Journal of Forestry Research and Management. Vol. 17(3).22-28; 2020, ISSN 0189-8418

www.jfrm.org.ng

EFFECTS OF DIFFERENT QUANTITY OF MANGO STEM BARK POWDER AGAINST MAIZE WEEVIL (*Sitophilus zeamais* Motsc hulsky)IN MAIZE (*Zea mays*) GRAINS.

*Oladejo A.O., Sikiru G. K., Olorundare O. O. and Obidola S. M

Department of Pest Management Technology, Federal College of Forestry, Jos Nigeria.
*Corresponding Author: Email: folabiola60s@gmail.com Cell No. +2348068040088

ABSTRACT

Agricultural crops are under constant assault by insect pests, either in the field or in the store making insecticides essential to reduce losses, but this pose serious threat to have after mart effects on the environment and people. This study is therefore, aimed at evaluating the effects of Mango Stem Bark (MSB) powder against *S. zeamais* pest. The study was carried out in the Entomological Laboratory of the Federal College of Forestry, Jos between May and July, 2019. Phytochemical constituent of MSB was analyzed and the different quantity (1.0g, 2.0g, 3.0g & 4.0g) were introduced into each treatmentcontaining200g of uninfected maize grains. Ten (10) newly emerged adult weevil (ratio 1:1 male: female) were introduced into each of the treatments. The standard check, Malathion 5% dust, was used at the dose of 0.1%. The treatments were replicated four times and were arranged in a Completely Randomized Design (CRD). Analysis of variance (ANOVA) was used to analyze the transformed data and the means that are significantly different were separated using Fisher's Least Significant Different (LSD). The result showed that no weight variation in the maize grain. However, there was significant differences (p =0.05) in mortality rate of adults *S. zeamais* pest with increased doses and extended time in all the treatments; the effectiveness varied when compared with untreated control. However, the standard check (Malathion 5% dust)recorded 100% mortality at both short and extended duration (24 to 120 hour time). There was no significant different among treatments 3, 4, and the check3.0g, 4.0g and Malathion which had 90, 96 and 100%mortality respectively but they were significantly different from treatments 1(74%), 2(80%), and the control (0%)1,0g (74%), 2.0g (80%)and 0.0g (4%).Therefore, it can be concluded that MSB powder using 3.0g or4.0g can be used to protect stored maize from *S. zeamais* pest damage.

Keywords*:* Mango stem bark, Malathion Dust, *Sitophilus zeamais*, Maize grain, Mortality.

Introduction

Maize, *Zea mays* (L.) belonged to family Gramineae and is one of the third most important cereal crops after wheat and rice (Lyon, 2000; Ogunsina, *et. al.,* 2011). Maize can thrive in diverse climatic conditions and is grown by small holder families in many countries of the world. It is considered as one versatile plant with many uses, the grain is very nutritious, with about 70 to 72% digestible carbohydrate, 4 to 4.5% fats and oils and 9.5 to 11% proteins(Larger and Hill, 1991). The maize kernel is also rich in vitamins and fats and makes the crop compare favourably, as an energy source, with root and tuber crops per unit quantity (Kling,1991). Worldwide, about 66% of all maize is used for feeding livestock, 25% for human consumption and 9% of the produce for industrial purposes. In the developing world, about 50% of all maize produce is consumed by humans as food, while 43% is fed to livestock and the remainder for industrial purposes such as starches, sweeteners, oil, beverages industrial alcohol and fuel, ethanol, toothpaste, cosmetics, adhesives, shoe polish, ceramics, explosives, construction materials, metal molds, paints and paper goods

(IITA, 2003; Ogunsina, *et.al.*, 2011). However, the heavy post-harvest losses and quality deterioration caused by storage pests are a major problem facing grain producers in developing countries such as Nigeria (Adedire and Ajayi, 1996).

