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Evaluation of Toxicity Potentials of Jatropha (*Jatropha Curcas* L.) Seed Powder on Adult Emergence, Mortality and Oviposition of *Callosobruchus Subinnotatus* on Bambara Groundnut in Mubi, Nigeria

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Abstract

The work was carried out in the Laboratory of the Department of Crop Science, Adamawa State, University Mubi, in 2024. This was to evaluate the Toxicity Potentials of Jatropha (*Jatropha Curcas* L.) Seed powder on adult emergence, mortality and oviposition of *Callosobruchus subinnotatus* Fab. on Bambara Groundnut in Mubi, Nigeria. The objective of the study was to evaluate the effectiveness of Jatropha seed powder in suppressing adult emergence, oviposition and increase mortality of *C. subinnotatus*. The experimental design used was the Completely Randomized Design (CRD) with five (5) levels of Jatopha Seed powder (2.5g, 5.0g, 7.5g, 10.0g, 12. 5g) and 2.5g of Actellic dust as treatment repeated three (3) times making a total of twenty-one (21) experimental units. The results show that, bambara groundnut is susceptible to attack by the bruchids in store. Bambara groundnut stored with Actellic dust recorded less mean number of adults alive (0.00), a smaller number of eggs laid (5.00) compared to the control at 0.05 level of significance. This further indicates that, synthetic insecticides are still the most effective control method against storage insect pests because of their efficiency and quick action status despite the healthy and environmental concerns. Consequently, levels of Jatropha seed powder also significantly suppressed the bruchid especially at 12.5g /300g of Bambara groundnut. Few adults emerged (4.00), a smaller number of eggs recorded (8.00). Moreover, the results obtained shows that, Jatropha seed powder could provide an alternative to comprehensive use of synthetic insecticides for controlling storage insect pests of Bambara groundnut and other grains. This work has suggested that, if Bambara groundnut seed are to be used for sowing, they should be stored with 12.5g level of Jatropha seed powder for twelve weeks. However, if they are to be used for consumption, they could be stored with 7.5-10.0g of Jatropha seed powder for every 300g of Bambara groundnut for 12 weeks especially in the study area.

Keywords: *Toxicity, Jatropha, Bambara, Powder, Insecticides, Control*

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Background to the Study

Bambara groundnut (*Vigna subterrancea* L.) commonly known as bean Congo, goober earth pea, ground-bean or hog-peanut is a member of the family Fabaceae and its name is derived from the Bambara ethnic ground of West Africa (Apata and Ologhobo, 2011). Bambara groundnut (*V. subterrancea* L.) is under researched grain legume crop. However, it is widely cultivated in sub-Saharan Africa (SSA) and Asia for security and for local and regional markets (Nuber, 2014; Mulungu, 2017). It is the third most cultivated legume crop in Africa often behind cowpea (*V. unguiculata* (L.) Walp) and groundnut (*Arachis hypogea* L.) (Agboola *et al.,* 2017). Bambara groundnut seed is known as Jugo beans or indlubu (South Africa) and Gurjiya or kwaruru in Hausa (Northern Nigeria) which is consumed in several ways and in different stages of maturity as vegetables or snack (Okonkwo and Opara, 2015; Amorim and Nascmento).

The young fresh seeds can be boiled and eaten as a snack similar to boiled groundnut. In some part of Nigeria, dry seed are made into pudding (or steamed paste) called "Moi-moi) or "alele" (in Yoruba or Hausa languages respectively) or fried in hot oil called "Kosai" (in Hausa) (Okonkwo and Opara, 2015). Dry seed are processed and used as animal feed, especially for poultry (Oaya *et al.*, 2013). Bambara groundnut has the potential for values addition and product development in South Saharan Africa (Stephens, 2016). Bambara groundnut is a versatile crop that tolerates harsh environments, including drought and heat stress and poor soil fertility where most other crop fails. Bambara groundnut fixes atmospheric nitrogen into the soil (32-81kg ha^{-1}) through a symbiotic relationship with Rhizobium spp. (Mills, 2012). It is valued for restoring soil fertility especially in crop rotation systems with cereals crops and can also tolerate various insect pests and diseases (Kogan, 2014).

