

**PHYSICAL AND CHEMICAL  
METHODS OF  
DETECTION OF INSECT PESTS**

# PHYSICAL AND CHEMICAL METHODS TO DETECT HIDDEN INSECTS

## I. PHYSICAL METHODS

### 1. Visual examination:

- ❖ Preliminary method
- ❖ Damaged grains in the samples is indicated by loss in its **natural luster- Dull -lifeless.**
- ❖ Trained worker can very easily determine the qualities of grain by its appearance.

## **2.Germ damage and insect emergence holes:**

- ❖ Very simple and gives a good index of deterioration or damage to the field workers**
- ❖ Does not indicate the damage going on inside the kernels**
- ❖ Per cent kernels damaged by insects including the germ eaten kernels is assessed**
- ❖ 100 g of grain sample is evenly spread out on a glass plate, the damaged kernels are picked up to assess the percentage of insect damaged kernels**

### **3. Determination of foreign matter, insect infestation etc.**

- ❖ Using sieves insect debris, webbing, larvae, their cast off exuviae etc, physically separated and hand picked
- ❖ Rough idea of the damage
- ❖ Foreign matter is also examined under microscope

### **4. Total damage: Quality test**

- ❖ Damage by heat, sprouted, mould and rotten wheat kernels are physically separated.
- ❖ This method is followed to assess the quality of grains—in commercial

## 5. Germination tests:

- ❖ Viability of the wheat and other food grains is reported in terms of percentage of kernels developing strong sprouts under controlled conditions
- ❖ 10 g seeds on the moist filter paper at optimum temperature.
- ❖ Reduced viability indicates increase in deterioration

## 6. Loss in weight:

- ❖ Estimated by determining volume weight ratio
- ❖ A decrease in volume / weight ratio indicates an increase in damaged kernels



$$\text{Dry mass loss (\%)} = \frac{(U_{nd}) - (D_{Nu})}{U (N_d + N_u)} \times 100$$

Where,

$N_u$  = Number of undamaged grains ;

$N_d$  = Number of damaged grains

$U$  = Dry mass of undamaged grains, and

$D$  = Dry mass of damaged grains

## **7. Acoustic method**

- ❖ Sounds produced by the insects due to their movement or feeding has been utilized in detecting insect infestation quantitatively
- ❖ Possibility of detecting the dead insects are serious limitation

## **8. X-ray radiographic method**

- ❖ Internal insect infestation can be detected
- ❖ All stages of development of the insects can be observed rapidly
- ❖ Recently Polaroid radiographic media

## 9. Traps

TNAU Insect traps are excellent insect detection devices and more effective in the detection of stored grain insects



