IJCRSSSL International Journal of Current Researches in Sciences, Social Sciences and Languages

Volume: 03 | Issue: 04 | 2023 | Open Access | Impact Factor: 5.735

Influence of Moisture Content Variation on Weight, Bulk Density, True Density and Porosity of Three Cultivars of Cowpea (Vigna Unguiculata)

Rotimi Emmanuel

Department of Agricultural and bio- Environmental Engineering Technology, Federal Polytechnic Bali, Taraba State, Nigeria

Abstract: Cowpea (Vigna unguiculata) plays a significant role in both food security, sustenance of healthy dietary and wealth creation among local farmers within the study area. This study was conducted to determine the effect of moisture content on seed weight, true density, bulk density and porosity of three cultivars of cowpea seed. Three levels of moisture content of 12%, 18% and 24% was applied to investigate the influence of moisture on the selected physical properties. The results obtained from the experiment were subjected to analysis of variance (ANOVA) and graphical representation using Microsoft Excel software. Values for 1000 seed was analyzed using two factor ANOVA with replicate and values for the relationship between bulk density, true density and percentage porosity was analyzed using two factor ANOVA without replicate. Summary of ANOVA result at P= 0.05 shows a significant respond of the physical properties of the seed under study. A decrease and increase of both bulk and true density were observed in all three cultivars. Weight of seed tends to increase as the moisture level is adjusted upward. The interactive effect of all three cultivars and moisture content was also significant base on F- value at P= 0.05 for percentage porosity all the three cultivars of seed.

Keywords: Bulk density, True density, Cultivars, Moisture level and Porosity

INTRODUCTION

Cowpea (Vigna unguiculata L. Walp.) is an important grain legume, a major staple food crop for household nutrition in sub-Saharan Africa, especially in the dry savanna regions of Nigeria. It plays an important role in human nutrition, food security, and income generation for both farmers and food vendors in the region [1]. The grain is rich in protein (25%), carbohydrates, vitamins, and minerals and complements the mainly cereal diet in countries that grow cowpea as a major food crop [1]. In addition to the grain, the young green leaves and pods are consumed as a vegetable by the people; the haulms (biomass) from the plants provide important nutritious fodder for ruminants, especially during the dry season. In Nigeria, farmers who cut and store fodder for sale at the peak of the dry season have been found to increase their annual income by 25% [2]. Cowpeas vary according to the size of the grain, skin colour, texture, eye colour, and insect damage tolerance [3].

Basic information on cowpea grain respond to change of moisture are of great importance and assistance for the engineers, food scientists and processors towards efficient process and equipment development. Describing and studying some of the physical properties such as the density, porosity, colour and appearance are important in designing particular equipment or determining the behaviour of the product for its handling. This investigation tries to look at the Influence of moisture content variation on weight, bulk density, true density and porosity of three cultivars of cowpea (Vigna unguiculate) and its relative significance in the design and development of handling and processing equipment.

STUDY AREA

Bali Local Government Area which was created in 1976 with its secretarial at Bali town is one of the sixteen Local Government Areas of Taraba State, a north eastern state in Nigeria. It has an area of 9,146 km2and a population of 208,935 at the 2006 census. The area is generally situated on the banks of the upper course of River Taraba at about 150km from Jalingo the state headquarters. Majority of the people dwelling inside the town and its immediate environment are mostly farmers. While does that are not into

farming combines farm related business with other types of trade. Federal Polytechnic, Bali.is the only federal government owned higher institution situated in the town.

MATERIALS

The experiment was carried out using local cultivars of cowpea namely: (Iron beans to be identify as sample A, brown beans as sample B and Kananado as Sample C). An electronic compact scale was used in this study for measuring the weight of samples. While a calibrated cylinder was employed to determine the volume of the grain and the displaced water. Grain moisture meter JGL-188 with measuring probe was used in measuring the moisture content in percentage of the three local cowpea cultivars under study at wet basis.