Jatropha (*Jatropha curcas*) is a species of flowering plant in the spurge family, euphorbiaceae that is native to the American tropics, most likely Mexico and Central America (Tibe *et al.*, 2017). It was originally a native to the tropical areas of the Americas ranging from Mexico to Argentina and has been spread throughout the world in the Tropical and Sub-tropical regions around the world becoming naturalized or invasive in many areas (Buvaneswari *et al.*, 2017). The specific epitht, "Carcas", was first used by Portuguese Doctor Garcia de Orta more than 400 years ago (Chang *et al.*, 2015). Common names in English include physic nut, Barbados nut, Poison nut, bubble bush or purging nut in parts of Africa and areas in Asia such as India. It is often known as castor oil plant or hedge castor oil plant (Mulatu and Gebremedhin 2017).

Jatropha, *J. curcas* is an ornamental, medical and a multipurpose shrub belonging to the family euphorbiaceace, it is widespread throughout arid and semi-arid tropical region of the world. Each fruit contains 2-3 oblong seeds that are matured when the capsule changes from green to yellow. Jatropha contain seae horose raddinose, staclyose, glucose, fructose, galactose and protein. The plant also contains curcasin arachidic, myristic and stearic acid and curcin. The Jatropha seed contains 46.27% oil, 4.56% w/w total ash content of seeds indicates presence of abrasive solids, soluble metallic soaps and silica residue in the seed (Shallam, 2017). *J. curcas* is plant harvested in tropical and subtropical regions and its high oil

content in the seeds is of emerging interest as a bioenergy resource which makes the convulsion of oil to biodiesel through trans-esterification easily (Oaya, 2021). Jatropha seed powder was reported to contain some pesticidal properties that could be used as pesticides of plant origin for pest management especially in within the storage environment (Araya and Emana, 2019).

Bambara groundnut production is limited by the activities of some biotic and abiotic factors such as light, temperature, moisture most importantly insect pests in the store. (Sesay, 2019; Garga *et al.,* 2019). Although, the use of chemical or synthetic pesticides is still seen as the most effective management method against pests both on the field and in the store, they are associated with so many detrimental effects to man, livestock and the environment (Oaya *et al.*, 2019). There is therefore the need to shift emphasis to the use of plant-based pesticides as an alternative since they have biocidal activities (toxic, repellent, anti-appetizing) vis-à-vis can manage a wide range of pests (Mishra *et al.,* 2016).

Materials and Methods

Experimental Site

The research was conducted in the Laboratory of the Department of Crop Science, Faculty of Agriculture, Adamawa State University, Mubi in the year 2024. The University is located in Mubi North Local Government Area. Mubi lies between latitude $10^{o}20^{O}$N and longitude $13^{o}5^{O}$E of the equator at an altitude of 696m above the sea level in the Northern Guinea Savanna Agro-Ecological Zone of Nigeria (Adebayo *et al.,* 2020).

Experimental Materials

The materials used for the experiment were sourced in Mubi. Bambara groundnut seeds, storage containers and the insecticide, Actellic dust were purchased in Mubi Main Market and the *Jatropha curcas* seeds were collected in the vicinity of Vimtim Ward, Mubi North Local Government Area of Adamawa State.

Preparation of Plant Materials

Matured Jatropha seeds were collected shelled with hand and the shelled seeds were shade dried and separately grounded manually using pestle and mortar. The powder was sieved to obtain fine powder. The plant powder was kept in separate plastic containers with a tightly fitted lid placed in a cool place in the Laboratory for the experiment.

