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Harvesting, Handling and Storage of Soybean Seed

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HARVESTING, HANDLING AND STORAGE OF SOYBEAN SEED [1]

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The great expansion in acreage planted to soybeans in the U. S. since the middle 1950's and the decreasing percentage of farmers who "save" planting seed provided an almost unparalleled opportunity for development of a substantial commercial seed industry of a self pollinated crop. A sizeable and widespread soybean seed industry is rapidly developing in response to this challenge and opportunity. The enactment of the Plant Variety Protection Act at the end of 1970 will undoubtably further stimulate the development of a commercial soybean seed industry.

Throughout the period of rapid growth of the soybean seed industry, major concern and effort has been necessarily focussed on expanding operational capacity of production and processing operations to keep abreast of increasing demand for seed. Established seed operations were modified to handle soybean seed, many new facilities were constructed - and in many cases are already inadequate, and even more modern, higher capacity facilities are presently under construction or in the planning stage. Attention, therefore, has been largely directed toward establishing the physical base of the soybean seed industry.

The over-riding and necessary preoccupation with quantity and capacity - bushels of seed bagged per year - has unfortunately mitigated against any significant advance in quality of seed bagged and marketed (exclusive of variety). The general quality of soybean seed marketed has not - in my experience - significantly improved in the past 15 years. The general quality of soybean seed in the market is still only moderately good.

Moderately good quality soybean seed are not now satisfying the expectations of the clientele of the industry. Farmers are increasingly aware of the importance of high quality seed for the economically successful production of soybeans as well as other crops. This gap between actual quality of seed offered in the trade and expectation of soybean growers will increase unless some of the quality problems in soybean seed production, harvest, processing and storage are resolved to some degree.

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[1] Paper based on the talk presented by the author during the 1971 meeting of the Southern Seedsmen's Association held in Dallas, Texas, which also appears in the proceedings of that meeting.

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Soybean seed quality problems stem from several sources: (1) inexperience of many of the new producers and companies that have entered the trade; (2) compromise between quantity and quality which has been understandably tipped in favor of quantity in the face of very strong demand; (3) the demand of soybean growers for higher quality seed as indicated above; (4) weed seed contaminations that have only surfaced in the past 8-10 years, and (5) the morphology and physiology of the soybean seed which makes it especially susceptible to mechanical damage, and deterioration in field or bin. Thus, knowledge and experience are the keys for improving soybean seed quality.

Two factors contribute to most soybean seed quality problems: mechanical damage and deterioration resulting from weathering before harvest and high seed moisture contents during bulk storage.

Harvesting

Harvesting is, perhaps, the most critical step in the over-all soybean seed production - processing operation. The timing of harvest is important because any delay in harvest after the seed are ready for harvest increases the possibility that the process of deterioration will be initiated in the field as a result of adverse climatic conditions (prolonged rain, high humidity and temperature). The data presented in Table 1 well illustrates the detrimental effect of weathering on germinability of soybean seed.

Table 1. Effect of time of harvest (weathering) on germinability of Bragg soybean seed.

Date of Harvest*	Moisture Content*	Germination (%)
10/9	19	93
10/16	20	93
10/26	18	85
11/4	14	83
11/24	14	80
12/6	14	70
12/18	13	48

*Seed hand harvested and threshed in Fall, 1970.

Bragg soybeans are usually ready for harvest the last week in October, but in the year (1970) that the data in Table 1 were taken, prolonged rains delayed harvest until mid-November. By this time germination of hand harvested beans had declined to about 80%. Seed from the same plots combine harvested on November 14 germinated only 72%, probably, as a consequence of additional damage during combining.

"Weathering" not only decreases germination and vigor as a result of deterioration in the field, but also increases the susceptibility of the seed to mechanical damage. The following data from Iowa State University substantiates this statement (Table 2).

Table 2. Effect of combine cylinder speed and date of harvest on percentage of splits in harvested soybeans.

Date of Harvest	Moisture %	% Splits Combine Cylinder Speed (rpm) 500	700	900
9/12	12.0	3	3	15
9/14	10.5	13	19	30
9/16	8.7	11	21	41
10/20	10.1	21	50	50

(Adapted from Iowa Certified News)

The data in Table 2 shows that the % of splits increased as cylinder speed increased, seed moisture content decreased below 12%, and time of harvest was delayed beyond September 12.

Research and experience has demonstrated that the optimum harvest date for soybean seed is just as soon as possible after the seed drop to 13-14% in moisture content. The adverse effect of weathering is minimized and the seed are less susceptible to mechanical damage at 13-14% moisture than they are at moisture contents above or below this level (Table 3).

Table 3. Relation of seed moisture content and force of impact (height of drop) to loss of germinability of soybean seed dropped onto a hard surface.

