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UNIT 1: ANALYSE THE GERMINATION OF SEED

1.1 Introduction

In agriculture it is very important to know that the seed sown has got the capacity to produce an abundant crop of the required cultivar. Seed testing can minimise the risk by assessing the quality of seed before it is sown. The germination test is used to determine the maximum germination potential of a seed lot. This can then be used to compare the quality of different lots and also estimate the field planting value. Throughout this manual the ISTA rules for seed testing was used as the main source of reference. It is important that all the companies with a registered seed testing laboratory, where germination tests are conducted are in possession of the latest version of the ISTA rules for reference when performing this test. It is also recommended that other laboratories that are not registered, but perform seed testing use the ISTA Rules as guideline.

1.2 Seed germination

A seed contains an embryonic plant in a resting condition and germination is the stage where the seed starts to grow. Seeds will begin to germinate when the soil temperature is in the appropriate range and when water and oxygen are available. Optimum soil germination temperatures will vary greatly from one species to another.

Germination of a seed in a laboratory test is the emergence and development of the seedling to a stage where the aspects of its essential structures indicates whether or not it is able to develop further into a satisfactory plant under favourable conditions. ¹

Seed germination, generally measured by percentage, measures the number of seeds in a lot that can be expected to germinate and grow healthy plants. According to ISTA the percentage germination reported on the International Seed Analysis Certificate indicates the proportion by number of seeds which have produced seedlings classified as normal under the conditions and within the period specified within the ISTA rules (Table 5A).

¹ International Seed & Testing Association
A seedling, depending on the species being tested, consists of a specific combination of some of the following structures which are essential for its further development:

- root system: primary root; in certain cases seminal roots
- shoot axis: hypocotyl; epicotyl; mesocotyl; terminal bud
- cotyledons
- coleoptiles

Seedlings are classed as normal or abnormal according to internationally agreed definitions, which are experimentally based, and only the former are included in the percentage germination reported.

### 1.2.1 Normal seedlings

These seedlings have the potential to grow and develop into physiological mature plants when planted in healthy soil and grown under favourable conditions which include factors such as moisture, temperature and light.

A seedling must conform to one of the following categories to be classified as normal:

- Intact seedlings: seedlings with all their essential structures well developed, complete in proportion and healthy.

![Figure 1: Seed structures](image)
Seedlings with slight defects: seedlings showing certain slight defects of their essential structures provided they show an otherwise satisfactory and balanced development comparable to that of intact seedlings of the same test.

Seedlings with secondary infections: seedlings which it is evident would have conformed to the above mentioned categories, but which have been affected by fungi or bacteria from sources other than the parent seed.

1.2.2 Abnormal seedlings

Abnormal seedlings do not show the potential to develop into a normal plant when grown in good quality soil and favourable conditions of moisture, temperature and light.

The following seedlings are classified as abnormal:

- Damage seedlings: seedlings with any of the essential structures missing or so badly and irreparably damaged that balanced development cannot be expected.
- Deformed or unbalanced seedlings: seedlings with weak development or physiological disturbances or in which essential structures are deformed or out of proportion.
- Decayed seedlings: seedlings with any of their essential structure so diseased or decayed as a result of primary infection that normal development is prevented.

1.2.3 Multi-germ seed units

Multi-germ seeds are seed units which are capable of producing more than one seedling.²

1.2.4 Ungerminated seeds

Seeds which have not germinated by the end of the test period when tested under the conditions given in Table 5A³ (germination methods) are classified as follows:

- Hard seeds: seeds which remains hard at the end of the test period, because they have not absorbed water.

² : International Rules for Seed Testing Chapter 5 (5.2.6A)
³ : International Rules for Seed Testing: Chapter 5
Fresh seeds: seeds, other than hard seeds, which have failed to germinate under the conditions of the germination test, but which remain clean and firm and have the potential to develop into a normal seedling.

Dead seeds: seeds, which at the end of the test period, are neither hard nor fresh nor have produced any part of a seedling. These seeds are generally soft, soggy and/or mushy.

A seed certainly looks dead if it does not seem to move, to grow, nor do anything. In fact, even with biochemical tests for the metabolic processes we associate with life (respiration, etc.) the rate of these processes is so slow that it would be difficult to determine whether there really was anything alive in a seed. Indeed, if a seed is not allowed to germinate (sprout) within some certain length of time, the embryo inside will die. Each species of seed has a certain length of viability. Assuming the seed is still viable, the embryo inside the seed coat needs something to get its metabolism activated to start the embryo growing. The process of getting a seed to germinate can be simple or complicated depending on the seed kind in question.

