SEED PROCESSING

J.P.Lakhani
R. Shiv Ramakrishnan

Jawaharlal Nehru Krishi Vishwa Vidyalaya
Jabalpur
Seed Processing

- Seed processing is a vital part of the total technology involved in making available high quality seed.
- It assures the end users, seeds of high quality with minimum adulteration.
- In Agriculture, the term seed processing includes cleaning, drying, seed treatment, packaging and storage.
- Seed processing may be understood to ‘comprise all the operations after harvest that aim at maximizing seed viability, vigour and health.'
• Sound seeds may be distinguished from inert matter, sterile and empty seeds by size and shape, specific gravity, colour and surface texture.

• Processing has well been mechanized and based on the physical characters of seed, separate machines are available for grading and upgrading, and these machines can be used either singly or in combination.
Principles and objectives:

• The quality of seed is improved during processing in two ways
  1. Separation of other tree seeds or inert matter and
  2. Upgrading or the elimination of poor quality seeds.
• The ultimate goal of seed processing is to obtain the maximum percentage of pure seed with maximum germination potential.
• The threshed produce is heterogeneous in nature.
• Processing brings homogeneity in the produce.
• This homogeneity helps in obtaining uniformity in the field.
Principles and objectives:

• Processing of seeds is carried out in approved (By Director of Seed Certification) seed processing plants.

• Seed processing is to narrow down the level of heterogeneity of the seed lot by using suitable processing methods.
Causes for heterogeneity

1. Variability in soil for fertility, physical, chemical and biological properties
2. Variability in management practices (irrigation, application of nutrients etc.)
3. Variability in ability of the seedling for utilizing the inputs
4. Variability in pest and disease infestation
5. Position of pod or fruit in a plant or the position of seed in a pod.
   • This heterogeneity can be narrowed down in the processing of seeds by eliminating the undersized, shriveled, immature, ill filled seeds using appropriate sieve size.
Causes for heterogeneity

• The germinability and vigour of the seed lot can be upgraded by grading the seeds according to size, specific gravity, length and density of the seeds.

• The inherent qualities such as germinability and vigour are exemplified by certain physical characteristics of the seed i.e., large size, a denser seed, optimum length etc., So, if grading is done to obtain a particular range of size, shape, length and density of the seeds, the quality of the lot is upgraded.
Requirement in seed processing

1. There should be complete separation
2. There should be minimum seed loss
3. Upgrading should be possible for any particular quality
4. There should be have more efficiency
5. It should have only minimum requirement
Types of materials removed during seed processing

1. Inert materials
2. Common weed seeds
3. Noxious weed seeds
4. Deteriorated seeds
5. Damaged seeds
6. Other crop seeds
7. Other variety seeds
8. Off-size seeds
Harvested Seed

- Threshed
- Shelled
- Dried

Inert Material

Common Weed Seed

Noxious Weed Seed

Other Crop Seed

Deteriorated Seed

ODV

Damaged Seed

Under sized Seed

 Marketable Seed

- Cleaned
- Graded
- Tested
- Treated
- Packaged
Sequence of operation in seed processing

1. Sequences of operations are based on characteristics of seed such as shape, size, weight, length, surface structure, colour and moisture content. Because each crop seed possesses individually seed structure.
   • Therefore, sequence of operation will be applied using proper equipments.
   • However, sequences of operation in seed processing are drying, receiving, pre-cleaning, conditioning, cleaning, separating or upgrading, treating (Drying), weighting, bagging and storage or shipping.
Basic Flow Diagram showing essentials Steps in Seed Processing

- Receiving → Conditioning and Pre-cleaning → Cleaning → Separating, upgrading & Testing
- Bulk Storage → Conditioning and Pre-cleaning → Cleaning → Separating, upgrading & Testing
- Cleaning → Treating & Bagging
- Treating & Bagging → Shipping
- Shipping → Storage
- Storage

- Bulk Storage
Pre-cleaning and Conditioning

This is the operation that prepares a seed lot for basic cleaning. The equipment required for preconditioning is generally specific for individual crop. Some important preconditioning equipment are:

**Sheller:** This is equipment is used for shelling of corn seeds from its cob.

**Huller:** It is an equipment which removers tightly fixed husk from seeds of grasses to facilitate in the process of sowing and germination (Hulling).
Debearder:
This is equipment removes the awns and other appendages from the seed of oat and barley that create problems in the seed processing (Debearding).

