JUST AGRICULTURE
multidisciplinary e-Newsletter

Seed Testing For Quality Assurance

Neha Boora*, Axay Bhuker, V.S. Mor and Puneeth Raj MS
Department of Seed Science & Technology
B.Sc. (Hons.) Final year, College of Agriculture*
CCS Haryana Agricultural University, Hisar -125004

ARTICLE ID: 63

Introduction

Seed testing is a science of evaluating the planting value of seed which has been developed to achieve the following objectives for minimizing the risk of planting low quality seeds:

- To gain information about the field planting value of the seed lot
- To obtain result that can be used to compare the value of different seed lots
- To identify the seed quality problems and their probable causes
- To determine the need for drying, processing and specific procedure that should be used
- To determine whether seed meets IMSCS for labeling
- Determination of selling price of seeds
- Predicting storability of seeds

According to seed act 1966, labeling is compulsory and various information such as germination, physical purity, moisture content are mentioned on the label of seed containers. Although, there are many components of seed testing such as moisture test, Germination test, Physical purity test, Dormancy test, Seed Vigour & viability Tests, Seed health test, Genetic purity test etc. but most of the samples are submitted in the seed testing laboratory for routine tests *i.e.* germination, physical purity and moisture content tests. International seed testing association (ISTA) which was established in 1924, standardize the seed testing rules. Under section 4 of the seed act 1966, there is provision of establishment of seed testing laboratory. At present more than 125 seed testing laboratories are working all over the country. Seed testing procedure in these laboratories is done as per handbook of seed testing published by IARI, New Delhi which is based on the ISTA rules.

Physical Purity Analysis:

JUST AGRICULTURE
multidisciplinary e-Newsletter

Physical purity of a seed lot refers to the physical composition of seed lots. A seed lot is composed of pure seeds-the seeds of same kind, inert matter, broken grains less than half in size, soil and dust particles chaff etc., weed seeds and other crop seeds.

Table 1. Standards for physical purity (%) for various crops

Crops	Physical purity (Minimum)
Okra	99
Most of the crops	98
Mustard, sesame, soyabean, jute, garden-beet, sugar beet	97
Groundnut, spinach	96
Carrot, amaranthus	95

Analysis of purity components:

The working samples are divided into different components of purity such as pure seed, other crops seeds, weed seeds and inert matter with the help of purity work board, spatula and magnifying glasses etc.

(i) **Pure Seed:** Pure seed refers to that species which is stated by the sender to be, in or found to be dominant in the seed lot. Such seeds as immature, undersize, shriveled, diseased, or germinated seeds unless transformed into fungal sceloratia, smut balls or nematode gall, are regarded as pure seed, provided they can be identified as of that species.

(ii) **Inert Matter:** Inert matter includes such seed like structures as pieces of broken or damaged seed, empty glumes or any other extraneous matter such as soil, sand, stone, chaff, stems, leaves, pieces of bark, flower, nematode galls, fungal bodies, insect larvae etc.

(iii) **Other Crop Seeds:** These refers to any kind of seed or seed like structures of any plant species other than of pure seed. The distinguishable characteristics set out for pure seed shall also be applicable to other crop seeds except certain weed seeds, which are classified separately.

(iv) **Weed Seeds:** Seeds bulblets or tubers of plants recognized as weed by laws or official regulations or by general usage shall be considered as weed seeds.

JUST AGRICULTURE
multidisciplinary e-Newsletter

The procedures for purity analysis (apart from sub-sampling, weighing and blowing is as follows:

1. The sub-sample purity-working sample is spread on the working table.
2. Each particle is judged individually, the criterion, therefore, being its external appearance (shape, size, colour, luster, surface structure etc.) under transmitted light.
3. All kinds of other crop, weed seeds seed and inert matters present therein are separated while selecting the pure seed.
4. Each component is weighed and the weights are recorded to determine their percentage by weight.
5. Component may be retained for future reference though some of the pure seed may be used for germination test.

