



## Grow Out Test and Field Inspection

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Seed certification is the primary institutional mechanism through which quality and genetic purity of seeds are assured before they reach the farming community. Central to this certification process are two indispensable procedures: the Grow-Out Test (GOT) and Field Inspection. The Grow-Out Test is a biological assay in which seeds are grown under controlled conditions to verify their varietal identity, genetic purity, and freedom from off-type plants. Field Inspection, on the other hand, is a systematic, on-site evaluation of seed crops at critical growth stages to detect rogues, off-types, diseased plants, and crop admixtures that would compromise seed quality. Together, these two procedures form the scientific and regulatory backbone of seed certification systems worldwide. This article provides a comprehensive review of both methodologies — their conceptual basis, procedural protocols, practical significance, challenges encountered in the field, and their relevance to contemporary seed quality assurance. The article further examines how grow-out testing and field inspection intersect with statutory frameworks, international standards, and emerging technologies such as molecular markers and remote sensing. It also presents four key research papers from the global literature that have shaped current understanding and practice in this domain.

### Introduction

The Grow-Out Test (GOT) also called a Grow-Out Trial, Post-Control Test, or Varietal Purity Test is conducted after harvest, in a test garden or greenhouse, by growing a sample of the harvested seed lot alongside a reference standard (often called a 'check variety'). Its purpose is to confirm that the harvested seed matches the registered variety description in terms of morphological and phenological traits.

Field Inspection, by contrast, is conducted during the growing season, at the site of seed production. Trained inspectors visit the crop at prescribed growth stages typically at tillering/vegetative, flowering, and maturity to assess the crop's compliance with isolation requirements, minimum distance from other varieties, rogue levels, disease incidence, and general crop health.

Together, these two tools one prospective (field inspection during crop growth) and one retrospective (grow-out testing of harvested seed) provide a comprehensive quality assurance framework. This article examines both in depth, drawing on scientific literature, regulatory practice, and emerging innovations to provide a thorough reference for students, researchers, seed technologists, and agricultural administrators.

### Grow-Out Test

A Grow-Out Test (GOT) is a biological verification technique in which a representative sample of seed from a harvested lot is planted in a controlled environment typically a specialized test garden, isolated nursery, or controlled greenhouse and the resulting plants are evaluated against a certified reference variety. The test is designed to reveal genetic

heterogeneity, outcrossing, mechanical admixture, or any deviation from the expected varietal profile.

### **Objectives of Grow-Out Testing**

- Verification of varietal identity by comparing test plants with registered variety description
- Detection of off-types, sports, natural mutants, and mechanical admixtures from other varieties
- Quantification of varietal purity as a percentage of true-to-type plants in the total population
- Assessment of germination vigor and stand establishment under semi-field conditions
- Detection of seed-borne diseases that may only become apparent in growing plants
- Supporting plant breeders' rights enforcement by confirming distinct, uniform, and stable (DUS) characteristics

### **Grow-Out Test Protocol**

The standard protocol for a grow-out test involves several carefully designed steps. First, a representative sample is drawn from the seed lot using approved sampling procedures (ISTA or national standards). The sample size is statistically determined to allow detection of off-types at specified frequencies typically a minimum of 400 plants for self-pollinated crops and 200 plants for cross-pollinated crops per lot, though this varies by crop and certification standard.

Seeds are planted in rows alongside a certified reference variety of the same notified variety. All agronomic conditions soil type, fertilization, irrigation, planting density are kept uniform between the test and the reference. Plants are evaluated at one or more growth stages for a prescribed set of morphological descriptors: plant height, leaf shape and color, panicle or spike morphology, flower color, kernel shape and color, days to heading/flowering, and other variety-specific traits registered in the variety catalog.

The percentage of off-type plants is calculated and compared against the permitted maximum for the seed class (Breeder, Foundation, or Certified). If the off-type percentage exceeds the permissible limit, the lot is rejected or downgraded. If it is within acceptable bounds, the lot is confirmed as genuine and certified for sale.

