonged to the heavy seed-fraction. Seeds from the first outlet were combined with this second fraction as these were free of extraneous matter. Seeds collected from the lower end of the deck, i.e., fourth outlet, constituted the light seed-fraction. Seeds collected from the middle spout, i.e., the third outlet consisted of heavy, medium and light seeds. These were again subjected to gravity separation. This recycling of the middle fraction continued until all the heavy seeds present in this fraction were separated, and were passed through a second outlet meant for the heavy seed-fraction. Finally, all three (heavy, medium and light) seed-fractions were collected separately, weighed and subjected to quality-assessment which consisted of 100 seed weight, number of black seeds (%), weight of black seeds (%), first count (%), laboratory germination (%), seedling vigour index I and II, and field-emergence.

Normal okra seeds are greenish in appearance. Seeds that were black in appearance were counted from a representative sample and expressed, in both number and weight basis, as percentage. Seed germination test was conducted as per ISTA (1976) procedures. Five replications of 100 seeds each were tested by the roll paper method. The first count was taken on 4th day, and the final germination on 12th day. Seedling vigour index I was calculated by multiplying germination % with seedling length. Seedling vigour index II was calculated by multiplying germination % with seedling dry weight. Field-emergence was tested by planting seeds on a raised nursery bed in open field. Five replicates of 50 seeds each were planted, and seedling emergence was recorded on 21st day after sowing. Data were analyzed using Analysis of Variance (ANOVA) for Completely Randomized Design, and means were compared using Least Significant Difference (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Test weight of three fractions obtained from specific gravity separation, viz., heavy, medium and light, was 7.79, 6.23 and 4.14g, respectively, in the year 2007. Black seed content (by number as well as weight) reduced significantly from about 4% in air-screen cleaned seed to about 1% in the heavy-seed fraction. Highest germination (96.4%) was observed in the heavy-seed fraction and was 9.6% higher than ungraded seeds (i.e., good-seed fraction from the air-screen cleaner). Hardly any germination was seen in the light-seed fraction, while, only a few seeds (17%) produced normal seedlings in the medium fraction. Seed vigour, expressed in as the first count (73.6 %), vigour indices I (3694) and II (1633) was highest in the heavy-seed fraction than in the air-screen graded seed. Total rejection, including medium and light fractions was around 3.5%. By rejecting these seeds, germination rate could be improved from 86.6% to 96.4%, and field-emergence from 63.3% to 82.0% (Table 1).

The experiment was repeated for confirmation, in the year 2008. Test weights of heavy, medium and light seed fractions were 7.34, 5.77 and 4.69 g, respectively (Table 2). Highest germination rate (89.6%) was observed in the heavy-seed fraction and was 10% higher than in the

Table 1. Various fractions of seeds obtained by specific gravity separation and their effect on seed quality in okra cv. Arka Anamika, in the year 2007

Category of seed	Proportion (%)	No. of black seeds (%)	Wt. of black seeds (%)	100 seed weight (g)	First count (%)	Lab. germn. (%)	Vigour index I*	Vigour index II**	Field emergence (%)
Seed from air screen	100	4.45	3.92	7.47	71.2 (57.5)	86.8 (68.7)	3056	1160	63.3
Heavy seed	96.4	1.09	0.96	7.79	73.6 (59.4)	96.4 (79.1)	3694	1633	82.0
Medium seed	2.1	8.67	8.54	6.23	15.2 (22.8)	17.2 (24.3)	390	179	10.5
Light seed	1.4	61.08	58.03	4.14	7.2 (15.5)	7.2 (15.5)	84	41	1.3
SEm ±		0.878	0.788	0.059	2.866	2.041	78.4	23.0	2.19
CD (*P=0.05*)		2.49	2.24	0.168	8.155	5.808	338.8	90.5	9.46

*germination % x Seedling length **germination % x Seedling dry-weight
Figures in parentheses are angular transformed values

Table 2. Seed-quality attributes in different categories of seed obtained after specific-gravity separation in okra cv. Arka Anamika, in the year 2008

Category of seed	Proportion (%)	No. of black seeds (%)	Wt. of black seeds (%)	100 seed wt (g)	First count (%)	Lab. germn. (%)	Vigour index I*	Vigour index II**	Field emergence (%)
Seed from air screen	100	20.5	15.8	7.03	74.8 (60.4)	79.6 (64.3)	2507	7292	62.8
Heavy seed	87.6	5.7	4.8	7.34	84.4 (68.2)	89.6 (72.4)	3138	10566	76.4
Medium seed	8.1	85.9	84.0	5.77	28.8 (23.3)	34.8 (28.1)	913	1685	22
Light seed	4.3	95.1	93.9	4.69	10.8 (8.7)	11.2 (9.0)	187	408	8
SEm±		0.716	0.721	0.023	1.93	1.32	49.6	334	0.99
C.D (*P=0.05*)		3.09	3.11	0.1	8.3	5.7	214	1443	4.3