METHOD

The whole experimental work was conducted to determine and compute the weight of one thousand seed, bulk density, true density and porosity of three cultivars of cowpea seed cultivated and available within the study area and its immediate towns and villages. Three samples of 10kg each from all the three local cultivars was collected and subjected to moisture adjustment of 12%, 18% and 24% wet base respectively. A portion of each cultivar was placed in a plastic bag. Calculated amount of water was added into each of the portion of seed and placed into a separate polythene bag and sealed [4]. The grain was allowed to absorb the moisture for a specific period of (30 to 180minutes). After the waiting period, the moisture content was observed using the moisture meter. The process was repeated until the desired moisture level is reached.

A standard container (cylindrical in shape) of known volume and an electronic compact scale was used to determine the bulk density of the cowpea seed. The cylinder was filled with grains and then levelled by striking off the top of the container. The electronic compact scale was set to ignore the weight of the cylinder and weight of grains inside the cylinder was measured and recorded. Bulk density was determined as the ratio of the mass of grains only to the volume occupied by the grains [5].

Bulk density = $\frac{Mass\ of\ grain\ in\ grams}{Volume\ of\ grain\ in\ cm^3}$

For true density, one thousand grains were picked at random from each sample with three replicate and three moisture content levels of 12%, 18% and 24%. The mass of all sample was determined using the electronic compact scale and the average value of each replicate was recorded. Clean water was poured into a measuring cylinder and the volume recorded. The already weighed grains were then poured into the cylinder and the \average volume of displaced water of each replicate recorded. The true density was found as an average of the ratio of the mass of grains to the volume of water displaced by the grains [5].

True density (TD)= $\frac{Mass\ of\ grains\ in\ grains}{Volume\ of\ displaced\ water\ in\ cm^3}$

Porosity = $\left(1 - \frac{Bulk\ Density}{True\ Density}\right) \times 100\%$

RESULT

The results obtained from the experiment were subjected to analysis of variance (ANOVA) and graphical representation using Microsoft Excel software. Values for 1000 seed was analyzed using two factor ANOVA with replicate and values for the relationship between bulk density, true density and percentage porosity was analyzed using two factor ANOVA without replicate.

Table 1: Summary of Result of ANOVA showing variation of moisture content on a thousand seed of three cultivars of cowpea seed

IJCRSSSL
International Journal of Current Researches in Sciences, Social Sciences and Languages
Volume: 03 | Issue: 04 | 2023 | Open Access | Impact Factor: 5.735

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Sample	7121.333	2	3560.667	6.003934	0.015594	3.885294
Columns	58026.89	1	58026.89	97.84393	4.03E-07	4.747225
Interaction	3411.111	2	1705.556	2.875878	0.09542	3.885294
Within	7116.667	12	593.0556			
Total	75676	17				

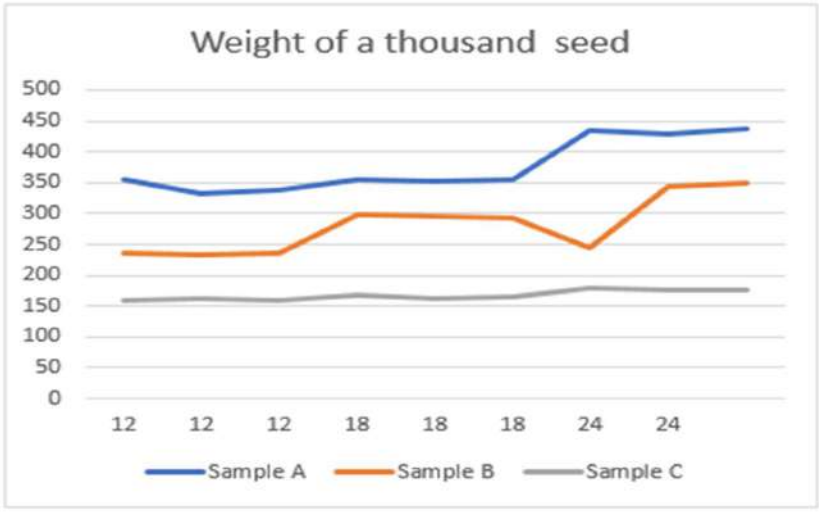
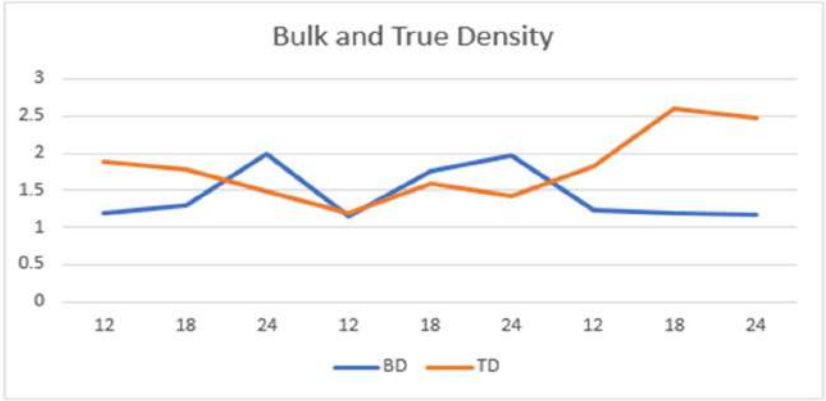