### **Field Inspection**

Field Inspection is the on-site, in-season evaluation of a seed crop by authorized inspectors from the State Seed Certification Agency or equivalent regulatory body. It is conducted at the field of the registered seed grower farmer, seed company, or public institution who has entered into a formal agreement (seed production contract) to grow a specific notified variety for seed purposes.

Field inspection is not a single event but a structured series of visits timed to coincide with the most diagnostically important growth stages of the crop. At each visit, the inspector systematically walks through the field, examines a statistically representative sample of plants, and records observations on a standardized inspection form.

### **Timing of Field Inspections**

The number and timing of inspections varies by crop species, but a typical schedule for a cereal crop like wheat or paddy would include:

- First Inspection :Vegetative/Tillering Stage: Assessment of isolation distance, variety identification, preliminary off-type detection, weed infestation, and crop stand uniformity
- Second Inspection :Flowering/Heading Stage: Most critical inspection for rogue detection, assessment of pollen shedding in hybrid seed production, off-type identification at panicle/spike stage, disease scouting
- Third Inspection : Maturity Stage: Final assessment of varietal purity, kernel characteristics, confirmation of disease-free status before harvest, verification that minimum standards are met

## Roguing

Roguing refers to the manual removal of off-type plants, diseased plants, and other contaminants from a seed crop before pollination or before harvest. It is one of the most labor-intensive but essential operations in seed production. Inspectors verify that the grower has adequately rogued the field prior to or during the inspection. If roguing is found to be inadequate and the off-type count exceeds prescribed limits, the inspector issues a warning or fails the crop. In some systems, a re-inspection is permitted after roguing has been completed.

## Standards and Tolerance Limits

Every seed certification system specifies maximum permissible levels of off-types for each seed class and crop. In India, under the Seeds Act 1966 and associated Seed Certification Standards, the following general limits apply for varietal purity during field inspection:

- Breeder Seed: 99.9% minimum varietal purity (maximum 0.1% off-types)
- Foundation Seed Stage I (FS-I): 99.5% minimum varietal purity
- Foundation Seed Stage II (FS-II): 99.0% minimum varietal purity
- Certified Seed: 98.0% minimum varietal purity for cross-pollinated crops; 99.0% for self-pollinated crops

Similar standards exist under OECD Seed Schemes for international trade, and under the Association of Official Seed Certifying Agencies (AOSCA) standards used in North America. ISTA Rules provide the globally harmonized methodologies for seed sampling and testing that underpin grow-out test protocols worldwide.

## Isolation Requirements in Seed Production

Isolation distance is one of the most critical requirements verified during field inspection. It refers to the minimum spatial distance required between a seed crop and any other field of the same species that could serve as a pollen source, thereby causing genetic contamination through cross-pollination.

Isolation distances are determined by crop pollination biology. Self-pollinated crops such as wheat, rice, and soybean require relatively small isolation distances (as little as 3–10 meters for certified seed, and 5–30 meters for foundation seed). Cross-pollinated crops such as maize, sunflower, sorghum, and many vegetable crops require much larger isolation distances ranging from 200 meters to over 1,000 meters for hybrid seed production — because pollen can travel considerable distances by wind or insect vectors.

## Conclusion

Grow-Out Testing and Field Inspection represent two of the most scientifically sound and practically indispensable tools in the entire edifice of seed quality assurance. Their complementary nature one focused on the growing season, the other on the harvested seed provides a robust, two-stage verification system that protects the genetic integrity of certified seeds from production field to farmer's bag.

The Grow-Out Test, with its biological basis and phenotypic evaluation methodology, remains the gold standard for varietal identity confirmation despite the emergence of molecular alternatives. It captures the full expression of varietal traits as farmers and end-users experience them, making it irreplaceable in the near term. Field Inspection, meanwhile, provides the in-season intelligence that allows corrective action roguing, crop rejection, or isolation violation remediation before genetic contamination becomes irreversible.

Ultimately, the value of any seed certification system is measured by the trust farmers place in the certified seed they purchase. Grow-Out Testing and Field Inspection, when conducted with precision, professionalism, and integrity, are the mechanisms through which that trust is earned and maintained. Strengthening these two pillars through better training, improved infrastructure, legislative support, and technological innovation must remain a priority for agricultural development in India and across the developing world.

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