Seed Moisture Content (%)	Height of Drop (ft.) 0	5	10	10(2X)*	20
	% Germination				
8	98	88	78	65	70
10	98	90	82	73	73
12	98	97	94	88	87
14	98	97	97	96	97

*Seed dropped twice from height of 10 ft.

Mechanical damage during harvesting, handling and processing not only causes "splitting" of the seed, but also cracking of the seed coat and embryo. The latter is, perhaps, more important in terms of germination because splits can be separated out of the seed lot by processing while cracked seed cannot. We have visually separated cracked soybean seed from many seed lots and

found that on the average only 50% of the cracked seed will produce a normal seedling in a germination test. Thus, if a lot contains 18% cracked seed after cleaning, then germination will be down 9% directly as a result of mechanical damage.

The soybean seed producer must be ever mindful that the seed are easily damaged and that the most severe damage is inflicted during harvest. General recommendations for minimizing damage during harvest are given below:

(1) Harvest just as soon after seed drop to 13-14% moisture as possible.

(2) Combine at uniform ground speed.

(3) Adjust cylinder speed so that complete threshing is achieved - but not higher.

(4) Adjust cylinder speed slightly higher in morning when beans are more difficult to thresh because of dew and lower during the afternoon when the beans dry and thresh more easily.

(5) Avoid use of augers in loading bulk storage bins.

(6) Practice good weed control so that threshing efficiency is maximal.

Bulk Storage

Soybean seed harvested at 13% moisture or above should be aerated in bulk storage to remove field heat, prevent moisture migration in bins, and to dry the seed down to below 13%. If the seed are between 13 and 14% moisture, the fans should only be operated during good drying days and not at night or during humid, rainy weather. However, if the seed are 14 to 16% in moisture, the fans should probably be operated continuously to prevent heating until such time as moisture content decreases to below 14%. Drying temperature should not exceed 100°F and the fan should be capable of delivering a minimum of 3-4 cfm of air through the seed mass.

After the seed have decreased in moisture content to 13% or less they should be periodically aerated (during good drying days) until processing to prevent moisture migration and stratification in the bins and to cool the seed to ambient temperature.

A lot of damage is caused by loading bulk bins with augers or similar types of conveyors. As suggested above, these should not be used. Short augers however, are satisfactory for unloading provided they are in good condition.

Processing

Soybean seed are not difficult to clean and process. Most cleaning "troubles" can be traced to attempts to "squeeze" too much capacity from the air-screen cleaner. Generally, cleaning with an air-screen cleaner at a reasonable rate (capacity) is satisfactory. In recent years, many soybean seed processors have installed spiral separators to remove moonflower seed (weed contaminant), shriveled seed, misshapened seed, soil particles, and the few splits or badly broken seed remaining after basic cleaning. Use of the spiral not only separates some weed seed that cannot be removed with the air screen cleaner but also greatly improves the appearance of the seed, thus, enhancing their market appeal.

Storage

Compared to other kinds of seed, soybean seed do not store very well. Seedsmen generally recognize this, so very few attempt to "carryover" seed from one selling season to the next. However, for the usual storage period from harvest to marketing (6-7 months) few problems should be encountered provided good bulk storage conditions are maintained as discussed above, and the quality of harvested seed was good.

The general recommendation for storage of soybean seed from harvest to marketing in the spring can be summarized as follows:

(1) Take proper precautions during harvest so that good, quality soybean seed are loaded into bulk storage.

(2) Load bulk storage bins with types of conveyors that cause only a minimum amount of damage.

(3) Reduce moisture content of seed in bulk storage to below 13% as soon as possible and maintain favorable environment in bulk storage up to processing as previously discussed.

(4) Package seed at moisture content of 13% or less.

(5) Place bagged seed in clean, ventilated, non-heated storage until distribution.

(6) Insure that storage at distribution points (retail outlets) is equally good.

Although we do not generally recommend carry-over storage of soybean seed (18-19 months), they can be "carried over" satisfactorily provided the lots

for carryover are carefully selected and conditioned storage over the warm spring, summer, and early fall months is available.

The seedsmen should decide on how much seed he needs to carryover before June 1. He should then select the highest quality seed lots in his inventory for carryover. These should then be placed in storage conditioned to not higher than 65° F and 50% relative humidity by June 15, and should be retained under these conditions until ambient temperature drops below 65°F the following fall.

Summary

Considerable improvement in the quality of soybean seed offered in the trade to farmers is possible. Since harvesting is the most critical step in soybean seed production-processing, major effort in improving seed quality must be concentrated in this area. The seed should be carefully harvested as soon as possible after they drop to 13-14% in moisture, and placed in properly aerated bulk storage. Favorable conditions must be maintained in bulk storage up until the time the seed are processed. After processing the bagged seed should be stored in clean, non-heated warehouses until marketing. Soybean seed can be successfully "carried-over" only if the seed enter conditoned storage before the middle of June.