*germination% x Seedling length **germination% x Seedling dry-weight
Figures in parentheses are angular transformed values

ungraded seed (i.e., good-seed fraction from the air-screen cleaner). Black seed content climbed down from 20% to 6% with gravity-separation. Black seed content was more in 2008 season than in previous season due to harvest time coinciding with rains. Medium and light seed fractions, though showing some germination (35% and 11%, respectively), were significantly lower in seedling vigour expressed in terms of first count and seedling vigour indices, than the heavy-seed fraction. Total rejection, including medium and light fractions, was around 12%. By rejecting these seeds, germination was improved from 79.6% to 89.4%, and field-emergence from 63% to 76%.

Two years' data revealed that use of specific-gravity separator had significant effect in improving the quality of air-screen cleaned okra seeds. Increase in field-emergence percentage observed was from 63% to 82% and from 63% to 76% in 2007 and 2008, respectively; whereas, in the case of laboratory germination, it was from 86.8% to 96.4% in 2007 and 79.6 to 89.6% in 2008. Similar findings have been reported by Sharma and Swaran Lata (2005) and Pandita *et al* (2002) in okra; Sadhna Arora Sharma *et al* (2009) in maize, and by Menaka and Balamurugan (2008) in amaranthus.

Impact of specific-gravity separation was greater on field-emergence percentage than on laboratory-germination percentage. Laboratory germination improved by 10% in both years, whereas, field-emergence increased by 19% in the year 2007, and 13% in 2008. This shows that even low-vigour seeds germinate and produce normal seedlings under ideal (laboratory) conditions, but not in the field. Field-emergence of air-screen cleaned seeds was just 63% in both the seasons, but germination under laboratory test-conditions was 86% and 76% in 2007 and 2008, respectively. This shows that specific-gravity separation is very effective in removing low-vigour seeds, thereby improving field-emergence rate markedly. High vigour in the heavy-seed fraction obtained by gravity-separation is reflected in Vigour Index I and Vigour Index II in both the seasons. Low-vigour seeds constitute black and chaffy seeds, and these were removed effectively by the specific-gravity separator. There was a tendency in stained, defective, germinated and *Rhizoctonia solani* and *Fusarium* infected seeds of French bean to go into the lower spout of the gravity separator (Lollato and Silva, 1984). In the present study too, black and partially filled/chaffy seeds got separated as light and medium fractions, and this was reflected in the higher number of black seeds and low test-weight in these fractions.

Deck-inclination and speed of oscillation are very important parameters in a specific-gravity separator to achieve good separation. In the present study, the oscillating deck inclined at 2.5^0 width-wise and 3.5^0 length-wise, and oscillating eccentric speed of 450rpm was found ideal for obtaining good separation on the deck. With this set-up, distinct bands of heavy, medium and light seed fractions could be seen on the deck, running from the inlet end to the corresponding outlets. Tiwari *et al* (2008), while working with lentil seed-lot processing, found that deck angle of 1.5^0 length-wise and 5^0 width-wise with oscillation speed of 450rpm was ideal for optimum separation. With these parameters in the machine, germination in lentil seed improved from 80% to 94%, and visual appearance improved by reductions in the amount of discoloured seeds from 5.1% to 0.6%.

Chaffiness, partial filling and occurrence of black seeds in okra could be due to many reasons. Washing off of pollen due to heavy rains, non-availability of adequate source (especially during the later stages of the crop) and biotic/abiotic stresses may lead to chaffiness or partial filling of seeds. Such seeds will turn black if the crop is exposed to rains at harvest. Lodging or damage to the plants/pods at seed-filling also results in chaffiness or partial filling.

Total rejection after gravity separation (including medium and light seed fractions) was 3.5% in 2007 and 12% in 2008. Though seed recovery declined in specific-gravity separation, seed quality significantly improved. Sharma and Swaran Lata (2005) reported significant improvement in seed quality and storability of the heavy seed-fraction in okra by subjecting seeds to gravity-separation.

From this study it is concluded that quality in okra seed lots, where cleaning and grading is done using air-screen cleaners, can be improved markedly by subjecting seeds to specific-gravity separation.

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