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Insecticidal Effect of *Piper guineense Seed* Powder in the Control of Beans Weevil *Callosobruschus maculatus* (Fabr)

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ABSTRACT: Piper guineense commonly called Usira in Edo, Uziza in Igbo and IgherelIyere in Yoruba belongs to the family piperaceae. The efficiency of its seed powder in the control of callosobruschus maculatus (beans weevil) was investigated in the Science Laboratory Department of Federal Polytechnic, Auchi, Edo State Nigeria. The seed powder was applied at the rate of O control, 15, 25, 50 and 100 (gkg^{-1}). The result obtained shows that piper guineense seed powder at $25gkg^{-1}$ to $100gkg^{-1}$ were effective in the control of callosobrusus maculatus at 0.01% level of significance. It was revealed that a very strong insecticidal action of I. piper guineense on beans weevil. However, the efficiency of this insecticidal action on callosobruschus maculatus with increasing concentration of the plant material seed powder with $100gkg^{-1}$ giving the highest mortality rate, residual action and egg plugs of the weevils. This finding is critical to resource poor farmers in developing countries who will find this trial practicable and affordable.

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Everywhere in the world stored products are attacked by a number of storage enemies. These enemies are group into fungi, insect pests, rat and mice, but the most destructive one is the insect pests (Agrodok, 2004). FAO (1985) reported that insect's pest can damage a considerable part of the stored product. Insect pests need food, air and water to live with. In most cases, stored grains provide a perfect place to live and grow (FAO 1983 Hill, 1987 and Akhideno 2020). Insect pests damage to stored grain results in major economic loss where grains production supports the livelihood of the majority of the population (Jose and Adesina, 2013). Udo, (2000) also reported that insects' pests and many others threaten food security. He also said that post-harvest storage losses to insect pest attack causes 25-100% damage. With the ever increasing population throughout West Africa especially in Nigeria, satisfying the damage for beans production becomes the basic goal in agricultural production. Beans production is, however, at a high risk as substantial losses that occur due to insect pest infestation, diseases and other harmful organisms during post-harvest storage. Beans losses caused by stored insect pest such as callosobruschus maculatus is a serious issue (Okonkwo, 1998, Onolemhemhem and Oigiengbe 2005 and Akhideno *et al*, 2015). In their view they reported that insect pest reduces the quality, quantity, nutritive value and viability of the stored grains. Legumes crops especially beans is widely attacked by the grain weevil callosobruschus maculatus causing total losses in storage (Yayaha, 2001). Koehler, (2000) reported that owing to their insidious feeding habits of these inspect pests; they damage the grains very fast. However, owing to the losses resulting from the feeding activities and damage of the beans weevils it is essential that necessary control measured are to be put in place to ensure adequate beans production and storage. Insect pest control in stored food products and field relied heavily on the use of gaseous fumigants and residual contact insecticides which is a serious problem to human health, Ulebor and Onolemhemhem (2001). Murugan (2006) also reported that the European Union has criticized the use of chemicals in the control of insect's pest in stored products, resulting to residual effects to human. Thus, this problem has created the need to find plant materials that will effectively protect field crops and stored products that are readily available, affordable relatively less poisonous and less determinant to the environment.

*Piper guineense*is an important ingredient and vegetable oil as primary use for compounding various types of drugs consumed by human beings. In view of this, natural plant species, *piper guineense*are much in abundance in the rain forest vegetation and around ourlocalities have some potential in grain preservation, which can be harnessed in the form of powders for use

in storage (Dike 2001). The achievement in this direction will help to increase the scope of beans production and utilization to meet up with the ever-increasing demand for beans products. This trial however aims to determine the efficacy of *piper guineense* seed powder in the control of *callosobruschus maculatus* at varied treatment level and to determine the residual effect and seed viability.

MATERIALS AND METHODS

The experiment was carried out at the Science Laboratory Department of Federal Polytechnic Auchi, Edo State, Nigeria which is located between attitude 6^0 45^1 North and longitude 6^0 8^1 East with a hot humid tropical climate.

Rearing of Beans Weevil: Adult callosobruschus maculatus obtained from naturally infested beans grain from Auchi Market. These were raised in two kilnerjar containing 200g of beans capped with muslin cloth and kept at an ambient temperature of 27^0c relative humidity of 75-80%. The muslin cloth allow for ventilation but precluded entry or exist of bronchids and other insects.

Plant Material: The fruit of *piper guineense* were collected from Iruekpen, Esan West Local Government Area of Edo, Nigeria. The fruits were dried to a constant weight of 60^0c in an Oven. The dry material was grounded to a very fine powder.The beans grains obtained from Auchi market were used. The beans grains were fumigated for 48hours and airated for 7 days, this was to ensure that any developing larva/pupa within the beans grain was killed, as suggested by (Ivbijaro, 1990).The test material *piper guineense* (powder) was admixed with the beans grain at different rates, (0, 15, 25, 50 and 100gkg^{-1}).Similarly, thirty beans weevils made up of 15 male and 15 female was introduced into the treated beans grains and morality court taken. Three replicate for each experiment was set up. All treatments were arranged using the completely randomized design. The following parameters were taken.

