Determination of the physical and mechanical properties

The methods used for are those that have been established in literatures.

Size and Sphericity

Fifty replicate samples of grain/seeds are randomly selected. The three linear dimensions of each seed namely major, intermediate and minor diameters are measured with a micro meter screw gauge, reading to 0.01mm or vernier calliper. The equivalent diameter and sphericity of each seed are determined using the following equation proposed by Mohsenin (1986)

Equivalent Diameter, $D_E = (L \times B \times T)^{1/3}$ …….. 1

and Sphericity, $\psi = \frac{(LXBXT)^{1/3}}{L}$ ……..…..…2

where: L = Longest intercept, (Length) in mm; B = Longest intercept normal to 'L' (Breadth) in mm; T= Longest intercept normal to 'L' and 'B'(Thickness) in mm.

Bulk Density:

The bulk density of seed at different moisture content is determined by filling a container of known self-weight and volume to the brim with seeds and weighing to determine the net weight of the seeds. Uniform density is achieved by tapping the container 10 times in the same manner in all measurements. The bulk density is calculated as

$$\text{Bulk Density (g/cm}^3\text{)} = \frac{\text{Weight of sample (g)}}{\text{Volume occupied (cm}^3\text{)}} \quad \ldots\ldots\ldots\ldots 3$$

True Density

The true or solid density defined as the ratio of a given mass of sample to its volume is determined by the water displacement method. Accordingly, a known weight (50g) of sample is poured into a $100cm^3$ fractionally graduated cylinder containing $50cm^3$ distilled water. The volume of water displaced by the seeds is observed. The true density s calculated as

$$\text{True Density (g/cm}^3\text{)} = \frac{\text{Weight of the sample (g)}}{\text{Volume of distilled water displaced (cm}^3\text{)}} \quad \ldots\ldots\ldots 4$$

The representative values of bulk and true densities are taken as the average of 3 replications.

Porosity

The porosity of an unconsolidated agricultural material can either be determined experimentally using the porosity tank method or theoretically from bulk and true densities of the material. Results from both methods have been found to be in close agreement (Waziri and Mittal, 1983). The porosity of seed determined using the relationship presented by Mohsenin (1986) as follows;

Porosity = (1 – (Bulk Density/ True Density))/100 ……5

Laboratory Determination of the Porosity of granular materials

Steps

- Fill jar 2 with the product and set up the two jars as shown
- Close valves 2 and 3 and pump air into jar 1until a considerable pressure P1 is recorded. Using the gas law
  $P_1 V_1 = m_1 R_1 T_1$
- Close valve 1 and open 3 with two remaining closed and draw out air from jar two
- Close valve 3 and open 2. The air in jar 1 will be distributed into the two jars. Pressure will drop. Record the pressure as P2
- In jar 1; $P_2 V_1 = m_{1a} R_1 T_1$
- In jar 2; $P_2 V_2 = m_2 R_2 T_2$
  But $m_1 = m_{1a} + m_{2,}$

Also since the same gas is used throughout under the same condition;

$R_1 = R_2$ and $T_1 = T_2$

Therefore from Equations 1,2,3 and 4

$P_1 V_1 = P_2 V_1 + P_2 V_2$

$\frac{V_2}{V_1} = \frac{P_1 - P_2}{P_2}$ = ratio of void in jar 2 to volume of jar2 (= Vol of jar1)