Maize weevil, *S. zeamais* (Mostch.) (Coleoptera: Curculionidae) is an important insect-pest of maize in the tropics, causing serious losses to many poor farmers who stored grains on farm for use as food and seed (Bosque-Perez and Buddenhagen, 1992; Thanda and Kevin, 2003). Worldwide, seed losses from *S. zeamais* pests are 20 to 90% from untreated maize (Derera, *et. al*., 1999).The conventional grains preservation such as insecticides, although found to be very effective against maize weevil, still they come with other problems, such as environmental pollution, insecticide resistance development, chemical residues in food, side effects on non-target organisms and the associated high costs (Talukder and Howse, 1994; Cherry, *et.al*., 2005). To this effect, the increased public awareness and concern for environmental safety has directed research to the development of alternative control strategies such as the use of botanicals against *S. zeamais* (Onuorah, 2000). Plant derivatives such as powders or extracts, from leaves,seeds, and bark influence pests activities through several mechanisms including toxicity on larvae and adult insects, oviposition reduction, adult emergence inhibition and reduction of maize seeds impairment (Kiendrebego, 2006) (Klendrebego, 2006 and Rajapakse, 2006). Mango stem bark powder is one of such botanicals which is relatively cheaper, renewable and is ecologically safer means of controlling storage insect pest of grains especially in the tropics where the small holder farmers are found (Ileke and Oni, 2011). The aim of this study is to investigate the effect of mango stem bark powder on the mortality of adult maize weevils.

Materials and Methods

Study Site.

This study was carried out in Entomological Laboratory of Federal College of Forestry Jos. The College lies around latitude 90 57' N and longitude 80 54' E latitude 9^{o} 51' to 90 57'N and longitude 8^{0} 53' to 8^{0} 54'E in the Northern Guinea Savannah zone of Nigeria with a height of about 1200m above the sea level. The mean annual rainfall forthe location ranges between 12000cm and 1250m and the mean temperature of 23^{o}C – 25^{o}C as obtained from University of Jos Metrological station (2013).

Collection and Preparation of plant materials

One kilogramme (1kg) of mango Stem bark was obtained from Federal College of Forestry Jos, Plateau State and was identify in the Herbarium unit of the College. The samples were washed withwater to removed impurity and rinsed with distilled water. This was dried under shade in a well-ventilated area in the Entomological Laboratory of the College for two weeks. The samples was pulverized into powder form using sterile mortar and pestle, then sieved into fine powder using 2mm sieve as described by Mukhtar and Tukur (1999). The powder samples was bagged in a black polythene bag and stored in air tight container for further work.

Determination of Phytochemical Constituents

The freshly prepared extracts were subjected to standard phytochemical analyses for different constituents such as tannins, alkaloids, flavonoids, anthraquinones, glycosides, saponins and phenols as described by (Jigna *et al*., 2006; Jigna and Sumitra, 2006).

Insect Culture

About 1kg infested maize grains were purchase from new market in Jos North L.G.A. and the infested seeds containing the eggs and larvae were separated and keep inside a container for adult weevils to emerge. A muslin cloth was used to cover the container to ensure adequateaeration and

to prevent the insects from flying out. The newly emerged weevil of about 24hours were used in the experiment.

Application of treatment

The effect of MSB powder on adult of *S. zeamais* was tested inbottle500ml glass beaker (20 cm diameter) containing 200 g of maize grains with dose of 1.0g, 2.0g, 3.0g, 4.0g and0.0g (control) weight by weight (*w/w*)of the plant powders. The powder was thoroughly mixed with the aid of a glass rod and agitated for 5 to 10 minutes to ensure uniform coating. Five pairs of newly emerged adults of weevils (male and female, in ratio1:1) were introduced into each treatment and was covered with a muslin cloth of about 0.02mm and held in place with robber bands, these was replicated four times. The standard check, Malathion 5% dust, was used at the dose of 0.1%. The experiment was arranged in a Completely Randomized Design (CRD) on a laboratory bench. Activities and mortality of the adult *S. zeamais* was observed at regular intervals of 24, 48, 72, 96, and 120hours respectively after application. Adult mortality was observed daily when no response was observed after probing them with forceps/brush in accordance with Ileke and Oni, (2011).

Data collection

Adult weevil mortalities data were collected from each treatment (1.0g to 4.0g and0.0g) at 24, 48, 72, 92and 120 hours after application. At each observation, dead weevils were removed and counted.

Data Analysis

Data collected were analyzed using ANOVA to determine the significant difference between the treatments and Duncan test was used to separate the means that are significantly different.