Table 2: Summary of Result of ANOVA showing variation of moisture content on Bulk and True Densities of three cultivars of cowpea seed

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Rows	80.5228	8	10.06535	1.165013	0.376451	2.591096
Columns	1610.439	2	805.2194	93.20003	1.53E-09	3.633723
Error	138.235	16	8.63969			
Total	1829.197	26				



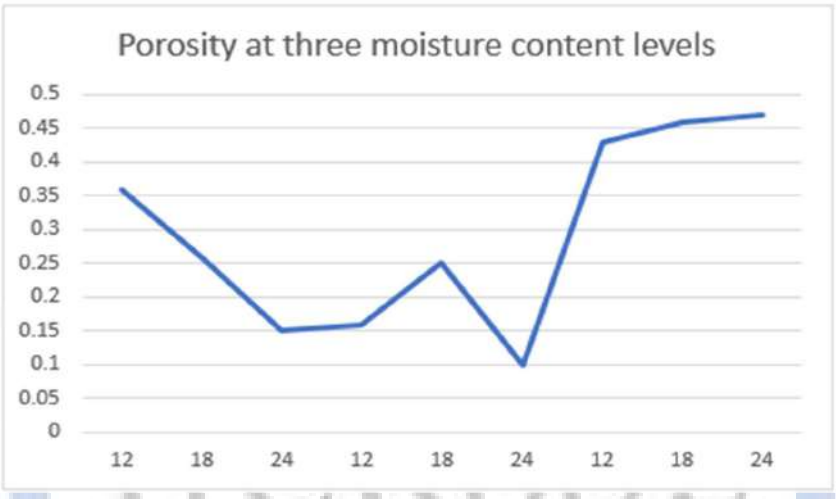
IJCRSSSL International Journal of Current Researches in Sciences, Social Sciences and Languages

Volume: 03 | Issue: 04 | 2023 | Open Access | Impact Factor: 5.735

Table 3: Summary of Result of ANOVA showing variation of moisture content on percentage porosity of three cultivars of cowpea seed

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	106.7004	8	13.33755	0.974785	0.513963	3.438101
Columns	1410.867	1	1410.867	103.1143	7.57E-06	5.317655
Error	109.4604	8	13.68255			
Total	1627.028	17				



DISCUSSION OF RESULT

WEIGHT OF ONE THOUSAND SEED

From the graph of a thousand grain weight for the three cultivars at moisture level of 12%, 18% and 24% wet base, the weight of the grain increases with increase in moisture content. The graph also shows that all three cultivars has a different respond to variation of moisture content. Also, summary of ANOVA result in table 1 indicates that there is Signiant difference in the moisture absorption of three cultivars at the three moisture levels under investigation. It also shows that all three cultivars have a different independently respond to moisture adjustment. Observations in this result is in agreement with [6] for African yam bean, [7] for corn seed and [8] for different varieties of cowpea seed.

