

Minimizing Mechanical Damage to Soybean Seed

Producing good seed is in a grower's best interest. A seed grower will lose price premium if there are excessive splits in a seedlot delivered to a seedsman. Seed cleaning can usually remove the splits, but seeds with seed-coat cracks or with internal injury are difficult to remove. Furthermore, seeds that have mechanical damage to the hypocotyl may not emerge or will produce weak plants in the field. Mechanically damaged seeds also have poor storability and reduced carry-over potential.

Why Mechanical Damage Occurs

Impact is the most common cause of mechanical damage. It is related to speed of the movement of equipment or seed. Impact from the threshing mechanism in a combine is perhaps the most serious cause of mechanical damage. Mechanical damage also occurs as seeds leave the end of a conveyor belt or are dropped and hit a surface.

The internal structure of soybean seeds makes them susceptible to mechanical damage. In soybean seed (fig. 1), the hypocotyl is positioned just under the thin seed coat and can be easily damaged by mechanical forces. Seed moisture greatly influences mechanical

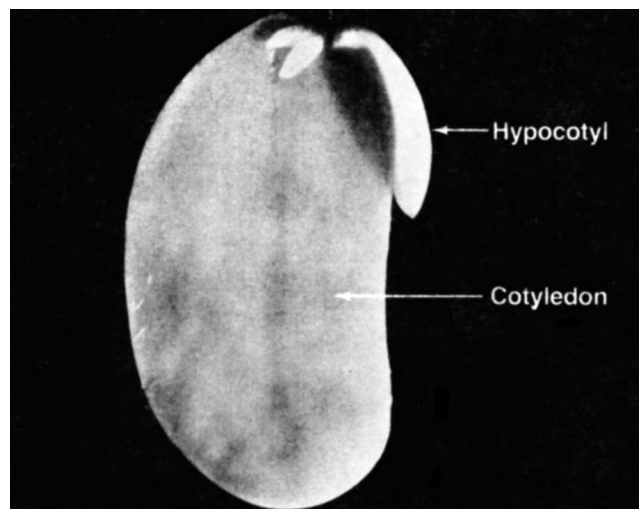


Fig 1. Soybean seed structure.

damage. Soybean seeds with 8 to 10 percent moisture are much more susceptible to mechanical damage than seeds with 11 to 15 percent moisture.

How to Minimize Mechanical Damage

Mechanical damage to soybean seed should be kept to a minimum during harvesting, cleaning, and handling. Important factors in minimizing mechanical damage to seed include (1) reducing the velocity of seed or equipment without significant loss in capacity and (2) harvesting and conditioning the seed at the proper moisture content.

Harvesting

Harvesting (fig. 2) must be timely and done properly to ensure that clean, undamaged seeds will enter bulk storage. The following guidelines will help a grower in successfully harvesting soybean seed.



Fig 2. Harvesting must be timely and done properly.

1. Harvest soybean seeds between 11 and 15 percent moisture.
2. Use a cylinder speed of 400 rpm or less.
3. Inspect for wear in the cylinder rasp bar.
4. Follow the operator's manual for width of concave setting. The concave setting should be as wide as possible and still allow for complete threshing.

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5. Check the threshed seed periodically and, if necessary, adjust cylinder speed and concave setting. This is particularly important under changing weather conditions.

6. Rotary and axial-flow mechanisms may offer gentler seed threshing from a design standpoint. However, with proper operation, a conventional cylinder and concave threshing mechanism will produce satisfactory results.

7. Maintain uniform ground speed with harvest equipment.

Cleaning

Our research with air screen cleaners, spirals, and gravity separators indicates that cleaning equipment causes very little mechanical damage to seed. Mechanical damage usually occurs as seeds are transferred from one piece of equipment to another. Hard surfaces that moving seeds are likely to hit should be lined with rubber or other cushioning material to reduce damage. Special care should be exercised to handle seed as gently as possible after the final cleaning operation.

Handling

After harvesting, soybean seeds usually go to bulk storage, cleaning, and then to a warehouse. Even in a small operation, seeds may be handled as many as 10 times before reaching the warehouse.

Many growers use a portable auger (fig. 3) to fill the bulk storage. The following recommendations will help minimize seed damage caused by an auger.



Fig 3. A portable auger can be used to fill bulk storage.

