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Assessment of Seed Quality Loss of Soybean under Existing Threshing Methods

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Abstract: Quality seed production is an important pre requisite for the agricultural production. Soybean seeds are susceptible to mechanical injury due to its very thin seed coat which mediated damage during post-harvest handling. This injury leads to deterioration during storage. Threshing is an important postharvest operation. The purpose of this investigation was to evaluate the effects of different threshing methods (mechanical, Tractor, Stick, Cattle) on soybean seed quality. The results showed significant differences among threshing methods on soybean seed quality. The seeds sampled from stick beating threshing method recorded 88.5 percent germination (normal seedling) followed by seeds sampled from cattle threshing (77.5 percent). The lowest germination of 69.5 per cent was recorded by tractor threshing method. From this study, it could be inferred that among threshing methods, beating with sticks recorded less mechanical damage and maximum germination.

Keywords: Soybean, Seed quality, Threshing.

Research Paper

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1. INTRODUCTION

Soybean (Glycine max (L.) Merrill) is an important global legume crop that grows in the tropical, subtropical and temperate climates. It has many benefits, nutritionally for man and livestock, as well as other industrial and commercial uses. It is classified as an oilseed, containing significant amounts of all the essential amino acids, minerals, vitamins for human nutrition and used for soil fertility improvement. It is therefore an important source of human dietary protein with an average of 40% content, 30% carbohydrate and oil content of 20% (Adu - Dapaah *et al.*, 2004).

Soybean was first introduced to Ethiopia in 1950's because of its nutritional value, multi-purpose use and wider adaptability in different cropping systems (Amare Belay,1987). It is a crop that can play major role as protein source for resource poor farmers of Ethiopia who cannot afford animal products. In Ethiopia, soybean has adapted to diverse ecological niches and provided wider yield range (Amare Belay,1987).

Soybean is emerging as a very important food, market and oil crop in Ethiopia. However, its productivity in Western Ethiopia is constrained by several production constraints, of which seed quality is one of the most important ones. Quality seed production is an important pre requisite for the agricultural production. The storage becomes successful depending upon quality of seeds to be stored. It is universal that when plant attains physiological maturity, on that day only the storage of seeds starts on plant itself.

The maintenance of seed quality after harvest and during storage, is a major problem in soybean seed because the seed is poor storer as it is more vulnerable to mechanical damage from harvesting to next sowing season (Paulsen *et al*., 1981). Soon after harvest, soybean seed is subjected to several post-harvest operations like threshing, drying, grading, transportation and other handling operations. During this loss of soybean seed quality is mainly due to mechanical damage, it is because of its very thin seed coat and low lignin content leads to little protection to the fragile radical which lies in a vulnerable position directly beneath the seed coat so soybean seed is regarded as a poor store and it loses its viability and vigour at a faster rate due to loss of membrane permeability of seed (Alvarez *et al*., 1997, Prakobbon, N., 1982, Puteh *et al.*, 1997).

Presence of high lipid content and high level of polyunsaturated oleic acid, linolenic and linoleic acid is the main reason for short shelf life of soybean seed (Sung. 1996, Trawartha *et al*, 1995). Storability of seed is mainly a genetic character and it is influenced by pre storage history of seeds, seed maturation and environmental factors during pre and post-harvest stages.

(Srivastava *et al*., 1975, Seneratna *et al*., 1988, Mahesha *et al*., 2001).

Threshing is a major post-harvest operation which is carried out after all crops have been gathered from the field. It consists of separating the beans from the pods (portion of the plant fruit that encases the soybean seeds), during this loss of soybean seed quality is mainly due to mechanical damage, it is because of its very thin seed coat and low lignin content leading to little protection to the fragile radical which lies in a vulnerable position directly beneath the seed coat. In Ethiopia threshing of soybean seed is generally done by hand beating of pods with sticks, trampling the pods under the feet of cows, use of tractors and mechanical thresher. The objective of this investigation was to assess quality loss of Soybean seed under existing threshing and generate information on quality loss of Soybean seed under existing threshing system.