The percentage of the components is determined on the basis of sum of weights of the components, not on the weight of the original sample.

$$\text{i) Pure seed (\%)} = \frac{\text{Wt. of pure seeds}}{\text{Total weight of all components}} \times 100$$

$$\text{ii) Other crop seed (\%)} = \frac{\text{Wt. of other crop seeds}}{\text{Total weight}} \times 100$$

$$\text{iii) Weed seed (\%)} = \frac{\text{Wt. of weed seeds}}{\text{Total weight}} \times 100$$

$$\text{iv) Inert matter (\%)} = \frac{\text{Wt. of inert matter}}{\text{Total weight}} \times 100$$

These should not be more than 1.0% variation between the weight of the original sample and the total weight of the components. If the gain or loss is greater than this, another test should be made. The result of purity analysis shall be given to one decimal place and the

JUST AGRICULTURE
multidisciplinary e-Newsletter

percentage of all components must total 100. The components of less than 0.05% shall be reported as 'trace', the percentage of pure seed, other crop seed weed seeds and inert matter must be reported, if the result of the component is nil, this must be shown as '0.0' in the appropriate space. The number of each spp. found be reported with actual weight and by number seed per kg.

Seed Moisture test:

From the time of harvest to time of planting, seed moisture varies and if it rises above certain critical levels for any appreciable time period at any stage there is danger or undesirable stimulation of physiological processes within the seed with consequent weakening and loss of seed viability. Knowledge of moisture content, therefore is needed to decide whether seeds should be dried down before storage or packing. Seed moisture content can be expressed either on wet weight basis or on dry weight basis but in seed testing, it is always expressed on a wet weight basis. Moisture content testing must commence within 24 hours of receipt of the seed as the seed is hygroscopic in nature. For all crops, seed moisture content should not more than the prescribed limit given in the IMSCS.

Table 2. Seed moisture content (%) requirement for major field crops

Name of crop	**Moisture content (%) maximum**	
	Ordinary container	**Vapour proof containers**
Wheat, barley, maize, sorghum, bajra, oat	12	8
Paddy	13	8
Gram, lentil, urd, green gram, cowpea, pigeon pea, guar	9	8
Cotton	10	6
Rape seed & mustard	8	7
Groundnut	9	5
Sunflower	9	7

Procedure of moisture analysis:

Weight of submitted sample:

Minimum weight of submitted sample for moisture determination should be 100g for crop that have to be ground and 50 gram for all other crops.

JUST AGRICULTURE
multidisciplinary e-Newsletter

Working sample size:

Five gram working sample should be taken when the container diameter is less than 8 cm. if container diameter is 8cm or more, 10g sample should be taken in the container.

Seed moisture content can be determined either by air oven or moisture meter. However, if prescribed standard for moisture content is less than 8%, air oven method shall be used. The following are the important methods for seed moisture analysis:

1. **Direct/ destructive Method:** In this method seeds remain as such (undamaged) and can be used after test. Although this is quick method but not an accurate method. Different types of moisture meters are available in the market to determine the moisture content of the seeds e.g. Universal moisture meter, Steinlite moisture meter, Digital moisture meter, Infrared moisture meter, Agromatic mark-II, Koster moisture tester, Farmi-35 grain moisture tester etc.

2. **Indirect/ non-destructive Methods:** In this method, seeds are damaged (viability completely lost) and cannot be reutilized. Principle of these methods is the elimination of water from the sample by heating, drying or chemically treating the seeds e.g. Karl Fisher method, toluene titration method, phosphorous pentaoxide method, hot air oven method etc. The officially hot-air oven method is recommended by ISTA for determining moisture in seed.

Hot-Air Oven Method:

The following two methods of hot-air oven methods are prescribed depending upon the drying temperatures and duration:

A. **High constant temperature method:** In this method most of the crop varieties are dried at $130^{o}C \pm 1^{o}C$ in oven for 1 hour, cereals (2 hours) and maize (4 hours).

B. **Low constant temperature method:** The oil containing seeds are dried at $103^{o}C \pm 1^{o}C$ for 17 hours without grinding.

Some requirements for moisture test:

- **Grinding:** Fine grinding is essential for cereals and cotton before determination of moisture content of seed. In case of pulses coarse grinding is recommended.
- **Pre-drying:** If the moisture content of the sample to be tested is more than 17% (or 10% in case of soybean & 13% in rice) pre-drying before grinding is necessary.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- **Desiccators:** The desiccators should be of good quality, the edges of the cover & the main body should have good ground glass joints & good quality grease should be used on these joints. The bottom compartment should have indicating type silica gel as a desiccant.

