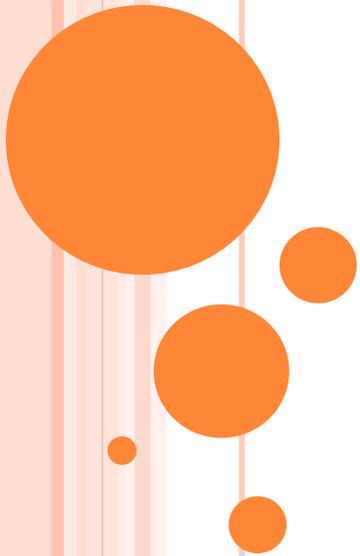
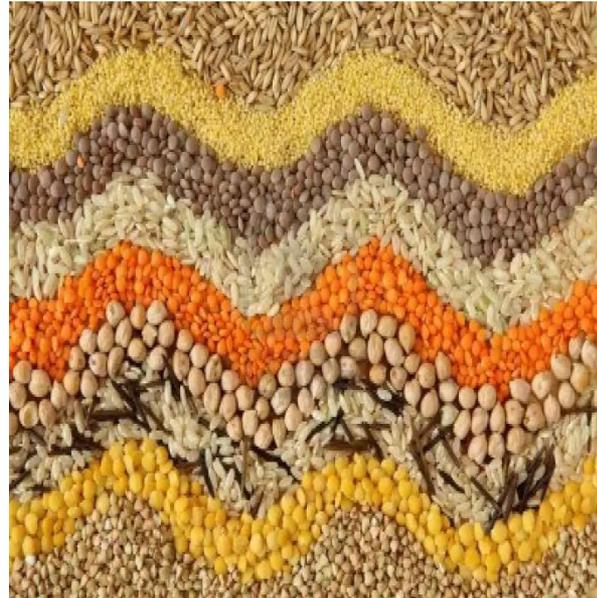


# SAFE SEED STORAGE



# IMPORTANCE OF SEED

- Most vital input
- 90% of all food is propagated through seeds
- > 200 species of insects are associated with stored seeds/ 12 are important
- Seed health test important due to global demand



# SEED HEALTH

- Term coined in 1928 at 5<sup>th</sup> International Seed Testing congress, Rome, Italy
- Seed Health Committee was formed as a part of ISTA
- Seed health refers to presence or absence of disease causing organisms – fungi, bacteria, viruses, animal pests including nematodes, insects.



# WHY PREPARE SEED FOR STORAGE?

- Nature prepares the seed for storage by drying
- Dry seed help in transmission of species over space and time
- Prevent entry of pest and diseases
- Prevent damage by accidental or wonton injury
- Storage on mother plant ranges from few days to several years
- Increased phenol content reduces pest damage
- Wild types are better storers than cultivated species.



# SEED STORAGE

- Preservation of seeds till next sowing
- Storage over space and time
- Temporary storage
- Short term storage
- Long term storage
- Conservation of germplasm



# NEED FOR STORAGE

- Storage begins on mother plant
- Storage during processing till tagging (6 months)
- Storage till next season
- Storage during transit
- Storage in farmers holding

*aims of storage* are:

- to make products available all year round
- improve quality of some crops *e.g.* Rice, tobacco



# FACTORS AFFECTING SEED STORAGE

- Preharvest factors (maturity, injury, insect damage, fungal infection, humidity)
- Nature of seed (orthodox/recalcitrant)
- Seed moisture content
- Storage room temperature
- Packaging material
- Handling methods during transit/godown



# FACTORS AFFECTING SAFE SEED STORAGE

<b>Grain/Seed moisture content</b>	<b>Effect on grain/seed</b>
33-60 %	Germination occurs
18-20%	Respiratory activity, heating, mould, insect. Susceptible to mechanical damage.
13-17%	Respiration high, mould, fumigants affect seed.
10-12%	Store reasonably well for 6-8 months in open storage in temperate climate, insect attack
8-10%	Store for 1-3 years open storage, little insect activity.
4-6 %	Safe for long term storage in moisture vapour proof storage.
0-4 %	Extreme desiccation- too brittle for seed.

