4-1-1962

Mechanical Seed Injury

D. H. Bunch

MECHANICAL SEED INJURY[1]

H. Dean Bunch[2]

In the discussion of this subject, we shall attempt to partially answer four questions: (1) What is mechanical injury? (2) What causes it? (3) What are its consequences? (4) What can be done about it?

What Is Mechanical Injury?

The term must be well defined because there are many types of injury which may occur in seeds. Immaturity can damage seed as can insects, diseases, or ageing. By mechanical injury or damage we refer to damage caused by the physical processes of handling seed. It might be illustrated by using man as a comparison. Immaturity can injure a man, especially if he is in the fight game or in politics. Insects, especially red bugs and mosquitoes can play havoc with a man's efficiency, not to mention bees, hornets and gnats. Disease is one of his greatest enemies and usually it is a disease that knocks him out for good. Ageing gets us all sooner or later and may be accelerated by a multitude of things, one of which is participating in too many Seedsmen's Short Courses. These illustrate certain types of injuries which plague man. But if a man is knocked down by a speeding automobile, run over by a steam roller or gets his hand in a silage cutter then we can truly say that he has been mechanically injured.

Disease, insects, ageing, etc., then are not mechanical injures although their causes and effects may be influenced by the degree to which the seed is mechanically damaged. Mechanical injury is a damaging thing that happens to a seed in a direct positive manner. In the animal kingdom and among growing plants many wounds heal. With the seed it is different. The seed is a non-growing organism so there is no way for injuries to heal.

Mechanical injury of seed takes many forms and may be evidenced as crushed parts, bruises, clean cuts, etc. Any portion of the seed is likely to be injured but more especially the more protruding parts. Damage in the area of the embryo of grass and cereal kernels are especially serious while breaks or bruises in the region on either side of the cotyledonary node of legume seeds are likely to produce abnormal seedlings.

---

[1] Presented by Charles E. Vaughan, Assistant Agronomist, Seed Technology Laboratory, Mississippi Agricultural Experiment Station, State College, Mississippi.

[2] Dr. Bunch is Agronomist In Charge of the Seed Technology Laboratory, Mississippi Agricultural Experiment Station, State College, Mississippi.

Seed injuries may be divided into two principal categories: (1) visible or external injury of the seed and (2) internal injury, detected only by a viability test. In the former group, crops which have been injured by threshing or other mechanical means usually show seeds with injured seed coats. This type of injury ranges from slightly cracked seed coats, hardly detected by the naked eye, to severely cracked and chipped seed. In extreme cases, many of the seeds are actually broken into pieces.

What Causes Mechanical Injury?

Mechanical injuries are nearly always a result of abrasions or impact. The latter causing the greater amount of damage. Several years ago, Asgrow researchers dropped Tender Green snap bean seed from differing heights on a solid metal floor to measure the effect of impact on seed viability. They found that germination was decreased from 95 percent to 53 percent in only one drop from a 6-foot height. They further found that the injurious effect was cumulative. After the same beans had been dropped 9 times, there was not a live seed left in the sample.

You may counter that you are not interested in damage to snap beans. It is true that these beans are very susceptible to damage, but it must be remembered that all of the legume seeds have the same type of internal structure and are apt to be damaged by severe impact. Many times a seed is not damaged enough to destroy the essential structures, only enough to cause abnormal or weak seedlings which are practically worthless anyway. Abrasive actions may cause seed injuries but ordinarily they are not nearly as serious as those caused from impact. In fact the use of a controlled abrasive action is the basic principle of the seed huller and scarifier.

Of all the operations from harvest to bagging the one process which produces the greatest amount of damage is the thresher or sheller. Speed and small clearances enable the combine to thresh about as clean as the stationary thresher, but they are also more apt to cause seed damage. The rapidly rotating cylinder on all types of threshers and shellers provide many opportunities for severe impacts.

