

Determination of Seed Moisture content



Seed Moisture Content !

- Is the most important attribute, influencing seed quality and storability
- Its estimation in seed quality assessment is vital
- Is expressed either on wet weight basis or dry weight basis
- In Seed Testing, always expressed on wet weight basis
- Can be determined either by using moisture meter(s) or hot air oven method

Objective

- To determine the moisture content of seed by methods suitable for routine use

Definition

- The moisture content of a sample is the loss in weight when it is dried in accordance with ISTA rules
- It is expressed as percentage of the weight of the original sample

Principle

- The methods prescribed are designed to reduce
 - oxidation
 - decomposition or
 - the loss of other volatile substances
 - ensuring the removal of as much moisture as possible

Seed ageing and loss of seed germination

Seed ageing can't be stopped, but can be minimized by proper seed storage conditions.

The two imp environmental factors influencing are

Relative humidity = governs seed moisture

Temperature

Harrington's rules

1. For every decrease of 1 per cent seed moisture the life of seed is doubled
2. For every decrease of 5°C in storage temperature the life of the seed is doubled

(Rule 1 hold's good, when the seed moisture content is b/w 14 and 5%)

Determination of Moisture Content

□ Moisture Meter(s)

- Estimation is quick and convenient
- Estimation is approximate (not precise)
- Estimation is generally based on electric conductivity
- Meter(s) to be calibrated, for each species
- Only to be used if, the results are comparable with an oven method

□ Air Oven Method

- Standard reference method
- Estimation is precise
- Seed moisture is removed by drying (under specified temperature for a specific duration)
- Approved by ISTA

Weight of Submitted Sample

- 100 gm for species that have to be ground
- 50 gm for all other species

- Be submitted in polythene bags of ≥ 700 gauge

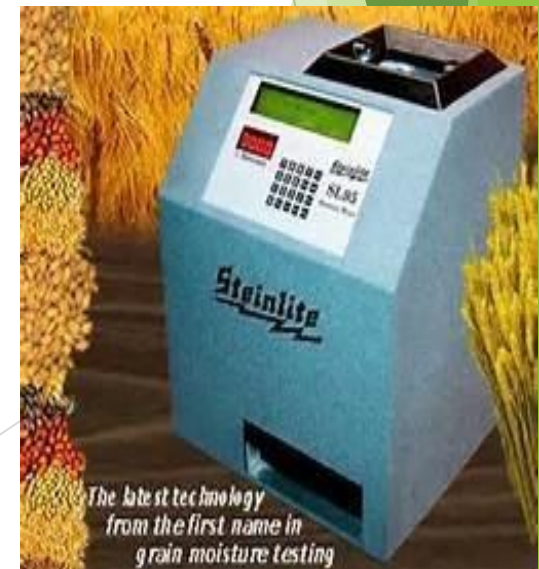
Equipments

- Moisture meter(s) of different types
- Constant temp oven
- Moisture containers/ bottles of glass or stainless steel
- Desiccator with silica gel
- An adjustable grinding mill/Seed grinder
- A small spoon
- Sieves set of 0.5, 1.0 & .0 mm mesh and receptacle
- Cutting tools
- Analytical balance
- Heat resistant hand glove
- A brush and a steel brush

Moisture Meters

Working principles, where the seed:

- Is weighed on built-in-balance, and heated by an infra-red lamp or electrical heating elements
- moisture is determined by their conductivity (moisture content is directly proportional to the resistance and the dielectric constant of the seed sample)



Constant Temp Oven

- Works on the principle of mechanical convection (forced draught)
- Oven must be Electrically heated, with thermostatic or electronic control with $\pm 1^{\circ}\text{C}$ accuracy
- Insulated and capable of maintaining uniform temp
- Equipped with removable perforated or wire shelves with a thermometer, tested to be accurate up to 0.5°C
- With a heating capacity, to regain the required temp (disturbed during loading the moisture containers), within 10 to 15 min