Procedure:

weigh the empty container along with its lid (M_1). The submitted sample is ground and thoroughly mixed with a small spoon and 4-5 g of the sample is weighed in duplicate directly into the container (M_2). Set the oven to pre-heat sample at the required temperature and put the sample in oven for required time period. At the end of the drying period, the lid is placed on the containers and is allowed to cool for 30 to 45 minutes in a desiccators and then weighed again (M_3). The moisture content (M) is calculated in percentage to one decimal place by using the following formula:

$$\text{SMC (\%)}, \quad M = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Where, M_1 = Weight of empty container with lid

M_2 = Weight of container with lid and seed before drying, and

M_3 = Weight of container with lid and seed after drying and cooling.

Germination Test:

Rabi crops seed are tested at 20°C while kharif crops seed are tested at 25°C temperature. Germinators are used to get desired temperature.

Table 3. Standards for germination(%) for different crops

Crop	Germination (Minimum)
Wheat, Barley, oat Chickpea, Rapeseed & Mustard	85
Paddy, berseem, lucern	80
Maize	90
Green gram, Pigeon pea, Lentil, Peas,	75
Groundnut, castor, soyabean, sunflower, Guar	70

Working sample:

JUST AGRICULTURE
multidisciplinary e-Newsletter

Four hundred seeds in replicate of 100, 50 or 25 seeds are taken at random from pure seed.

General requirements for seed germination: For successful germination, the requirements are: substrate, adequate moisture and favourable temperature.

Germination test procedure: On the basis of substrate, the following methods are commonly used for germination test:

a. **Top of paper (TP) method:** In this method the seeds are placed directly on one or more layers of moist filter paper in petridishes. These petridishes are covered with lid and placed in the germinator cabinet. The relative humidity in the cabinet must then be maintained as close to saturation to prevent drying out.

b. **Between papers (BP) method**: In this the seeds are germinated between two layers of paper. This may be achieved by loosely covering the seeds with an additional layer of paper or by placing the seed in rolled level. The rolls are then placed inside the germination in an upright position.

c. **Sand (S) method:** The seeds are planted on a leveled layer of moist sand and covered with 10-20 mm of uncompressed sand depending on the size of the seed. The bottom layer of sand is loosened by raking before sowing to ensure good aeration.

Seedling evaluation:

At the end of germination test, the samples are taken out and evaluated and classified into the following:

a) **Normal seedlings:** Seedlings which show the capacity for continued development into normal plants, when grown in good quality soil and under favorable conditions of water supply, temperature and light. These are the seedlings which possess all the essential structures with a well developed root.

b) **Abnormal seedlings:** Abnormal seedlings are those which do not show the capacity for continued development into normal plants, when grown in good quality soil and under favorable conditions of water supply, temperature and light.

c) Dead seeds: Seeds which at the end of test period are neither hard nor fresh and have not produced seedlings are classified as dead seeds.

JUST AGRICULTURE
multidisciplinary e-Newsletter

d) Hard Seeds: Seeds of legumes and *Malvaceae*, which remain hard until the end of the prescribed test period, because the impermeable seed coat prevent them from absorbing water, are classified as hard seeds.

e) Fresh seeds: These are the seeds other than hard seeds which remain firm and apparently viable at the end of the test period. Such type of seeds results from physiological dormancy. They are able to imbibe water but further development is blocked.

Reporting of results:

The percentage germination is calculated to the nearest whole number. If the result is nil for any type of category, it is reported as zero instead of leaving the appropriate column blank. The sum of the percentage of the normal, abnormal seedling, hard and dead seeds must be 100.

- Germination (%) = Normal seedling/ No. of seeds per rep. x 100
- Germination (%) = Normal seedling + Hard seeds/ No. of seeds per rep. x 100

Table 4. Substrate, temperature and duration for germination test of major field crops

Crop	Substrate	Temperature (^{0}C)	Duration of test (days)
Wheat	S,BP,TP	20	8
Barley	S,BP	20	7
Paddy	BP, TP,S	20-30, 25	14
Maize	BP,S	20-30, 25	7
Sorghum	BP,TP	20-30, 25	10
Bajra	BP,TP	20-30	7
Gram	BP,S	20-30,20	8
Lentil	BP,S	20	10
Urd	BP,S	20-30, 25	7
Green gram	BP,S	20-30, 25	8
Pigonpea	BP,S	30	6
Cotton	BP,S	20-30	12

JUST AGRICULTURE
multidisciplinary e-Newsletter

Rape seed & mustard	TP	20, 20-30	7
Groundnut	BP,S	20-30,25	10
Sunflower	BP, S	20-30, 25,20	10