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Basic Operations in Seed Conditioning "Pre-Conditioning"

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"Pre-Conditioning"

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Seed conditioning is the act of preparing harvested seed for planting. The purposes of seed conditioning are to improve the physical purity, germination level, appearance, planting characteristics; to apply seed treatment materials and package the conditioned seed. In the modern context, seed conditioning is done mechanically.

Seed conditioning may be sub-divided into five operational phases based upon differences in the physical characteristics of harvested seed of different kinds and varieties, the unit value of the seed conditioned and the seeding methods used. Sequentially the five phases are pre-conditioning, basic cleaning, upgrading and finishing, seed treatment and packaging. A given lot of harvested seed may be subjected to one or several of these operational phases. Only the basic cleaning phase is required by all seed lots which move through commercial channels; the need for additional conditioning is determined on a lot by lot basis.

Seed of many, but not all, kinds may require some additional preparation after they have been harvested and placed in bulk but before they can be cleaned, graded or treated effectively. For example; maize must be shelled from the cob; "beards" (awns) must be removed from some varieties of barley, oats and grass seed; before the quality characteristics of the seed lot can be improved significantly. Those activities necessary to prepare a seed lot for basic cleaning are referred to as pre-conditioning the seed.

Pre-conditioning is usually a high volume operation done primarily to increase the effectiveness and efficiency of subsequent operational phases. Seed lots are pre-conditioned to change the physical characteristics of the entire seed lot and/or the individual seed in the lot. The physical characteristics of the seed lot are changed by removal of materials much larger, smaller or lighter than the good seed in the lot. Characteristics of individual seed may be altered by removal of appendages or coverings, separation of seed clusters into individual seed, removal of the seed from other plant parts, and/or scarifying the seed coats to make them permeable to water.

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The specific operations included in pre-conditioning seed are as follow: scalping, shelling, debearding and hulling-scarifying.[2] The kind and physical condition of the harvested seed determines which, if any, of the pre-conditioning operations may be necessary and, therefore, the equipment necessary.

Scalping (Pre-cleaning)

Scalping is generally considered to be the removal of those materials larger in size than the bulk of the seed mass. However, because of the availability of a wide assortment of equipment, the "scalping" operation may include removal of the very small materials (grading) and/or materials significantly lighter than the seed mass (fanning). The basic purposes of scalping operations are to improve the flow characteristics of the seed mass and increase the efficiency of the subsequent cleaning and conveying operations. Figure 1 depicts samples typical of rice before and after scalping and the advantage of scalping - increased capacity of the basic cleaner.

The maximum benefits from scalping operations are received when they are done as the seed are received. The machine selected should have a capacity equal to that of the receiving elevator. Scalping the seed mass before conveying into bulk storage and/or drying bins contributes to insect and storage mold control, reduces the resistance of the seed mass to air flow, and increases the drying rate while reducing power and fuel consumption.

The type scalper most often used in the seed industry are the screen scalpers similar to those shown in Figure 2. These scalpers are available in one, two and three screen models, with or without air aspiration systems and in a range of capacities. The more sophisticated models permit removal of materials larger, smaller and lighter than the seed mass. Reel type-aspirating scalpers (Figure 3) are effective when it is only necessary to remove materials much larger (straw or pods) and lighter than the seed mass in crops such as rice, oats or wheat. "In-line aspirators" and "single-reel circular screen scalpers" are effective for removing dust and light materials or sticks and straw, respectively, during receiving operations.

Shelling Corn

Most seed corn is delivered to the conditioning plant on the ear and, therefore, must be shelled before the seed can be cleaned (Figure 4). Because much of the mechanical injury to seed corn occurs during shelling, very special attention must be given to this pre-conditioning operation.

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[2]Seed drying is included as a part of the pre-conditioning phase by some but is not included in this discussion.

Figure 1. Combine-run rice seed (above) the same seed after scalping (middle). Rice seed after cleaning with an air-screen cleaner (below). Note the influence of scalping on the cleaning capacity.

