



SHORT COMMUNICATION

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Insecticidal potential of *Momordica charantia* (L.) leaves powder against maize weevil *Sitophilus zeamais* (Mots.) (Coleoptera: curculionidae) infestation

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Abstract

The protection of stored agricultural products against insect pest attack is essential for safe and steady supply of high quality food. In an attempt to find alternative to synthetic insecticides control measure an experiment was conducted in the Pest Management laboratory of Crop, Soil and Pest Management Technology Department of Rufus Giwa Polytechnic, Owo, Nigeria to evaluate the potential of *Mormodica charantia* for the control of *Sitophilus zeamais* (Mots.) infestation in storage. The experiment was laid out in Completely Randomized Design (CRD) and replicated three times. The plant powder was tested at 0.5g, 1.0g, 1.5g and 2.0g per 20g of maize seeds to evaluate its ability to suppressed the population of *S. zeamais* and reduce seed damage of stored maize seeds. The plant powder resulted in effective protection in treated seed comparable to control experiment. There were significant low percentage seed damage and weight loss in seeds treated with *M. charantia* leaf powder. Total number of adult weevil emergence was least in treated grains at 2.0g dosage rate compared to other treatment dosages. This study shows that it is possible to use *M. charantia* to protect maize against *S. zeamais* infestation in storage in the context of sustainable pest management in organic agriculture. At present, there is scanty report on insecticidal activities of *M. charantia* against stored product pests. Therefore, this experiment was carried out to determine the possible insecticidal activities of the leaf essential oil of *M. charantia* on *S. Zeamais*.

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Introduction

Sitophilus zeamais is the most widespread and destructive major insect pest of stored cereals throughout the world. It is an internal feeder causing considerable loss to cereals affecting the quantity as well as quality of the grains (Gupta *et al.*, 1999). The insect damage to stored grains is known to cause major economic losses to warehouse keepers, the milling industry and small scale farmers throughout the world. This problem is greatest in developing countries where modern storage technologies are lacking.

Though spectacular progress in pest control has been achieved by chemical measures, its adverse effect on ecological system and human life has stressed the need to develop alternative methods for controlling the various arthropod pests (Risk *et al.*, 2001). In responses to the problems associated with the adoption of conventional insecticides, research workers in the last two decades have embarked on the evaluation of the insecticidal properties of some local plants to storage pests as alternative to the existing insecticides. It was reported that when mixed with stored – grains, leaf, bark, seed powder or oil extracts of plant reduce oviposition rate and suppress adult emergence of bruchid and also reduce seed damage rate (Ogunleye, 2000). The tropical region is well endowed with a wide array of floristic species with defensive chemicals and quite a number of them have been used traditionally in protecting against grain beetles attack and many of which are yet to be identified. The use of botanicals in crop protection may be a solution to prevent the environment and the consumer from the effect of synthetic pesticides (Tapondjou *et al.*, 2002). *M. charantia* is a branched climbing annual which is growing throughout tropical countries. The plant is of great medicinal importance in India and major countries in the tropics. The leaves are useful in vitiated conditions of *pita*, helminthiasis, constipation, intermittent fever, burning sensation of the sole and nyctalopia. (Joy *et al.*, 1998) The leaves and fruits are also used for external application in lumbago, ulceration and bone fractures and

internally in leprosy, haemorrhoids and jaundice (Warrier *et al.*, 1995; Husain *et al.*, 1992). The environmental and health risk posed by the continued use of synthetic insecticides in the protection of stored products against insect pest infestation necessitate the search for ecofriendly alternatives. This research therefore aims to evaluate the insecticidal efficacy of *M. charantia* in reducing adult emergence and seed damage on treated maize grains.

Materials and methods

Culturing of insects

Sitophilus zeamais used for the study were collected from infested stock of grains at the Ehinogbe market, Owo, Ondo State, Nigeria (7° 11' 43" N, 5° 33' 57" E) and reared on whole grains in the Pest Management laboratory of Crop, Soil and Pest Management Technology Department of Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria (7° 11' 43" N, 5° 33' 57" E). Culture conditions were 28±2°C, 65% relative humidity and 12L: 12D photo regime (Udo, 2005). Insects were placed in jars containing 200 g of sterilized grains to allow oviposition.

Collection and preparation of plant materials

Whole plants of *M. charantia* were collected from the polytechnic environs, washed with borehole water. The leaves were detached and air dried in the laboratory for two weeks to avoid possible volatilization of the active ingredients. On drying, the leaves were ground into powder using an electric blender and packed into black polythene bags for future use.