Results and Discussion

The result obtained as shown in table 1 indicated that there were neither weight gain nor weight loss in the treatment of maize grains except in the control. Visual observation showed that most of the weevil in all the treated treatments had contact with MSB powder. This is line with established fact that natural insecticide works in four ways: by ingestion, through contact, as a deterrent, and by disrupting developmental processes. Ingestion is when the insect consume the pesticide and are poisoned. Contact poisoning is when the solution kills the insect through their skin or other tissue. A deterrent is when the insecticide prevents the insect from feeding, and they starve. Finally, certain pesticides disrupt the hormones that control molting and other processes (Kalia, 2011). Constant weight of all the samples from beginning to the end of the study (table 1) could probably be due to the presence of tannin (table 2) that repelled the weevils from attacking maize grains (Dawit and Bekelle, 2010). However, there was slight loss in weight in the control which could be attributed to the activities of the pest attack.

Table 1: The weight of maize grains at the beginning and end of the experiment

Treatment	Wt at the beg(g)	Wt at the end(g)	Diff
T1	20	20	0
T2	20	20	0
T3	20	20	0
T4	20	20	0
T5	20	16	4

***Key**: T1…..T5 = Treatments 1…5; Wt = weight; Diff = Difference*

Table 2. Phytochemical profile of stem bark extract of *Mangifera indica*

Phytochemical	Presences
Tannins	++
Anthraquinones	-
Steroids	+
Terpenoids	+
Saponins	++
Flavonoids	++
Alkaloids	++
Phenol	+

***Key**: (+) Present, (-) Absent*

Table 2 shows the result of preliminary phytochemical screening of the mango stem bark. It showed the presence of very high alkaloids, flavonoids, tannin and saponin, presence of Steroids, terpernoids, and Polypheno while anthraquinones was absent

The results of adult *S. zeamais* pest mortality recorded for 24, 48, 72, 96 and 120 h were shown in Table 3. The percentage mortality of maize weevils in different concentrations of Mango stem bark powder showed an initial low mortality and the effectiveness varied when compared with untreated control but as the doses of the treatments increased with extended time, the mortality rate of the *S. zeamais* pest was also increased. Highest mortality of 24 to 48% was observed for treatments 1(1.0g *w/w*) and 4 (4g *w/w*) respectively at48 hours after application, and 74 to 96% for the same treatments at 120 hours after application. Malathion dust which is the check recorded 100% mortality at both short and extended duration (24 to 120 hour time). However, treatment 5 (control) had little or no adult mortality (4%) till the end of the experiment (Table 3), and the gap is quite wide when compared with other treatments.

Table 3: Mean % cumulative mortality of adult maize weevil after treatments application.

Treatment(g) mean% adult maize weevil mortality, hours after exposure

	24	48	72	96	120
1.0g	8^{c}	24^{c}	44^{c}	60^{c}	74^{b}
2.0g	20^{b}	42^{b}	62^{b}	78^{b}	80^{b}
3.0g	16^{b}	42^{b}	60^{b}	82^{b}	90^{b}
4.0g	22^{b}	48^{b}	68^{b}	82^{b}	96^{a}
0.0g	2^{c}	4^{d}	4^{d}	4^{d}	4^{c}
0.1%M. dust	100^{a}	100^{a}	100^{a}	100^{a}	100^{a}
Mean ± SE	3.559	4.243	5.477	6.325	6.272

Mean within a column followed by different letters shows significantly different P= 0.05
M =Malathion.

Analysis of variance showed that there were significant differences among the treatments at 24hours. Means separations using Duncan Multiple Range further revealed that treatment 5(control) was significantly different from all other treatments except for treatments 1 (1g).However, treatment 2, 3 and 4 were not significantly different from each other, but significantly different from check which had 100% mortality. The same trend of significance was

observed for the treatments at 48, 72 and 96 hours, but at 120 hours, treatments 3 and 4 showed 90 and 96% adult mortality respectively (Table3). This findings is in agreement with Grenier *et. al.*, (1997); Pretheep-Kumar and Mohan, (2004) who reported mixed milled rice with pea flour extract at 1% concentration had toxic effect on *Sitophilus oryzea*, and also the mortality of insects increase with increase in concentration and numbers of days. Also, this findings is inline with Stoll (2001) who reported that extract of several higher plants have been tested to be effective against insects pests and diseases of various crops on the field and in stored. This maybe due to the presence of identified chemicals compounds, such as alkaloids, polyphenol, saponins, and tannin from stem back of mango. This correspond with the work of Okwu and Ezenagu (2008) that reported that mango stem back and mango leaves contain mangiferin chemical which has a potential pesticides compounds.