1.3 Factors influencing germination

The process of seed germination is complex and can be affected at different stages by many factors and interactions of factors such as:

- temperature,
- water availability,
- oxygen,
- light,
- substrate,
- maturity of seed, and
- physiological age of seed,
- storage conditions,
- inhibitory substances.

In laboratory germination tests these factors are optimised in order to measure the maximum number of seeds capable of producing healthy well-developed seedlings. A laboratory germination test does not take into account the effects of non-optimal
conditions on the seed. It is therefore useful to view a laboratory germination test result as potential rather than absolute emergence.

1.4 Requirements for seed germination

Seed germination depends on both internal and external factors. The most important external factors include: water, oxygen, temperature. Every kind of seed requires a different set of variables for successful germination. This depends greatly on the individual seed kind and is closely linked to the ecological conditions in the plants' natural habitat.

Seed must be viable, meaning it must be capable of germinating. Proper storage of seeds also plays a role in successful germination. Finally, a seed's ability to overcome primary dormancy will effect seed germination. If these conditions are met, germination can take place.

1.4.1 Water

Seed germination requires moist conditions. Mature seeds are typically extremely dry and need to take up significant amounts of water before metabolism can resume. Imbibition is the uptake of water into seeds and leads to a marked swelling.

![Figure 2: Imbibition](image)

The pressure caused by imbibing water aids in cracking the seed coat/pericarp for germination. Most plants store large amounts of food, such as starch, proteins, or oils, for
the embryo inside the seed, when it is formed. When the seed imbibes water, hydrolytic enzymes are activated that break down these stored food resources and allow the seedling to germinate and grow non-photosynthetically until it reaches the light. Once the seedling starts growing, it requires a continuous supply of water and nutrients.

1.4.2 Oxygen

Most seeds respond best when water levels are enough to moisten the seeds but not soak them, and when oxygen is readily available. The germinating seedling requires oxygen for its metabolism, once the seed coat/pericarp is cracked. If the soil is waterlogged, it might cut off the necessary oxygen supply and prevent the seed from germinating as it prevents aerobic respiration, which is the main source for the seedling's energy until it starts to photosynthesize.

1.4.3 Temperature and light

There are a wide range of temperatures over which seeds germinate. Often, seeds have a set temperature range for germination and will not germinate above or below a certain temperature while others have a range of temperatures for e.g. 20°C being the minimum and 30°C being the maximum. It is also so that, some seeds may require exposure to light or to cold temperature to break dormancy before they can germinate. Seeds will not germinate as long as it is in its dormant state, even if conditions are favourable. For example, seeds requiring the cold of winter are inhibited from germinating if they never experience frost. Some seeds will only germinate when temperatures reach hundreds of degrees, as during a fire. Without fire, they are unable to crack their seed coats. Many seeds in forest settings will not germinate until an opening in the canopy allow them to receive sufficient light for the growing seedling. Other seeds require a “soaking” period where the seed is exposed to water which allows the inhibiting substance to leach into the surrounding soil/water.

1.4.4 Stratification

When the seeds are mature and environmental factors are favourable germination can take place. If a mature seed is placed under favourable conditions and fails to germinate (not because it is dead), it is said to be dormant. Some seeds need to be dormant for a while before they will germinate. The length of time plant seeds remain dormant can be reduced or eliminated by a simple seed treatment called stratification. Seeds should be planted promptly after stratification.
Stratification imitates natural processes that weaken the seed coat before germination. In nature, some seeds require particular conditions to germinate, such as the heat of a fire or soaking in a body of water for a long period of time. Others have to be passed through an animal's digestive tract to weaken the seed coat and enable germination.

### 1.4.5 Hormonal control

Besides environmental factors, germination and dormancy in seeds are also influenced by plant hormones. The plant hormone abscisic acid affects seed dormancy and prevents germination, while the hormone gibberellin's breaks dormancy and induces seed germination. This effect is used in brewing where barley is treated with gibberellin's to ensure uniform seed germination to produce barley malt.

### 1.5 Stages of Germination

Three stages of germination are typically identified with different physiological and physical changes taking place within the seed.