# HARRINGTON'S THUMB RULE

## Rule of the thumb

- For every decrease of 1% seed moisture content, the life of the seed doubles. This rule is applicable when moisture content between 5 and 14%.
- For every decrease of 5°C in storage temperature the life of the seed doubles. This rule applies between 0°C to 50°C.

## Numerical rule of the thumb

- Good seed storage is achieved when the % of relative humidity in storage environment and the storage temperature in degrees Fahrenheit add upto hundred but the contribution from temperature should not exceed 50°F



# EFFECT OF SEED MOISTURE CONTENT ON SEED LONGEVITY

Seed moisture content	Storage life
11-13 %	½ Yr
10-12 %	1Yr
9-11 %	2 Yrs
8-10 %	4 Yrs
8-9 %	>4 Yrs



# ROLE OF RH ON SEED MOISTURE CONTENT

AGRICULTURAL CROPS		Equilibrium moisture content at different RH			
		15 %	45 %	75 %	100 %
1	Shelled maize	6.4	10.5	14.8	23.8
2	Rice (milled)	6.8	10.7	14.4	23.6
3	Sorghum	6.4	10.5	15.2	21.9
4	Wheat	6.4	10.5	14.6	25.0
VEGETABLES		20 %	30 %	45 %	75 %
5	Beet root	4.0	5.8	7.6	11.2
6	Cabbage	4.6	5.4	6.4	9.6
7	Bhendi	7.2	8.3	10.0	13.1
8	Onion	6.8	8.0	9.5	13.4
9	Peas	7.3	8.6	10.1	15.0

# SEED LEGISLATION

- Seeds Act, 1966
- Seeds Rules 1968
- Plant Varieties, Fruits, Seeds - Import into India Order, 1988
- New Seeds Bill, 2004



# CONTROL AT PRODUCTION AND POST PRODUCTION LEVELS

- Identification of seed borne diseases/pest at field level
- Identification of seed borne diseases/pest at lab
- Seed borne insect inspection at port of entry (banana stem weevil, coffee bean borer, golden nematode of potato, mango nut weevil, African giant snail?)
- Decontamination procedures
- Customs at land, sea and air frontiers
- Rules for moisture content and treatment



# MOISTURE CONTENT REQUIREMENT FOR CERTIFICATION OF STORED SEEDS (CLOTH BAG)

Moisture content	Crop category	Crops
13	Cereals	Rice variety and hybrid
12	Cereals	Barley variety and hybrid, Wheat variety and hybrid Triticale
	Millet	Bajra variety and hybrid, Common millet, Finger millet, Italian millet, Kodo millet, Maize inbreds & hybrids, synthetics and composites, Oats, Sorghum variety and hybrid
	Oilseeds	Soyabean
	Forages	Forage sorghum, Teosinte
10	Fibre crops	Cotton variety and hybrid
	Vegetables	Bhindi
	Forages	Berseem, Buffel grass, Dharaf grass, Dinanath grass, Guinea grass, Indian clover, Lucerne, Marvel grass, Setaria grass, Stylo

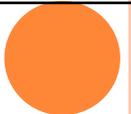
# MOISTURE CONTENT REQUIREMENT FOR CERTIFICATION OF STORED SEEDS (CLOTH BAG)

9	Pulses	Blackgram, Bengalgram, Cowpea, Greengram, Horsegram, Kesari, Lentil, Mothbean, Redgram
	Oilseeds	Groundnut, Linseed, Safflower, Sesame, Niger, Sunflower variety and hybrid
	Fiber crops	Jute
	Forages	Ricebean
	Vegetable	Beet, Cluster bean, French bean (Rajmash), Lablab, Pea, Spinach
8	Oilseeds	Castor variety and hybrid, Rape, Mustard
	Vegetable	Amaranthus, Asparagus, Brinjal varieties and hybrid, Capsicum, Carrot variety and hybrid Celery, Chillies, Fenugreek, Lettuce, Onion variety and hybrid, Parsley, Tomato variety and hybrid, True Potato Seed