2. MATERIALS AND METHODS

The laboratory experiment was conducted to determine the seed quality of soybean varieties collected from different threshing methods. Four samples of the same variety (Belas) each from four threshing methods (mechanical, Tractor, Stick, Cattle) were collected and used as treatments in four replications. The experiment was conducted in pawe agricultural research center laboratory, which was carried out as per International Seed Testing Association rules and procedures (ISTA, 2014). The experiment was laid out as Completely Randomized Design (CRD).

2.1. Determination of Seed Physical Purity

A seed sample of 1000 gram (g) was obtained from each experimental treatment for laboratory analysis. The 1000 g of seeds from each treatment was divided into 4 each 250 g which was used for the laboratory tests that include purity, moisture content determination, germination, vigor. Each sample was sorted into three components that include pure seed, inert matter and other crop as suggested by the International Seed Testing Association (ISTA, 2014).

2.2. Determination of Seed Physiological Quality

2.2.1. Standard Germination Test

The germination test for soybean was done at the temperature of 25°C (ISTA, 1999). Thus, the first and second counts were done at 5 and 10 days after planting, respectively. Sand will be used as a substrate for germination. The germination test was done from the pure seed fractions obtained from the purity test. Four hundred seed (400) pure seeds were taken from each treatment, and divided into four replicates of 100 seeds. Each replicate was sown on a sterilized sand medium on plastic box. Finally, at the 10th day of the planting seedling was categorized in to normal, abnormal, dead seeds and their percentages was calculated.

$$\mathrm{StG} = \frac{\text{Total number of normal seedling}}{\text{Total number of seeds planted}} \times 100$$

2.2.2. Shoot and Root Length

Ten normal seedlings were randomly taken from each replicate and shoot length was measured from the point of attachment to the cotyledon. Similarly, the root length was measured. The averages of shoot and root lengths were computed by dividing the total shoot or root lengths by the total number of normal seedlings measured (Fiala, 1987).

2.2.3. Seedling Dry Weight

The seedlings dry weight was measured after the final count of the standard germination test. Ten randomly taken seedlings from each replicate was identified and placed in envelopes and dried in an oven at 80°C for 24 hrs. The dried seedlings were weighed by using sensitive balance and the average seedling dry weight was calculated.

2.3. Data Analysis

The data recorded in this study were subjected to statistical analysis. The analysis of variance was carried out using SAS software (SAS, 2000). Significance differences between treatment means were delineated by Least Significance Difference (LSD) test at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1. Seeds Physical Quality Test

Analysis of variance revealed that threshing methods had significant effect on pure seed and inert matter (Table 1). Ujjinaiah and Shreedhara (1998) reported significant difference for mechanical damage, seed quality aspects among threshing methods. Significantly higher mechanical damage of 6.55 per cent was recorded in multicrop thresher as compared to beating with stick (2.33%). In addition, Jha *et al.*, (1996) indicated that significant differences in mechanical damage were caused by different threshing methods.

The highest pure seed (98.03) was registered for sample seeds from stick threshing method followed by sample seed from cattle threshing while lowest pure seed (86.1) obtained for sample seed from mechanical threshing method. The highest inert matter (13.9) was registered for sample seeds from mechanical threshing method followed by tractor threshing method while lowest inert matter (1.93) obtained for sample seed from stick threshing method. This showed that the use of mechanical threshing type decreases pure seed and increases inert matter but the use of stick beating threshing method increases pure seed and decreases inert matter. This suggestion was supported by Gagre *et al*, who reported among the threshing methods, the lowest mechanical damage (8.62%) was recorded due to threshing with stick beating (T1) followed by multi-crop thresher (T2). The highest mechanical damage (15.87%) recorded in combine harvester threshing (T3).

Table 1: Effects of threshing methods on soybean seed physical purity.

Threshing methods	Pure (%)	Inert matter (%)	Other seed (%)
Mechanical	86.1^{d}	13.9^{a}	0.00
Tractor	87.05^{c}	12.9^{b}	0.00
Stick	98.03^{a}	1.93^{d}	0.00
Cattle	96.38b	3.53^{c}	0.00
Mean	91.89	8.08	0.00
LSD	0.309	0.334	
CV (%)	0.22	2.7	

3.2 Seeds physiological quality test

Percentage of normal, abnormal seedling and dead seeds was significantly influenced by threshing method (Table 2).

