Short Note

Journal of AgriSearch 2(4): 300-303
Peer Reviewed Quarterly

ISSN : 2348-8808 (Print), 2348-8867 (Online)

Effectiveness of Seed Processing Machinery on Seed quality Improvement in Wheat (*Triticum aestivum L.*)

RABINDRA KUMAR* AND BRIJENDRA KOLI

National Seeds Corporation Ltd (NSC), Patna, Bihar, India

ARTICLE INFO

Received on	: 06.06.2015
Accepted on	: 29.07.2015
Published online	: 07.12.2015

ABSTRACT

Wheat seed quality improvement through basic processing machines was investigated and quantified. It was observed that consistent seed quality could be achieved by efficient use of processing machines viz. air screen cleaners (seed pre-cleaner and seed grader) and specific gravity separator (SGS), irrespective of initial quality of the seed lot. The product and reject of these machines were evaluated for seed quality parameters. The physical purity of wheat seed lot was upgraded from 97.62% to 99.46%, and germination was improved from 80.70% to 86.20%, which made the seed lot acceptable as per the Indian Minimum Seed Certification Standards. Other seed quality parameters viz. test weight (37.76 g to 41.88 g), germination index (19.20 to 21.24), vigour index - I (1426.78 to 1750.72) and vigour index - II (101.68 to 115.50) were also improved. Air screen machine were found effective in improving physical purity and specific gravity separator improved the germination and vigour of the wheat seed lot.

Keywords: Seed quality, vigour index, germination index, processing machinery

Quality seed plays a vital role in sustainable agricultural production (Kumar *et al.*, 2014b). The genetic purity, physical purity, viability, vigour and uniformity in seed size are important parameters to determine the quality of seed. Among these parameters, genetic purity is mainly dependent on source seed, crop husbandry and production techniques (Atwal and Sinha, 2002), whereas other parameters are greatly affected by post-harvest handling methods (Sundaram *et al.*, 2014), Seeds are required to be stored since harvest of the preceding season till sowing of the next season. The harvested seed lot contains impurities, immature and damaged seeds. Seed size is also positively correlated to seed vigour, and larger seed tends to produce vigorous seedlings increasing productivity in seeds like wheat (Ries and Everson, 1973; Singh and Kailasanathan, 1976). Uniformity in size and constituents of seed lot were emphasized for mechanized sowing as well as better crop establishment (Bishaw and Gastel, 1996). Mechanical seed processing improves physical purity as well as grade the seed according to size and specific gravity. This also improves test weight, germination and vigour. Post-harvest processing machine parameters affected seed quality in chickpea (Sinha *et al.*, 2009), green gram, black gram, soybean, sunflower (Bansal and Lohan, 2009), onion (Singh *et al.*, 2010); tomato, brinjal, chilli, cucumber, squash and watermelon (Verma and Singh, 1988). With advent of new improved varieties and hybrids, it is advisable to check various seed processing machines with different screen sizes to find its impact on seed recovery and upgradation in seed lot quality. Different extent of seed recovery and upgradation in seed lot quality was observed in different wheat varieties in similar studies (Anon, 2012). Since, wheat is one of the premier cereal crops of worldwide importance which is grown under a wide range of climatic conditions. India is one of the major producers of wheat and it is maintaining its second position of wheat producing nation after china (Kumar *et al.*, 2014a and Meena *et al.*, 2013), the objective of this investigation was, therefore, to evaluate the extent of quality improvement through mechanical seed processing of wheat cv HD 2967.

Seed lot of wheat cultivar were raised at field farmer field, Mahuar, Munjhar, Aurangabad, under grower seed production programme of National Seeds Corporation, Sheikhpura, Rajabazar, Patna, Bihar, India during *Rabi* season 2012-13. The raw seeds were transported and processed at designated seed processing plant of NSC,

* Corresponding author email: rabik_seed@rediffmail.com

Patna. The size of the seed lot was 20800 kg was taken for the study. Parameters like moisture content, weight of seed lot and test weight were recorded. Moisture content was determined as per ISTA rules (ISTA, 1993). The average moisture content of the wheat seed was 10.8% (w. b.), and hence seed drying was considered not necessary for processing. Visual evaluation of the harvested seed lot did not show broken seed, and therefore the length separator was by-passed by keeping the trough in vertically downward position.