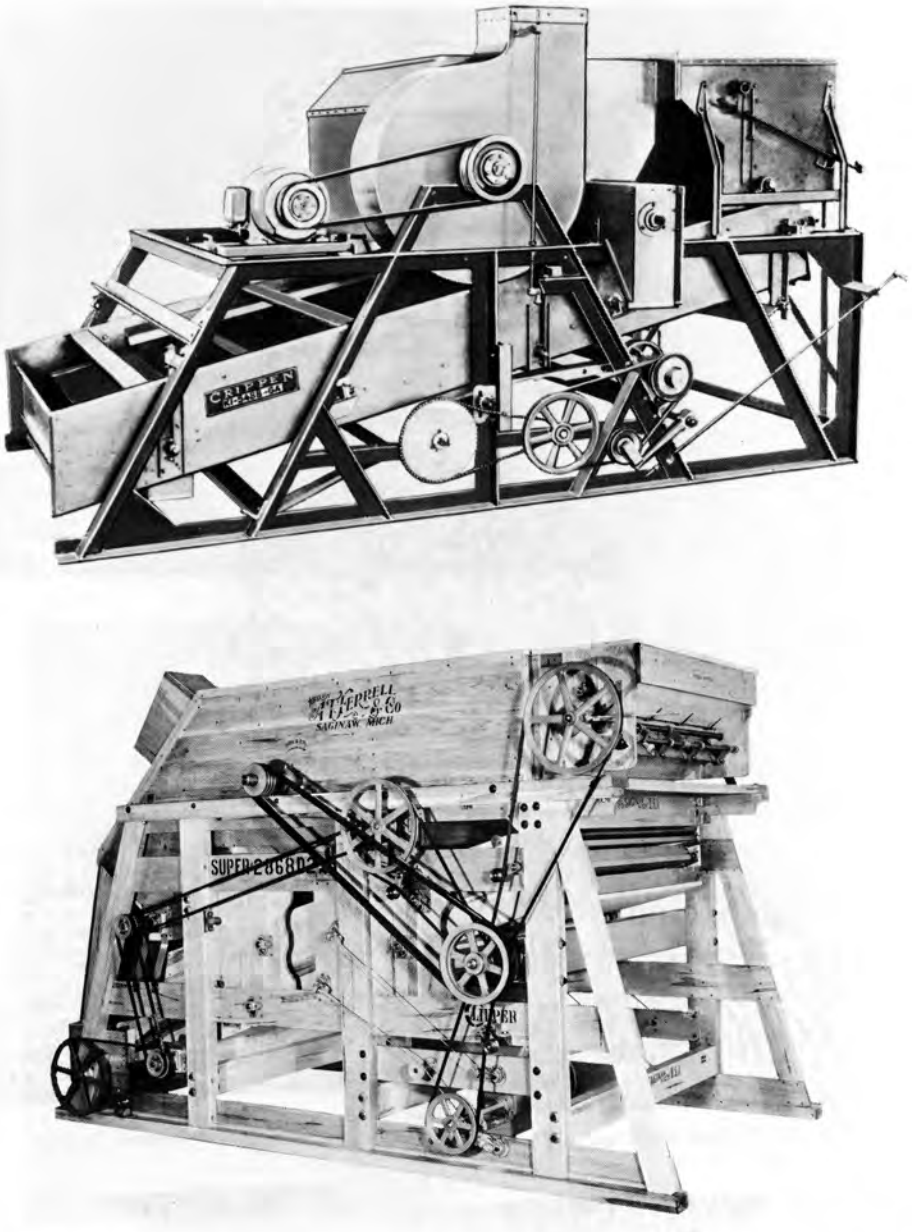
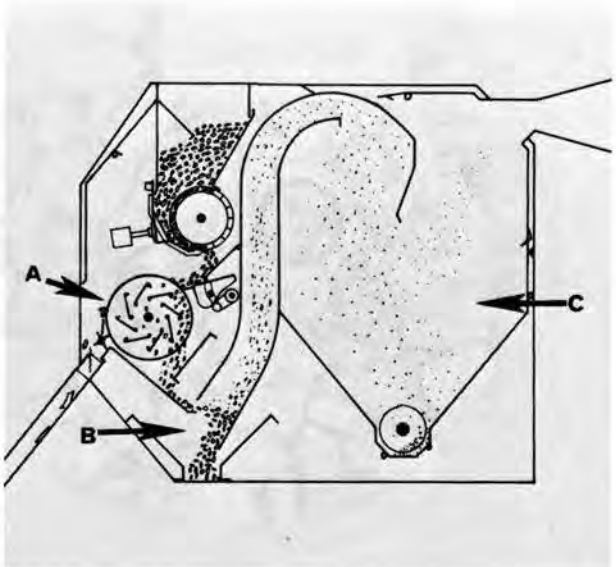


Figure 2. Flat screen scalpers. A single screen scalper with an upper air system (above). A two screen scalper with upper and lower air system (below).