Reproductive Capacity: Effects of *piper guineense* powder on the reproductive capacity of the adults' beans weevils was also investigated 20 days after infestation by treating jars set aside with gentian violent as suggested by (Onolemhemhem and Oigiangbe, 1991) to reveal egg plugs of the weevils. Progeny emergence was recorded from 25 days after infestation till 60 days after infestation.

Mortality: For morality test, the beans grains were treated the test plant material powder at different rates (0, 15, 25, 50,100 gkg^{-1}) before the introduction of *callosobruschus maculatus*. The jar was covered with the muslin cloth, held in place with a rubber band. Morality of *callosobruschus maculatus* was determined from daily counts for dead adults for 15days after which all surviving adults were removed as suggested by (Ivbijaro, 1990 and Onolemhemhen and Oigiangbe, 1991).

*Residual Effects of the Test Material:*The plant material (powder) treated jar was infested with the test beans weevils, 10, 20, 40, 60, 80 and 100days after application. The 30 weevils made up of 15 male and 15 female used morality were used. The reproduction of the test weevils was also studied using the method adopted by (Ivbijaro, 1990).

Seed Viability: This was carried out 0, 30, 60, 90 and 120 days after treatment with powder of the test plant. Twenty seeds at each treatment level were placed in a moistened petri-dishes for 7days. Daily counts of the seed emergence were taken after 5 days and germination means was used to assess beans seed viability.

Data collected were subjected to analysis of variance (ANOVA) using the Genstat release 8.1 statistical software and the means separated using tarkey's test of 1% level of significance.

RESULTS AND DISCUSSION

The bio-activities of the residual toxicity of *piper guineense* seed powder on beans seed viability is presented in table 1 below. The data indicated that at 15 days after treatment had no bad effect on the beans seed viability. There were significant different ($P<0.001$) between control (O) and the powder treated seed at rates applied. The control (O) having the lowest viability data value while the 100kg^{-1} had the highest viability value. In table 2 below, showing the effect of *piper guineense* powder on reproductive capacity of *callosobruschus maculates* in the treatment means as it affected the life cycle of the *callosobruschus maculatus. Piper guineense* seed powder showed ovicidal effect in the control of the egg plugs of the beans weevil. After treatment, it was observed that the number of emerged adults ranged from O to 20, with the control (O) recording the highest number of 20 adults emergence from the egg plugs, while 100gmkg^{-1} recorded no egg plug.In table 3 below, showed the result of the bio activities of *piper guineense* seed powder on beans weevil mortality. Data indicate that the *piper guineense* powder at rates applied caused morality of *callosobruschus maculatus* adults depending on the length of exposure to the test plant materials. All 24hrs after infestation, the test plant

powder caused morality which ranged from 0.00 to 7.20 with 100mgkg^{-1} treated seeds recorded the highest morality value. The difference between the treatment means were significant (P<0.001).The table 4 below, showing the effect of residual toxicity of*piper guineense* seed powder on *callosobruschus maculatus* indicates that there was a significant difference at (P<0.01) among the treatment test with 100gmkg^{-1} recorded the highest mortality value while the control (0gkg^{-1}) recorded the lowest value. Thus *piper guineense* seed powder has some residual effect on the beans weevil causing up to 70% morality at 60 days after treatment in 50gmkg^{-1}-100gmkg^{-1} treated seeds.

Table 1: Effect of residual toxicity of *piper guineense* powder in Beans grain viability/Days after treatment.

No of Seed	Piper Guineense Powder (gmk^{-2})	Days 15	30	60	90	120
20	17.01^{d}	0	13.61^{d}	14.00^{d}	15.03^{d}	16.32^{d}
20	17.42^{0}	15	14.51^{0}	15.56^{0}	16.54^{c}	17.03^{b}
20	17.58^{0}	25	15.67^{b}	16.00^{b}	17.23^{b}	17.33^{b}
20	18.72^{b}	50	17.20^{b}	17.47^{b}	18.33^{b}	18.00^{0}
20	22.00^{a}	100	22.00^{a}	22.00^{a}	22.00^{a}	22.00^{a}
Means		0.38	1.25	0.99	1.04	0.63
LSD						
CV%	2.71	3.81	2.92	3.00	1.80	

Means followed by the same letter with a column are not significantly different of 1% level (P>0.001) Ducan's multiple range.