Conveyors contribute to seed injuries. Too many elevators are built to sell at a price. Many elevators are designed to run too fast because it's cheaper to get increased capacity by stepping-up the speed than by increasing the size of the buckets. Here again the effects are accumulative. Our research and that of others has shown that the more times seed is passed through elevators, the more damage that will result.

Although seed cleaning and sizing equipment contribute to the accumulated injury effects, we have found that most such equipment adds little to the overall injurious effects. On the other hand debearders, scarifiers, and polishers can detrimental if not properly used.

One of the chief causes of seed damage within the processing plant is just plain drops. I would venture to suggest that there is not a processing plant anywhere in which the seed does not drop at least 10 feet. Maybe it does not free fall that far but aren't there places in your plant where the piping is almost vertical for that distance or more? There certainly is here in the Seed Technology Laboratory - but we're not proud of them. These then are the principle sources of seed injuries due to mechanical handling.

What Are The Consequences of Mechanical Injury?

It is said that for every action there is a reaction. How do the seeds react to these injuries? They don't yell like the boy who drops a rock on his big toe, but they are hurt. The worst consequence of mechanical injury is death, and as cited earlier some seeds are damaged so severely that they will not germinate. Short of being killed many seeds may be so severely damaged that they produce abnormal seedlings. The seedlings may be abnormal because some essential structure was broken partially or completely off or they may be abnormal because the injury has allowed a disease-producing organism to become established in the interior of the seed. If you want to establish destructive organisms in your seed, you can find no better way to do it than to roughen up the seed coat and bruise the seed a little. Scratch or break the seed coat and microorganisms will enter just as sure as flys will find a hole in a screen door. Even breaks too small to be seen without a magnifier will allow disease organism entry. An unbroken seed coat is the best protection you can give a seed.

In general, members of the grass family, which includes the cereal grains, corn and sorghum as well as the forage and pasture grasses, are equipped to withstand rough treatment better than the seed of legumes. The attached inner glumes act as shock absorbers for the kernels of many caryopses in many members of the grass family. In other species the embryo is recessed. Nevertheless, the more adverse the conditions of treatment, the less likely it will be that strong seedlings will result.

Injured seed are more likely to be damaged by volatile fungicides, insecticides and fumigants than non-injured seeds. Authenticated data have proven that some of the lower seed germination that seedsmen have experienced after using mercurial treatment or fumigants have been due at least in part to excessive mechanical injury.

Finally, all else being equal, mechanically damaged seed will not maintain vigor and viability in storage as long as the same kind of seed undamaged. The breaks interfer with the respiration rate and allow microorganisms to enter. Perhaps other things unknown to researchers also happen. But the net result is seed which may not carry over until next season except under the very best storage conditions.

What Can Be Done About Mechanical Injury?

By now you are probably mumbling that anyone can be a prophet of doom, but tell me what I can do to prevent, cure, or at least improve the situation. This is the hard part because the answers may be easy but the solution is difficult. For example, the answer to how to prevent mechanical injury is not to use any machines. The answer is easy but to attempt to apply it to the occasion is absurd. We must be realistic in our approach to the problem, at the same time realizing that some capacity, speed and even conveniences may have to be sacrificed in order to bag the best possible product. Your customers are more discriminating than they were 10 years ago, and 10 years from now they will be demanding better quality seed than they are today. Someone has rightly said, "Quality will be remembered long after the price is forgotten." I submit these ideas at this point because you will be calling some of our suggestions "impractical".

Let us look first at the harvesting operation. The speed of the threshing cylinder chiefly determines the force of the impact of the machinery with the seeds. Since high speed damages the seed and low speeds may not thresh completely, the operator is in somewhat of a dilemna when it comes to adjusting cylinder speed.

As a rule of thumb, speed of the cylinder should not be any faster than required to thresh the seed. It should be remembered that the speed required for threshing in mid-day will probably be less than during early morning and late afternoon. Close attention at this point will minimize seed injury considerably. In shelling corn, the sharp edges of sheller bars or teeth can be filed off and speed reduced 1/3 to 1/2 from that used in commercial shelling to decrease pericarp injury.

