Seed Research, Vol. 36(1): 115-119, 2008

Short Communication

Seed Quality Enhancement in Soybean by Spiral Separators

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The oil-seed production has increased from 10.8 million tones in 1985-86 to 26.1 million tones in 2004-05 [1]. Among the nine oil seed crops grown in India, soybean occupied 27.6 per cent out of total oil-seed acreage of 23.25 million ha, and contributed 28.6 per cent of the total oil production of 18.40 million tones during 2000-01 [2]. However, average national productivity of soybean is 1105kg^{-1} which is quite low as compared to world productivity of 2338kg^{-1}.

Soybean under Indian conditions is a poor storer as it loses viability rapidly in warm and humid conditions of storage [3]. The breakability of testa and position of radical in soybean seed makes it vulnerable to injuries during harvesting, threshing, processing and storage [4]. Soybean seed is vulnerable to mechanical damage at 12 per cent mc or less. Higher moisture content i.e. 15 per cent and above during threshing leads to bruising injury and affects seed quality. Genotypic variability in terms of seed viability during storage has been reported by many workers [5, 6]. However, reasons for such differences are more or less speculative such as seed size [7, 8] and testa thickness [9].

Kumar [10] tested 693 genotypes of soybean, which were stored in water-proof envelops for two years (Harvest of *kharif* 2002 stored up to 2004) under ambient conditions in the Division of Genetics, IARI, New Delhi. Out of 693 genotypes, 20 genotypes each of better; medium and poor storer group were selected based on germination test. Among the better storer group, germination ranged from 81-90 per cent, in the medium group it ranged from 37-68 per cent while in poor storer group it ranged from 20-38 per cent.

Keeping this background, it was decided to visit the seed processing plants of Madhya Pradesh which is the major soybean producing state in the country. Since a large number of seed processing plants are located in and around Indore, the authors visited the seed processing plants during the processing time of soybean to assess the extent of mechanical damage caused to the seeds during processing.

The authors visited various seed processing plant in and around Indore (M.P.) and collected unprocessed (raw) and the corressponding processed seed samples from the processing plants of seed companies listed in Table 1.

It was observed that about 80 per cent of the area is under JS-335 followed by JS-9305 and Samrat. Samrat is a local un-notified variety which has probably been propagated by the farmers themselves and is in great demand because of its agronomic superiority. The use of Spiral Separators in place of gravity separator is a recently introduced system. These Spiral separators are 8' in height with spirals made of galvanized sheets and are locally fabricated by M/s Balaji. Depending upon the amount of seed to be processed a number of Spiral units are attached in a series (Fig. 1). The seeds after being processed in the graders are fed to the Spirals either through an inclined conveyor belt (Fig. 2) or manually (Fig. 1). The conveyor belts are made up of poly vinyl chloride and thus do not cause mechanical injury

Received March 2007 Revised November 2007 Accepted May 2008

to the seeds during processing and are superior to traditional conveyor belts as they are provided with corrugated side walls and partitions at regular interval. Once the seed is put in the hopper of the Spirals, due to centrifugal force heavy seeds get separated from the rest of the seeds. The Spiral separators saves lot of time and labour which is required otherwise for separating the soil clods and small or broken seeds from the processed seed lot. The Spirals do not require any kind of energy whatsoever for operation as it works on the simple principal of gravitational forces.

In all 20 seed samples were collected from the eight processing plants at different stages of processing (Table 1). These seed samples were brought to the Division of Seed Science and Technology, IARI, New Delhi, where they were subjected to Purity analysis. The pure seed component was subjected to germination test as per ISTA rules [11]. On 8th day at the time of final count for germination, 10 randomly selected normal seedling were measured for seedling length and then they were placed in a butter paper envelop which was in turn placed in an oven for 17h at 80°C for drying. After drying was complete, the dry weight of the seedlings was taken for assessing the seed vigour (Table 2). The Vigour

Table 1. Source and stage of processing at which the seed samples were collected

Sample No.	Source	Date of collection	Stage at which collected
1	Mayur Seeds & Agritech., Indore	28.1.2006	Processed
2	Mohra Seeds, Indore	28.1.2006	Processed
3	Mohra Seeds, Indore	28.1.2006	Processed (under size)
4	Mohra Seeds, Indore	28.1.2006	Processed (under size)
5	Mahadhan Seeds, Indore	29.1.2006	Raw seed
6	Mahadhan Seeds, Indore	29.1.2006	Processed (before spiral)
7	Mahadhan Seeds, Indore	29.1.2006	Processed (after spiral)
8	Mahadhan Seeds, Indore	29.1.2006	Processed (under size)
9	Vigour Agritech Seeds, Indore	29.1.2006	Processed
10	Vigour Agritech Seeds, Indore	29.1.2006	Processed (under size)
11	Vigour Agritech Seeds, Indore	29.1.2006	Processed
12	Green Gold Agritech, Indore	29.1.2006	Raw seed
13	Green Gold Agritech, Indore	29.1.2006	Processed
14	Manikya Agrotech Seeds, Indore	29.1.2006	Processed (before spiral)
15	Manikya Agrotech Seeds, Indore	29.1.2006	Processed (after spiral)
16	Eagle Seeds and Biotech, Indore	30.1.2006	Raw seeds
17	Eagle Seeds and Biotech, Indore	30.1.2006	Processed (before spiral)
18	Eagle Seeds and Biotech, Indore	30.1.2006	Processed (after spiral)
19	Krishidhan Seeds, Indore	30.1.2006	Raw seeds
20	Krishidhan Seeds, Indore	30.1.2006	Processed