The mean mortality at the end of the experiment indicated that as the MSB powder concentration quantity increased, the mortality of the weevils increases. This findings collaborates the work of Field and Xie (2001) who reported an increase in effectiveness of pea flavor on the mortality of rice weevils with increase in quantity. Also toxicity, either through fumigation or through direct contact is usually the major action of plant powder against insects tested in the laboratory. The effect of MSB powder was found effective at 3.0gand 4.0g for the treatment of adult maize weevil (*S. zeamais*) when compared with chemical treatment. This could probably due to different chemical constituents of the crop plant, especially the tannin, polyphenolic, flavonoids triterpenoids and other compounds present in the plant may have act as repellant or interfered with the respiratory activity of the insect and resulted to the observed mortality of the weevils. This is in agreement with Dawit and Bekelle (2010) who reported that the presence of plant powdered dusts between grains interfered with movement and respiratory of insects; the insect die from ingesting the dust particles, which the insects just absorb through the epi-cuticular lipid layers of the insect body leading to excessive loss of body fluid from the cuticle. Also the result agrees with findings of Hebeish *et al.* (2008) and Ojewole (2005) who reported that limonene present in flavonoid of mango stem bark may cause mortality in storage insect pests. The potency of this was confirmed in finding of Lee *et.al.*,(2003); Jang *et.al.*,(2005) and Philip *et.al.*,(2010) who reported that limonene was used as systemic and contact fumigants with toxicity that can cause up to 100% mortality in house flies, bruchids, Saw-toothed grain beetle and German cockroach.

Conclusion

The finding from this research showed that the mango stem bark powder at 3 and 4 grams can effectively control *S. zeamais* pests just as conventional chemical would do. Therefore, to solve the present food crisis it is recommended that: Effort should be geared toward not only producing, but saving yield from pest damaged through the use of this botanical. However, further research is recommended to determine their efficacy on a wide range of other common insect pest of stored products.

References:

Adedire, C. O. and Ajayi, T. S. (1996). Assessment of the insecticidal Properties of Some Plant Extracts as Grain Protectants against the Maize weevil, *Sitophiluszeamais*Motschulsky. *Nigerian Journal of Entomology*, 13: 93 – 101.

Bosque-Perez, N.A. and Buddenhagen, I.W. (1992). The development of hostplant resistance to insect pests. Outlook for the tropics. In: Menken SBJ, Vissu JH, Harrewijn P, (Eds.) *Proceedings of the 8th International symposium*.

Insect-Pest Relationships Kluwer 8:235-239.

Cherry, A.J.; Bantino, A.; Djegui, D. and Lomers, C. (2005). Suppression of the stem borer *Sesamia calamistis* (Lepidoptera: Noctuidae) in maize following seed dressing, topical application and stem injection with African isolates of *Beauveriabassiana*. *International Journal of Pest Management* 50:67- 73

Dawit, K.Z and Bekelle J. (2010). Evaluation of Orange Peel citrus citrussinensis (L.) as a source of Repellent, Toxicant and Protectant against Zebrotessubfasciatus (Coleopter; Bruchidae). C.N.C.S Makelle University, 2(1):61-75.

Derera, J.; Pixley, V. and Giga, D.P. (1999). Resistance of maize to the maize weevils. *Africa Crop Science Journal* 9:431-440.

Field P.G and Xie Y.S, (2001) Repellant Effect of Pea (*Pasumsaticum*) Fraction against stored products Pest *Journal of Stored products Research*, 27: 37:359-370-0022-474.

Grenier A.M., Mbaiguinam, M, and Delobel B. (1997). Genetical Analysis of the Ability of Rice Weevil *Sitophilusoryzea L* (Coleophera: Curculionidae) to Breed of Split Peas. Heredity 79:15-23.

Hebeish, A.; Moustafa, M.G.; Fouda, I.A.; Hamdy, S.M.; El-Sawy, F.A. and Abdel, M. (2008). Preparation of Durable Insect Repellant Cotton Fabric: Limonene as Insecticide. Cabohydrate Polymers 74 (2), 268-273.