Various devices can be installed for reducing the impact of seed falling into deep bins or into equipment hoppers. Little can be done to decrease mechanical injury in the cleaning and sizing equipment but speed and adjustments of debearders and scarifiers must be carefully controlled if impairment of seed quality is to be kept at a minimum.

In spite of all precautions excessive mechanical injury may still occur where seed moisture is low. The research which revealed that a single 6-foot drop reduced the percentage germination of snap beans from 95 to 53 was done with beans of 8% moisture. Beans containing 12% moisture withstood 5 drops of 6 feet each before germination was reduced as much. Experiments by other workers have found that corn processed with a moisture content of 14% showed only 3 to 4% mechanical injury while the same treatment of corn containing 8% moisture produced 70-80% damage. Similar results have been obtained with soybeans in the same moisture ranges. Work here at the Seed Technology Laboratory with soybeans and corn conveyed with air lift and bucket elevators have shown that the least amount of damage occured in the 14 to 16 percent range.

Considerable damage occurred at 20% while seeds containing 8% moisture were worthless after 5 passes through the elevators.

The relationship between moisture content of the seed and degree of mechanical injury which may occur during harvesting, conveying and cleaning presents a critical situation for the seed producer-processor. Under "standard" methods of procedure, seed crops are allowed to dry in the field until the seed moisture is low enough for safe storage, or the crop is harvested at a higher-than-safe moisture level and artifically dried prior to cleaning.

In the handling of seeds which damage easily, partial reversal of this procedure may be necessary, because the moisture level at which seed can be handled with minimum damage to the seed contains too much moisture for safe storage. This is especially true if the seed is located here in the Southeast and is to be carried beyond the next planting season without controlled temperature or humidity in the storage area. For instance, soybeans at 14% moisture can be handled relatively safely, but at this moisture content they would not remain fit for seed any longer than 3 months at 85° F. The same lot of beans dried to 9% moisture could be expected to be valuable seed after a full year's storage at the same temperature. At winter temperatures the 14% seed would still deteriorate faster than seed with the lower moisture level. However, if the beans are dried to 9% before conveying and cleaning, there is a great danger of excessive injury unless they are handled very carefully during the processing.

The solution points toward a reversal of the "standard" procedure, that is, conveying and cleaning <u>before</u> drying. This would mean that the cleaning capacity of the plant would have to equal the harvesting rate and that distribution of labor might not be entirely desirable since harvesting and cleaning would proceed at the same time. Under such a system, freshly harvested seed would have to be cleaned immediately upon arrival at the processing plant and placed in the dryer in bulk or only partially dired before processing. This suggestion may seem impractical, but it is also impractical to attempt to maintain high quality of seed as to varietal purity, freedom from noxious weeds, etc., if it is so badly damaged that it will not give satisfactory performance for your customer.

In conclusion, may we submit the observation that from the standpoint of the seed, there are many undesirable characteristics of combines, conveyors, and other seed handling equipment. However, there is a note of encouragement in that manufacturers are becoming more aware of the need for equipment which will treat the seed more kindly. While that equipment is being developed every good seedsmen should critically analyze his own plant and eliminate the rough places. Strive to handle your seed as nearly as you would eggs, within the area of practicability, remembering always that there is not much of a market for cracked eggs. Remember too, that seed of medium high moisture damages less during handling than very dry or excessively wet seed, but don't forget that this same moisture level also causes seed deterioration in other ways. Before

storage get the seed good and dry, and treat with a non-mercurial fungicide to help compensate for the scratched seed coats. This treatment won't heal the breaks but it will discourage the entrance of disease-producing organisms. If to this point you have used care during harvesting, drying and cleaning and can put pure well-cleaned, correctly treated seed in new bags and can store them in a cold or dry atmosphere, you will have the satisfaction of knowing that your product is good. If you are able to convince your potential customers that high quality seed pays, you might even make a little profit - and rest assured you will have earned every penny of it.