4-1-1973

Considerations in Cleaning and Processing Seed

H. C. Potts

CONSIDERATIONS IN CLEANING AND PROCESSING SEED

Howard C. Potts[1]

The purpose of this discussion is to bring into focus the specific considerations which should be made before the cleaning and processing operations are begun.

The removal of undesirable materials from a seed lot is an art based on the application of scientific principles. Just as a doctor must know how your body functions when you are well, the processing manager must have a thorough knowledge of good seed. In good seed, emphasis is placed on (1) genetic purity, (2) mechanical purity, and (3) high germination percentage. In seed processing, primary interest is on improving mechanical purity and germination percentage, because these two factors are most often manifested in different physical characteristics of a seed.

What is seed processing? In the broad sense, it encompasses all the steps involved in the preparation of a harvested seed lot for marketing. In common usage, seed processing refers to (1) preconditioning, (2) cleaning, (3) size grading, and (4) upgrading. During this discussion, the common definition of seed processing will be used.

With these facts in mind, it is now logical to state that the purposes for processing seeds are: (1) to remove contaminants, (2) size-grade to improve plantability, (3) upgrade quality, and (4) apply seed treatment materials. To achieve this purpose, the processor simply decreases the percentage inert matter, other crop seed, weed seed, and poor quality seed present in the original lot. Note that these factors which must be affected by processing are the same as those for which seed are examined under the various seed laws, that is, pure seed, inert matter, other crop seed, weed seed, and germination.

The processing of individual lots of seed is divided into three sequential events: (1) pre-cleaning examination, (2) removal of undesirable materials, and (3) upgrading and/or sizing. The first two steps are essential to effective processing of all lots; the third is dependent upon the kind of seed being processed, the nature and kinds of contaminants, the quantity of each contaminant in the raw seed, and the quality standards that must be met.

A basic requisite for effective seed cleaning is the capability of the processor to identify and distinguish the seed to be cleaned from the contaminants that occur in every seed lot. He must also know enough about seed to be able to distinguish between good, healthy seed

---

[1]Professor of Agronomy, Seed Technology Laboratory, Mississippi State University.

and those of questionable quality, because at some point in the processing operation, he must make a decision concerning which seed he will keep and those that will be removed from the lot. Thus, the processor's ability to render the desired service is affected by: (1) the processing and handling equipment available, (2) their arrangement within the plant, (3) the operator's skill in operating the equipment, and (4) his knowledge of seed characteristics. Notice that the first two of these factors were fixed when the processing plant was built. *Therefore, operational skills and knowledge of seed characteristics are the only variables immediately available to either the processing manager or management to control seed quality.*

The Pre-Cleaning Examination

As previously indicated, the first step in processing each seed lot is the pre-cleaning examination. Before giving any consideration to the equipment to be used in cleaning a lot of seed, a representative sample of the lot should be examined to determine the following factors:

1. Differences in physical characteristics
2. Frequency of occurrence of contaminants
3. Size variation of the good seed
4. Flowability
5. Need for pre-conditioning
6. Damaged seed

There is no significance to the order in which these factors are determined.

The primary purpose of the pre-cleaning examination is to determine the separable components of the seed lot. *Remember: unless there are distinguishable physical differences among the components of the seed lot, no separation is possible.* Thus, it is the components of the seed mixture and not the machine that determines if a particular separation is possible or practical.

Now, let's consider these six factors individually to see how each relates to seed processing. Seed, people, or any solid product, can be separated on the basis of differences of their physical characteristics. There are eight physical characteristics of importance in seed separations. These eight characteristics are: (1) shape, (2) length, (3) size, (4) color, (5) affinity for liquids, (6) electrical charge, (7) surface texture, and (8) specific gravity. Keep in mind that even though physical differences exist and proper equipment is available, it is not what you have but how you use it that determines success in making the desired separation.

Contaminants which have physical characteristics similar to those of good seed are of greatest concern. When examining the seed lot, particular emphasis must be placed on determining the presence of contaminants such as noxious weeds, nematode galls, etc., which could

cause the seed to be unusable even though the mechanical purity may exceed 99%. Seeds of noxious weeds, other crops or varieties, common weed seed, damaged seed, and inert matter *similar* in physical characteristics to those of the good seed, are of descending importance in most seed lots.