Toxicity of ground plant materials to S. zeamais

Twenty grams (20g) of maize grains were measured into five (5) 9 cm disposable Petri dishes and leaf powders of *M. charantia* were admixed with the grains in proportion of 0.5g, 1.0g, 1.5g and 2.0g. The dishes were tumbling several times to ensure homogenous mixing of the powder with the grains (Adesina, 2010). The control treatment had no plant powders added. One hour after the addition of plant powders, 5 pairs of adult insects of between 3–7 days

old were introduced into treated and untreated grains (Udo, 2000). The Petri dishes were covered and placed on the laboratory benches for observation. The experiment was replicated three times and mortality was recorded 48 hours and 15 days after infestation (DAI). Insects were considered dead on failure to respond to three proings using a blunt dissecting probe (Obeng-Ofori *et al.*, 1997). After 15 days, live adult insects were removed from the dishes.

Damage assessment

Fifteen days after treatment (DAT) the adult live insects were removed from treated and control dishes. The numbers of adult exit holes was counted; damaged grains and undamaged grains were counted at 45 DAI for the computation of percentage seed damage according to Adetunmbi and Olakojo (2010).

$$\% \text{ seed damage} = \frac{\text{No. of seed damage}}{\text{No. of seed stored}} \times 100$$

Percentage weight loss was computed according to the method of Babarinde *et al* (2010) as follows:

$$\text{Percentage weight loss} = \frac{Wc - wt}{Wc} \times 100$$

Where: Wc = weight of infested sample; Wt = weight of infested sample

Determination of progeny production

The number of insects emerging was counted after 24 hours and up to 96 hours of the sixth week i.e. 45 days after treatment.

Experimental design and data analysis

The experiment was laid out in Completely Randomized Design (CRD) and each treatment replicated three (3) times. Data from the three replicates of the experiment were pulled together and subjected to one way analysis of variance using SPSS software package and means were separated using Least Significance Difference (LSD) at 5% probability level (Gomez and Gomez, 1994).

Results

Adult mortality of insects 48 h and 15 DAI is presented in figure 1. The leaf powder of *M.*

charantia applied at 2.0g, 48 h after infestation inflicted significantly, greater mortality (37.22%) to *S. zeamais* adults than when applied at other dosages, the least being 0.5g dosage level (23.85%). While at 15 DAI all the treatments exhibit non-significant difference.

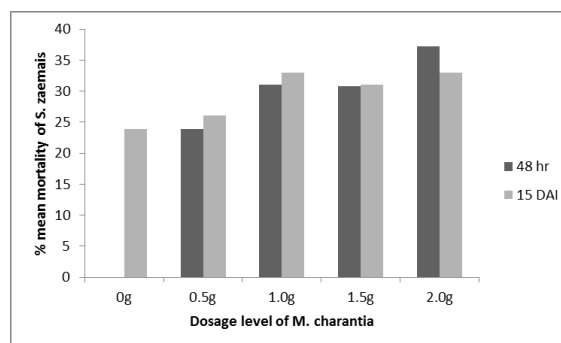


Fig. 1. Percentages mean mortality of *S. zeamais* 48 h and 15 DAI.

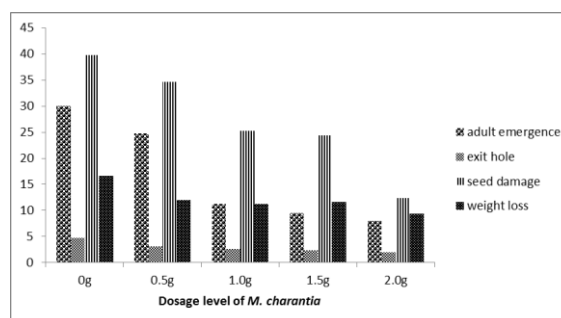


Fig. 2. Percentage mean weight loss, seed damage, exit hole and adult emergence on grains treated with leaves powder of *M. charantia*.

Percentage mean adult emergence, adult exit hole, seed damage and weight loss is presented in figure 2. The result shows that leaf powder applied at the rate of 2.0g per treatment influences reduction in adult emergence (7.95), exit hole (1.98) and greatly reduce seed damage (12.37) and grains weight loss (9.31) and was highest in control treatment this was significantly different compared to other dosages under study. Results in Figure 1 and 2 further reveal that 2.0 g per 20 g of grain rate performed significantly better than all the other lower rates in killing adult weevils and as well reducing percentage damaged grains and per cent loss in grain weight.

Discussion

Safe storage of grains and food products against insect damage is a serious concern (Haq *et al.*,

2005). Around the world, residual chemical insecticides are currently the method of choice for the control of stored-product insects (Epidi and Odili, 2009), but extensive use has resulted in the conversion of innocuous species to pests and the evolution of resistant forms (Rahman *et al.*, 2009) in addition to environmental contamination and health hazards. Under such conditions, the use of bioactive pesticides for protection of stored grains would be a safe alternative (Hasan *et al.*, 2006; Epidi *et al.*, 2008).