#### 1.5.1 Phase One: Activation

The first process that occurs during activation is the imbibition of water. Once it has occurred, activation or the synthesis of enzymes is initiated. The function of the enzymes is the breaking down of storage material within the seed into simpler compounds such as sugars, which are utilized by the embryo for germination. During respiration there are other enzymes activated which start the breaking down of sugars for the production of energy that the developing seedling can use for growth and development. At the end of activation cell elongation and radicle emergence occur - the first visible sign that germination is taking place.

#### 1.5.2 Phase two: Digestion and Translocation

During digestion and translocation, enzymes that were synthesized or activated begin to break down storage material within the seed into simple compounds which are translocated to the embryo axis, the plumule (part of a seed embryo that develops into the shoot, bearing the first true leaves of a plant) and radicle (or root). The plumule (which emerges after the radicle) will grow and develop as the cells elongate and divide.
1.5.3 Phase Three: Seedling Growth

The germinating seed continues to undergo metabolic changes while developing into a seedling. There are two types of seedling growth namely epigeous germination or hypogeous germination. Both refer to the position of the cotyledons during germination. In epigeous germination (epi - Latin meaning above or beyond), the cotyledons are pushed above the soil surface. An example of this is the bean. In hypogeous germination (hypo - Latin meaning under), the cotyledons as well as most of the seed remains underground with only the shoot emerging from the soil surface. An example of this is the pea.

1.6 Germination Test

Germination testing is important to both the seed regenerator and the seed producer. Seed germination tests measure the number of healthy well-developed seedling under laboratory conditions, not just whether a root has emerged from the seed. Testing under field conditions is normally unsatisfactory, as the results cannot be repeated with reliability. Laboratory methods have, therefore, been evolved in which external conditions are controlled to give the most regular, rapid and complete results. The conditions have been standardised to enable the test results to be reproduced within limits as near as possible to those determined by random sample variation.

Figure 3: Germinating seed

There are some general principles that need to be followed:

- Pure seeds will be used for the test, except where testing of seed by weighed replicates is allowed. The pure seed definition for species shall be applied. The pure seed can be taken from either the pure seed fraction of a purity test carried out or from a representative fraction of the submitted sample. When the seed lot has been coated, the pure pellet definition shall be used.
The seed shall receive no pre-treatment except those recommended according to ISTA regulations and worksite procedures.

The seeds, arranged in replicates, are tested under favourable conditions and in accordance with methods prescribed in Table 5A of the International Seed Testing Association Rules Handbook and/or Handbook for Seedling Evaluation as issued by ISTA.

1.6.1 Sampling

The germination replicates are to be drawn from the pure seed fraction of the purity test. If a purity test has not been conducted, a random sample is to be drawn from the submitted sample. The working sample is drawn (according to the correct method for purity sampling) and weighed, approximately that of the working sample (purity analysis) weight. From this working sample pure seed is obtained for the germination replicates. The inert matter and other seed component parts are placed in an envelope, sealed, clearly marked “germination test” and placed in the sample bag/container for future reference should it be required. If multiple germination tests are conducted in this manner, mark the envelope test 1, test 2 or retest 1 etc. (the same manner in which the germination test is indicated). The pure seed definition for that seed kind is to be applied when counting replicates for the germination test.

Working sample

To obtain a working sample 400 seeds are counted at random from the sample previously obtained according to the prescribed work site procedures. There must be no selection of seeds thus causing biased results. Four hundred seeds in replicates of 100 (or as otherwise stated in the worksite procedures) are taken at random from the pure seed and spaced uniformly and adequately apart on the moist substrate. Replicates may be divided into sub-replicates of 50 or 25 seeds depending on the size of seeds and the amount of space needed between them. These sub-replicates are combined to form replicates of 4 x 100 seeds (or as indicated by the worksite procedures). Multi-germ seeds units are not broken up for the germination test but are tested as though they were single seeds units. Special care is taken when placing multiple seed units on the substrate to allow for easy evaluation i.e. do not place seeds too close together so that they grow into each other and so making evaluation impossible.
1.6.2 Material and apparatus

Counting equipment

This may include counting boards used for large seeds such as Zea, Phaseolus and Pisum or vacuum counting heads which are mostly used for species with regular shapes and relatively smooth surface, such as cereals, brassicas etc.

Germination apparatus

Jacobsen apparatus is a germination table. The seeds are placed on a substrate, which is in contact with the water and covered with a bell jar to avoid drying out of substrate. The seeds generally germinate in light with a constant or alternating temperature.

