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Review Article

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Effect of Moringa Roots and Neem Roots in the Control of Maize Weevil (*Sitophilus Zeemais*) in Mubi North, Adamawa State, Nigeria

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ABSTRACT: ***A laboratory study with the objective of investigating the effects of moringa and neem root powder in the control of maize weevil was conducted at Mubi North Local Government Area, Adamawa State. The study has two factor neem root powder and moringa root powder at the rates of 1, 2 and 3% w/w. The treatments were arranged in Complete Randomized Design (CRD) with three replications. Data were collected on dead adult weevils only. The dead adult weevils were counted within 1, 5, 10, 15 and 20 days after the infested maize was treated by moringa and neem root powder. The collected data were subjected to one way ANOVA using the general linear model procedure (GLM) of the statistical analysis system (SAS JMP statistical discovery v10). Results showed that there were significant differences (p<0.5) in the mean percent mortality of S. zeamais among the different concentration of Moringa and Neem root powder with time of storage. It was therefore recommended that small scale farmers should employ Moringa and Neem root powder as an alternative cheaper and healthier control option in integrated stored pest management strategy.***

KEYWORDS: ***Moringa Roots, Neem Roots, Maize Weevil, GLM, Mubi North.***

INTRODUCTION

Maize (Zea mays L.), belonging to the family Poaceae is a staple food in Africa contributing largely to the Agricultural sector. Post harvest maize insect pests pose a major setback to food security and income generation in Sub-Saharan Africa because of ample yield losses and grain quality degradation (Abebe et al., 2009). Despite the recent volatile food market and rising prices for most food products and wide adaptation, maize remains a staple food with great potentials to improve the livelihoods of most famers in developing countries (Food and Agricultural Organization [FAO], 2011). But its productivity is low due living, non-living and socio-economic factors (Community Supported Agriculture [CSA], 2010). Maize can be processed into various food and industrial products including starches, sweeteners, oil, beverages, industrial alcohol and fuel ethanol (CSA, 2010). Likewise, thousands of foods and other everyday items, food utensils of renewable resource and textiles contain corn components. In addition, maize products are rapidly replacing petroleum in many industries in the world (Ogunsina et al., 2011). Maize storage is affected by a number of factors which include attack from disease causing organisms and insect pests. Insect pests are the major

threat, destroying approximately 20 to 50% of stored maize in most African countries. Jian and Jayas, (2012) defined storage as an approach by which grains integrated with other factors like relative humidity and temperature to enhance protection of grains and environment to deliver good quality grains at the end of storage time.

Maize weevil (Sitophilus zeamais Motsch) is a major pest that attack stored maize grains in the tropics and sub-tropics of the world (Sagheer et al., 2013). The attack may start in the mature crop when the moisture content of the grain had fallen to 18-20% (Radha, 2014). Subsequent infestations in storage result from the transfer of infested grain or from the pest flying into storage facilities, probably attracted by the odor of the stored grain (Adedire, 2001). In view of the great value of maize, it is imperative that greater attention should be given to the crops during storage in order to make them available for use throughout the year (Longe, 2010).

In order to reduce the large losses experienced during storage and adequately subdue the destructive activities of insects and other storage pests, synthetic chemical control methods comprising fumigation of stored commodity have been developed (Ileke & Oni, 2011). However, there are challenges associated with the use of these chemicals. Recently, there is a steady increase in the use of plant products as a cheaper, renewable and ecologically safer means of controlling insect pest infestations of stored cereal and grains (Ileke and Oni, 2011). Such plant materials include powders from parts of the neem tree (Azadirachta indica A. Juss) and Moringa oleifera. These are well known for their insecticidal properties and they are very effective against a wide range of insect pests (Radha, 2014). The most active insecticidal ingredients are present mostly in the seeds, leaves and other parts of the plants (Sonalkar et al., 2014). Hence this research investigated the effects of moringa roots and neem roots in the control of maize weevil (Sitophilus zeemais) in Mubi North Local Government.

METHODOLOGY

Study Area

The study was conducted in the Department of Zoology Laboratory, Adamawa State University, Mubi. Mubi is located in the North-Eastern region of Nigeria between latitude 10º 14' N and 10º 18' N of the equator and longitude 13º 14' E and 13º 19' E. It occupies a land of about 725.85Km^2. The area has a climate with an average temperature of 32^0 C and lies within the Sudan Savannah vegetation zone of Nigeria with an average relative humidity ranging from 28%-45% and an annual rainfall of about 1056 millimeter (Adebayo, 2004).

Experimental design

The experiment had two factors neem roots and moringa roots powders at the rate of (1%, 2%, and 3% w/w). The treatments will be arranged in Complete Randomized Design (CRD) with three replications.