# CERTIFICATION OF STORED SEEDS (CLOTH BAG)

7	Vegetables	Ashgourd, Bittergourd variety and hybrid, Bottlegourd variety and hybrid, Broccoli, Cabbage, Cauliflower, Cucumber variety and hybrid, Indian Squash, Knol-khol, Muskmelon variety and hybrid, Pumpkin variety and hybrid, Ridgegourd variety and hybrid, Seedless Watermelon, Snakegourd, Spongegourd, Summersquash, Watermelon variety and hybrid
6	Vegetables	Rat-tail Radish, Radish variety and hybrid, Turnip variety and hybrid
Not specified	Vegetables	Aggregate Onion, Chow-chow, Garlic, Lesser Yam, Potato, Taro, Sweet potato, Tapioca
	Forages	Bajra-Napier Hybrid, Napier grass



# MOISTURE CONTENT REQUIREMENT FOR CERTIFICATION OF STORED SEEDS (MOISTURE PROOF BAG)

Moisture content	Crop category	Crops
8	Cereals	Rice variety and hybrid, Barley variety and hybrid, Wheat, Triticale
	Millets	Bajra variety and hybrid, Common millet, Finger millet, Italian millet, Kodo millet, Maize inbreds, hybrids, synthetics and composites, Oats, Sorghum variety and hybrid
	Pulses	Blackgram, Bengalgram, Greengram, Cowpea, Kesari, Lentil, Mothbean, Redgram
	Oilseeds	Soyabean
	Forages	Bluebuffel grass, Dharaf grass, Dinanath grass, Guinea grass, Forage sorghum, Marvel grass, Napier grass, Setaria grass, Teosinte
	Forage legumes	Clover, Lucerne, Rice bean, Stylo
	Vegetables	Bendhi, Cluster bean, Garden beet, Lab lab, Peas, Spinach, Sugar beet
7	Pulses	Horse gram
	Vegetables	Carrot Variety and hybrid, Celeriac, Celery, French bean (Rajmash), Parsley,
	Oilseeds	Linseed, Rape seed, Safflower, Soyabean, Sunflower variety and hybrid
	Fibre crops	Jute

# MOISTURE CONTENT REQUIREMENT FOR CERTIFICATION OF STORED SEEDS (MOISTURE PROOF BAG)

6	Vegetables	Amaranthus, Ashgourd, Asparagus, Bittergourd variety and hybrid, Bottlegourd variety and hybrid, Brinjal variety and hybrid, Cabbage, Cauliflower, Capsicum, Chillies, Cucumber variety and hybrid, Fenugreek, Indian Squash, Knol-khol, Lettuce, Muskmelon variety and hybrid, Onion variety and hybrid, Pumpkin variety and hybrid, Ridgegourd variety and hybrid, Seedless Watermelon, Snakegourd, Spongegourd, Summer squash variety and hybrid, Watermelon variety and hybrid, Broccoli, True Potato Seed, Tomato variety and hybrid, Winter squash
	Fibre crops	Cotton variety and hybrid



# MOISTURE CONTENT REQUIREMENT FOR CERTIFICATION OF STORED SEEDS (MOISTURE PROOF BAG)

5	Oilseeds	Castor variety and hybrid, Groundnut, Mustard, Niger, Sesame
	Vegetables	Broccoli, Cabbage, Cauliflower, Chinese cabbage, Knol-khol, Radish Variety and hybrid, Rat tail radish, Turnip variety and hybrid
Not specified	Vegetables	Aggregate Onion, Chow-chow, Garlic, Lesser Yam, Potato, Sweet potato, Taro, Tapioca
	Forages	Bajra-Napier Hybrid, Napier grass

# SEED STANDARDS FOR INSECT DAMAGE

- A seed lot under certification can have at the maximum 1 % damage by insects for both FS and CS for seeds of maize and pulses and 0.5% for seeds other than maize or legumes unless otherwise prescribed.



CROPS	PACKAGE MATERIAL
Pulses and oilseeds	Jute or Cloth bags
Flower and vegetable crops	Paper bag, Cardboard boxes, Aluminium foil and polythene bags.