Index (I and II) was calculated by the method suggested by Abdul-Baki and Anderson [12]. These seeds were also subjected to seed health test by standard blotter method as per ISTA rules [11] (Table 2). These samples were kept in cloth bags and stored under ambient conditions of temperature and humidity in Delhi. After six months of storage the seeds were sown in well prepared plots in four replicates of 100 seeds each for studying the field emergence.

The 20 samples of seed collected from eight seed processing units at different stages of processing (Table 1) were subjected to purity analysis, germination, and vigour index studies. It was observed that sample no. 3, 4, 5 and 8 collected

Table 2. Assessment of seed quality parameters of the collected seed samples of soybean

Sample	Pure seed		Inert matter		Germination	Root length	Shoot length	Seedling dry wt.	Vigour index I	Vigour index II	Seed health			
	gms	%	gms	%	(%)	(cms)	(cms)	(mg)			*Alternaria alternata*	*Aspergillus flavus*	*Cladosporium cladosporioides*	*Penicillium* spp.
1	750	99.7	2.23	0.3	92	11	14	2.42	2300	222.8	2	-	29	-
2	675	99.4	3.78	0.6	83	13	11	2.24	1992	185.6	9	2	7	1
3	NIL	NIL	300.0	100	NA	NA	NA	NA	NA	NA	-	-	-	-
4	NIL	NIL	420.0	100	NA	NA	NA	NA	NA	NA	-	-	-	-
5	NIL	NIL	380.0	100	NA	NA	NA	NA	NA	NA	-	-	-	-
6	400	99.4	2.20	0.6	78	10	12	2.54	1716	198.3	2	-	21	-
7	500	99.4	3.20	0.6	92	15	12	2.49	2484	229.1	2	4	23	-
8	NIL	NIL	210.0	100	NA	NA	NA	NA	NA	NA	-	-	-	-
9	650	96.3	25.00	3.7	94	12	9	2.52	1974	236.5	5	3	25	-
10	500	95.2	25.00	4.8	78	12	15	2.22	2106	172.8	7	3	27	2
11	650	99.9	0.48	0.1	91	15	15	2.52	2730	228.9	5	-	32	-
12	325	89.0	40.00	11.0	84	10	12	2.26	1848	189.0	7	5	10	4
13	410	99.4	2.28	0.6	90	16	13	2.13	2610	191.3	5	3	15	-
14	430	98.7	5.50	1.3	86	10	10	2.19	1720	188.4	-	6	24	-
15	465	99.3	3.20	0.7	90	15	16	2.22	2790	199.8	2	2	32	2
16	450	85.7	75.00	14.3	76	9	13	2.42	1672	183.9	4	5	17	4
17	250	99.1	10.46	3.2	78	11	9	2.43	1560	189.6	-	4	28	5
18	250	96.8	2.30	0.9	80	12	12	2.52	1920	201.6	5	4	16	-
19	480	90.6	50.00	9.4	70	8	9	2.12	1190	147.9	-	3	19	5
20	525	99.5	2.62	0.5	72	14	12	2.17	1872	156.3	4	5	24	3