Storage Measures Used

Storage Containers

Partially airtight storage containers were used which permits the flow and circulation of air in the storage containers. The storage containers were covered with muslin cloth to prevent suffocation and entry or exit of the test insects. Such containers are often used for storage of farm produce particularly among the local farmers and the householders in the study area.

Actellic Dust (Pirimiphos-Methyl)

Chemicals applied before storage such as actellic dust and phostoxin was identified as the chemicals used for treatment of the cowpea grains. It is certified that, 32% of the farmers store

their Bambara groundnut for more than three (3) months using these synthetic insecticide Actellic dust which has fumigant properties, stomach poison and contact activity against insect pests in the store. One rate of the Actellic dust was applied at 2.5g per 300g of Bambara groundnut seed respectively as suggested by Oaya *et al*. (2013).

Bambara Groundnut Grains used for the Experiments

Bambara groundnut grains for the experiment were packed in airtight container bag and were fumigated with Apron Star dust before use in order to eliminate possible contamination by insects and other pests. The Bambara groundnut grains were sieved to remove dead bruchids and dirts.

Test Insects Culture

Adults *C. subinnotatus* Fab. were obtained from natural infested Bambara groundnut grains cultured in Bambara groundnut grain that was obtained from the market. Five (5) pairs of adult *C. subinnotatus* were introduced into rearing bottle/Jar of 1 litre capacity containing 300g of Bambara groundnut grains. The bottle/Jar was covered with muslin cloth and secured with rubber band kept in the Laboratory at ambient temperature and relative humidity of 32°C and 75% respectively. The parent *subinnotatus* was sieved out ten (10) days after oviposition and later the grains were kept in their respective jar until the emergence of F1 progeny. The F1 generations of 0-2 weeks was used for the experiment.

Treatments and Experimental Design

There were seven (7) treatments which include: Actellic dust (2.5g), five levels of Jatropha seed powder (2.5g, 5.0g, 7.5g, 10.0g, 12.5g) and the control (0g) replicated three times making a total of twenty-one (21) experimental units as shown in Figure 1. The experiment was arranged in a Completely Randomized Design (CRD) setting on the Laboratory table for the duration of the experiment (twelve weeks).

Procedures for Insecticidal Test

Five (5) pairs of freshly emerged adult of *C. subinnotatus* were introduced into 500 ml storage containers already containing 300 grams of disinfected Bambara groundnut grains treated with the various control measures, containing Actellic dust (2.5g), Jatropha seed powder (2.5g, 5.0g, 7.5g, 10.0g, and 12.5g) and the control (0.0g). The initial weight of the Bambara groundnut grain was taken and the moisture content of the stored products certified. The Bambara groundnut grains were properly coated with the control measures and thoroughly shaken to ensure uniform spread. The storage containers were covered with muslin cloth to prevent suffocation and entry or exit of the test insects.

Data Collection

Data were collected on the following parameters:

Mean Mortality Count

Mean percentage mortality was determined using the formula as reported by Oaya and Malgwi (2014).

$$Percentage\ mortality = \frac{number\ of\ dead\ adult\ subinnotatus}{total\ number\ of\ subinnotatus\ alive\ or\ dead} \times 100$$

Mean Number of Adults Alive

The total mean number of emerged adults was calculated by direct counting of matured *C. subinnotatus* after the experiment.

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) appropriate to Completely Randomized Design using Genstat software, according to Cox and Cochra (2003).

Treatment means were separated using the least significant different (LSD) at 5% level of probability.

Results

Mean Number of Adults Alive of *C. subinnotatus* on Bambara-Groundnuts after 12 Weeks of Storage

The results of the mean number of adults alive after 12 weeks of storage is presented in Table 1: The result revealed that the highest mean adults alive was recorded in the control (80.33) followed by 2.5g (30.00) 5.00g (16.00) 7.5g (10) 10.00g (7.0) 12.5g (4.0) of Jatropha seed powder respectively and the least was reported in Actellic dust treatment 2.5g (0.00) at 0.05 level of probability.