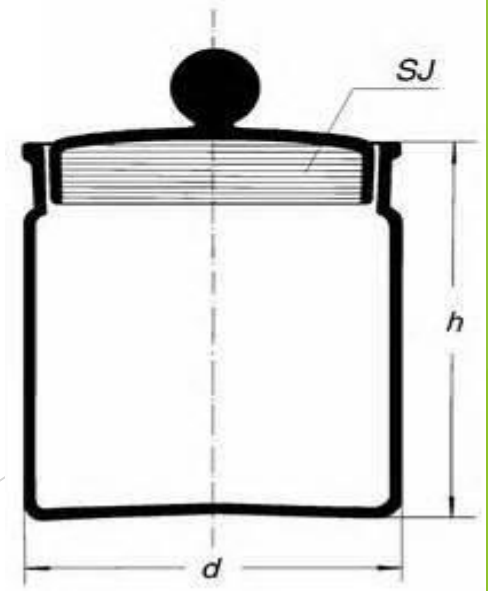
Grinding Mill

- Adjustable, to obtain particles of dimensions desired
- Constructed of non-absorbent material
- Constructed so that both the seeds and ground material are protected from ambient air, to the extent possible
- Air currents that might cause loss of seed moisture be reduced to a minimum
- Grind the seed evenly at a speed that does not cause heating, and loss of moisture
- Easy to clean



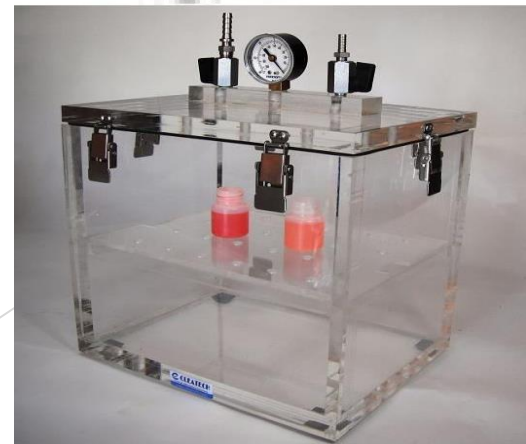
Moisture Containers

- Glass or stainless steel bottles/ cans
- Of approx. 0.5 mm thickness, and have snug fitting covers
- With round sides, a flat bottom and level edges
- Both the container and its cover be identified with same number
- Have constant weights on heating or cooling
- Effective surface must enable the working sample to give $0.3\text{g}/\text{cm}^2$



Desiccator

- Be of good quality
- The edges of the cover and the main body should have good ground glass joints and use good quality grease, on the joints
- Be fitted with a thick metal plate or porcelain plate to promote rapid cooling
- Bottom compartment should contain a suitable desiccant eg silica gel (self indicating) or phosphorus pentoxide or activated alumina
- Reactivate the silica gel, by heating at 200°C , for 17 hrs in an electric oven



Analytical Balance

- Must be quick and accurate in weighing
- Capable of weighing up to 0.001 gm or 1 mg



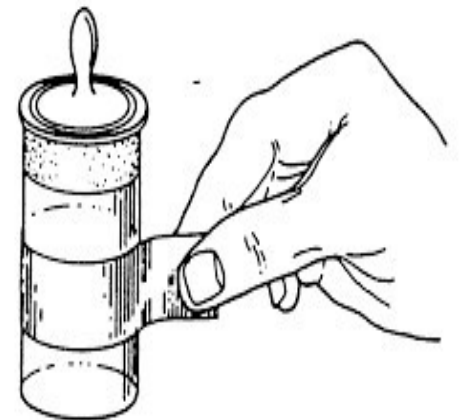
Weighing

- Shall be in gm to three decimal place or in four significant figures



Working Sample

- Determination in two replicate *ie* two independently drawn sample
- Sample size depends on the diameter of the containers, If diameter
 - is ≤ 8 cm - 4 to 5 gm
 - is ≥ 8 cm - 10 gm
- Sample be thoroughly mixed
 - Stir the sample with spoon or
 - Pour the sample back and forth between two similar containers
- Exposure of sample to lab atmosphere be minimum *ie* ≤ 30 seconds