ILeke K.D and Oni M.O. (2011). Toxicity of some plants powder to maize weevil, *Sitophilus zeamais* (motschusky) (coleapterani: corculiondae) and stored maize grains).

International Institute of Tropical Agriculture (IITA) (2003). Research Guide. IITA Training Program PMB 30:5320, Ibadan, Nigeria.

Jang, Y.S.; Yang Y.C.; Choi, D.S. and Ahn, Y.J. (2005). Vapor phase toxicity of marjoram oil compounds and their related monoterpenoides to *Blattellagermanica*(Dicytoptera: Blattellidea). *Journal of agriculture and food Chemistry*, 50 (20): 7892-7898.

Jigna, P andSumitra, C. (2006). *In-vitro* antimicrobial activities of extracts of *Launaeaprocumbns*Roxb. (Labiateae), *Vitisvinifera*L. (Vitaceae) and *Cyperusrotundus*L. (Cyperaceae). *African. Journal Biomedical Research* 9(2):89-93.

Kalia, Grade 8 (2011). Plant Extracts as Natural Insecticides. Part of the Young Naturalist Awards Curriculum Collection. Young Naturalist Awards Collect. Ney York TNA Winner.

Klendrebego, S. (2006). Active insecticide *Strigahermathica*(del) Benth (Scrophulariacease) sur *Sitophiluszeamais*. Pesticide Industry Sales and Usage Report: 2006. Environmental Protection Agency (EPA). www.epa.gov.

Kling, J.G. (1991). A parameter for expressing the suitability of an environment for insect Development. *Journal of Stored Produce Research* 7:13-20. Elsevier Science Ltd.

Larger, R.H.M. and Hill, G.D. (1991). Agricultural Plants. Second Edition, Cambridge University Press: New York, USA. P 387.

Lee, S.; Peterson, C.J. and Coat, J.R. (2003). Fumigation toxicity of monoterpenoides to several stored products insects. Journal of stored products Research, 77-85.

Lyon, F. (2000). The creation of social capital in agricultural economies in Ghana. *Journal of Stored Produce Research* 28(4):663-681.

Mukhtar, M.D. and Tukur, A. (1999). *In-vitro* screening activity of *Pistiastratiutes*extract. NISED *Journal* 1(1):5–6

Ogunsina, O; Oladimeji, O.M. &Lajide, L. (2011). Insecticidal action of hexane extracts of three plants against maize weevil.

Ojewole, J.A.O. (2005). Antiinflammatory, analgesic and hypoglycemic effects of *Mangifera indica* Linn. (Anacardiaceae) stem-bark aqueous extract. Science gov.www.science.gov

Okwu, D.E. and Ezenagu, V. (2008). Evaluation of the Phytochemical Composition of Mango (*Mangiferaindica* Linn) Stem Bark and Leaves.*International Journal of Chemical Sciences: 6(2). Pg. 705-716*.

Onurah, E.O (2000). Short communication. The wood preservation potential of heartwood extracts of milicia excels and *Erythroptileumsuaveolens*. Bioresource technology 75:171-173.

Pretheep-Kumar, P. Mohan, S. and Ramaraju, K. (2004). Protei enriched pea flour extract protexts stored milled rice against the rice weevil, stitophilusoryzae. *Journal of insect science* 4:26 -32.

Philips, A.K.;Appel, A.G. and Sims, S.R. (2010). Tropical toxicityof Essential oilto the German cockroach (Dictyoptera: Blattellidae). *Journal of Economic Entomology*, 448- 459.

Rajapakse, R.H.S (2006). The potential of plants and plant product in stored insect pest management. *The Journal of agricultural science*, 2(1):11-20.

Stoll, G. (2001). *Natural Crop Protection in the Tropics*.MullerbaderFieldstadt Publishers, Germany.

Talukder, F.A and Howse, D.E (1994). Repellent, Toxic and food protectant effects of pithriaj, Arphanamixixpolystachya extracts against the pulse beetle calls orbrucheschinensis in storage. *Journal of Chemical Ecology* 20.899-908.

Thanda D and Kevin, V.P. (2003). Divergent Selection for Resistance to Maize Weevil in Six Maize Populations. *Crop Science Journal* 43(6):2043-2049.

University of Jos Metrological Station (2013). Metrological Station Geography and Planning Department, Faculty of Environmental Science University of Jos, Jos Nigeria.