Modern germination cabinets are well insulated with both heating and cooling systems. They can be used to germinate seeds in darkness and light with constant or alternating temperatures.

The "walk in" germinator is a modification of the cabinet, constructed on the same principles, but is large enough to allow workers to enter. This apparatus is ideal for the large seed kinds such as Zea mays, Phaseolus vulgaris, Arachis hypogaea etc., as they are planted in larger containers, although not exclusively for these seed kinds.

Substrata

The general requirements of any germination substratum are that it provides adequate moisture and aeration for the germinating seeds, is non-toxic to germinating seedlings and is relatively free of fungi and other micro-organisms. The most popular germination substrata are blotters and towels although sand or soil, filter paper, and creped cellulose paper can also be used.

1.6.3 Growing Media

There are three kinds of growing media that can be used according to the ISTA standards:

- Sand (sterile),
- paper, and
- organic media according to ISTA requirements.

These growing media are products that provide sufficient pore space for air and water, for the anchorage of the root system and for contact with solutions like water needed for plant growth.
General specifications for growing media:

- **Composition** – the growing media can be sterile sand, paper or a mixture of organic compounds with added mineral particles.

- **Water retention characteristics** – when the appropriate amount of water is added, the particles of the growing medium should have the capacity to hold sufficient water to provide continuous movement of water to the seed and seedlings but also provide sufficient pore space for aeration required for optimal germination and root growth, throughout the test period (in other words, the addition of extra water during the test should not be necessary). Additional moisture (water) during the test period is not advised due to standardisation procedures.

- **pH** – the pH value must be within the range 6.0 – 7.5.

- **Conductivity** – the salinity must be as low as possible. See ISTA requirements and work site procedures.

- **Cleanliness and freedom from toxicity** – the growing medium must be free from seeds, fungi, bacteria or toxic substances.

- **Re-use of media** – media should only be used once, sand can however be used again provided it is re-sterilised (refer ISTA Rules).

**Growing media characteristics**

- **Paper** – it should be wood, cotton or other purified vegetable cellulose.

- **Sand** – it should be uniform and free from very large or small particles and sterile (i.e. no additives that could improve the germination of the seed).

- **Organic** – must comply according to ISTA standards.

**1.6.4 Equipment**

To conduct this test you will need the following:

- **Suitable (size, light penetration and moisture proof) container** in which the seeds are placed.

- **Water absorbent material** – Tissues or cotton wool are ideal.

- **One hundred seeds** (replications of 4x100, 8x50, 16x25 or according to worksite procedures)

- **Good quality water supply**
1.7 Methods

Various different methods are used to analyse the germination of seed, according to the specific seed kind. In order to analyse the germination of seed and obtain reliable results, the International Rules for Seed Testing and the appropriate work site procedures must be adhered to. You should be fully aware and informed on the appropriate methods used at the workplace in order to conduct the germination of seed.

Test conditions

The conditions as set out according to the ISTA regulation in Table 5A should be followed especially for the substrates, temperatures and duration of the test. Workshops offered by Department of Agriculture, Genetic Resources can and will make recommendations (within ISTA Rules guidelines) as to test conditions for certain seed kinds.

Duration of the test

The duration of the test for individual species is indicated in Table 5A (ISTA) or according to worksite procedures. It is important to know that the duration of the treatment require to break dormancy before or during the tests is not taken as part of the germination test period.

Evaluation

For evaluation it is necessary that every seedling must be evaluated in accordance with the general principles of essential structure and normality. The essential structures must be sufficiently developed to permit detection of any abnormality. If after the first evaluation date has been reached and the seedling development is insufficient to make a determination, the seedlings can be left to develop further. If a test is to be prolonged (longer than the required period) clear guidelines are in the ISTA Rules. The general rule is that for a short germination period (7 days) the test is prolonged for an additional 3/4 days. If it is a longer period (14 days and longer), the period can be extended with ½ the number of days (e.g. 7 days, with 2 evaluation intervals: 3 – 4 days).

Multi-germ seed units are counted as single units and result of the test indicates the percentage of units which have produced at least one normal seedling.

1.7.1 Different growing media

Paper

There are three methods being used for paper substrates.
Top of paper (TP) – seeds are germinated on top of one or more layers of paper.

Between paper (BP) – seeds are germinated between layers of paper.

Pleated paper (PP) – seeds are placed in a pleated, accordion-like paper strip with 50 pleats, usually two to a pleat.

