Seed Processing: Principles, Practices and Importance in Enhancing Seed Quality and Longevity

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Abstract

Seed processing is an essential post-harvest activity that enhances seed quality, viability, and market value. It includes multiple stages such as drying, pre-cleaning, conditioning, cleaning, grading, treating, and packaging, tailored according to seed traits like size, shape, density, and surface texture. The main objectives are to eliminate impurities, lower moisture to safe levels, and improve seed quality for better field performance and longer storage life. Applying chemical or biological treatments helps manage seed- and soil-borne diseases and boosts germination and seedling strength. Proper storage techniques, especially for orthodox and recalcitrant seeds, are vital to preserving seed viability over time. This article outlines the organized approach to seed handling from harvest through marketing, underscoring the significance of each step in delivering superior seeds to consumers.

Introduction

Seed processing is the procedure of removing dockage from a seed batch and preparing the seeds for sale. It involves enhancing the quality of the harvested seeds through various operations that begin with harvesting the seed crop and continue until the seeds are ready for marketing. Generally, seed processing encompasses all the necessary steps to prepare harvested seeds for the market, including handling, drying, shelling, preconditioning, cleaning, size grading, treating, and packaging.

Importance of Seed Processing

Seed lots received from the field are often at high moisture content and contain trash and other inert material, weed seeds, deteriorated and damaged seeds, off-size seeds, etc. Therefore, seed processing is necessary in order to

- Dry the seeds to safe moisture level.
- Remove or reduce to the extent possible the various undesirable material, weed seeds, other crop seeds, deteriorated or damaged seeds.
- Maintain seed viability and vigour
- Uniform size grading.
- Make seed handling easy.
- Seed treatment to upgrade the overall seed quality.

The processing operation carried out based on the principle of physical differences found in a seed lot.

Physical difference	Suitable machineries
Seed size - varied from small to bold	Air screen cleaner cum grader
Density - ill filled, immature to well matured, light weight to dense seed	Specific gravity separator
Shape - round to oval and different shapes	Spiral separator
Surface texture - smooth to wrinkled and rough	Roll mill / dodder mill
Colour of the seed - light color to dark colors	Electronic color shorter
Conductivity of seed - low to high	Electronic separator

Sequence of operation in seed processing

1) Seed drying

Seed drying refers to lowering the moisture content of seeds to a safer level. The purpose of this process is to preserve the seeds' viability and vigor for an extended duration while in storage.

Methods of seed drying

1. **Sun drying:** The system includes harvesting crops once they are completely dry in the field, then leaving the harvested crops there for a few days to dry further in the sun. Afterward, the threshed and winnowed produce is spread out in a thin layer on threshing floors for additional sun drying.
2. **Forced air drying**
   i. Natural air drying: Natural air is used in this type of drying method.

ii. Drying with supplemental heat: Temperature of the air is raised to about 10 to 20°F for reducing relative humidity of the air.

iii. Heated air drying – The drying air is heated to 110° F and seed is dried in special drying bins or wagons using heated air.

2) **Receiving:** The field run produce after threshing is received in the processing plant.

3) **Pre-cleaning and pre-Conditioning:** It involves processes like shelling and debearding that ready seed lots for primary cleaning and help eliminate larger unwanted materials such as trash, stones, and clumps that are bigger than the crop seeds. Additionally, some pre-cleaners can also remove lighter and smaller particles compared to the crop seeds.

Equipments used are

- **Scalper or Rough Cleaner:** They are used to remove large trash.
- **Huller-Scarifier:** Huller is a device to remove husk or outer seed coat. Scarifier scratches the seed coat.
- **Debearder:** The Debearder removes the hairlike structures present on the seeds.

4) **Seed cleaning:** It involves the physical cleaning and sorting of seeds. The primary seed cleaning is carried out using an air screen machine, often called an air screen cleaner. This machine is a fundamental piece of equipment found in all seed processing facilities. The removal of unwanted materials from the seeds is achieved by exploiting differences in their size and weight.