Cutting

- For large tree seeds (1000 seed wt > 200gm)
- Tree seeds generally have very hard seed coat, eg leguminous species
- Be done on a sub-sample
- Use scalpel or hand pruning shears with blade (at least 4.0 cm long)
- Cut the seed into 4 or 5 pieces
- Mix with a spoon
- Draw the two working sample (weight approx equal to weight of five intact seeds)



Constant Temp Oven Methods

- The low constant temperature oven method
- The high constant temperature oven method

The Low Constant Temperature Oven Method

- At temperature: 103°C for 17±1 hrs
- At the end of prescribed period, cover the container, place in desiccator to cool for 30 to 45 min
- The RH of lab be $\leq 70\%$, during moisture determination
- Good for seed species with high oil/volatile content eg onion, groundnut, mustard, chillies, soybean, cotton, linum, castor, til & tree spp

The High Constant Temp Oven Method

- Temperature: 130° to 133°C
- Drying period
 - 4hrs for Maize
 - 2hrs for other cereals
(wheat, barley, paddy, sorghum & oat)
 - 1 hr for other species
(gram, pea, bakla, cowpea, lathyrus, lupinus;
cenchrus, panicum, berseem;
beet root, tomato;
watermelon & other cucurbits)
- No special requirement to lab RH, during moisture determination

Testing Procedure

- Be carried out in duplicate on two independently drawn working samples
- Weigh with an accuracy of 1 mg
- Weigh the empty container with its cover (M_1)
- Mix thoroughly the submitted sample (using spoon)
- Two small portions of seed samples are weighed directly into the containers (M_2)
- Seed material to be evenly distributed on bottom of the containers
- After weighing, remove the cover or lid of container
- Place the container in the oven, already heated to desired temperature
- At the end of drying period, container be closed with its lid or cover, transfer to the desiccator, to cool down, for 30 to 45 min
- Weigh again (M_3)
- Calculate the moisture content

Calculation of Results

The moisture content (mc)

- be calculated up to one decimal place
- as %age by weight, using the formula:

$$\%age\ of\ mc = \frac{(M_2 - M_3) \times 100}{(M_2 - M_1)}$$

Where

M_1 : is the wt in gm of the container and its cover,

M_2 : is the wt in gm of the container, its cover and its contents before drying, and

M_3 : is the wt in gm of the container, its cover and its contents after drying

$M_2 - M_3$: Moisture loss

$M_2 - M_1$: Fresh weight of sample

(weight should take at minimum of three decimal places)

Pre-drying

- Not obligatory for tree seeds
- For seed species, where grinding is obligatory and with $\geq 17\%$ moisture
- Soybean seed with $\geq 10\%$ moisture
- Paddy seed with $\geq 13\%$ moisture
- On two sub-samples, each weighing 25 ± 1 gm, dried on open trays, for 5 to 10 min at 130°C
- In *Zea mays* with $\geq 25\%$, dried for 2-5 hrs at $65- 75^\circ\text{C}$
- For other species with $\geq 30\%$, dried overnight in a warm place

If the Seed Material is Pre-dried

- The seed mc is calculated from the results obtained in the first stage (pre-drying) and second stage of drying (normal), by using the formula:

$$\%age\ mc = \frac{(S_1 + S_2) - (S_1 \times S_2)}{100}$$

Where

- S_1 - is the moisture lost in the first stage (pre drying)
- S_2 - is the moisture lost in second stage (normal drying method)

Tolerance

- The difference must be calculated to three decimal places and then rounded off to one decimal place.
- The max. difference b/w two replicates must not exceed 0.2% for crop seed species
- If $> 0.2\%$, then repeat determination in duplicate
- Up to 0.3 to 2.5%, for tree and shrub species (impossible to meet up to 0.2% tolerance)
- If the results of the duplicate determinations are out of tolerance, repeat the test
- For repeated test, report the result of the second test if its replicates are within tolerance
- If the replicates of the second determination are out of tolerance as well, check if the averages of the two tests are in tolerance (0.2%), if so report this average
- If replicates of the both tests are out of tolerance and the average results of the repeat tests are out of tolerance - discard the results