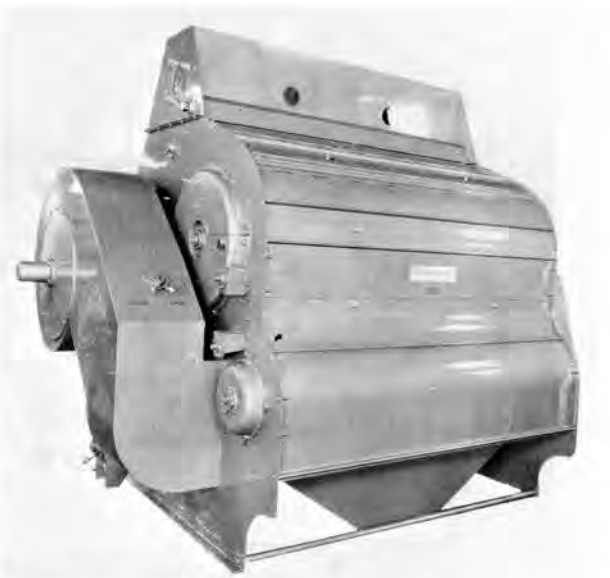


Figure 3. Reel-type scalping aspirator. Schematic flow diagram A-scalping reel, B-aspiration chamber, C-settling chamber (above). A commercial model (below).

Figure 4. Seed corn as discharged from the sheller (above) note mechanical injury to kernels circled. Cleaned, size graded seed corn (below).

Regardless of the sheller used, it is necessary that the "caps" of most seed impact with the bare metal "lugs" inside the sheller and some damage will occur. Damage can be minimized by operating the sheller at the minimum speed for the capacity needed; keeping the shelling unit full at all times, and shelling when the moisture content is below 20 % but above 13%. Based upon the observation that, "used shellers caused less damage than new ones", some corn seed conditioners have recommend filing down the sharp edges of the lugs on new shellers before initial use.

Most corn shellers have both a sheller and a screen and/or aspiration system which separates a major portion of the cobs from the shelled seed (Figure 5). Nevertheless, if the shelled seed are to be dried or placed into bulk storage it is highly desirable to further pre-condition the seed with an aspirating scalper to remove the light materials (bees wings) and small cob particles.

Debearding

Some seed have nat ural appendages attached, are not threshed free from other plant parts or remain in clusters after mechanical threshing. The presence of awns, glumes, seed clusters, etc.interferes with seed flow characteristics, separation efficiency and appearance of the cleaned seed.

The debearder is designed to reduce or eliminate problems such as those indicated above. The sequence of samples shown in Figure 6 depicts combine run barley before and after passing through a debearder and the appearance of the clean seed which were or were not debearded. Not indicated is the fact that the clean, debearded seed were higher in test weight than the non-debearded seed.

Seed fed into a debearder are vigorously agitated and rubbed together between sets of rotating and stationary beater bars (Figure 7A). This rubbing action completes threshing and breaks most appendages which project from the main seed unit. Seed moisture content should be below 13% prior to bedearding.

Most debearders are equipped with both a variable speed drive and a weight mechanism on the discharge gate. The desired debearding action is accomplished by controlling the rate of feed, rotation speed of the beater bars and the force required to open the discharge gate. The rotation speed and weight controls should be adjusted to minimize mechanical injury while still removing the undesired appendages from the good seed. The good seed and materials removed must then be separated during subsequent cleaning operations.