The air screen machine uses three cleaning elements:

- **Aspiration:** the light seed and chaffy material is removed from the seed mass through aspiration.
- **Scalping:** Good seed are dropped through screen openings but large material (trash, clods etc.) are scalped off over the screen into a separate spout.
- **Grading:** The good seed ride over the screen openings, while smaller particles (undersized, weed seeds, shriveled) drop through the screen perforations.

5) **Separating or Upgrading:** The grading process consists of sorting seeds into various grades or categories according to criteria like size, weight, shape, color, purity, and germination ability. The main goals of seed grading are to ensure quality control, achieve uniformity, provide an accurate seeding rate, and enhance market value.

6) **Seed treatment:** Seed treatment involves applying fungicides, insecticides, or a combination of both to seeds to eliminate (deep within) and protect (on the seed surface) them from harmful pathogens present on the seed or in the soil, as well as from storage pests. It can also include exposing seeds to sunlight or soaking them in water under specific conditions.

Types of seed treatment

- Seed disinfection: It refers to eradication of fungal spores present within the seed coat or more deep-seated tissues. For effective control the fungicide must penetrate into the seed to kill the fungus.
- Seed disinfestations: It refers to the destruction of surface borne organisms that contaminated the seed surface but not infected the seed. Chemical dips, soaks, fungicides applied as dust, slurry or liquids have been found successful.
- Seed protection: To protect the seed and young seedling from organisms in the soil which might otherwise cause delay of the seed before germination.

Benefits of seed treatment

1. Prevention of spread of plant diseases both systemic and non-systemic.
2. Seed treatment protects seed from seed rot and seedling blights. Once the seed is planted the protective coating around the seed, acts as a barrier against seed borne and soil borne organisms.
3. Improves germination – Seed treatment improves the germination through the control of surface moulds and flora, which are not pathogenic but may infect the seed during moist harvesting and storage condition. In the germination test thus may kill or cover the seed before it has germinated.

4. Provides protection from storage insects and pests. For complete protection it is necessary to treat the seeds with insecticide also.

7) Seed weighing, packing and handling, storage or shipping:

Seeds possess a unique ability to remain alive and capable of regeneration until favourable conditions arise for a new generation to grow. However, like all living organisms, they cannot stay viable forever and will eventually degrade and perish. Based on how long they can remain viable in storage, seeds are classified into two categories:

- **Orthodox Seeds:** Orthodox seeds are known for their longevity. They can be safely dried to moisture levels as low as 5% without being damaged and can withstand freezing temperatures. When they reach physiological maturity, their moisture content typically ranges from 30% to 50%.
- **Recalcitrant Seeds:** These seeds have a short lifespan and cannot be dried below 30% moisture without being damaged. They are also sensitive to freezing temperatures. Due to their high moisture content, they are challenging to store effectively, as it promotes microbial growth and speeds up seed deterioration. Typically, recalcitrant seeds do not enter dormancy; instead, they keep developing and move steadily toward germination.

Storage containers

1. **Moisture pervious:** If a seed store is equipped to regulate temperature and relative humidity, permeable containers can be safely used to store orthodox seeds for several years, as long as pests are kept out. Examples include cotton bags, paper, cardboard, and fiberboard.
2. **Moisture impervious:** Once orthodox seeds are dried to the appropriate moisture level, they can be stored in airtight, moisture-proof containers. For long-term preservation, the best results are achieved by combining these containers with low temperatures, typically maintained through refrigeration. This approach also helps by limiting oxygen exposure. However, it is not appropriate for storing recalcitrant seeds.
3. **Moisture resistant:** They consist of polyethylene or other plastic films, as well as aluminium foil. While polyethylene is not ideal for the long-term preservation of orthodox seeds in genetic conservation due to the lack of complete moisture control, it is highly effective for short- to medium-term storage and has produced excellent outcomes.

Conclusion

Seed processing is crucial for improving the physical and physiological quality of seeds by eliminating impurities, lowering moisture levels, and enhancing consistency. By using a mix of mechanical and chemical methods, it helps maintain seed viability, vigor, and safeguards against diseases and pests. Proper seed processing not only boosts crop yields but also facilitates effective seed marketing and prolonged storage. With the increasing need for high-quality seeds, efficient processing practices are key to sustainable agriculture and ensuring food security.

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