Seeds were processed in Agrosaw, (Ambala) make processing plant of 4 TPH capacities. The processing line comprised of seed pre-cleaner-cum-grader (model – PCS-NB), screen grader (model –SG3), indented cylinder grader (model – IC4) in bypassed mode and specific gravity separator (model – G4). Air screen machines (pre-cleaner and screen grader) were equipped with feed control, scalping screen, grading screen and aspiration system. Top and bottom screen of these air screen machines were 6.00 mm (round) and 1.80 mm (oblong), respectively, as per recommendations of Indian Minimum Seed Certification Standards (Tunwar and Singh, 1988). The essential parts of specific gravity separator were an adjustable porous deck, fan system that forces air through the porous deck, assemblies that oscillate and incline the deck. The inclination of deck and volume of air were adjusted for better separations of low – density seeds from the lot.

Ten seed samples, each weighing 500 g, were drawn for quality assessment at different stages viz. unprocessed, product outlets of pre-cleaner, screen grader and specific gravity separator and reject outlets of screen grader and specific gravity separator at intervals of 25 min. These 10 primary samples collected from each stage were mixed separately using mixer and then divided by seed divider. Three replications weighing 1 kg each were drawn from the mixture for each stage, and classified as representative samples. These representative samples were used for physical purity, germination, test weight, germination index and vigour index evaluation as per ISTA rules (ISTA, 1999). The laboratory-based study with Complete Randomized Design, physical purity was measured using '2' replications of 20 g each. Pure seed, inert matter and other crops seed were separated using purity board, and physical purity was calculated on weight basis (Agrawal, 1993). Four replications of hundred seeds each were kept between wet paper towels in the germinator for 8 days at 20° C and 95% RH. The number of normal and abnormal seedlings and dead seeds were counted and recorded. Germination percent (%) was expressed on the basis of normal seedlings. The 1000 seed weight of each sample was measured. Number of seedlings emerging daily was also counted from the day of sowing the seeds in the medium till the completion of germination. Thereafter, a germination index (G.I.) was computed using the Eq. 1 (Gupta, 1993) as:

$$G.I. = n/d \quad ... (1) \qquad [Eq.1]$$

Where, n = number of seedlings emerging on day 'd', and

d = day after planting.

After the germination count, ten normal seedlings from every replication of each treatment were randomly taken without damaging their root system, and were measured for their root and shoot length. The seedlings were dried at 100° C in oven for 24 h to get dry weight of seedlings. Seed vigour index - I and II were derived by multiplying per cent germination with total seedling length (cm) and dry weight of seedlings (g), respectively (Gupta, 1993). Data were noted for three replications and analysis of variance using completely randomized design (Gomez and Gomez, 1984) was carried out. Standard error of mean and critical differences at 5% probability level were calculated and used for interpretation

The quality parameters of wheat seed lot i.e. physical purity, germination per cent, test weight, germination index, seedling length, dry seedling weight, vigour index-I and vigour index-II at each stage of processing are presented in table 1. The germination and physical purity of unprocessed seed was 80.70% and 97.62%, respectively; which were lower compared to the Indian Minimum Seed Certification Standards of 85% and 98%, respectively (Tunwar and Singh, 1988). In the present study, out of the total of 20800 kg seed processed, 18320 kg (88.08%) seed fulfilling Indian Minimum Seed Certification Standards of quality seed was received at the product outlet after processing. The seed lot, which was below minimum standards of physical purity and germination turned to acceptable lot with 99.46% physical purity and 86.20% germination. The cleaning and grading efficiency of the pre-cleaner and grader were 91.18% and 82.34%, respectively. The specific gravity of wheat samples ranged between 1.30 and 1.33.

It has been reported that change of bottom screen from 2.3 mm to 2.0 mm improved wheat seed recovery to the tune of 6%, with maintaining physical purity and germination level above Indian Minimum Seed Certification Standards. Screen grader with 1.8 mm screen was also suggested in case of wheat cv. PBW 343 for higher seed recovery (Anon, 2012). It was observed that out of total impurities of 2.38% in the unprocessed seed lot, 0.48% was removed collectively by Air screen machines (pre-cleaner and grader), showing removal of 11.92 % of total impurities present in the seed lot. Physical purity after specific gravity separation was significantly higher than that of pre-cleaned and graded seed lot. This shows necessity of all the three processing operations in processing wheat seed.