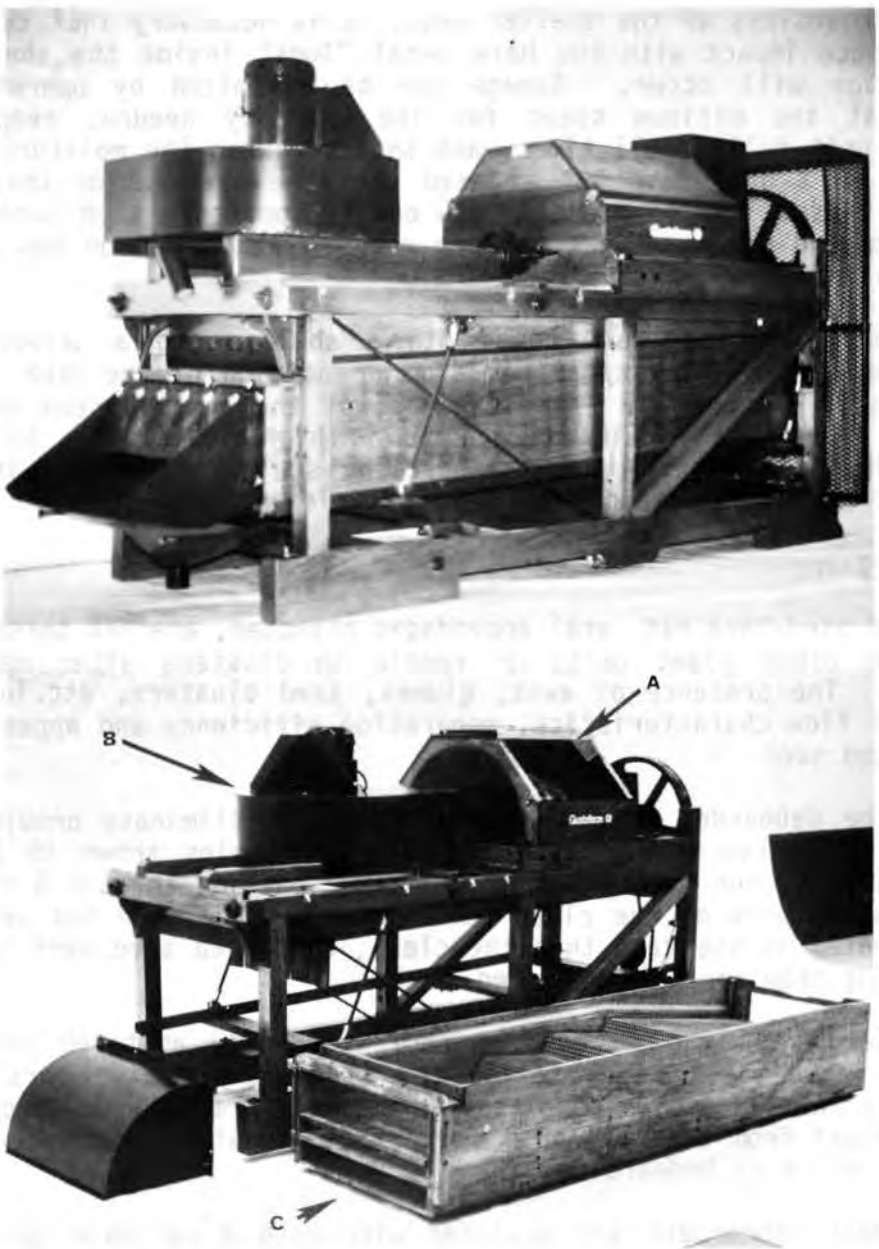


Figure 5. Corn sheller. Disassembled sheller with major components identified (above). A-shelling chamber, B-aspiration fan, C-screening mechanism. Commercial model of an assembled corn sheller.