BULK DENSITY AND TRUE DENSITY

The bulk and true densities of three samples of cowpea cultivars decreases then rises before decreasing as the moisture content is adjusted from 12% to 24% wet base as shown in the graph above. The effects of cultivars and moisture content were not significant at ($p \leq 0.05$) on the bulk and true densities of the three cowpea cultivars. The interaction effect of all three cultivars of the cowpea under study and moisture content variation was also significant ($p \leq 0.05$) on the bulk and true densities. Also, there is a significant difference as the moisture content is adjusted within any of three of the cultivars. The decrease in both Bulk and True densities with increase in moisture content can be linked to the principle that an increase in the volume of the seed as they absorbed moisture is higher than the corresponding weight gained. The results observed here are in line with similar observations of [6] for African yam bean, [7] for corn seed and [8] for different varieties of cowpea seed.

PERCENTAGE POROSITY

The porosity of sample A which is cultivar describes as iron beans decreases with increase in moisture content from 12% to 24%. and that of sample B and Sample C increased with an increase in moisture content while all two cultivars that sample B (Brown beans) and Sample c (Kananado) at certain moisture content levels between 12% to 24% shows some decreased in porosity with an increase in moisture content. Summary of Analysis of variance showed that the effect of cultivars and moisture content is significant at ($p \leq 0.05$) on porosity. The interactive effect of all three cultivars and moisture content was also significant base on F- value on porosity. Related investigations also confirm similar observations for other types of seeds which includes [9]; faba bean grains and [8] for cowpea varieties.

CONCLUSION

Moisture content remains an important factor that influence the harvesting and post-harvest operation of local cowpea cultivars within the study area. Many common problems associated with design and construction of machine for handling and processing of cowpea locally can easily be resolved with the knowledge of behavior of cowpea seed cultivated within the study to responds in moisture adjustment. Moreover, different responds of all three cultivars at different moisture content indicates that there is a need to properly understand the physical properties such as seed weight, Bulk density, True density and porosity of cowpea seed before developing machines for its handling and processing operation locally.

ACKNOWLEDGEMENT

It is my delight to appreciate the management of our great institution, Federal Polytechnic Bali for giving me this great opportunity to be a beneficiary of TETFund sponsored research work. I also wish appreciate and salute all staff of my department for their immense support and cooperation towards the success of this research work.

REFERENCES

[1] Omoigui L.O., Kamara A.Y., Kamai N., . Ekeleme F, and Aliyu K.T. (2020). Guide to cowpea production in Northern Nigeria. IITA, Ibadan, Nigeria. 48 pp.

[2] Dugje, I.Y., L.O. Omoigui, F. Ekeleme, A.Y. Kamara, and H. Ajeigbe (2009). Farmers' Guide to Cowpea Production in West Africa. International Institute of Tropical Agriculture, Ibadan, Nigeria. 20 pp.

[3] Murdock, L. L. and R. E. Seck, G. Ntoukam, L. Kitch and Shade R. E., (2003). "Preservation of Cowpea Grain in Sub-Saharan Africa Bean-Cowpea CRSP contributions." Field Crops Research, 82: 69 – 178

[4] Coşkun MB, Yalçin I, Özarslan C (2005). Physical properties of sweet corn seed (Zea mays saccharata Sturt.). J. Food Eng., 74(4): 523- 528.

[5] Babatunde O. S. (2020). Determination of Some Properties of Rice and Cowpea in Relation to Thresher Design. Iconic research and engineering journals, Volume 3 Issue 11 | ISSN: 2456-8880, 242-246.

[6] Irtwange, S.V., Igbeka, (2002). Some physical properties of two African yam bean (Sphenostylis stenocarpa) accessions and their interrelations with moisture content. Applied Engineering in Agriculture, 18(5): 567-576.

[7] Javad T., Asghar M., and Naser A., (2011). Some mechanical and physical properties of corn seed (Var. DCC 370). African Journal of Agricultural Research Vol. 6(16), ISSN 1991-637X ©2011 AcademicJournals, pp. 3691-3699, DOI: 10.5897/AJAR10.521.

[8] Aderinlewo A.A., Raji A.O. And Olayanju T.M.A. (2011). Effect of moisture content on some physical properties of cowpea (Vigna unguiculata), Journal of Natural Sciences, Engineering and Technology. 10(2): 133-145, ISSN: Print - 2277 - 0593 Online - 2315 – 7461.

[9] Konak M, Carman k, Aydin C (2002). Physical properties of chickpea seeds. Biosyst. Eng., 82(1): 73-78