**Sand or organic media**

Top of sand (TS) or Top of organic growing media (TO) – seeds are pressed into the surface of the sand or the organic medium.

In sand(S) or organic growing media (O) – seeds are planted on a level layer of moist sand organic or the growing medium and covered with uncompressed substrate.

**Soil**

It is not generally recommended that soil be used as a primary growing medium. If being used it must meet the specifications of the ISTA standards.

### 1.7.2 Promoting germination

It is possible that a considerable amount of hard or fresh seeds may still remain at the end of the germination test. Possible reasons for this might be dormancy, hardseededness, inhibitory substances and other possible factors. A retest may be carried out either after a period of dry storage of the sample or by applying one or more special treatments.

**Breaking physiological dormancy**

- **Dry storage:** If dormancy is naturally of a short duration, storing of the sample in a dry place for a short time is often sufficient.

- **Pre-chilling:** The replicates for germination are placed in contact with the moist substrate and kept at low temperature for an initial period before they are moved to the temperature indicated in Table 5A.

- **Preheating:** The replicates for germination are heated at a temperature not exceeding 30-35 °C with free air circulation for a period before they are placed under described germination conditions.

- **Light:** The tests should be illuminated during at least 8 hours in every 24 hours cycle and during the high temperature period when the seeds are germinated at alternating temperatures.

- **Potassium Nitrate (KNO₃):** Instead of water KNO₃ is used to saturate the germination substrate at the beginning of the test.
Gibberellic acid: This method is very specific and mainly recommended for species as listed in the ISTA requirements.

Sealed polyethylene envelopes: This method is used when a high proportion of fresh ungerminated seeds are found at the end of the test, retesting in a polyethylene envelope of just sufficient size to hold the test satisfactory, will induce the seeds to germinate.

Removing hardseededness

The following treatments can be used:

- Soaking: Seeds are being soaked in water for up to 24 - 48 hours.
- Mechanical scarification: Seeds are being pierced, chipped or sand papered.
- Acid scarification: Seeds are being digested in sulphuric acid until seed coat becomes pitted. Special care is taken with this method as sulphuric acid is dangerous!

1.8 Retesting

The germination test shall be repeated for each of the following cases:

- When dormancy is suspected (fresh ungerminated seeds). If a particular seed kind, freshly harvested is known to have primary dormancy dual tests can be done simultaneously (control + dormancy breaking treatment). In this way time is saved and a retest does not have to be done after the initial test.
- When the results may not be reliable because of phytotoxicity or spread fungi or bacteria,
- When there is difficulty in deciding the correct evaluation of a number of seedlings,
- When there is evidence of errors in test conditions, seedling evaluation or counting,
- When the range of test replicates exceed the maximum tolerated range according to ISTA Rules (tolerance tables).

1.9 Calculating germination rate

The result of the germination test is calculated as the average of four 100 seed replicates. It is then expressed as a percentage by number of normal seedlings. The percentage is normally calculated to the nearest highest number. The percentage of abnormal seedlings, hard, fresh and dead seeds is calculated in the same way. The sum of the percentage of normal and abnormal seedlings and ungerminated seeds must be 100.
Example

If 86 seeds germinated in a replicate of 100 seeds:

\[
\text{Germination } \% = \frac{\text{Number of seeds germinated}}{\text{Number of seeds on tray}} \times 100
\]

\[
\frac{86}{100} \times 100 = 86\%
\]

The modern germination test demonstrates the capacity of a population of seeds to produce plants in the field. This is done by exposing them to conditions in the laboratory which are optimal for germination.

**Tolerance**

The result of a germination test can be relied upon only if the difference between the highest and the lowest replicates is within accepted tolerances according to ISTA regulations (tolerance tables). Tolerances must be applied to the normal seedling category.

### 1.10 Reporting results

There are specific items that should be entered in the appropriate space of the ISTA International Seed Analysis certificate when reporting the results of the germination test.

- Duration of test.
- Percentage of normal seedlings, abnormal seedlings, hard seeds, fresh seeds and dead seeds.

The following additional information shall also be reported:

In all cases

- Substrate and temperature used,
- Any special method or treatment used for promoting germination,
- The germination percentage obtained within the prescribed time, if the germination period has been extended beyond this period indicated in Table 5A,
- The second result obtained when duplicate tests are indicated in Table 5A.