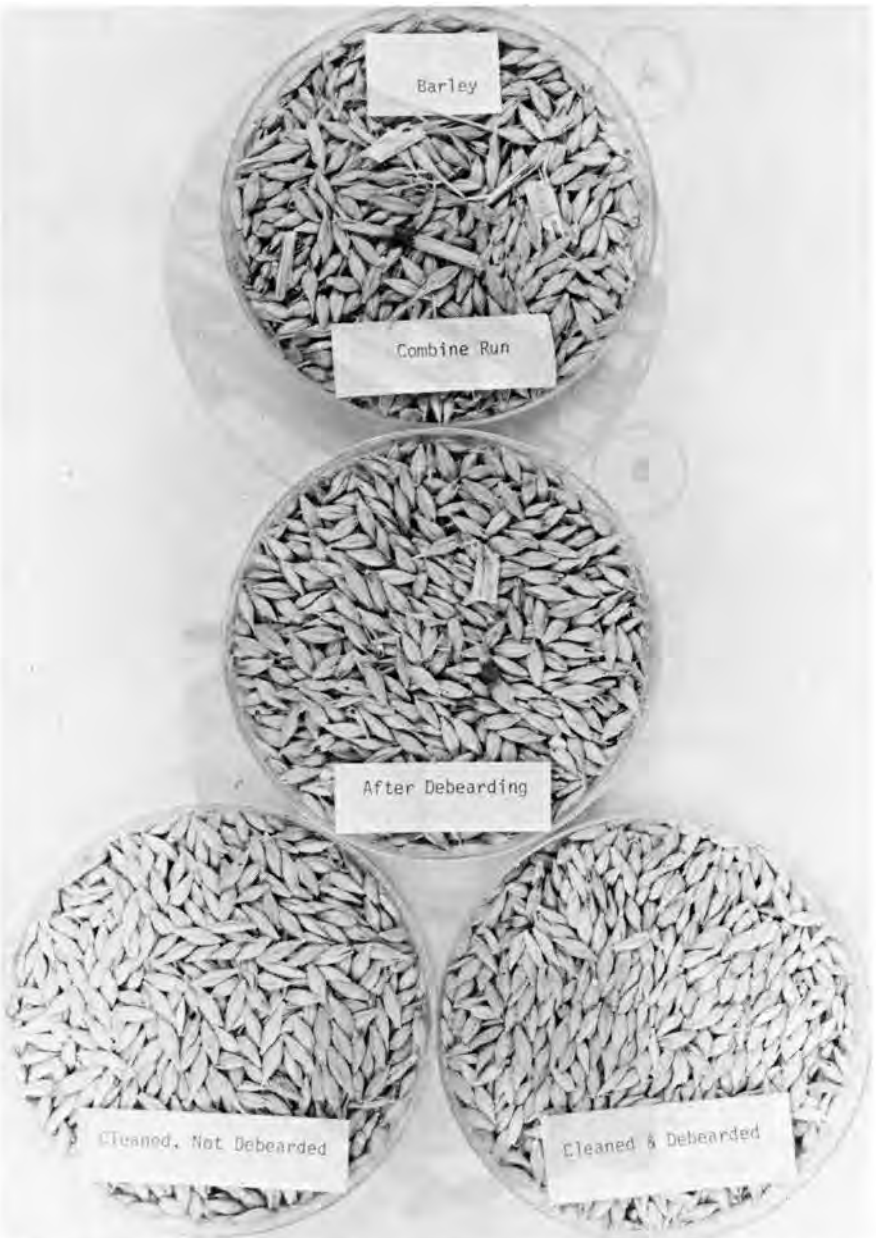


Figure 6. Barley seed. Combine-run seed (above). Seed after debearding (middle). Clean seed from lots that were not and were debearded (below).

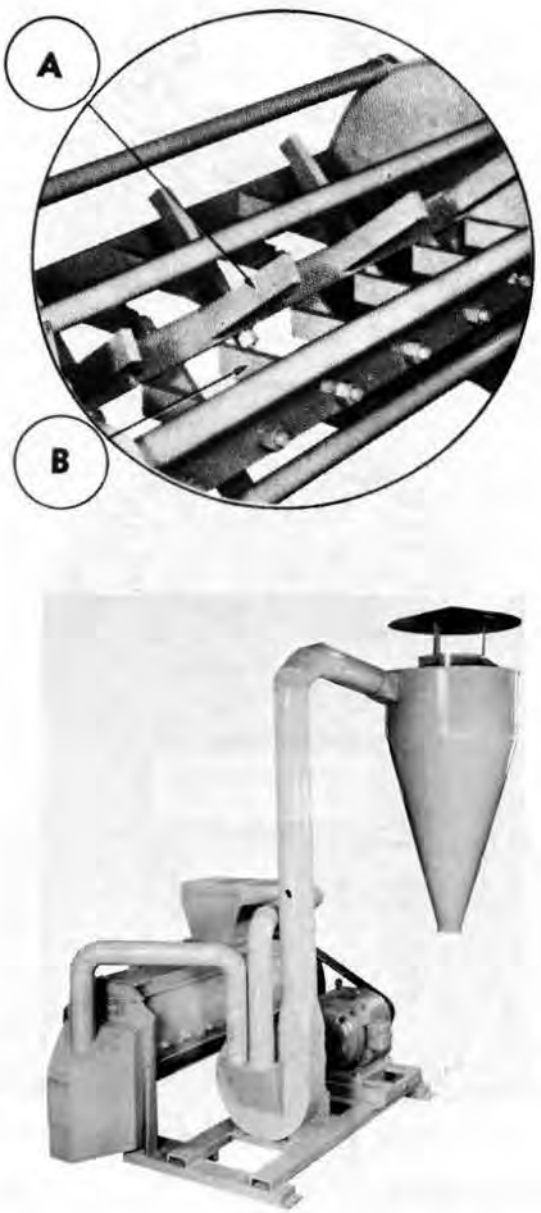


Figure 7. Debearder. Cut-away view showing (A) rotating and (B) stationary beater arms inside the debearder (above). Commercial debearder with dust aspiration system attached.

Hulling and Scarifying

Hulling; removal of the pods or "hulls" not removed during threshing, and scarifying; mechanically scratching the seed coat to make it permeable to water, is accomplished with a huller-scarifier. Hulling and scarifying can be different operations. It may be necessary to hull or scarify seed which are not threshed free of natural coverings and/or have a hard seed content in excess of 10-15% after threshing. Hulling/scarifying is primarily for seed of the small-seeded legumes; such as alfalfa, lespedeza, red clover, arrowleaf clover, etc., but is also used to decorticote seed such as sugar beet, dill, and carroway seed.

