International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391

Toxicity Effect of *Xylopiaaethiopica* Seed Powder in the Control of Insect Pest of Maize

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Abstract: ***Xylopiaaethiopica is a slim, tall, aromatic and evergreen tree belonging to the family Annonaceae. The efficacy of its seed powder in the control of Situphiluszeamais(Maize weevil) was investigated in the Science Laboratory Department of Federal Polytechnic Auchi, Edo State, Nigeria. The seed powder was applied at the rates of 0 (control), 10, 25, 50 and 100 (gkg^{-1}). The results obtained showed thatXylopiaaethiopica seed powder at 25gkg^{-1} - 100gkg^{-1}were effective in the control of Situphiluszeamaisat 0.01% level of significance. Thetrial revealed very strong insecticidal action of X. aethiopica on maize weevil. Furthermore, the efficacy of this insecticidal action on S. zeamaisincreased with increasing concentration of the X. aethiopica seed powder with 100gkg^{-1} giving the highest mortality rate, residual action and egg hatchability of 87.15%, 78% and 0% respectively. This finding is critical to resource poor farmers in developing countries who will find this trial practicable and affordable.***

Keywords: *Xylopiaaethiopica* seed powder, aromatic, maize weevils (*Sitophiluszeamais*)

1. Introduction

Maize (*Zea mays*) is a staple and most popular food crops of high nutritional value grown and consumed in the entire ecological zone in Nigeria [1] and globally. Presently, maize constitutes a critical component in the food basket of over 60% in the population in West Africa [2].

Insect pest damage to stored grains results in major economic losses in Nigeria and Africa in general where subsistence grain production supports the livelihood of majority of the population. This grain loss caused by storage pest such as maize weevils [3] is a serious issue. Insect pest on stored products reduce the quality, quantity, nutritive value and viability of stored crops, like maize, sorghum, wheat, and rice [4]. [5]reported that these pests and many others, threaten food security.Insect pest especially grain weevil such as *Sitophilus* species causes 25-100% post harvest losses in storage in cereal crops [6]. [7]reported that *Sitophiluszeamais* and *Sitophilusorzea* are the two main species known to attack maize and rice production in Nigeria. Also, their insidious feeding habits are often undetected until damage has occurred.Many farmers in Nigeria record losses resulting from the feeding activities and damage of the maize grain pests; it is essential that necessary control measures are put in place [8, 7].

Insect pest control in stored food product has relied heavily on the use of gaseous fumigants and residual contact insecticides. The implication is a serious problem to health, toxic residues, and environmental hazards. Similarly, this control measure adopted in storage has of recent been criticized because of the difficulties associated with its hazards, procurement, development of pest resistance and pest resurgence problem [9]. Thus, these problems have created the need to find materials that will effectively protect stored grain that are readily available, affordable, relatively less poisonous and less detrimental to the environment. This has stimulated interest by finding alternative control strategies using re-evaluation of traditional botanical pest control agent [10].Poor farmers in developing countries use different plant materials to protect stored grains against pest infestation by mixing grains with protectants made up of plant products. This idea is supported with the fact that the use of natural plant materials to protect agricultural products against many varieties of insect pests is an old-age practice in some part of the world and Nigeria in general[11].

Xylopiaaethiopica is an important plant specieswhich is much in abundance in the rainforest and moist fringe forest vegetation belt of Africa, but largely found in the West, Central and Eastern parts of Africa [12]and have some potential in grain preservation which can be harnessed in the form of powder for use in storage entomology [13, 8]. This achievement will help to increase the scope of maize production and utilization, as well as to meet up with the ever increasing demand for maize products. This trial however aims to determine the efficacy of *Xylopiaaethiopica* seed powder in the control of *Sitophiluszeamais* at varied treatment level and to also determine the residual effect of *Xylopiaaethiopica*seed power in the control of *Sitophiluszeamais* at varied treatment level.

2. Materials and Methods

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

Rearing of Maize weevil

Adult *Sitophiluszeamais*were obtained from naturally infested maize grains from Auchi market. These were raised in two Kilner jars containing 200g of maize grains capped with muslin cloth and kept at an ambient temperature of 27^0C and relative humidity of 75-80%. The muslin cloth allowed for ventilation but precluded entry or exit of bronchids and other insects.