Treatment details

Neem root powder treatment:

i. 1% w/w neem root powder + 2g maize + weevils
ii. 3% w/w neem root powder + 6g maize + weevils
iii. 5% w/w neem root powder + 10g maize + weevils
iv. 10% w/w neem root powder + 20g maize + weevils

v. 0% control + 40g maize + weevils

Moringa root powder treatment:

i. 1% w/w moringa root powder + 2g maize + weevils

ii. 3% w/w moringa root powder + 6g maize + weevils

iii. 5% w/w moringa root powder +10g maize + weevils

iv. 10% moringa root powder + 20g maize + weevils

v. 0% control + 40g maize + weevils

Preparation and Extraction of Plant Materials

Fresh *Moringa oleifera* roots and Neem roots (*Azadiracta indica*) were collected from Adamawa State University. These were air dried at room temperature under shade. Each was pulverized separately into fine powder using pestle and mortar and then it was sieved through a 0.5 millimeter mesh. The pulverized sample was packaged into cellophane bags and labelled appropriately.

Table 1: List of plant materials to be used

Treatment	Scientific name	Common name	Part to be used
T1	*A. Indica*	Neem	Root powder
ÀT2	*M. oleifera*	Moringa	Root powder

Application of Plant Materials for the Control of S. zeamais

About 30 kg of maize seed was bought from Mubi main market from the harvest of 2022 crop season. About 200g of disinfested maize seeds were kept in plastic jar of 1lt capacity and five different rates of each botanical (1%w/w (2g), 3%w/w (6g), 5%w/w (10g), 10%w/w (20g) 0% control (40g)) was weighed and added onto the grain in each glass jar and shaken well to guarantee uniform distribution. 30 adult maize weevils were introduced into each treatment, including the untreated control and maintain under laboratory conditions. The glass jars were covered with muslin cloth and fixed by rubber band to allow for enough air circulation and to stop the escape of the weevils.

Effect of Plant Materials on Adult weevil

This was assessed at 1, 5, 10, 15 and 20 days after infestation with the weevils. Dead adult weevils were counted and discarded during each assessment, while the live ones were returned to their respective treatments. On the 20th day, the remaining weevils (dead and alive) were counted and discarded. Cumulative insect mortality rate (%) was calculated using the Equation developed by Omotoso and Oso (2005) as follows:

$$\text{Cumulative mortality (\%)} = \frac{\text{Cumulative number of dead insects}}{\text{Total number of insects}} \times 100$$

Seed weight loss assessment

Weight loss assessment was conducted on treated and untreated grains. The number of destroyed (grains with characteristic hole) and undestroyed grains were counted and weighed

and percentage weight loss was determined using the method described by Gwinner et al. (1996) which is known as count and weigh method.

$$\text{Weight loss (\%)} = \frac{(\text{Wu x Nd}) - (\text{Wd x Nu})}{\text{Wu x (Nd + Nu)}} \times 100$$

Where: Wu = Weight of undamaged grains

Nu = Number of undamaged grains

Wd = Weight of damaged grains

Nd = Number of damaged grains

Data Analysis

Data obtained were analyzed using the general linear model procedure of the statistical analysis system (SAS JMP statistical discovery v10). For botanicals and rates Significant means ($P<0.05$) were separated using Tukey's Studentized range test at 5% significant level.

RESULT AND ANALYSIS

Weight loss of treated and untreated maize using Moringa root powder

The percentage of weight loss of both treated and untreated maize using Moringa root powder was determined and the result presented in Table 1.

Table 1: Weight loss of treated and untreated maize using Moringa root powder.

Initial Weight (g)	Weight loss of Untreated Maize (g)	Weight loss of treated Maize with Moringa root powder (g)	Percentage (%)	Mean D/F (T & UT) (g)
2	1.6	1.8	2.40	0.20
6	5.5	5.7	7.61	0.20
10	8.8	9.5	12.68	0.70
20	17.6	18.7	24.96	1.10
40	38.7	39.2	52.33	0.50

[Summarized Computational Output, (2023)]

Table 1 revealed that 40g of maize has the highest weight loss after being treated with Moringa root powder with about 52.33% followed by 20g with the weight loss of 24.96%, then 10g with the weight loss of 12.68% and 6g with the weight loss of 7.61%. Then 2g has the least weight loss of 2.40%. The implication is that there is minimal weight loss when maize is treated with moringa root powder compared to the untreated maize.

Weight loss of treated and untreated maize using Neem root powder

The percentage of weight loss of both treated and untreated maize using Neem root powder was determined and the result presented in Table 2. Results from the treatment in Table 2 showed that 40g of maize has the highest weight loss after treated with Neem root powder with about 51.90% followed by 20g with the weight loss of 25.97%, then 10g with the weight loss of 12.00, 6g with the weight loss of 7.55% and finally 2g had the least weight loss of 2.50%.