Contaminating materials obviously much larger, smaller, or lighter than the good seed are not of great importance except when such materials affect seed flowability or when they represent more than about 20% of the seed lot. Seed lots containing a very high percentage of inert matter or removable crop and weed seed normally must be cleaned at a reduced rate of flow to allow removal of these materials and to avoid flooding of the discharge spouts provided for materials removed from the seed mass.

The frequency of occurrence of contaminants refers to the ratio between the desirable seed or characteristics of a lot and the undesirable. When looking at the seed to be cleaned, a thorough examination may reveal an undesirable characteristic, but it usually is the ratio of good to bad that is important, not the fact that a minor, oftentimes correctable defect is noted. This is usually a judgment decision, but we are generally willing to give up or overlook one thing to get something we really want.

Depending upon the quality standards to which the seed must be raised, certain contaminants can be ignored. All clean seed will contain a fractional percentage of inert matter. Many lots of seed contain small amounts of other crop seed or common weed seed because the cost of removing these seed exceeds the value that would be added to the seed after the contaminant is removed.

As an example, if the pre-cleaning examination revealed the presence of one oat seed per handful of wheat seed in a lot of non-certified wheat seed, the occasional oat could be ignored. However, if the wheat seed were to be certified, it would be necessary to remove the oat seed. Thus, the presence of this oat seed would require the use of additional equipment, therefore increasing the cost of processing the certified seed. This same example is equally valid for common weed seed and inert matter, in that the quality standard set by management or, in some cases, by law determines what contaminants must be removed from each seed lot. Ideally, every lot of seed would be 100% pure seed; realistically, 100% purity is not practical, physically or economically.

Variation in size of the good seed is one factor frequently overlooked when examining seed for processing. Research conducted in 1875 showed that the smallest seed in any lot are of little value for reproductive purposes. On the other hand, subsequent research on seed size indicated that the exceptionally large seed, although nice to look at, are not the most desirable for reproductive purposes. Therefore, in seed, what we really want are those large enough to perform their function, but small enough to avoid problems due to size.

For most crops, the better the climatic conditions for seed production, the more uniform the size of the seed. In all species, the more uniform the seed size, the easier the seed are to clean. Effective processors know that different varieties of the same species often differ significantly in average seed size and they adjust the machines accordingly. One of the poorest testimonies to a seed processor is to observe screens marked with the name of a crop. Such marking usually indicates a disregard for the natural variation in seed size and the other variable physical characteristics of a seed lot.

Another factor determined during the pre-cleaning examination is flowability. Flowability refers to the ease and uniformity with which seed will flow in the absence of mechanical force. A large sample of the entire lot must be used to determine flowability, because compaction must be considered in addition to the presence of inert material and natural seed appendages. This sample should be drawn by hand because probes often exclude large pieces of inert materials.

Seed must flow uniformly through the equipment before they can be effectively separated from the contaminants. As a general rule, a lot of seed which has an angle of repose greater than 70 degrees should be pre-cleaned or conditioned before attempting any separation by the air-screen or subsequent processing machines. Anyone who has spent a day or two forcing seed into an elevator or pushing seed through a bin opening will testify for the need of pre-determining the flowability of every seed lot.

Most seed lots which have been harvested and threshed mechanically will flow through a properly designed processing plant. However, an occasional lot of any kind of seed may lack the necessary flow characteristics because of natural appendages on the seed, high quantities of coarse inert matter, high moisture content, or poor threshing. Such lots should be pre-conditioned to improve flowability before attempting to clean the good seed.

A factor related to flowability is the need for pre-conditioning. In seed processing, the term pre-conditioning is used in two different contexts. First, it may refer to any method used to circumvent or remove those obstructions which reduce flowability. If long pieces of plants, such as straw or stems, or large quantities of sand or soil are the cause of poor flowability, these are normally removed with a scalper or aspirator. Drying lots which are high in moisture or which contain green plant materials often will give a lot the desired flow characteristics. Of course, corn must be shelled before processing. There are several techniques which can be used to improve flowability, but the method used will depend upon what you want to remove.