Hulling a seed changes its physical characteristics. When compared with an unhulled seed, hulled seed are smaller and have a higher weight per bushel. Hulled seed also have better flow characteristics than unhulled seed and, after cleaning, have a better appearance. There is both a weight and volume loss when seed are hulled; however, the overall quality of the cleaned seed is usually higher because immature and insect damaged seed can be removed more easily from hulled seed (Figure 8). One disadvantage of hulling occurs when contaminating weed seed present are smaller than the unhulled seed but similar in size to the hulled seed. Thus, a careful examination of the seed lot is necessary to determine whether the seed should be cleaned, then hulled and recleaned or simply hulled then cleaned.

Some lots of red, arrowleaf and subterraenean clover and hardseeded varieties of common vetch seed have as high as 50-70% hard seed after mechanical threshing even though the seed are threshed free from their pods and may not require hulling. Many other small-seeded legume seed may have more than 10% hard seed after threshing and cleaning. Seed lots which contain more than 10-15% hard seed should be scarified to permit rapid, uniform, stand establishment when planted. Unlike hulling, scarification does not change the physical characteristics of a hulled seed since, when done correctly the seed coat is only scratched, not broken. Conditioning personnel must be aware that scarification is controlled mechanical injury.

The samples shown in Figure 9 permit a comparison of the seed of arrowleaf clover which are not scarified and those that were scarified before cleaning.

All huller-scarifier machines utilize the same general principles to accomplish the job. They "throw" the seed at an angle against an abrasive surface. The force used to throw the seed and the surface against which they are thrown determines whether the seed are hulled, scarified, hulled and scarified or broken into pieces (Figure 10).

Whether hulling or scarifying, the seed moisture content and the quantity of cushioning material in each seed lot are the most important characteristics of the seed that influence machine operation. For