Fig. 1. Series of spiral separators being manually fed with soybean seeds

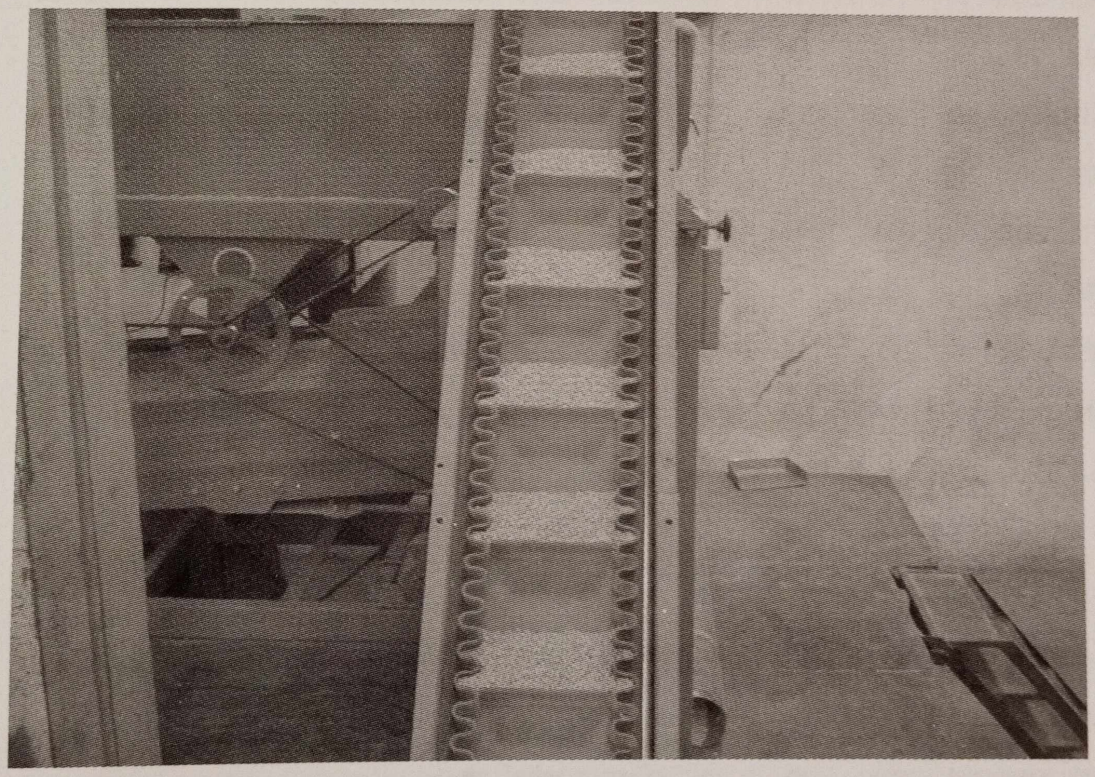

Fig. 2. Conveyor belt made up of polyvinyl chloride with corrugated side walls and partitions at regular intervals

from M/s Mohra Seeds and Mahadhan Seeds were from the undersized or raw seed lots. These samples were out-rightly rejected from the studies as they did not qualify the prescribed minimum standard of purity. The entire samples undergone germination test maintains the germination in the range of 70 to 94 per cent. However, the raw seeds of M/s Green Gold Agritech showed 84 per cent germination which improved further to 90 per cent after processing. On the other hand, unprocessed seed of M/s Eagle Seed & Biotech and M/s Krishidhan Seeds showed a marginal improvement of only 2 per cent from 76 to 78 per cent and 70 to 72 per cent respectively after processing. An undersized seed collected after processing maintained 78 per cent germination (sample no.

10 of Vigour Agritech) while other two samples of the same firm showed more than 90 per cent germination which is remarkably higher than 72 per cent (sample no. 20 of Krishidhan Seeds), 78 per cent (sample no. 17 of Eagle Seeds & Biotech) and 83 per cent (sample no. 2 of Mohra Seeds) the processed sample. The results suggests that processed undersized seeds if maintains the IMSCS of germination may be used separately as quality seed. However, the seed drill used for sowing be recalibrated to maintain the required plant population. Therefore, the undersized seeds may also be considered for commercial use.

The use of spiral separators for soybean has been recently incorporated in, most of the seed processing units. The gravity separator grades the seed lot on the basis of difference in density, however spiral separator utilizes the centrifugal force or rolling mass as grading parameter. Apparently, it was considered to improve physical purity, but it has shown improvement in germination from 78 to 90 per cent (sample no. 6 and 7 of Mahadhan Seeds) and 86 to 90 per cent (sample no. 14 and of Manikya Agritech). There was an overall significant improvement of seed quality parameters by the efficient use of spiral separators. The germination was also increased from 78 to 80 per cent (sample no. 17 and 18 of Eagle Seeds and Biotech) indicates the efficiency of spiral separators in improving the physical purity as well as germination percentage. All the processed, unprocessed and undersized seeds have good vigour index I and II as calculated by multiple criteria [12]. The good vigour indicates better field emergence after storage under ambient conditions.

The incidence of associated seed mycoflora by blotter method was observed on the seed samples and are presented in Table 2. Only four saprophytic fungi viz. *Cladosporium cladosporioides, Alternaria alternata, Aspergillus flavus* and *Penicillium* spp. were found in order of severity of incidence on the seed samples. The incidence of *Cladosporium cladosporioides* was in the range of 7-32 per cent in which six samples had >20 per cent incidence. The incidence of other mycoflora was less than 10 per cent in the seed samples. The presence of these fungi may adversely affect seed quality in general. However, it is reported that these infections do not affect seed quality if the seed is not to be stored for longer durations. The field emergence (%) is dependent on the quality of seed i.e. germination, vigour index and seed health. The analysis of three parameters indicate that the seed samples in question will meet the criteria of quality in the field emergence as reflected by higher vigour index.

ACKNOWLEDGEMENTS

Authors are thankful to various seed companies for their cooperation in felicitating the visit to their seed processing plant and the seed samples provided for the above studies. Special thanks are due to Sri Vaibhav Jain of Eagle Seeds and Biotech, Indore for providing the photographs of the spirals and the conveyor belt.

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