Upon request

- The result of any additional tests,
- The viability of ungerminated seeds and methods used to determine it,
- Categories of ungerminated seeds and method used to determine them,
- With multi-germ seed units: number of normal seedlings produced by 100 units; proportion of units producing one, two or more than normal seedlings.
ANNEXURE 1 : REFERENCES

This document does not claim to be an original publication. Various sources of information and documents were used when compiling this document. Any neglect to make reference of any source, including an author, web site or publication is not through intent. Such omissions should be brought to the attention of SANSOR, who will gladly rectify the omission.

Plant Improvement Act (1976)

www.seedtest.org

www.aosaseed.com

www.seedburo.com
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PURPOSE OF THE UNIT STANDARD
A learner who has achieved this unit standard will be competent in:

- Analyse the germination of seed to determine quality.

LEARNING ASSUMED TO BE IN PLACE AND RECOGNITION OF PRIOR LEARNING
To enter a learning programme for this unit standard or to be assessed against this unit standard, the learner is assumed to have:

- Understanding of general safety in the work place at NQF level 2.
- Literacy, numeracy and communication skills at NQF level 3.
- Introduction to the seed industry and relevant workplace.
- Basic computer literacy.

UNIT STANDARD RANGE
The learner is expected to perform the specific outcomes as reflected in this unit standard without direct supervision, but with access to work-site procedures, operating instructions and statutory requirements.

- The learner is expected to be able to analyse the germination of the kinds of seed included in the work site procedure.
- Operational procedures are limited to International Seed Testing Association (ISTA) Rules and Handbooks.
- Equipment refers to, but is not limited to: microscope; magnifying lamp; germination chambers and planting containers.
- Materials refer to, but are not limited to: sub-strata; chemicals and water.
- Peculiarities are limited to: normal and abnormal seedlings; fresh, hard and dead seed.

Specific Outcomes and Assessment Criteria:

SPECIFIC OUTCOME 1
Prepare the work area for analysis.

OUTCOME NOTES

- Cleaning and sterilising work area and equipment according to work site procedures and operational procedures (ISTA Rules).
- Identifying and selecting appropriate equipment and test methods according to work site procedures and operational procedures.
- Reporting any defects pertaining to appropriate equipment or materials according to work site procedures and operational procedures.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1
Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes. In this unit standard the following specific criteria should be used:

- Consequences of not sub-sampling accurately according to the operational procedures are explained.
- Consequences of not using correct sanitary procedures according to work site procedures are explained.
- Consequences of not identifying and reporting findings accurately according to the operational procedures and work site procedures are explained.
- Consequences of not reporting deviations are explained.
- The importance of using the correct equipment, sub-strata and methods for planting and evaluating according to work site procedures are explained.
- The importance of recording the different fractions according to the operational procedures and work site procedures are explained.
- The importance of retaining the sample and prescribed records according operational procedures, work site procedures and statutory requirements are explained.

**SPECIFIC OUTCOME 2**

Prepare planting sample and relevant documentation.

**OUTCOME NOTES**

- Familiarising with the peculiarities of the specific crop type regarding germination requirements according to operational procedures and work site procedures.
- Acquiring the working sample according to work site and operational procedures.
- Preparing relevant documentation to record action taken.
- Counting the seed from the working sample, for planting according to operational procedures and work site procedures.
- Returning the balance of the working sample according to operational procedures and work site procedures.

**ASSESSMENT CRITERIA**

**ASSESSMENT CRITERION 1**

Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes. In this unit standard the following specific criteria should be used:

- Consequences of not sub-sampling accurately according to the operational procedures are explained.
- Consequences of not using correct sanitary procedures according to work site procedures are explained.
- Consequences of not identifying and reporting findings accurately according to the operational procedures and work site procedures are explained.
- Consequences of not reporting deviations are explained.
- The importance of using the correct equipment, sub-strata and methods for planting and evaluating according to work site procedures are explained.
The importance of recording the different fractions according to the operational procedures and work site procedures are explained.

The importance of retaining the sample and prescribed records according operational procedures, work site procedures and statutory requirements are explained.

SPECIFIC OUTCOME 3
Plant sample for germination.