# TYPES OF SEED TREATMENT

- Dry dressing
- Slurry treatment
- Coating
- Pelleting



# RULES FOR SEED TREATMENT

- statement indicating that the seed has been treated;
- the commonly accepted chemical or abbreviated chemical name of the applied substance
- if the substance of the chemical used for treatment and present with the seed is harmful to human beings or other vertebrate animals a caution statement such as a **DO NOT USE FOR FOOD, FEED OR OIL PURPOSES**. The caution for mercurials and similarly toxic substances shall be the word **POISON** which shall be in type size, prominently displayed in red.



# SEED SELECTION FOR EXTENDED STORABILITY

- Store well matured seeds.
- Store normal coloured seeds.
- Store well processed seeds.
- Seeds should be free from mechanical injury.
- Seed must be free from fungi or micro organisms
- Storage environment must be dry and cool
- Seeds should not have met with adverse conditions during maturation.
- Seeds should be dried to optimum moisture content.
- Seeds should be treated with fungicides before storage.
- Suitable packaging materials should be used for packing.
- Required temperature and RH must be maintained
- Godown must be fumigated prior to storage
- Godown / container must be cleaned to remove all previous crop seeds

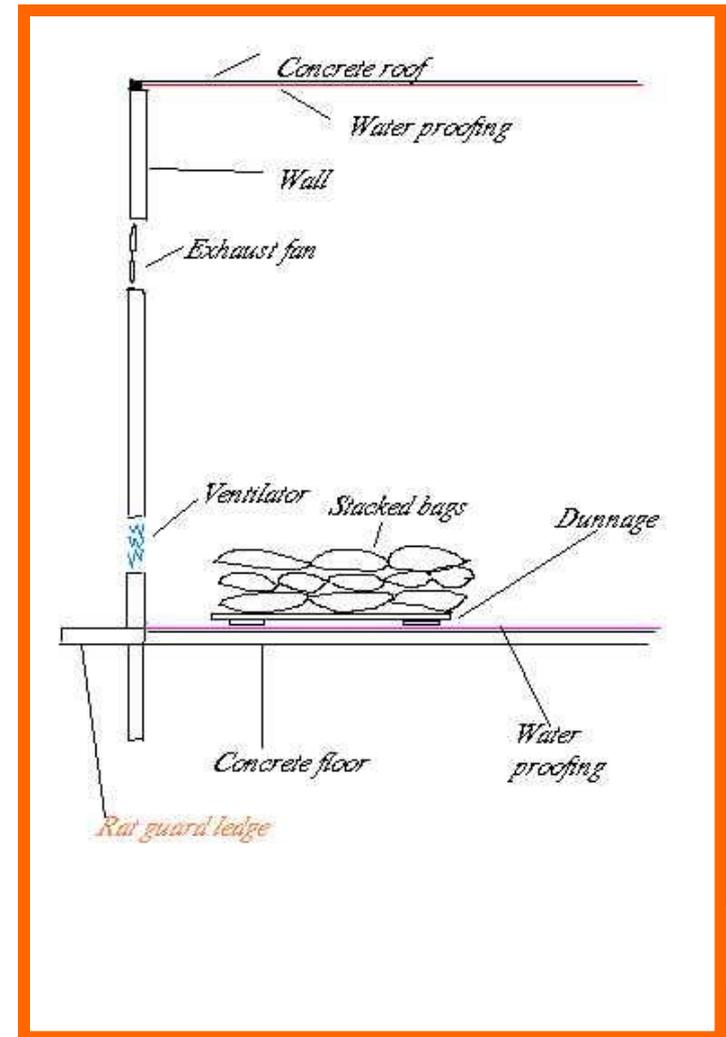


# SEED STORE / GODOWN SANITATION

- Storage environment should be free from insects and rodents.
- Chemicals such as insecticides, fertilizers should not be stored along with seeds.
- Storage room should be kept cool and dry by maintaining required RH and temperature.
- Fumigation may be done whenever needed. Repeated fumigation, beyond 4 times may seriously reduce the vigour and even the germination capacity of seeds. Seeds with moisture content greater than 14% should be dried to below this value before fumigation.
- Use wooden pallets for arranging the bags in criss-cross manner for effective ventilation on all sides of the bags.
- Seed bags should be stacked upto 6 - 8 tiers for cereals, millets, pulses and 4 stack layer in case of groundnut (depending upon density of seeds).