Table 2: Weight loss of treated and untreated maize using Neem root powder

Initial Weight (g)	Weight loss of Untreated Maize (g)	Weight loss of treated Maize with Neem root powder (g)	Percentage (%)	Mean D/F (T & UT) (g)
2	1.7	1.9	2.50	0.20
6	5.3	5.7	7.55	0.40
10	9.6	9.9	12.00	0.30
20	18.5	19.8	25.97	1.30
40	37	39.5	51.90	2.50

[Summarized Computational Output, (2023)]

Mortality rate of S. zeemais after the replication of Moringa root powder

The percentage Mortality rate of S. zeemais after the replication of Moringa root powder was determined and the result presented in Table 3.

Table 3: Mortality rate of S. zeemais after the replication of Moringa root powder.

Weight (g)	Replicate (w/w moringa root powder)	Mortality rate (Day 1 – 20)	Percentage (%)	Mean D/F (T & UT) (g)
2	1%	13	17.56	6.50
6	3%	17	22.97	13.50
10	5%	20	27.02	10.00
20	10%	18	24.32	9.00
40	0%	6	8.11	3.00

[Summarized Computational Output, (2023)]

Results from Table 3 depicted that the replication of 5% of w/w of moringa root powder on 10g of maize has the highest mortality of 27.02% followed by replication of 10% of w/w of moringa root powder on 20g of maize with 24.32% then replication of 3% of w/w of moringa root powder on 6g of maize with 22.97% followed by the replication of 1% of w/w of moringa root powder on 2g of maize with 17.56% and finally 0% control of w/w moringa root powder has the least mortality rate of 8.11%.

Mortality rate of S. zeemais after the replication of Neem root powder

The percentage Mortality rate of S. zeemais after the replication of Neem root powder was determined and the result presented in Table 4. Table 4 revealed that the replication of 1% 0f w/w Neem root powder on 2g of maize has the highest mortality rate of S. zeemais with 40.50% followed by 3% of w/w Neem root powder on 6g of maize with 26.58%, followed by 5% of w/w Neem root powder on 10g of maize with 18.98% then 10% of w/w Neem root powder on

20g of maize with 11.39% and lastly 0% control of w/w Neem root powder on 40g of maize has the least mortality rate with 2.53%.

Table 4: Control of S. zeemais after the replication of Neem root powder.

Weight (g)	Replicate (w/w neem root powder)	Mortality rate (Day 1 – 20)	Percentage (%)	Mean D/F (T & UT) (g)
2	1%	32	40.50	16.00
6	3%	21	26.58	10.50
10	5%	15	18.98	7.50
20	10%	9	11.39	4.50
40	0%	2	2.53	1.00

[Summarized Computational Output, (2023)]

DISCUSSION

Result from the study revealed that the effect of Moringa and Neem roots powder have insecticidal effect on Sitophilus zeemais and can be used as an alternative to control maize weevils during the process of maize storage. This agreed with the study of Nta et al (2024), which reported that higher plants such as neem, moringa and various herbs and spices possessed antimicrobial and insecticidal properties. With regards to the quality of the seed, little damage from weevils was recorded in the seeds treated with the applied treatment compared to the control. This is in line with the study carried out by Mohammed and Iddriss (2022). This could be attributed to the fact that both organic and inorganic insecticides containing active constituents have the potential to protect stored seeds of maize. The analysis of variance showed that there were significant differences ($p<0.05$) in the mean percent mortality of maize weevil among the different concentration of neem root powder and moringa root powder with time of storage. This finding completely agreed with the study done by Mohammed and Iddriss (2022) who reported that there was significant difference between the applied treatment and the mortality of the maize weevil on a weekly basis for a period of 8 weeks.

CONCLUSION

The findings of this study clearly demonstrate the effectiveness of Moringa oleifera and Azadirachta indica (Neem) root powders in the control of maize weevil (Sitophilus zeemais) under laboratory conditions. Both botanicals exhibited significant insecticidal properties, resulting in considerable mortality rates and reduced weight loss of stored maize. Notably, lower concentrations of neem root powder (particularly 1% w/w) proved highly effective in inducing weevil mortality, while moringa root powder also showed commendable results across all tested concentrations. These outcomes highlight the potential of using locally available, eco-friendly, and cost-effective botanical materials as viable alternatives to synthetic insecticides in integrated pest management strategies. The application of these plant-based powders can thus contribute significantly to post-harvest preservation and food security among small-scale farmers in rural communities.

Recommendation

Based on the findings of this research, it was recommended that:

- Small scale farmers should use neem and moringa root powder as an alternative cheaper and healthier control option in integrated stored pest management strategy
- Further research to be carried out on other plants of indigenous origin.

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