The highest normal seedling percentage (88.5) was registered for sample seeds from stick beating threshing method followed by cattle threshing method while lowest normal seedling percentage (69.5) was registered from sample tractor threshing method with statistically non-significant difference sample seed from mechanical threshing. On other hand, highest percentage of abnormal seedling percentage was estimated for seed sample from mechanical threshing method with non-significant difference sample seed from tractor and cattle. The seed from tractor threshing had higher dead seed and had non-significant difference with dead seed from mechanical threshing method. Lowest proportion of dead seed (5%) was registered from seed sample of stick beating. This indicate that use of stick beating to thresh soybean increase normal seedling percentage. This result was in agreement with the findings of Senthil Raj *et al.,* 2021, who reported that more germination percentage (81) was obtained from stick threshing method. The threshing methods particularly by mechanical, produce more breaks, cracks, bruises and abrasions in seeds which in turn resulted in abnormal seedlings (Green *et al.*, 1966).

Table 2: Effects of threshing methods on soybean normal seedling, Abnormal seedling and dead seed

Threshing methods	Normal seedling (%)	Abnormal seedling (%)	Dead seed (%)
Mechanical	71^{c}	8.5^{a}	20.5^{a}
Tractor	69.5^{c}	8.5^{a}	22^{a}
Stick	88.5^{a}	6.5^{b}	5^{c}
Cattle	77.5^{b}	8^{a}	14.5^{b}
Mean	76.6	7.88	15.5
LSD	1.722	1.334	1.886
CV (%)	1.46	11	7.9

In addition, analysis of variance revealed that shoot, root length and seedlings dry weight were significantly influenced by threshing methods (Table 3). The highest shoot length (6cm) was recorded for seedlings from cattle threshing method with statistical parity seedling from stick (5.9cm) threshing method while the lowest shoot length was registered for seedlings from mechanical (5.2cm) threshing method. This indicated that use of stick and cattle to thresh soybean increase shoot length. Utrecht *et al.*, 2000, remarked that, as the embryonic axis in soybean seed is placed at surface of seed, it is prone to the injuries of impacts due to brusing.

Table 3: Effects of threshing methods on soybean seedling shoot length, root length and dry weight

Threshing methods	Sl	Rl	Sdw
Mechanical	5.2^{c}	10.9^{b}	0.77^{c}
Tractor	5.5^{bc}	13.1^{a}	0.88^{b}
Stick	5.9^{ab}	12.2^{a}	1^{a}
Cattle	6^{a}	13.3^{a}	1^{a}
Mean	5.6	12.4	0.91
LSD	0.409	1.078	0.041
CV (%)	4.7	5.67	2.95

Where *Sl=shoot length,Rl=root length,Sdw=seedling dry weight,*

The highest root length (13.3cm) was recorded for seedlings from cattle threshing method with statistical parity seedling from tractor (13.1cm) and seedling from stick (12.2 cm) threshing methods while the lowest root length was registered for seedlings from mechanical (10.9 cm) threshing method (Table 3). This finding was supported by Senthil Raj *et al*, (2021) who reported among the threshing methods, the highest root length (10.1cm) was recorded due to threshing with stick beating. Higher seedling dry weight was estimated for seed from both stick and cattle threshing methods while least seedling dry weight was estimated from seed from mechanical threshing method (Table 3). Zewdie (2004) indicated that seedlings with well-developed shoot and root system would withstand adverse conditions and provide better seedling emergence and seedling establishment in the field and thus, seedlings with higher index are expected to show rapid germination and emergence that eventually leads to escape adverse field conditions.

3. SUMMERY AND CONCLUSSION

Soybean is considered as one very important grain grown commercially in northwestern Ethiopia. The importance of soybean arises from its high nutritional value i.e. high protein, oil and fat content, and its market value as whole grain, and factory processed food products, such as oil, margarine, and concentrate infant feeds. It is also a crop of worldwide market importance.

Threshing method is a crucial factor as it directly impacts on seed quality. Soybean seed with a thin seed coat and embryo placed outwards is susceptible to mechanical damage during the threshing operations as the seeds are being rubbed. Thus, this research was conducted to alleviate some of the quality constraints by assessing the effects of existing threshing method of soybean. Physical and physiological seed quality of soybean were influenced by threshing method. Stick beating threshing method produced higher physical purity (98.03%) and normal seedling (88.5%) respectively.

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