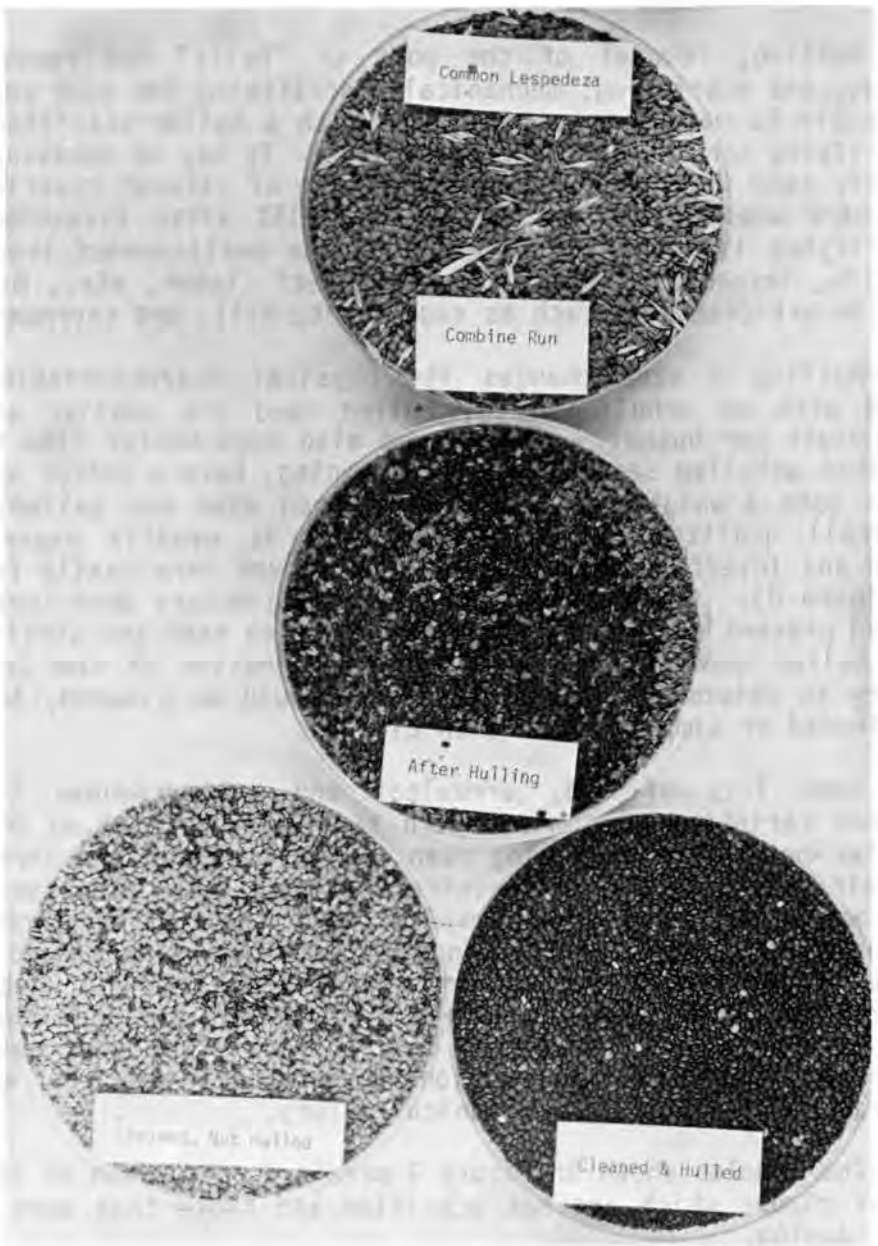


Figure 8. Common lespedeza seed. Combine-run seed (above). Hulled seed as discharged from a huller/scarifier (middle). Cleaned unhulled and hulled seed (below).

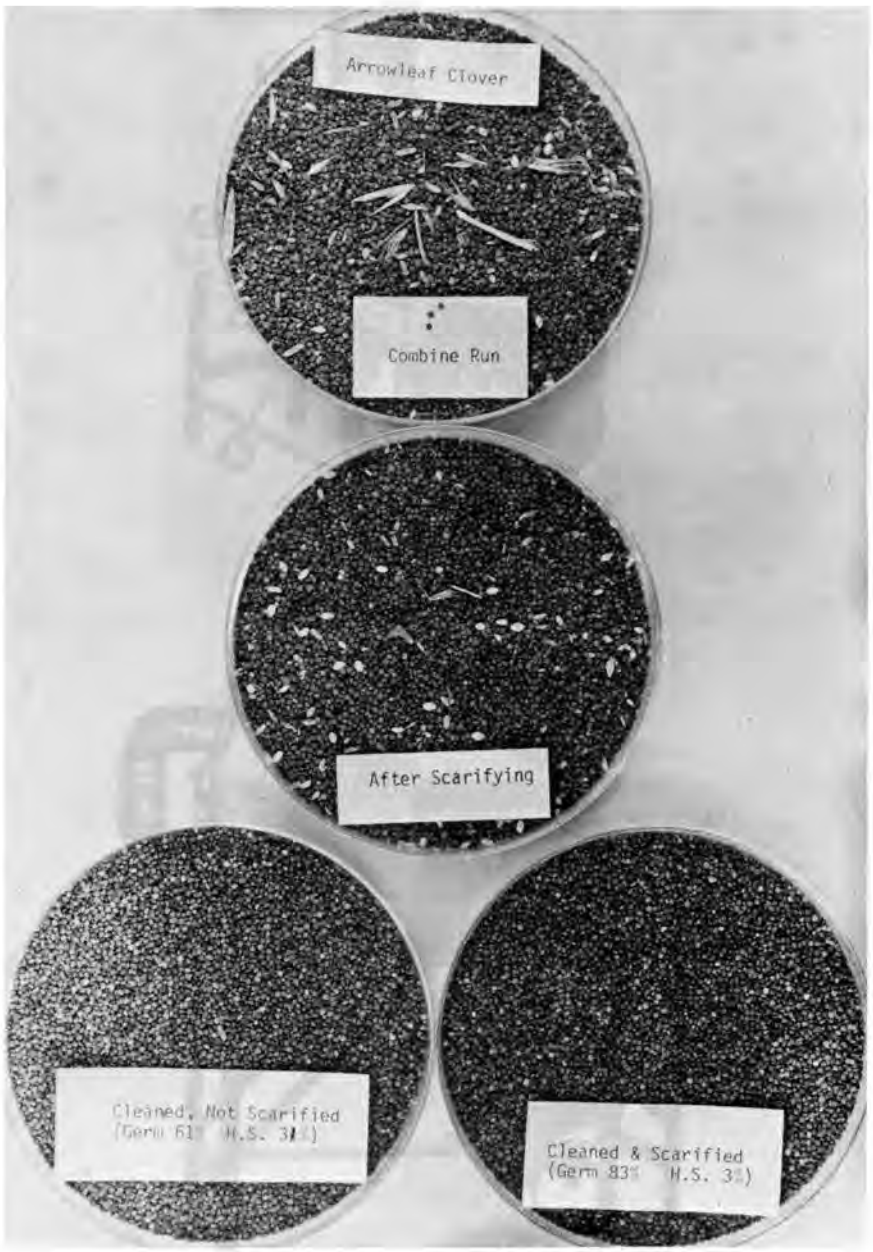
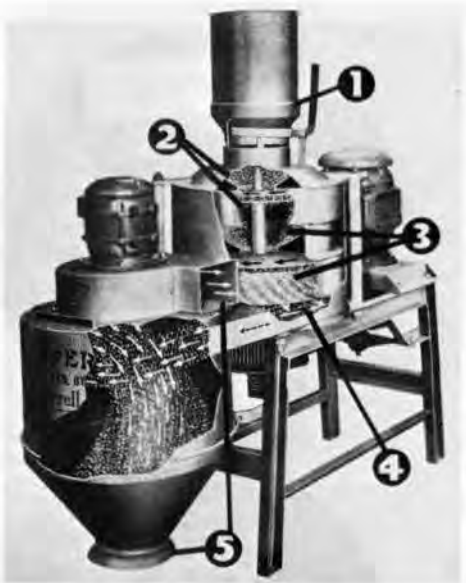