Plant material

The fruits of *Xylopiaaethipica*were collected from Iruekpen, Edo State. The fruits were dried to a constant weight at 60^0C

in an oven. The dry material was grounded to a very fine powder.

The maize (DMR-yellow)grains obtained from the ADP office at Auchi was used. The maize grains were fumigated for 48 hours and aerated for 7 days, this was to ensure that any developing larva/pupa within the grains was killed, as suggested by [14].

The test material (powder) from the fruit of *Xylopiaaethipica* was admixed with the maize grain at different rates (0, 10, 25, 50 and 100gkg^{-1}). Similarly, twenty maize weevils made up of 10 female and 10 males was introduced into the treated grains and mortality counts taken. Three replicates for each experiment was set up. All treatments were arranged using the completely randomized design. The following parameters were taken:

Mortality

For mortality studies, the maize grains weretreated with the seed powder at different rates (0, 10, 25, 50 and 100gkg^{-1}) before the introduction of *Sitophiluszeamais*. The jar was covered with a muslin cloth, held in place with a rubber band. Mortality of *Sitophiluszeamais* was determined from daily counts for dead adults for 15 days after which all surviving adults were removed as suggested by [14, 11].

Reproductive capacity

Effect of *Xylopiaaethiopica*seed powder on the reproductive capacity of adult maize weevil was also investigated 20 days after infestation by treating jars set aside with gentian violet as suggested by [11] to reveal egg plugs of the weevils. Progeny emergence was recordedfrom 25 days after infestation till 60 days after infestation.

Residual effect of the test material

Powder of *Xylopiaaethipica* treated jars was infested with the test weevils 10, 20, 40, 60, 80 and 100 days after application. The 20 weevils made up of 10 males and 10 females used mortality of the test weevils was determined by daily mortality counts. The reproduction of the test weevils was also studied using the methods adopted by [14].

Data collected were subjected to Analysis of Variance (ANOVA) using theGenstat Release 8.1 statistical software and the means separated using Turkey's Test at 1% level of significance.

3. Results

The effect of *Xylopiaaethiopica* seed powder on the mortality of *Sitophiluszeamais*is presented in Table 1 below. The result shows that barely 24 hours after infestation, the jar treated with 100gkg^{-1} recorded the highest mortality value. At 48, 72, 96 and 120 hours after infestation, the trend remained the same with more significant ($p<0.01$) efficacy recorded with increasing concentration of the seed powder. 25gkg^{-1}-100gkg^{-1} recorded values were significantly ($p<0.01$) higher than 0gkg^{-1} -10gmkg^{-1} treated seed powder.

Table 1: Effect of *Xylopiaaethiopica* seed powder on adult *Sitophiluszeamais*mortality

*X. aethiopica*powder (gkg^{-1})	24hrs	48hrs	72hrs	96hrs	120hrs
0	0.0^{d}	0.23^{e}	1.34^{e}	2.61^{e}	3.33^{e}
10	0.0^{d}	1.02^{d}	2.20^{d}	3.02^{d}	4.03^{d}
25	1.23^{c}	2.60^{c}	5.02^{c}	6.87^{c}	8.40^{c}
50	3.03^{b}	4.57^{b}	10.01^{b}	13.58^{b}	15.02^{b}
100	4.57^{a}	5.03^{a}	11.57^{a}	14.67^{a}	17.43^{a}
Mean	1.89	2.79	5.80	8.15	9.50
LSD	0.20	0.83	1.86	0.49	1.26
CV (%)	18.4	15.2	17.0	3.40	7.0

Means followed by the same letters within the column are not significantly different at 1% level

The Table 2 below, showing the effect of residual toxicity of *Xylopiaaethiopica*on*Sitophiluszeamais* indicates that there was a significant difference at ($P < 0.01$) among the treatments tested with 100gkg^{-1} treated seeds recording the highest mortality value while the control (0gkg^{-1})recorded the lowest value. Thus xylopia powder has some residual effect on the maize weevil causing up to 60% mortality at 60 days after treatment in 50gkg^{-1} – 100gmkg^{-1} treated seeds.