Mean Mortality Count of *C. sabinnotatus* on Bambara Groundnuts after 12 Weeks of Storage

The results of the mean mortality count at 12 weeks of storage are also presented in Table 1. The results revealed that the highest mean mortality count was recorded in the control (72.67) followed by 5.00g (56.67), 2.5g (54.33), 7.5g (29.67), 10.00g of (28.67) 12.5g (10.00) of Jatropha seed powder respectively and the least was reported in the insecticide, Actellic dust treatment 2.5g (5.00) at 0.05 level of probability.

Mean Oviposition Count of *C. subinnotatus* on Bambara-Groundnuts after 12 Weeks of Storage

The results of the mean Oviposition Count on Bambara groundnut stored for 12 weeks against the weevil *C. Subinnotatus* are presented in Table 1: The results shows that, the highest mean Oviposition count was reported in the control 0.0g Jatropha seed powder (47.33) followed by 2.5g (32.67), 5.0g (26.33), 7.5g (22.33), 10.0g (16.33), 12.5g(8.00) Jatropha seed powder respectively and the least was reported in the synthetic insecticide, Actellic dust 2.5g (5.00) at 0.05 level of probability respectively.

Table 1: Mean Number of Adult Alive, Mortality and Oviposition Count of *C. subinnotatus* on Bambara after 12 weeks of storage.

Treatment	Mean adults alive	Mean mortality count	Mean oviposition
Actellic Dust 2.5g	0.00[d]	5.00	5.00[f]
Jatropha seed powder 2.5g	30.00[b]	54.33[b]	32.667[b]
Jatropha seed powder 5.0g	16.00[c]	56.67c	26.333[d]
Jatropha seed powder7.5g	10.00[d]	29.67[c]	22.333[d]
Jatropha seed powder 10.0g	7.000[e]	28.67[c]	16.333[e]
Jatropha seed powder 12.5g	4.00[f]	10.00[d]	8.000[f]
control	80.33[a]	75.67[a]	47.333[a]
S.E	18.60	26.27	1.02

Means with the same letter (s) in the column is not significantly different at 0.05 level of probability using DMRT.

Discussion

Insect pests are among the most pressing problems faced in bamba groundnut production and its storage in a dry land of sub-saharan Africa (Rowland, 1993). It is apparent that, the storage of Bambara groundnut without the use of of synthetic chemicals could be a futile exercise, however, it is toxic and detrimental effect to man, the wild life and the residual damage done to the entire environment is of great concern (Zetter *et al.,* 1997). This shows that, the use of synthetic insecticide for the control of storage insect pests is still the most effective means of insect pests' control despite the serious hazard they cause to humans, wild life and the environment, in addition to the development of resistance insect pest strains (Oaya and Headboy, 2024).

The plant material Jetropha seed powder at 2.5g, 5.0g 7.5g, 10.0g and 12.5g also significantly controlled the Bambara groundnut bruchids as shown by the results obtained of adult's alive mortality count and oviposition. The observations suggest that, Jatropha seed powder has oviposition defference as well as lavicidal properties. They also activate the mortality of the insects prior to oviposition or that it had ovividal and larvicidal activities which prevented egg and larval development. This work is consistent with Oaya *et al*. (2011) and Oaya (2020) who reported that, the use of bio-insecticides as a control measure both on the field and in the Laboratory had considerable effect on the bruchids and weevils respiratory system, resulting in a knock down effect within a short period of time. Jatropha seed Powder has proven to be effective in suppressing adult emergence, mortality and oviposition of *C. subinnotatus* on Bambara groundnut grains in storage for at least twelve weeks.

Conclusion

Bambara groundnut bruchids, *C. subinntatus* Fab. is one of the most devastating insect pests in the storehouse and their effects recorded more than 40% loss in normal situations. The use of highly hazardous pesticides such as aluminum phosphate (celphos), Malathion powder, apron plus, actellic dust etc are the common weevil management practices in the storehouse.