Figure 9. **Arrowleaf clover seed. Combine-run seed (above). Scarified seed as discharged from a huller/scarifier (middle). Cleaned seed which were not and were scarified. Note the differences in germination and hard seed contents.**



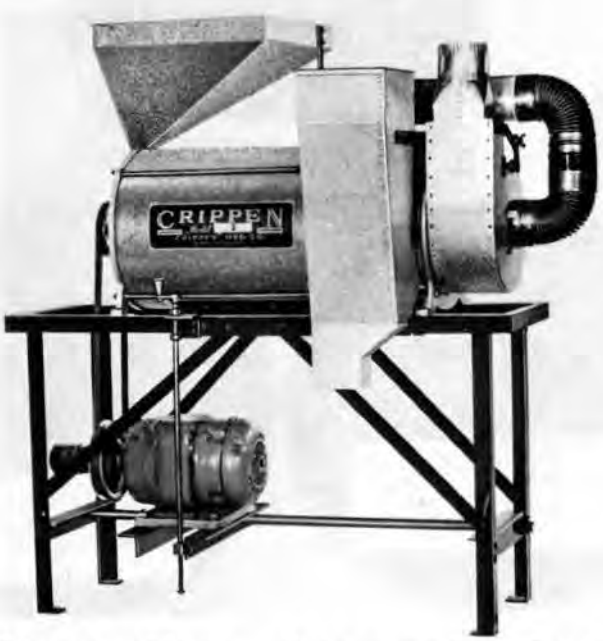


Figure 10. Huller scarifiers. Cut-away view of one commercial machine showing (1) feed mechanism (2) seed distribution (throwing) mechanism (3) abrasive surface (4) huller/scarified seed (5) aspiration system (above). Exterior view of another commercial huller-scarifier (below).

example, seed and plant materials are more resilient (tougher) at 14% moisture than at 10%. In a similar fashion, plant materials, such as hulls and stems, have a cushioning effect. For these reasons it is necessary to increase the speed of impact as the moisture and/or inert matter content of the lot increases.

The abrasive surface, feed rate and rotation speed of the seed distributing mechanism are the three operational controls common to all huller-scarifier machines. The abrasive surfaces used may be either "hard rubber" (urethane), carborundum or metal. The abrasive surfaces in all machines can be changed. When hulling, the less abrasive, hard rubber surface is recommended. When hulling and scarifying or only scarifying the carborundum or metal surface are usually necessary to achieve the desired results.

All scarifiers have a feed control mechanism. A uniform rate of feed is very important to obtain uniformity in hulling and scarifying operations. For this reason, most seed should be scalped before being fed into the machine. Surging of the feed rate can result in either excessive abrasion when the rate of feed slows or incomplete hulling or scarification when the feed rate increases from that desired.

Possibly the most important adjustment on a huller-scarifier is the speed of the seed distributing mechanism. The force at which the seed are thrown against the abrasive surface is controlled by movement of a variable speed pully which permits the operator to select from a wide range of speeds. The faster the rotation of the distributing mechanism the greater the impact force of the seed.

In summary, lots of field run seed which have high percentages of inert matter, are not completely threshed, or have a hard seed content exceeding 10-15% should be pre-conditioned before being cleaned. Properly done, pre-conditioning reduces drying time and costs, increases the capacity and efficiency of subsequent cleaning equipment, improves germination percentages and planting characteristics and can greatly improve the physical appearance of the cleaned seed. On the other hand; shellers, debearders and huller-scarifiers have the potential for causing high levels of mechanical damage to seed, and therefore, caution must be exercised when they are used.