The second meaning applied to pre-conditioning refers to the removal of undesired or unnecessary coverings and appendages from the seed which may interfere with the cleaning process. This type pre-conditioning also serves to improve the appearance of the product. It is custo-

mary to hull and/or scarify combine-run seed of many of the small seeded legumes to facilitate cleaning and increase the speed of germination. Awned varieties of oats and barley are normally debearded both to improve flowability and appearance.

The final factor which should be determined during the pre-cleaning examination is damaged seed. There are three main causes of seed damge: (1) insects, (2) disease, and (3) mechanical abuse. Many different things can and do happen to seeds which make them undesirable, or at least reduce their capability to perform as well as undamaged seed.

When insects are active in the seed, the lot should be fumigated before it is cleaned with a fumigant recommended for use on seed. Disease damaged seed are usually lighter in specific weight than healthy seed of the same dimensions. Thus, the presence of more than 2 or 3% damaged seed is an indication to increase the velocity of the final air separation on the air-screen cleaner and the possible need to utilize a specific gravity separator. In most instances, seed lots that require specific processing to remove disease damaged seed should be treated with the appropriate fungicide.

Mechanical damage to seed can be classified into three categories: (1) seed destroying, (2) major, and (3) minor. As the name implies, seed destroying damage is mechanical injury which splits or breaks the seed, such as split beans or cross broken seed, causing such seed to be unfit for planting purposes. Usually, these seed parts can be removed because breaking changes the physical characteristics.

Major damage is damage to the seed coat or covering which is visible to the naked eye, such as cracked or chipped corn seed and machine cut cottonseed. Nothing can be done to remove such seed from the lot unless the damage alters the physical characteristics of the seed. When the undamaged seed have smooth seed coats, the damaged seed can frequently be removed by using a machine which separates on the basis of differences in seed coat texture, *i.e.*, magnetic separator or roll mill. Seed having minor damage, such as pin-holes, are not normally noticed in the pre-cleaning examination. A general rule concerning mechanical damage is that for each seed that is split or broken, there will be three other seed which have suffered major or minor damage.

Techniques for Making Pre-cleaning Examinations

Under optimal conditions, the processing manager will have an opportunity to process a sample of each seed lot, using hand screens and/or model equipment. Organizations equipped to conduct such pre-processing tests are among the most efficient in their cleaning and processing operations. Such testing requires advanced sampling and control over delivery of various seed lots to the processing plant. This type sampling and control is not feasible for processing plants

engaged in custom cleaning operations or processing seed coming directly from the field.

An intermediate method of making the pre-processing examination is to conduct a routine purity analysis on a sample of the field run seed. This analysis will provide valuable information on the kind and rate of occurrence of various contaminants. However, such factors as comparative physical differences between the good seed and contaminants, variation in seed size, flowability, and damaged seed must still be determined on the basis of a visual examination.

In spite of the more desirable methods of examination listed above, the pre-cleaning examination is most frequently made by simple visual examination of several handfuls of the field-run seed taken at the time the seed are delivered for processing. To make this examination, the seed are poured slowly from hand to hand or spread into a thin layer on a table or floor, in a well-lighted area, and mental notes made concerning potential separation problems. It should be obvious that this method will result in a higher frequency of lots which are below or above desired quality levels after processing than when more detailed methods are utilized.

Precision of the hand method of examination can be increased if the processor knows the approximate weight of his handful of seed. This can be easily determined if the examiner will weigh several handfuls of seed of the various kinds processed. Greater repeatability can be gained if the operator will close his fingers against the fat part of his hand. For most persons, this will be a sample of one or two ounces.

Regardless of the techniques used for the pre-cleaning examination, it is of vital importance that the processor be thoroughly knowledgeable in seed identification and purity analysis. An experienced operator can closely approximate the percent cleaning loss, mechanical purity of the clean seed, and the probable presence of undesirable seed or characteristics of the processed seed before the seed enter the processing plant by combining his knowledge of seed with that of equipment operation.

The phrase often used by TV star, Flip Wilson, "What you see is what you get," could be considered as a summary to the consideration necessary for seed cleaning and processing. However, our experience both as seed processors and seed control officials, have led us to a slightly different conclusion. Hopefully, you will agree with our conclusion rather than Flip's -- "What an operator considers is what he gets, but those things he doesn't consider will finally get him."