The current use of insecticides negatively affects the human health and cause great damage to the environment. Hence locally available repelling plant materials such as Jatropha seed powder with good partial airtight containers were tested for insecticidal efficacy which has significantly reduced the bruchids population as shown by the results recorded. The adults alive, mortality count, oviposition count was significantly lower compared to the control for bambara groundnut grains. This finding is therefore suggested for developing integrated bruchids management model in storehouse which can be socially adaptable, economically friendly most especially in the study area.

References

Adebayo, A. A., Tukur, A. L. & Zemba, A. A. (2020). *Adamawa State in Maps (2nd edition*), Department of Geography, Modibbo Adama University of Technology, Yola, Adamawa State, Nigeria, Paraclete Publishers, Yola. Pp. 25-27.

Adebowale, W. H. & Adedire S. A. (2016). Enterococci in foods—A conundrum for food safety, *International Journal of Food Microbiology*, 88, 105-22.

Agboola, S. D (2017). Research for effective storage in Nigeria, *Nigerian Stored Product Research Institute Occasional Paper Series* 4, 21-23.

Amorim, A. M. & Nascimento, J. D. (2017). *Acinetobacter*: an underrated foodborne pathogen? *Journal of Infection in Developing Countries*, 11, 111-114.

Apata, D. F. & Ologhobo, A. D. (2011). Biochemical evaluation of some Nigerian legume seed, *Food Chemistry*, 49, 333-338.

Araya, I. M. & Emana, E. M. (2019). Bioautography detection in thin-layer chromatography, *Journal of chromatography*, 1218, 2684-2691.

Buvaneswari, K., Ramamoorthy, D. & Velanganni, J. (2017). Preliminary phytochemical and antimicrobial activity studies on the leaves of the Indian plant *Thevetia neriifolia* Juss, *World Journal of Agricultural Sciences*, 7, 659-666.

Cheng, Z. & Wu, T. (2013). TLC bioautography: High throughput technique for screening of bioactive natural products, *Combinatorial Chemistry and high Throughput Screening*, 16, 531-549.

Garga, C., Khan, S. A., Ansari, S. H., Suman, A. & Garg, M. (2019). Chemical composition, therapeutic potential and perspectives of *Foeniculum vulgare*. *Pharmacognosy Review,* 3: 346-52.

Kogan, M. (2014). Natural chemicals in plant resistance to *insects*. In: Role of secondary plant compounds in insect pest control (J.P. Chaudraty and R. Singh eds), Bioecology and control of insects.

Mills, K. A. (2012). Resistance to fumigant hydrogen phosphide in some stored product species associated with repeated inadequate treatments, *Commications of the German Association of General and Applied Entomology Meeting* 4: 96-101.

Mishra, V., Ingram, C., Gray, J., Talpur, N. A., Echard, B. W., Bagchi, D. & Preuss, H. G. (2016). Antifungal activities of origanum oil against *Candida albicans, Molecular and Cellular Biochemistry*, 228, 111-117.

Mulatu, M. & Gebremedhin, D. I. (2017). Chapter 7 herbal extracts. In: *Natural Extracts Using Supercritical Carbon Dioxide*, (edited by M. Mukhopadhyay). Pp. 203-204. CRC Press, Taylor and Francis Group, Mumbai, India.

Mulungu, P. K., Biswas, A. K., Choi, K. & Pal, U. K. (2017). Methods for rapid detection of Foodborne Pathogens: An overview. *American Journal of Food Technology*, 6, 87-102. 32

Nuber, B. A. (2014): The ability of powders and slurries from 10 plants species to protect stored grain from attack by *Prostephanus truncates* and *Sitophilus oryzae, Journal of Stored Product Research,* 30: 297 -30.