# SAFE STORAGE OF SEEDS



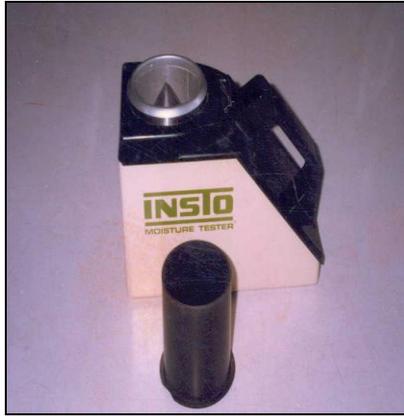
# Maintaining godown

- Restacking once in 3 months or less is important for prolonging seed viability.
- Before storage disinfect the godowns by spraying Malathion 50% E.C @ 5 lit / 100 m<sup>2</sup> area or Dimethoate / Monocrotophos/ Dichlorvos 4ml/L.
- If old gunnies, cloth bags and containers are to be used these should be fumigated with Aluminium phosphide.
- Size of the stack should be 30x20 feet to facilitate fumigation under gas proof or polythene covers.
- One meter space must be left all around the seed stack for better monitoring of seed and for sampling during inspection
- Periodical inspections should be carried out and control measures to be taken i.e., Malathion 50% E.C @ 5 lit / 100 m<sup>2</sup> should be sprayed on walls and seed stack every 3 weeks.
- Do not allow over-hanging branches of trees.
- Check once in three months whether the wiremesh fixed to the ventilators and exhaust are proper.



## Methods of moisture estimation

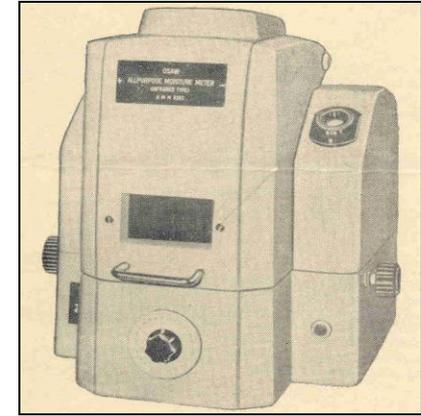
Generally two methods are involved 1) Gravimetric 2) Electrical resistance 3) Chemical reaction.



Instant Moisture meter



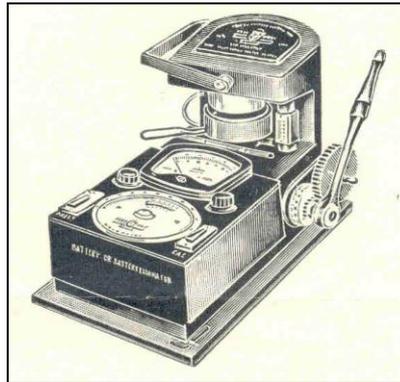
Infra red moisture meter



Infra red moisture balance



Steinlite moisture meter



OSAW moisture meter



Infra red moisture balance ( top opened – showing the IR lamp)

## Maintaining godown

- Check electrical wiring / installations once a year.
- Periodically dry the stored seeds during the forenoon hours over tarpaulin
- Check for cracks and crevices in godown walls, floors and patch them immediately.
- Clean the godown roof once a year to prevent germination of tree seeds and lodging of leaf litter.
- Maintain rat guard ledges properly.
- Do not store seed processing rejects along with seed, dispose rejects as early as possible.
- Label the seed lots properly and as far as possible do not store two or three varieties near each other.
- Check for integrity of sacks once a while.



# PREVENTION IS BETTER THAN CURE

- Preharvest sanitation spray
- Spraying 1% bavistin to rice prior to harvest during humid days
- Spraying Monocrotophos (3ml/L) to pulses to prevent field carry over of bruchids
- Following seed crop rotation practices
- Monitoring insect activity in harvest fresh seeds



# FUTURE OUTLOOK

- Genetically modifying seeds for storability
- Reducing oil content of seeds
- Deep freezing of germplasm
- Monitoring insect activity thru infra-red probe
- Cold storage practices for seeds
- Organic, ecofriendly methods
- Seed bank techniques
- Role of traditional varieties
- Role of coating and pelleting techniques