Specific gravity separator improved germination (3%), followed by screen grader (2.30%) and pre-cleaner (0.20%). Germination was non-significant among processing machines, which reflected that the original seed lot had less proportion of poor germination seed. Moreover, all the three machines together improved the seed lot germination by 5.50 per cent. This implied that significant difference existed in size and aerodynamic behaviour of quality seed and rejected seed/ impurities. Similar results were observed in wheat by earlier researchers (Sinha *et al*., 2001; Sinha *et al*., 2002; Doshi *et al*., 2013). Moreover, the improvement was rapid in initial stages than in subsequent stages. It confirmed that it is normally difficult to improve the better product than the product of poor grade.

Test weight was significantly higher in the seed lot after gravity separation. Maximum rise in test weight was observed after passing through specific gravity separator (1.52 g), followed by screen grader (1.40 g) and pre-cleaner (1.20 g) (Table 1). This implied the positive effect of gravity separation on seed test weight. Present results confirmed the earlier findings of (Sinha *et al*., 2001; Doshi *et al*., 2013).

Germination Index and seedling length were non-significant, showing little differences in these parameters among seeds from various outlets. These parameters are related with vigour of the seed. It may also imply that the seed lot had narrow differences in these vigour related parameters, and individual processing machine had little role in upgradation of these qualities. Though, germination, speed of germination (germination index) and seedling length at different stages of processing were statistically at par, remarkable improvement in desired quality parameters of seed lot was observed through processing, and the highest values were observed in the seed lot after specific gravity separation. The dry weight of seedling, vigour index – I and vigour index – II were significantly higher in the seed lot after specific gravity separation, which implied the effect of size and density on seed vigour. This also shows importance of gravity upgradation in improving vigour of the seed lot.

All the quality parameters of seed component of reject port of the specific gravity separator were far below the standards, and were also inferior to the unprocessed seed lot at each stage. It emphasized the necessity of processing, and showed positive impact of separation process in all the three machines. Moreover, the reject of screen grader was also unfit as per Indian Minimum Seed Certification Standards, justifying the need of collective use of all the three processing machines

Table 1: Mean values of different quality parameters improved through processing of wheat seed

Stage	Physical purity (%)	**Germination, (%)**	**Test weight (g)**	**Germination Index**	**Seedling length (cm)**	**Seedling dry weight (g)**	**Vigour index-I**	**Vigour Index-II**
Unprocessed	97.62	80.70	37.76	19.20	17.68	1.26	1426.78	101.68
Pre-cleaned	97.79	80.90	38.96	20.25	17.96	1.28	1452.96	103.55
Screen graded	98.10	83.20	40.36	21.05	19.33	1.32	1608.26	109.82
Specific gravity separated	99.46	86.20	41.88	21.24	20.31	1.34	1750.72	115.51
Rejected by SGS	89.74	63.70	24.84	14.98	17.51	0.92	1115.39	58.60
Rejected by screen grader	95.34	59.40	20.59	14.07	18.48	0.82	1097.71	48.71
CD at 0.05%	0.83	20.12	0.035	6.52	4.18	0.131	342.88	23.30
SEM ±1	0.34	9.58	0.01	3.10	1.99	0.06	163.21	11.09
	S	NS	S	NS	NS	S	S	S

Note: NS: Non-significant; S: Significant

Air screen machines (seed pre-cleaner and seed grader) with 6.00 mm (round) top screen and 1.8 mm (oblong) bottom screen improved the physical purity of Wheat cv. HD2967; whereas, the specific gravity separator improved the germination and vigour of the seed lot. Specific gravity separation appeared to be the most effective stage regarding germination improvement, followed by screen grading and pre-cleaning. The reject of screen grader and specific gravity separator were found to be unfit as per Indian Minimum Seed Certification Standards, justifying the need of collective use of all the three processing machines. The present study also provides basis for further investigation on other seeds and machine parameters for optimum results in processing seeds.

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Citation:

Kumar R and Koli B. 2015. Effectiveness of Seed Processing Machinery on Seed quality Improvement in Wheat (*Triticum aestivum L.*). *Journal of AgriSearch* **2** (4): 300-303