OUTCOME NOTES
- Preparing the sub-strata according to operational procedures and work site procedures.
- Placing the counted seed on sub-strata according to operational procedures and work site procedures.
- Placing the planted sample in the appropriate growth chamber according to operational procedures and work site procedures.
- Storing the submitted sample and cleaning the work area according to operational procedures and work site procedures.
- Completing documentation according to operational procedures and work site procedures and informing relevant parties.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1
Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes. In this unit standard the following specific criteria should be used:

- Consequences of not sub-sampling accurately according to the operational procedures are explained.
- Consequences of not using correct sanitary procedures according to work site procedures are explained.
- Consequences of not identifying and reporting findings accurately according to the operational procedures and work site procedures are explained.
- Consequences of not reporting deviations are explained.
- The importance of using the correct equipment, sub-strata and methods for planting and evaluating according to work site procedures are explained.
- The importance of recording the different fractions according to the operational procedures and work site procedures are explained.
- The importance of retaining the sample and prescribed records according operational procedures, work site procedures and statutory requirements are explained.

SPECIFIC OUTCOME 4
Evaluate the germination sample.

OUTCOME NOTES
- Obtaining action documentation, germination sample and operation manuals according to work site and operational procedures.
Familiarising with the peculiarities of the germinating and non-germinating seed of the specific crop

Appraising the sample at specified evaluation intervals according to operational procedures and work site procedures.

Recording findings and deviations according to operational procedures and work site procedures.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes. In this unit standard the following specific criteria should be used:

- Consequences of not sub-sampling accurately according to the operational procedures are explained.
- Consequences of not using correct sanitary procedures according to work site procedures are explained.
- Consequences of not identifying and reporting findings accurately according to the operational procedures and work site procedures are explained.
- Consequences of not reporting deviations are explained.
- The importance of using the correct equipment, sub-strata and methods for planting and evaluating according to work site procedures are explained.
- The importance of recording the different fractions according to the operational procedures and work site procedures are explained.
- The importance of retaining the sample and prescribed records according operational procedures, work site procedures and statutory requirements are explained.

SPECIFIC OUTCOME 5

Complete the process.

OUTCOME NOTES

- Restoring the work area according to operational procedures and work site procedures.

ASSESSMENT CRITERIA

ASSESSMENT CRITERION 1

Assessors will observe, confirm and evaluate evidence that will indicate that learners have demonstrated competence in each of the specific outcomes. In this unit standard the following specific criteria should be used:

- Consequences of not sub-sampling accurately according to the operational procedures are explained.
- Consequences of not using correct sanitary procedures according to work site procedures are explained.
- Consequences of not identifying and reporting findings accurately according to the operational procedures and work site procedures are explained.
- Consequences of not reporting deviations are explained.
The importance of using the correct equipment, sub-strata and methods for planting and evaluating according to work site procedures are explained.

The importance of recording the different fractions according to the operational procedures and work site procedures are explained.

The importance of retaining the sample and prescribed records according operational procedures, work site procedures and statutory requirements are explained.

UNIT STANDARD ACCREDITATION AND MODERATION OPTIONS

- An individual wishing to be assessed against this unit standard may apply to an assessor accredited by SETASA.
- Any training provider offering learning that will enable achievement of this unit standard must be registered and accredited by SETASA.
- Moderation of assessment will be done by SETASA in its ETQA capacity at its discretion.

UNIT STANDARD ESSENTIAL EMBEDDED KNOWLEDGE

- General knowledge of the differences between germinating and non-germinating seed, as well as normal and abnormal seedlings; fresh, hard and dead seed.
- Knowledge and theory of operation of microscopes, growth cabinets and seed-counting equipment.

Critical Cross-field Outcomes (CCFO):

UNIT STANDARD CCFO IDENTIFYING
Identify and solve problems by assessing and reporting the germination of seed.

UNIT STANDARD CCFO WORKING
Work effectively with others with whom the relevant function interfaces.

UNIT STANDARD CCFO ORGANIZING
Organise and manage oneself when preparing for analysis of the germination of seed.

UNIT STANDARD CCFO COLLECTING
Collect, analyse, organise and critically evaluate the information documents, samples and condition of work site.

UNIT STANDARD CCFO COMMUNICATING
Communicate with others in the process of the analysis of the germination of seed.

UNIT STANDARD CCFO DEMONSTRATING
Understand the world as a set of related systems in appreciating the importance of accurate analysis, identification of abnormalities, irregularities and defects and the consequences of not reporting these with regard to the analysis of the germination of seed.

UNIT STANDARD NOTES
Values
All learners should demonstrate:

- An application of company ethics, values as well as general safety and customer care principles.
- An awareness of expectations and obligations of basic worker/management/customer relationships.