Scarification:
This is equipment scratches the hard seed coat to improve the process of germination by increasing exchange of water and oxygen in crops like lucern, fababean, ricebean etc. (Scarification).
Advantages gained from pre-cleaning are:

- Removal of large trash improves the flow ability of seed mass through elevators, hoppers and conveyors.
- Better separation can be made with air screen cleaner when large trashes have been removed. Screen perforation close to the size of seeds can be used to give a more accurate separation.
- Increase the capacity of air-screen cleaner
- Removes high moisture unwanted material which would otherwise increase time and cost of drying.
- Reduced storage volume
This step of seed processing removes the larger, smaller, and thicker adulterants as compares to the crop seed from the seed lots. Basic cleaning is done based on weight, size and density using cleaner with air screen. This process involves following equipment:
<table>
<thead>
<tr>
<th><strong>Grader:</strong></th>
<th>It separates the undersized seeds from the normal desirable seeds based on seed density and size with the help of screen and its vibrations.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Scalper:</strong></td>
<td>It is top most screen of seed cleaner/grader with larger holes than the desirable seed size to remove the inert matter of larger size than the seed (Scalping).</td>
</tr>
<tr>
<td><strong>Aspirator:</strong></td>
<td>It removes lighter inert matter and adulterant than the crop seed from the seed lot with the help of pressure.</td>
</tr>
</tbody>
</table>
Cleaned seeds

Graded final Seed
Air Screen Cleaner

It is generally made up of 2-3 screen of different mesh sizes, which are agitated to provide proper speed and place for separation. Air operation removes light and inert matter.
Selection of Screen:

Most of the seed lots contain undesirable material larger, smaller, heavier and lighter as compared to the desirable seed crop. Hence one screen with larger mesh and second with smaller mesh than the crop seed is selected for proper cleaning. The hole of the screen is normally oblong, round or triangular.
Selection of top screen:
Screens (5-6) with the hole size slightly larger and smaller than the crop seeds are selected. Stack of these screens is made keeping largest size on top and smallest at the bottom in descending order.

Selection of bottom screen:
From the same stack of screens the screen is selected which holds the crop seed but allows broken seed, smaller weed seed and under sized crop seeds to fall through. This is the mesh size best suited for bottom screen.
Screen types (slotted holes, round holes and wire mesh)
<table>
<thead>
<tr>
<th>Crop</th>
<th>Top screen</th>
<th></th>
<th>Hole type</th>
<th>Grading screen</th>
<th></th>
<th>Hole type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From</td>
<td>To</td>
<td></td>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>1.75</td>
<td>2</td>
<td>round</td>
<td>0.5</td>
<td>0.6</td>
<td>slotted</td>
</tr>
<tr>
<td>Barley</td>
<td>5.25</td>
<td>5.6</td>
<td>round</td>
<td>2.1</td>
<td>2.3</td>
<td>slotted</td>
</tr>
<tr>
<td>Bean</td>
<td>5.5</td>
<td>7</td>
<td>slotted</td>
<td>3</td>
<td>4</td>
<td>round</td>
</tr>
<tr>
<td>Clover</td>
<td>1.5</td>
<td>1.8</td>
<td>round</td>
<td>0.5</td>
<td>1.2</td>
<td>slotted</td>
</tr>
<tr>
<td>Maize (white dent)</td>
<td>8</td>
<td>11</td>
<td>round</td>
<td>7.5</td>
<td>3.3</td>
<td>round</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>3.7</td>
<td>slotted</td>
</tr>
<tr>
<td>Maize (flint/ semi-dent)</td>
<td>7</td>
<td>9</td>
<td>round</td>
<td>5</td>
<td>3</td>
<td>round</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.5</td>
<td>3.5</td>
<td>slotted</td>
</tr>
<tr>
<td>Oats</td>
<td>3</td>
<td>3.5</td>
<td>slotted</td>
<td>1.4</td>
<td>1.6</td>
<td>slotted</td>
</tr>
<tr>
<td>Rice (long grain)</td>
<td>5</td>
<td>5.5</td>
<td>round</td>
<td>1.6</td>
<td>1.9</td>
<td>slotted</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>2.8</td>
<td>slotted</td>
<td>1.6</td>
<td>1.9</td>
<td>slotted</td>
</tr>
<tr>
<td>Sorghum</td>
<td>4</td>
<td>4.5</td>
<td>round</td>
<td>3</td>
<td>2.2</td>
<td>round</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.3</td>
<td>2.3</td>
<td>slotted</td>
</tr>
<tr>
<td>Sorghum (sudan)</td>
<td>3</td>
<td>4</td>
<td>round</td>
<td>2.2</td>
<td>1.4</td>
<td>round</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.3</td>
<td>1.6</td>
<td>slotted</td>
</tr>
<tr>
<td>Soybean</td>
<td>10</td>
<td>9</td>
<td>round</td>
<td>5.5</td>
<td>3.4</td>
<td>round</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.3</td>
<td>3.6</td>
<td>slotted</td>
</tr>
<tr>
<td>Sunflower</td>
<td>5.5</td>
<td>7.5</td>
<td>round</td>
<td>2.3</td>
<td>2.6</td>
<td>slotted</td>
</tr>
<tr>
<td>Wheat</td>
<td>4.5</td>
<td>5</td>
<td>round</td>
<td>2.1</td>
<td>2.3</td>
<td>slotted</td>
</tr>
</tbody>
</table>
**Selection of air pressure:**

The lighter contaminants present with the graded seeds are removed by the air pressure adjusted in such a way that all the lighter contaminants are removed without any loss of the crop seed.