Oaya, C. S., Kwaji, C. I. & Agwanda, G. A. (2011). Integrated Pest management (IPM) for *Callosobruchus maculatus* Fab. on Stored Cowpea in Yola. Adamawa State, *International Journal of Agriculture,* 3(5), 51-55.

Oaya, C. S. & Jada, M. Y. (2013). Efficacy of Wild Spikenard (*Hyptis suaveolens* (L.) Poit) Leaf Powder against the Cowpea Bruchid (*Callosobruchus maculatus* Fab.) [Coleoptera: Bruchidae] on Stored cowpea, *African Journal of Agricultural Research and Development*, 6(3), 2013. Pp. 41- 46.

Oaya, C. S. & Malgwi, A. M. (2014). Evaluation of the Impact of *Mesostena picca* (Kraatz), a Predator of the Bruchid, *Caryedon serratus* (Olivier) on Stored Groundnut and Tamarind. *Science Journal of Agricultural Research and Management*. Volume 2014, Article ID sjarm 117, 4Pages,2014, dol:10.7237/sjarm/1.

Oaya, C. S., Malgwi, A. M., Degri, M. M. & Samaila, A. E. (2019). Impact of synthetic pesticides utilization on humans and the environment: An Overview, *Journal of Agricultural Science and Technology*, Trakia University, Stara Zagora, Bulgaria: 11(4), Pp. 279-286.

Oaya, C. S. (2020). Study on the Biology of groundnut Bruchid, *Caryedon serratus* Olivier [Coleoptera: Bruchidae] on stored groundnut in Ganye Area, Adamawa State. on an overview, *Journal of Agricultural Science and Technology*, Trakia University, Stara Zagora, Bulgaria: 12(3), Pp. 272-276.

Oaya, C. S. (2021). Principles and fundamentals of crop protection for tertiary institutions, Awaru Publishers, Sangere University Village, Yola, Nigeria. Pp. 20-60.

Oaya, C. S. & Headboy, P. (2024). Effect of Temperature and Humidity on the Biology and Morphometric Measurement of Groundnut Bruchid (*Caryedon serratus* Olivier) [Coleoptera: Bruchidae] in Groundnut Seed. *Sahel Journal of Life Sciences*, Federal University Dutsen-Ma. 2(1): 158- 164. ISSN: 3027-0456 (Print) ISSN: 1595-5915(Online). DOI: *https://doi.org/10.33003/sajols-2024-0201-019*

Okonkwo, S. I. & Opara, M. F. (2015). The analysis of Bambara Nut (*Voandzeia subterranean* (L.) *thouars*) for Sustainability in Africa. *Research Journal of Applied Sciences*, 6, 394-396.

Porcher, M. H. (2012). Sorting vigna names. Multilingual multiscript plant name database (M.M M.P.N.D). The University of Melbourne, Melbourne.

Sallam, M. N. (2017). Insect damage; Damage on post-harvest, International centre of insect physiology and ecology.http:www.icipe.org.

Sesay, A. (2019). Influence of flooding on bambara groundnut (*Vigna subterranea* L.) germination: Effect of temperature duration and timing. *African Journal of Agricultural Research*, 4, 100-106.

Stephens, J. M. (2016). Bambara groundnut-*Voandzeia subterranean* (L.) Thouars. Gainesville, Florida: University of Florida. http://edis.ifas.ufl.edu/mv014 (accessed 19 March 2015).

Tibe, O., Amarteifio, J. O. & Njogu, R. M. (2017). Trypsin Inhibitor Activity and Condensed Tannin Content in Bambara Groundnut (*Vigna subterranea* (L.) Verdc) grown in Southern Africa, *Journal of Applied Science Environ. Manage*, 11, 159-164.

Zetter, J. I., Leesch, J. G., Gill, R. E. & Markey, B. E. (1997). Toxicity of Cabaryl Sulfide to stored product insects, *Journal of Economic Entomology.* 90, 832-834.