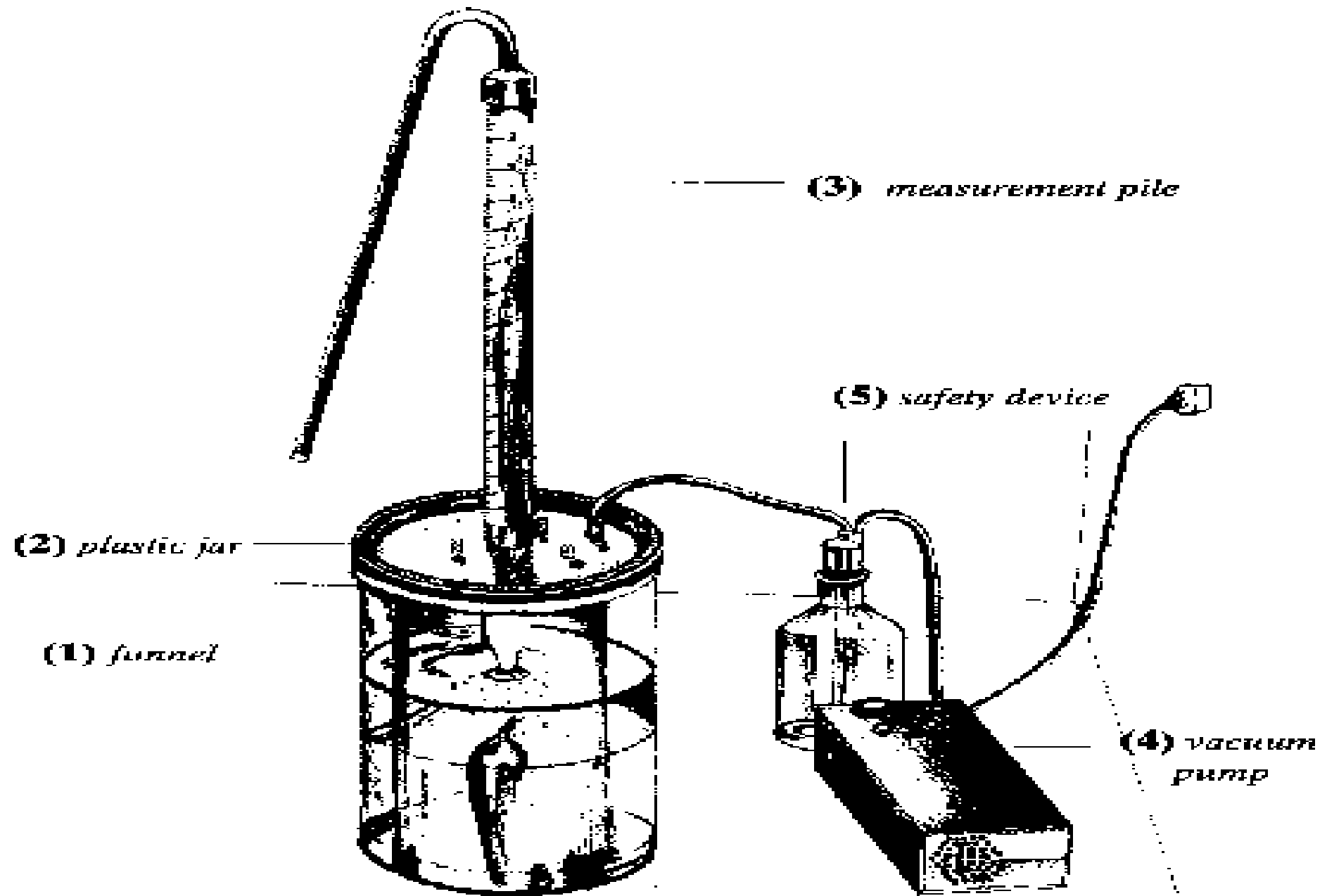


## 10. Near Infrared Spectrometer (NIRS)

- ❖ Detects and measures the chemical composition of biological materials.
- ❖ Molecules comprising organic matter vibrate at frequencies corresponding to wavelengths in the infrared region
- ❖ Optical sensors measure this absorption and quantified

## 11. Development of a new loss-assessment method [MM]

- ❖ This method is capable of determining the frass activity of beetles tunneling through the dried chips
- ❖ The increase in inner volume of a cassava chip is measurable by means of vacuum equipment and can be converted into weight loss.



**Vacuum equipment**

## B. Chemical method to detect Hidden infestation

### 1. Use of stains

#### a) Acid fuchsin

- ❖ Mix 50 ml. glacial acetic acid in 950 ml of distilled water and add 0.5 g acid fuchsin
- ❖ Soak grain samples in warm water for 5 minutes
- ❖ Then immerse the soaked grain samples in the **stain** for 2 to 5 min.
- ❖ Remove excess stain by washing in tap water.
- ❖ Observe under microscope – egg plug stains show **bright cherry red**
- ❖ While feeding punctures including mechanical injuries in **light pink**.

## b) Gentian violet

- ❖ Prepare 1% aqueous stock solution of gentian violet in 50 ml of 95% ethanol.
- ❖ Immerse the sample for 2 minutes in a solution containing 10 drops
- ❖ Observe under microscope – egg plug stains show purple colour.

## c. Berberine sulphate

- ❖ Kernels are immersed in dilute solution of the dye (20 parts per million) for one minute
- ❖ Rinsed and examined under ultra violet light
- ❖ Egg plug stains show intense greenish yellow under ultra violet light.

## 2. Flootation or density method

- ❖ Involves the use of two solutions of different specific gravity.
- ❖ Sodium silicate in water (sp. gravity 1.160 to 1.190) and Methyl chloroform (sp. gravity 1.30) with debase oil
- ❖ Grain is immersed in the fluids
- ❖ A three layer separation occurs
- ❖ Non-infested kernels sink to the bottom
- ❖ Infested one floats and
- ❖ Light weight kernels including those infested by early stages of insect hang in the line of separation between the two fluids.



### **3. Gelatinization method**

- ❖ In this method the grain is boiled for ten minutes in 10% solution of sodium hydroxide.
- ❖ The treatment renders the kernels translucent, thereby, revealing the presence of internal infestation

### **4. Cracking floatation method**

- ❖ Cleaned grain is coarsely ground to release the internal insects
- ❖ Soaked either in a water-alcohol mixture or in boiling water
- ❖ Mix with gasoline or mineral oil.
- ❖ Insects float with the oil layer in a flask
- ❖ Collect it on a filter paper and count it

## 5. Fragment count or acid hydrolysis method

- ❖ Presence of insects fragments such as elytra, head capsules, mandibles, counted basically involving a flotation technique but in a modified way.
- ❖ A mixture of oil and aqueous phase (besides surfactants) is used in making the fragments to float
- ❖ Test involves digestion of a sample with an acid, wet sieving, or a defatting treatment using a detergent or solvent
- ❖ Insect fragments which are olephilic, are separated from food particles by the attraction of the oil phase (light mineral oil in an oil-aqueous mixture).
- ❖ Floating fragments are trapped or filtered and examined under a microscope. Infestation detection by the fragment count chocolate and powdered spices.

## 6. Spectrophotometric analysis

- ❖ De-hydroxyphenol occurring in insect cuticle is estimated by spectrophotometer
- ❖ Phenols produce certain dyes and are reacted with dichloroquinne chlorimide.

## 7. Ninhydrin colour reaction: chemical indicator technique

Insects body fluid produces a colour with ninhydrin impregnate filter paper (0.7% soln. in Acetone).

High sensitivity and specifically suitable to mechanization

A machine has also been manufactured in which wheat kernels are crushed on a treated strip of paper tape and the same observed for stains The machine is known as "Ashman Simon Hidden Infestation Detector".

## 8. Carbon dioxide determination method

- ❖ Quantity of carbon dioxide produced by a given sample of grain in 24 hours, is measured and the extent of internal infestation can be estimated.
- ❖ Representative grain sample free from moving insects is incubated for 24 hours at 25°C.
- ❖ The concentration of CO<sub>2</sub> is measured with the help of gasometric method accurate to ± 0.2 %.





Thank You