**Operation of seed cleaner:**

Proper screen is placed on top and bottom. The air vents and feed hopper are kept closed. Empty bags are placed at exit. The seed lot is poured through the hopper after turning on the machine.
Seed Grading

Classification of seed lot based on commercial usage viz., size shape, density and colour is known as grading. It is done further improvement of seed lots as finishing operation. It improves the seed lot by removal of cracked, damaged, shriveled and other defective seeds apart from inert matter.
### Physical characteristics of seed and the processing equipments available for grading

<table>
<thead>
<tr>
<th>Characters</th>
<th>Processing equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Size</td>
</tr>
<tr>
<td>2</td>
<td>Length</td>
</tr>
<tr>
<td>3</td>
<td>Weight</td>
</tr>
<tr>
<td>4</td>
<td>Shape</td>
</tr>
<tr>
<td>5</td>
<td>Surface texture</td>
</tr>
<tr>
<td>6</td>
<td>Colour</td>
</tr>
<tr>
<td>7</td>
<td>Electrical conductivity</td>
</tr>
</tbody>
</table>
Air screen cleaner

• This is the most important machine of every cleaning plant.
• It uses screens and aspiration (air blow) for two separations.
• A coarse upper screen removes larger material, a lower fine screen stops the seeds and lets through fine matter and then the seed fraction passes through a transverse or nearly vertical air stream which can separate light impurities such as empty or partly filled seeds, husks and glumes from the seed.
• In most cases a number of sieves with different sized perforations are used and the cleaning is a process of gradually shifting out smaller particles.
Air screen cleaner

• Factors which determine the quality and quantity of seed cleaned include

1. Size of the perforations,
2. Precision of the perforation,
3. Angle at which the sieves operate,
4. Amplitude and speed of movement of the sieves
5. Correct cleaning and maintenance of the equipment.
Specific gravity separation

- This method makes use of a combination of weight and surface characteristics of the seed to be separated.
- The principle of floatation is employed here.
- A mixture of seeds is fed onto the lower end of a sloping perforated table.
- Air is forced up through the porous deck surface and the bed of seeds by a fan, which stratifies the seeds in layers according to density with the lightest seeds and particles of inert matter at the top and the heaviest at the bottom.
- An oscillating movement of the table causes the seeds to move at different rates across the deck.
Specific gravity separation

- The lightest seeds float down under gravity and are discharged at the lower end, while the heaviest ones are kicked up the slope by contact with the oscillating deck and are discharged at the upper end.

- This machine separates seeds of the same density but of different size and seeds of the same size but of different densities.
Indented cylinder

- This helps to separate seeds according to the length.
- The equipment consists of a slightly inclined horizontal rotating cylinder and a movable separating trough.
- The inside surface has small closely spaced hemispherical indentations.
- Small seeds are pressed into the indents by centrifugal force and can be removed.
- The larger seeds flows in the centre of the cylinder and is discharged by gravity.
Magnetic Separator

• The magnetic separator separates seed according to its surface texture or related seed characteristics.
• First, seed is treated with iron filings, which adhere to rough surface alone.
• The treated seed lot is passed over a revolving magnetic drum and separated from smooth, uncoated seed.
• It may help to add varied amounts of water while mixing seed and powder, depending on the seed type.
• At any rate, the effectiveness of magnetic separation depends on the components of the seed lot and on the powder and water used in the treating operation.
• The greater the difference between surface textures of the seed lot’s components, more effective will be the separation.
Colour Separator

• The colour separator is used to separate discoloured seed, greatly of lower quality.

• Separation based on colour is necessary because the density and dimensions of discoloured seed are the same as those of sound seed, so other machines are not effective for separation.

• Electronic colour separation uses photocells to compare the seed colour with “background” which are selected to reflect the same light as the good seed.

• Seed that differs in colour is detected by the photo cells, which generate an electric impulse.

• The impulse activates an air jet to blow away the discoloured seed.
Friction Cleaning

• The air-screen combinations cannot remove debris that has a size and density similar to the seeds.

• However, if the debris has a different surface texture, it may be possible to remove by friction cleaning.

• Any object rolling or sliding over a sloping surface encounters a certain friction depending on the texture of itself and that of the sloping surface.

• Separation is made on a velvet cloth or rubber belt with variable inclination, which ensures that the slope necessary for the run off of the seed is different from the slope necessary for run off of the debris.