Table 2: Effect of *piper guineense* seeds powder in the reproductive capacity of *callosobruschus maculates*

Piper guineense Seed powder gmkg^{-1}	No of egg Plugs	No of emergent Adults	Length of the life cycle
0	23	20	34.00^{0}
15	18	8	40.00^{b}
25	8	2	43.00^{b}
50	0	0	0.00^{a}
100	0	0	0.00^{a}
Means			23.8
LSD			4.49
CV%			5.00

Means, followed by the same letters within a column are not significantly different at 1% (P>0.001) by Ducan's multiple range test.

Table 3: Effect of *piper guineense* seeds powder on the morality of *callosobruschus maculatus Piper guineense*

Seed powder (gmkg^{-1})	24hrs	48hrs	78hrs	96hrs	120hrs
0	0.00^{d}	0.00^{d}	0.62^{c}	2.33^{d}	2.20^{d}
15	2.00^{c}	3.00^{c}	4.00^{d}	7.67^{c}	8.87^{c}
25	3.00^{b}	5.32^{b}	8.40^{c}	10.21^{b}	15.40^{b}
50	5.67^{a}	8.91^{a}	13.61^{a}	15.50^{b}	17.42^{b}
100	7.20^{a}	9.32^{a}	15.41^{a}	17.33^{a}	19.00^{a}
Means	4.26	5.42	8.20	10.65	12.32
LSD	0.45	1.43	1.20	1.50	0.81
CV%	6.30	13.2	6.4	5.60	2.60

Means, followed by the same letters within a column are not significantly different at 1% level (P>0.001) by Ducan's multiple range test.

Table 4: Effect of residual toxicity of *piper guineense* seed powder on adult *callosobruschus maculatus Piper guineense*

Seed powder (gmkg$^{-1)}$	10 days	20days	40 days	60 days	80 days	100 days
0	0.00^{d}	0.47^{c}	0.00^{c}	0.23^{d}	0.23^{c}	0.23^{cd}
15	2.00^{c}	6.00^{b}	0.00^{c}	4.12^{c}	2.61^{c}	1.67^{c}
25	2.67^{b}	7.01^{b}	6.33^{b}	4.33^{c}	3.00^{ab}	3.00^{ab}
50	3.02^{b}	12.23^{a}	10.20^{a}	6.87^{b}	6.00^{a}	6.00^{a}
100	8.41^{a}	14.07^{a}	12.30^{a}	10.54^{a}	7.23^{a}	7.33^{a}
Means	8.41	6.63	5.40	5.13	4.07	2.40
LSD	1.21	1.01	2.33	3.53	3.01	1.23
CV%	38.04	6.31	6.60	26.07	35.06	39.71

Means, followed by the same letters with the column are not significantly different at 1% level (P<0.001) by Duncan's multiple range test.

Many plant extracts have insecticidal properties which can be used to evaluated against stored product insect pest (Adedire and Ajayi, 2003). Forest tree seeds oil have medicinal and bioactive compounds that is either aromatic or toxic to number of insects at various stages of application, (Huang and Lam and, 2000). *Piper guineense* seed powder *exhibited insecticidal properties that had a great effect on callosobruschus*

maculatus. This insecticidal feature from the plant extracts as aromatic component or essential oil present in the fruit and seeds. This has been validated by scientist (Orwa et al, 2009). The insecticidal functions of the *piper guineense* powder are supported by the previous reports that extracts from plant have been shown to possess insecticidal properties against insect pest (Ulebor and Onolemhemhem 2001, Yayaha, 2002, *Akhideno et al* 2017). The powder from *piper guineense* showed a significant ($P<0.01$) effect in the control of the reproductive capacity as shown in table 2. However, the efficacy of this insecticidal action of *callosobruschus maculatus* increased with increasing concentration of the *piper guineense* seed powder into $100g.kg^{-1}$ giving the highest mortality rate, residual action and egg hatchability of 87%, 70% and 0% respectively. This report is in agreement with (Onolemhemhem and Oigiagbe 1998, Niber, 1994 and Yayaha, 2002) who noted that piper guinueense, vegetable oil, were significant to beans weevil control. The aromatic smell is enough to suffocate the beans weevils resulting in residual killing of the weevils over a period of time thus indicating the very strong insecticidal properties of the test plant. Similarly *piper guineense* seed powder do not have adverse significant effect ($P<0.01$) in the bean seed viability as shown in table 1. This report is in agreement with Udo 2005, stated that plants extracts are safe for use, environment, but are broad spectrum pesticides to control insect pest.

Conclusion: The results obtained from this study indicate that using natural plant extracts as grain protectant in storage insect pest management system is very important. The use of this plant materials used for controlling insect pest of stored products are low to mammalian toxicity, affordable, by our resource poor farmer, not harmful, safe to use, pose no environmental hazard, easy to extract, formulate and use with the skill available. It is however suggested that further trial should be directed towards discovering the active constituent in the test material *piper guineense*.

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