1. The combination of operating at less than full capacity and at high speed causes the most mechanical damage in an auger operation. To minimize mechanical damage run the auger full and at a slow speed. (How much the speed can be slowed can be determined from a few trials and depends on the needed capacity.)

2. Use of hanger bearings prevents misalignment of the shaft and may help reduce mechanical damage to seed.

3. When possible, use a large diameter auger. For example, an 8-inch auger is better than a 6-inch auger.

4. Avoid elbows or sharp turns.

5. Repair or replace bent or dented tubes.

6. Use the least possible incline.

A bucket elevator (fig. 4) can also be used to fill the bulk storage facility and is often used to receive seed in the cleaning plant. See publication SSC-1, "Selecting a Bucket Elevator for Handling Seed," available from the ISU Seed Science Center. Following are some recommendations for operating a bucket elevator to handle seed.

1. A continuous bucket elevator in which seeds are guided to the discharge spout or fall out of the buckets by gravity is preferred over the kind where seeds are thrown out of buckets.

2. Slow the belt speed to help reduce mechanical damage. Adjust the belt speed to avoid backlagging (seeds falling into the housing).

3. Feeding on the up-leg side (buckets traveling up) is best for handling seed. Place inlets on the up-leg side above the center line of the boot pulley.

4. Line the inside of the head with belting or some other cushioning material.

5. Use plastic buckets.

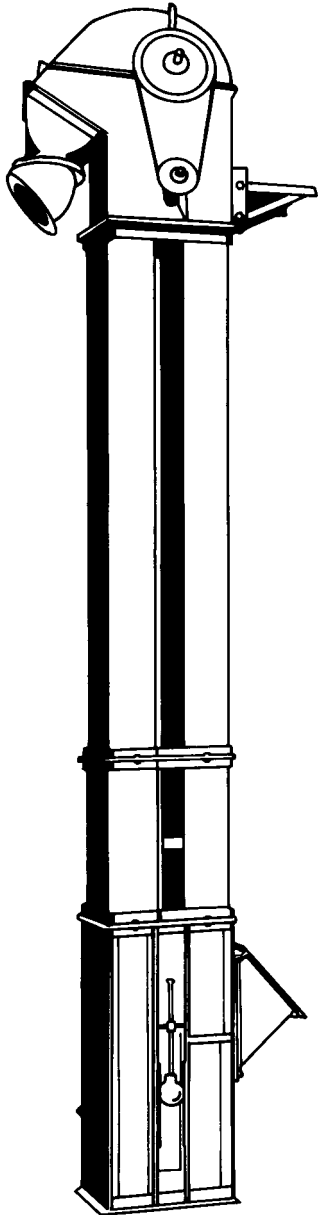


Fig 4. A bucket elevator can be used to fill bulk storage or to receive seed in the cleaning plant.

There are several commercial conveyors designed to gently handle seed such as belt conveyor, auger with rubber intake, paddle conveyor, flight conveyor, pneumatic conveyor, and bristle conveyor. For a thorough discussion of these conveyors, see publication SSC-2, "Conveyors for Bulk Handling of Seed," available from the ISU Seed Science Center.

Regardless of the type of conveyor used, most handling operations include free fall of seed. If precautions are not taken to reduce the free fall, considerable mechanical damage may occur. A drop of 3 meters increased mechanical damage 2 to 4 percent and decreased germination 2 to 3 percent (table 1). Even greater damage has been reported in other studies.

Table 1. Effect of dropping soybean seed.*

Variety	Drop (meters)	Mechanical damage (%)	Germination (%)
Amsoy	0	19.1	89
	3	23.1	86
Beeson	0	14.1	90
	3	16.4	87
Corsoy	0	8.3	93
	3	10.3	91
Wayne	0	14.8	82
	3	16.9	80

*Source: Burriss, J. 1979. "Bulk handling of soybeans." Proceedings of the Seed Technology Conference. Iowa State University.

The following recommendations will help minimize mechanical damage from free fall.

1. Use a bin ladder when filling the bin. Some bin ladders can also be used to unload a bin.
2. Any device that reduces the velocity of seed in continuous deceleration is more effective than an abrupt reduction in velocity.
3. The moisture content of seed influences mechanical damage from free fall. If seeds are artificially dried or have a low moisture content, particular care should be taken to avoid long drops.
4. Whenever possible, move seeds horizontally with a suitable conveyor.

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