• The belt continuously moves upwards and removes the debris while the seeds roll down the slope.
Spiral Separator

• The separator, which classifies seed according to its shape and rolling ability, consists of sheet metal strips fitted around a central axis in the form of a spiral.

• The unit resembles an open screw conveyor standing in a vertical position.

• The seed is introduced at the top of the inner spiral.

• Round seeds roll faster down the incline than flat or irregularly shaped seeds, which tend to slide or tumble.

• The orbit of round seed increases with speed on its flight around the axis, until it rolls over the edge of the inner flight into the outer flight where it is collected separately.

• The slower moving seed does not build up enough speed to escape from the inner flight. Most spirals have multiple inner flights arranged one above the other to increase the capacity.
Liquid flotation

- Cleaning by flotation relies on the Principle that the density of the seed of a given species is specific both for filled and ill filled seed. In this method, liquids with a density or specific gravity between that of the full and empty seed are used.
- The specific gravity of the liquids used is such that the full seed sinks and the empty seed and light debris float.
- The following factors to be taken in to consideration when designing a seed – cleaning plant:
  1. Handling and cleaning of the seeds should be possible without mixing or damaging seed with a minimum of equipment, personnel and time.
2. Seed separators, elevators, conveyors and storage bins should be arranged so that seeds can flow continuously from beginning to end, yet be flexible enough to bypass a machine or return part for recleaning.

3. Other factors to be considered are kinds of crop seeds to be cleaned, nature of contaminants and weed seeds, volume of seed to be handled, method of handling, type of conveying system and location of shipping and receiving facilities

- Cleaning usually requires a succession of operations, which can be regarded as proceeding in three stages

1. Conditioning or pre-cleaning,

2. Basic cleaning and

3. Separation and grading.
Seed Treatment

- Before bagging, seeds are treated with suitable fungicide often in combination with an insecticides.
- The treatment may be in the form of a powder, liquid, or slurry. Special machines are available for applying each type of treatment.
- If it is desired not to treat the seed, it goes directly to the bagging machine.
Seed treatment is helpful in the following ways:

- It is helpful in controlling seed borne diseases, such as bunt in wheat; grain smut in jowar; seedling blight in maize, rice, jowar and wheat; fusarium wilt of jowar and wheat etc.
- It protects seeds from seed and seedling rots caused by phythium and rhizoctonia commonly present in soil
- It protects against damage by storage pests
There are two classes of seed treatment chemicals

1. Disinfectant
2. Protectants

- Disinfectant inactive in the organism present in seed surface e.g.; organo-mercurial compound like Agroson GN, Cereson

- Protectants protect seeds from attack by seed born and soil borne pathogen e.g.; Thiram, Captan, etc.
Organo-mercurial compound are injurious to seeds, particularly cracked seed. Therefore they are used when the disease incidence in the seed crop necessitates in and in crops where seed is not injured easily injured, e.g. rice, wheat, barley, cotton etc. ; organo-mercurial compound are not used in such crops as maize, beans (P. vulgaris ), peanut (A. hypogaea) and vegetable seeds. An appropriate insecticide is often combined with the fungicide to protect seed from insect damage.
Bagging and Labeling

After Seed Treatment seeds are distributed in bags of appropriate size (generally 40 kgs bags are used), the process is known as bagging and is placed in a paper, plastic, or jute bag. Each bag is labeled with an appropriate label that carries following information:

(1) Kind of Seed, (2) Name of Variety, (3) Pure Seed %, (4) Germination %, (5) Date of Testing, (6) Weed Seed %, (7) Inert Matter %, (8) Name and Address of Seller, (9) Period of Validity of Certification and (10) Any other information patient to the Seed
Accurate labelling is important to the purchaser as it provides the necessary details about the seed laws required that accurate information to be provided on label. The Indian seed act of 1966 is designed to regulate the quality of seed offered for sale.
Different kinds of seed storage materials
Weighing and sewing bags of quality seed
Shipping and Storage

- After the seed is placed in bags, it is ready for shipment into the market channels or to be placed in storage to await shipment at a later date.
- The storage area should be of ample size so that the seed lots can be kept separated.
- It should also be well-constructed, with a good roof and dry floor.
- The bags should be placed on pallets or on boards to keep them from being in contact with the concrete floor.
- A good loading area should be provided so the seed can be easily loaded into trucks.
- Warehousing and inventory control is a discipline within itself.
- However, it is a very important part of the system and is worthy of further study by the serious seed processor.
Steps in Seed Processing:

1. Fresh Seed from Field
2. Seed Processing
3. Moisture Testing
4. Drying
5. Pre-Cleaning
6. Fine Cleaning
7. Grading (Gravity Separation)
8. Seed Treatment
9. Seed Packaging
Air Screen Cleaner  

Seed Scalper
Seed Gravity Separator  Spiral Separator
Debearder

Magnetic Separator

Colour Separator