



METHODS FOR ESTIMATION OF STORAGE LOSSES





- Loss
 - Reduction in weight
 - Deterioration between two handlings
 - Production and consumption
- Direct loss - disappearance of food by spillage or consumption by organisms including insects.
- Indirect loss - the lowering of quality to the point where people refuse to eat it.

1. Weeviled and Germ Eaten Grain Counting Method

- The insects such as rice weevil, lesser grain borer eat out the contents of the grain from within and result into weeviled grains.
- The khapra beetle larvae prefer the germ portion of the grains and eat away the germ from outside.



Procedure

- Grain sample of 50 g is taken
- From which a random sample of 100 grains is drawn.
- Out of these 100 grains, weeviled grains and germ eaten grains are sorted out and are separated from the samples
- Are counted separately
- The 100 more purely health grains are randomly selected and weighed.



Calculation

- Per cent mass loss is calculated as per the formula

Mass Loss (%) = $(W+G) - 100/S (W1 + G1)$ Where,

- W = Percentage by number of weeviled grains
- G = Percentage by number of germ eaten grains
- W1 = mass of W grains (in grams)
- G1 = mass of G grains (in grams)
- S = mass of 100 healthy grains



- This method lays stress on the **nature of the damage**
- This method first involves
 - The separate counting of two types of damaged grains
 - And then again counting a separate set of hundred healthy grains for ultimately arriving at mass loss due to insect pests.
- This method, hence, is preferred where pest complex causing the different nature of damages is causing infestation to the grains.
- However, mass loss due to weeviled grains and germ eaten grains cannot be estimated separately by this method.



2. Comparing Healthy Grains and Damaged Grains

Procedure

- In this method, a random sample of 50 g of grains is taken
- Out of which hundred grains are randomly selected.
- Out of these hundred grains, the number of damaged grains are separated and counted and the same are then weighed.
- Then an equal number of healthy grains are selected and counted
- One more separate set of hundred exclusively healthy grains is selected and weighed.



Calculation

- The loss due to insect pests is then calculated as per the formula

$$n - n_1$$

- Mass Loss (%) = ----- x 100 where,

$$n_2$$

- n_1 = mass of the number of damaged grains in 100 grains (in grams)
- n = mass of the equal number of healthy grains (in grams) and
- n_2 = mass of 100 healthy grains (in grams)



- Under this method, the damaged grains are put in single lot irrespective of the nature of the damage inflicted by insect pests.
- This method is quite time consuming since
 - It involves three sets of grains and counting of an equal number of times as first the damaged grains have to be counted
 - Then equal number of healthy grains have to be counted and then counting of 100 healthy grains.



3. Counting and Weighing Method (Gravimetric Method)



- The most common method and has been widely adopted throughout the world
- Since this is a very easy method that employs only one set of grains
- wherein only single counting and weighing is sufficient to reach at mass-loss.

Procedure

- Generally, a sample size of 100 to 1000 grains for this method is recommended.
- However, some has set a limit of 1000 grains.
- Out of this sample, the damaged and undamaged grains are sorted out
- and are then counted and weighed.



Calculation

The mass loss is calculated as per the following formula

$$\text{Mass loss (\%)} = \frac{(U.N_d) - (D.N_u)}{U (N_d + N_u)} \times 100 \quad \text{where,}$$

- U = Mass of undamaged grains
- Nu = Number of undamaged grains
- D = Mass of damaged grains and
- Nd = Number of damaged grains



- Besides the simplicity of this method, it has advantage that
- Damage by different species of insects causing different type of nature of damages can also be estimated.
- Under such case, out of the damaged grains, the grains infested by a particular species of insect-pest are separated
- Counted and weighed separately
- Then per cent mass loss due to that particular insect can be worked out.
- This method has wide acceptance since it can also be used to determine damage caused by termites, rodents and birds.



Equipment

- a) Seed counter
- b) Weighing balance
- c) Polythene sample bags
- d) Liquid fumigant such as CCl_4 to retain sample for examination at a later date
- e) Sieve of suitable size for removal of insects, dusts and any prior processing



Converted Percentage Damage Method

- Though this method is very quick and does not involve much equipment, it is not very accurate method, it may, however, be recommended rather than guessing.
- This method is applicable only in cases where insects leave clear exit holes, i.e. their larval stages develop within the grains e.g. *Sitophilus spp.*, *Sitotroga cerealella* and *Bruchids*. The method is based on using already worked out established conversion factors.



Procedure

- **Cereals**

- i) Take a random sample of 100 to 1000 grains
- ii) Count the number of bored grains in the above sample
- iii) Calculate the percentage of bored grains as

- $$\text{Per cent bored grains} = \frac{\text{Number of bored grains}}{\text{Total number of grain in the sample}} \times 100$$



Number of bored grains

- Conversion factor = $\frac{\text{Number of bored grains}}{\text{Mass loss (\%)}}$



Population count

- In some cases, the losses cannot be estimated directly.
- In the case of milled rice, although the lot may be heavily infested with beetles, it might sometimes be difficult to establish the damage to have been caused by the beetle.
- the population count could be good indicator of its absolute quality or relatively when compared with healthy lot or with one at the beginning of storage.
- The insect population thus may be the means for judging the grain quality indirectly



- In these cases, the population of adult insects is generally counted (for both living and dead) and is then expressed per unit by weight of the grains.



Indirect loss

- The insects do not only eat away the grains and thus cause a direct mass-loss but also inflict an indirect loss through deterioration of its quality
- Such infestation may result in several biochemical changes among the grains such as
 - it may result in increase in the free fatty acid content
 - increase in alcoholic acidity and uric acid content
 - decrease in gluten content.
- These chemical changes are generally good indices for quality of the grains which ultimately affects the nutritional quality.



- So quantification of the above chemical changes and also of flour, baking and cooking properties provides a good parameter of the quality of the grains





Thank You

