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QUALITY SEED AND ITS' IMPORTANCE IN AGRICULTURE

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Abstract

Seed is the basic input in agriculture, seed quality plays a crucial role in modern agriculture, acting as the foundation for crop productivity, food security, and sustainable farming. Quality seed is defined as the seed with highest physical purity, genetic purity, vigour, viability and free from pests and diseases. Quality seed ensures uniform crop stand, resistance to biotic and abiotic stresses, and optimal use of agro-inputs, and resulting in higher yields. The production of quality seed involves strict genetic, agronomic, and physiological standards from field level to storage. However, factors like improper field conditions, mechanical mixtures, poor post-harvest handling, and improper storage can lower seed quality. Low quality seeds result in poor germination, uneven crop growth, disease incidence, which finally leads to lower yields. Several organizations like ISTA, OECD, and FAO, around the world, and in India, institutions like NSC and ICAR, regulate and promote quality seed production and certification.

***Keywords*:** Quality seed, Seed production, Seed deterioration, Seed certification, Seed storage, Sustainable agriculture

Introduction

Seed is the basic and most important input in agriculture, among all inputs used in crop production, quality seed has great impact on crop yield. A quality seed is defined by several parameters like physical purity, genetic purity, vigour, viability and freeness from pests and diseases (Copeland & McDonald, 2012). According to the International Seed Testing Association (ISTA), quality seed must meet minimum standards of physical and genetic purity, germination, and seed health to be categorized as 'certified' or 'foundation' seed.

Characteristics of quality seed

- **Genetic purity**: Genetic purity refers to the true to type ness with the parent material.
- **Physical purity**: Absence of inert matter, weed seeds, and other crop seeds.
- **High germination percentage**: Indicates potential for rapid and uniform field emergence.
- **Seed vigour**: Reflects seed's performance under unfavourable conditions.
- **Moisture content**: Maintained at a safe level (usually below 12%) to ensure viability.
- **Seed health**: Must be free from seed-borne pathogens and pests.

How to produce quality seeds?

Producing quality seed is a scientific and systematic process involving several critical steps to ensure genetic purity, vigour, and physical purity. The entire seed production process, from selecting parental material to processing and packaging, must be carefully managed to maintain seed quality.

1. Selection of suitable variety and source

The first step in quality seed production is the selection of genetically pure, disease-free breeder or foundation seed. This ensures that the desirable traits of the variety are retained in subsequent generations. It is essential to source seed from authorized institutions like ICAR or NSC.

2. Isolation distance

To maintain genetic purity, crops must be isolated from other varieties and related species.

The isolation distance varies depending on the crop and pollination mechanism.

3. Land and field selection

The field must be free from volunteer plants and previous crops of the same species to prevent genetic contamination. The land should be fertile, well-drained, and free of soil-borne pathogens.

4. Field standards and crop management

Seed crops should be grown following best agronomic practices including timely sowing, nutrient management, irrigation, weed control, and pest and disease management. Regular field inspections are done at different crop stages (vegetative, flowering, maturity) to control for off-types and disease incidence.

5. Rouging

Rouging involves the removal of off-types and diseased plants to maintain genetic purity. This is crucial during flowering and maturity stages when varietal characters are easily distinguishable.

6. Harvesting and threshing

Seed crops should be harvested at physiological maturity when seeds have attained maximum dry weight and viability. Mechanical damage during harvesting and threshing should be avoided as it affects seed viability and germination.

7. Drying

Post-harvest drying is critical to reduce seed moisture content. Sun drying or mechanical drying should reduce moisture content to safe levels. High moisture levels lead to fungal growth and seed deterioration.

8. Seed processing

Processing includes cleaning, grading, treatment, and packaging. Cleaning removes inert matter and undersized seeds. Grading helps in maintaining uniformity in seed size. Seed treatment with fungicides and insecticides protects the seeds from seed-borne diseases and storage pests. Packaging should be done in moisture impermeable bags.

9. Seed testing

Seed lots are need to be tested in seed testing laboratories to ensure they meet prescribed standards for germination, purity, moisture, and health. ISTA protocols are widely used for international testing.

10. Seed certification

Seed certification is the official assurance of seed quality. Certified seed is labelled after field and lab inspections. It involves multiple inspections to ensure genetic and physical purity, vigour, and seed health (ISTA, 2021).

Factors affecting seed quality

Field conditions

- Abiotic stresses such as drought, excessive rainfall, or extreme temperatures can affect seed development and viability.
- Biotic factors including insect pests, fungal diseases, and nematodes impact seed health.
- Off-types and cross-pollination during flowering may reduce genetic purity if isolation distance is not maintained.
- Improper rouging results in mixing of inferior genotypes, reducing seed quality.

Processing factors

- Mechanical damage during threshing and handling can cause seed injury, affecting germination.
- Contamination with inert matter, weed seeds, or other crop seeds lowers physical purity.
- Incorrect grading leads to non-uniform seeds, affecting field performance.

Storage conditions

- Temperature and humidity are critical. Seeds should be stored at low temperature (10–15°C) and relative humidity (<60%) to preserve viability.
- Pest infestation, especially by storage pests, leads to weight loss and reduction in germination percentage.

- Fungal contamination such as Aspergillus and Penicillium causes mycotoxins and seed decay.

Problems associated with low quality seeds

Using low quality seeds can lead to several agronomic, economic, and environmental problems:

1. Poor germination and crop stand

Low quality seeds will result in less germination percentage, which leads to poor crop establishment. This results in uneven plant populations, which reduces photosynthetic efficiency and yield.

2. Susceptibility to pests and diseases

Seeds infected with pathogens are the main source of field infestation. They lack genetic resistance and vigour to withstand stress, increasing the dosage of pesticide application.

3. Yield loss

Low-quality seeds fail to express their full genetic potential, resulting in significantly lower yields. Farmers may suffer losses due to low marketable produce and economic returns.

4. Increased cost of production

In order to deal with low germination, vigour and pest incidence, farmers use excess seeds and chemical inputs, thereby increasing the cost of production and reducing profitability.

5. Market rejection

Produce from low-quality seed often fails to meet market standards for grain size, uniformity, and quality, affecting marketability and income.

6. Spread of invasive species

Contaminated seeds with weed seeds like *Parthenium hysterophorus* or *Phalaris minor* can introduce invasive species into new areas.

Organizations involved in quality seed production

Organization	**Global / India**	**Role**
FAO (Food and Agricultural Organization)	Global	Sets global seed policy guidelines and promotes seed security
ISTA (International Seed Testing Organization)	Global	Develops international seed testing standards
OECD Seed Schemes	Global	Provides international certification for global seed trade
ISF (International Seed Federation)	Global	Facilitate international seed movement and standards
ICAR (Indian Council of Agricultural Research)	India	Conducts research and develops breeder seed
NSC (National Seed Corporation)	India	Produces and distributes certified seeds across India
State seed corporations	India (State level)	Produce and supply foundation and certified seeds locally
Seed certification agencies	India (State level)	Inspect, certify and ensure seed quality in field and lab

Conclusion

Quality seed is the backbone of sustainable agriculture and food security. It ensures higher crop productivity, resilience to biotic and abiotic stresses, and better resource use efficiency. Scientific seed production practices, supported by institutional frameworks, are essential for maintaining seed quality throughout the production and distribution chain. Farmers must be educated and empowered to adopt certified seeds and avoid the use of poor-quality planting material. Governments and international bodies must strengthen seed certification, quality control, and R&D infrastructure to support the seed sector. Ultimately, investment in quality seed production is an investment in the future of agriculture.

References

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