Reporting Results

To be reported on ISTA Analysis Certificate

- Results up to one decimal place (ie nearest to 0.1%)
- The method must be reported (duration & temp)
- If using the moisture meters
 - the brand and type of the equipment
 - the range for which the moisture meter is calibrated, under "Other Determinations"
 - If moisture test has done for pelleted seeds, the statement "the seeds of the submitted moisture sample were pelleted, and the moisture content reported is the average of the seed and pelleting materials" must be entered

Species for Which Grinding is Obligatory

- *Amorpha fruticosa*
- *Arachis hypogaea*
- *Avena* spp
- *Cicer arietinum*
- *Citrullus lanatus*
- *Fagopyron esculantum*
- *Glycine max*
- *Gossipium* spp
- *Hordeum vulgare*
- *Lathyrus* spp
- *Lupinus* spp
- *Oryza sativa*
- *Phaseolus* spp
- *Pisum sativum*
- *Ricinus communis*
- *Secale cereale*
- *Sorghum* spp
- *Triticum* spp
- *Vicia* spp
- *Zea mays*

Species for Which the Low Constant Temp Oven Method Shall be Used

- *Allium* spp
- *Amorpha fruticosa*
- *Arachis hypogaea*
- *Brassica* spp
- *Camelina sativa*
- *Capsicum* spp
- *Glycine max*
- *Gossypium* spp
- *Linum usitatissimum*
- *Raphanus sativus*
- *Ricinus communis*
- *Sesamum indicum*
- *Sinapis* spp
- *Solanum melongena*
- All tree spp

Species for which Constant High Temperature (130°-133°C) Oven Method is Used

<i>Agrostis</i> spp	<i>Citrullus lanatus</i>	<i>Lolium</i> spp	<i>Phaseolus</i> spp
<i>Alopecurus pratensis</i>	<i>Cucumis</i> spp	<i>Lotus</i> spp	<i>Phelum</i> spp
<i>Anethum graveolens</i>	<i>Cucurbita</i> spp	<i>Lupinus</i> spp	<i>Pisum sativum</i> (all vars)
<i>Anthoxanthum odoratum</i>	<i>Cuminum cyminum</i>	<i>Lycopersicon lycopersicum</i>	<i>Poa</i> spp
<i>Anthriscus</i> spp	<i>Cynodon dactylon</i>	<i>Medicago</i> spp	<i>Scorzonera hispanica</i>
<i>Apium graveolens</i>	<i>Cynosurus cristatus</i>	<i>Melilotus</i> spp	<i>Secale cereale</i>
<i>Arrhenatherum</i> spp	<i>Dactylis glomerata</i>	<i>Nicotiana tabacum</i>	<i>Sorghum</i> spp
<i>Asparagus officinalis</i>	<i>Daucus carota</i>	<i>Onobrychis vicifolia</i>	<i>Spinacea oleracea</i>
<i>Avena</i> spp	<i>Deschampsia</i> spp	<i>Ornithopus sativus</i>	<i>Trifolium</i> spp
<i>Beta vulgaris</i> (all vars)	<i>Fagopyrum esclentum</i>	<i>Oryza sativa</i>	<i>Trisetum flavescens</i>
<i>Bromus</i> spp	<i>Festuca</i> spp	<i>Panicum</i> spp	<i>Triticum</i> spp
<i>Cannabis sativa</i>	<i>Holcus lanatus</i>	<i>Papaver somniferum</i>	<i>Valerianella locusta</i>
<i>Carum carvi</i>	<i>Hordeum vulgare</i> (all vars)	<i>Paspalum</i> spp	<i>Vicia</i> spp
<i>Chloris gayana</i>	<i>Lactuca sativa</i>	<i>Pastinaca sativa</i>	<i>Zea mays</i>

Precautions

- Submitted sample be accepted for moisture determination only if, it is in an intact moisture-proof container
- Determination be started soon after receipt
- Exposure of sample to lab atmosphere be reduced to the absolute minimum
- If grinding not required, not more than two min elapse from the time the sample is removed from container

THANK YOU