

## 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.

1. Using sieves insect debris, webbing, larvae, their cast off exuviae etc, physically separated and hand picked

2. Rough idea of the damage

3. 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:

1. Viability of the wheat and other food grains is reported in terms of percentage of kernels developing strong sprouts under controlled conditions

2. seeds on the moist filter paper at optimum temperature.

3. 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

$$(\text{Und}) - (\text{DNu})$$

$$\text{Dry mass loss (\%)} = \frac{\text{D}}{\text{U (Nd + Nu)}} \times 100$$

Where,

Nu = Number of undamaged grains ;

Nd = 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.

## **B. Chemical method to detect Hidden infestation**

### **1. Use of stains**

#### **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 floats 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 de-fating treatment using a detergent or solvent. Insect

fragments which are oleophilic, 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 dichloroquinone chlorimide.

#### **7. Ninhydrin colour reaction: chemical indicator technique**

Insect 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 %.