Table 2: Residual effect of *Xylopiaaethiopica* powder on mortality of *Sitophiluszeamais* some days after treatment (DAT)

X. aethiopica powder (gkg^{-1})	10 days	20 days	40 days	60 days	80 days	100 days
0	0.00^{e}	0.00^{e}	0.00^{d}	0.00^{d}	0.00^{d}	0.00^{c}
10	4.52^{d}	3.68^{d}	2.10^{c}	1.65^{c}	0.00^{d}	0.00^{c}
25	6.30^{c}	5.26^{c}	3.00^{b}	1.00^{c}	0.31^{b}	0.00^{c}
50	7.12^{b}	6.35^{b}	3.00^{b}	2.52^{b}	1.32^{b}	0.32^{b}
100	15.60^{a}	10.30^{a}	9.01^{a}	6.70^{a}	3.10^{a}	1.57^{a}
Mean	6.12	4.50	2.67	1.82	0.94	0.30
LSD	1.07	0.87	0.37	0.57	1.12	0.63
CV (%)	9.10	9.01	7.00	2.40	6.34	8.54

Means followed by the same letters within a column are not significantly different at 1% level

The data shown in Table 3 below indicates that there is a significant ($P<0.01$) difference in the treatment means as it affects the life cycle of the maze weevil. The *Xylopiaaethiopica* seed powder proved very effective in the control of the eggs plug of the weevils. The number of emergent adults and egg plugs was high in the control (0gkg^{-1}) while 100gkg^{-1} recorded no progency. The result shows that *Xylopiaaethiopica* powder impaired not only oviposition but also affected the length of the life cycle of the weevils.

Table 3: Effect of *Xylopiaaethiopica* seed powder on the reproductive capacity of *Sitophiluszeamais*

X. aethiopica powder gkg^{-1}	No of egg plus	No of emergent adults	Length of the cycle
0	27	24	30.0^{a}
10	18	10	33.2^{a}
25	10	7	34.3^{a}
50	2	1	40.5^{a}
100	0	0	0.00^{b}
Mean			27.51
LSD			4.80
CV (%)			3.30

Means followed by the same letters within a column are not significant different at 1% level

4. Discussion

Insecticidal properties of a number of plant extracts have been evaluated against stored product insects [15]. Essential oils from some medicinal and aromatic plants are known to possess bioactive compounds that are either toxic to a number of insects at various stages of growth or elicit antifeedant properties [16]. *Xylopiaaethiopica* seed powder exhibited insecticidal properties that had a great effect on *Sitophiluszeamais*. This insecticidal feature from the plant extracts are as a result of the aromatic component or essential oils present in the fruit and seeds. This assertion has been validated by scientist [12]. This aromatic or essential oil is responsible for the insecticidal properties exhibited by the *X. aethiopica* seed powder against the maize weevils. The insecticidal function of the *Xylopiaaethiopica* powder are supported by the previous reports that extracts from plant have been shown to possess insecticidal properties against insect pest [8, 17, 4]. The powder from the *Xylopiaaethiopica* showed a significant ($P<0.01$) effect in the control of the reproductive capacity of *Sitophiluszeamais* as shown in Table 3. Furthermore, the efficacy of this insecticidal action on *S. zeamais* increased with increasing concentration of the *X. aethiopica* seed powder with $100gkg^{-1}$ giving the highest mortality rate, residual action and egg hatchability of 87.15%, 78% and 0% respectively. This is in agreement with [5] who noted that five species, *Xylopia, aethiopica, Terapleuratetraptera, Alluimsativum, Afromomummeleguata and Piper guineense* were significant to maize weevil control. It exhibited an aromatic smell enough to suffocate the maize weevils resulting in residual killing of the weevils over a period of time thus indicating the very strong insecticidal properties of the test specie.

5. Conclusion and Recommendation

The results obtained from this study indicates that using natural plant extract as grain protectants in storage pest management system is very important. The use of this plant extract to control pest are readily available, safe to apply, affordable by our resource poor farmers and not harmful to health. It is however suggested that further trial should be directed towards discovering the active constituent in the test material *Xylopiaaethiopica*. Its use as an ornamental tree also deserves more attention.

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