The significant mortality of *S. zeamais* when leaf powder of *M. charantia* was applied indicates the presence of toxic substance which shows there are insecticidal properties in this plant that impacted negatively on survival of the adult beetles. The toxicity effect of the tested plant powder support the findings of Patila and Chavan, (2009) who reported that LC₅₀ values of *M. charantia* for 48 hrs reveals that maximum toxicity was recorded against the sugarcane wholly aphids. This is also consistent with the findings of Yusuf and Muhammed, (2009); Adesina *et al.*, (2012) who have reported the effectiveness of *M. balsamina* and *M. charantia* plant powders respectively used as grain protectants against *C. maculatus* on stored cowpea. Insecticidal property of any plant material would depend on the active constituents of the plant material (Asawalam *et al.*, 2007). Joy *et al.*, (1998) reported that leaves and vines of *M. charantia* give tetracyclic triterpenes-momordicines I, II and III (bitter principles) and this might be responsible for its insecticidal activity. The insecticidal effect of the leaf powder could be attributed to one or more of the following: fumigation effect, repellency, stomach poison, effecting case where the weevil feed on admixed grains, mechanical action, starvation or desiccation (Sharby, 1988; Dales, 1996).

The reduction in the number of F₁ progeny produced by *S. zeamais* when leaf powder of *M. charantia* was applied to stored maize, suggests the presence of ovicidal properties in the plant and this confirms the findings of Maurya, (2009) that *M. charantia* fruit

wall acted as an effective biolarvicide against mosquitoes. The decrease in F₁ progeny in the treated grains could be result from increased adult mortality, ovicidal and larvicidal properties of the tested plant. The ovicidal and larvicidal properties could have arisen from impairing respiration through blockage of spiracle thereby resulting in suffocation (Dales, 1996).

Percentage seed damage and weight loss were in positive correlation with the total number of weevils because treatments with high total number of weevils inflicted more damage and weight loss. These results are in accordance with other reports on a positive relationship between weevils density/or emergence and damage on stored grains (Schoonhoven, 1978; Busungu and Mushobozy, 1991; Adesina, 2010). The significant reduction in percentage seed damage and weight loss indicating that the plant materials were effective in reducing the normal growth and developmental processes of *S. zeamais* and found to be seed protective as the spoilage of seeds were reduced to a significant extent. The efficacy of the leaf powders of the plants in reducing percentage seed damage weight loss is probably attributable to the strong pungent odour of the freshly prepared plant product. This agrees with the findings of Adesina *et al.*, (2011); Yusuf and Muhammed, (2009). This effectiveness may be related to the presence of either repellent and/or antifeedant property in the plant leaf powders against *S.zeamais*. The result suggested that the plant leaf powder was effective in reducing maize grains damage caused by *S. zeamais*. Increased concentrations can further boost the rate of mortality within a short time span and provide long lasting seed protection.

The present investigation clearly indicate that the performance of the plant leaves used increased with increasing rate of application, as shown by the effectiveness of the highest rate (2.0 g per 20 g of grain) in protecting the grains against damage by *C. maculatus* throughout the period of experimentation. This agrees with reports Yusuf and

Ahmed (2005) and Yusuf *et al.*, (2006), with respect to the dependence of the effectiveness of the various plant products tested on the increasing rates of application.

The effectiveness of *M. charantia* leaves powder to control *S. zeamais* post-harvest food grain losses during storage have shown promising signs of seed protection and insecticidal properties with the tested concentrations. It would therefore suggest the use of higher dosage as grain protectants to improve insecticidal property as well as help to control post-harvest and food grain losses during storage at farm level. Thus, if well utilized, *M. charantia* would minimize the use of synthetic chemicals in stored product pest control. Also, since *M. charantia* is locally abundant, the leaves could be collected, grinded and admixed with grains by small scale farmers in traditional pest control systems. This is of practical importance to the farmers as they can improve their traditional method of seed protection with use of the pulverized leaves.

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References

- Adesina JM.** 2010. Laboratory Evaluation of *Secamone afzelii* (Shult) K. Schum powder for reducing damage seed by beetles in stored grain. Post Graduate Diploma Thesis, Federal University of Technology, Akure, Nigeria. 15 – 28.
- Adesina JM, Afolabi LA, Aderibigbe ATB.** 2011. Efficacy of *Senna occidentalis* leaves powder on oviposition, hatchability of eggs and emergence of *Callosobruchus maculatus* (Fab) on treated cowpea seeds South Asian Journal of Experimental Biology 1(3), 168-171.
- Adesina JM, Afolabi LA, Ofuya TI.** 2012. Evaluation of insecticidal properties of *Momordica charantia* in reducing oviposition and seed damaged by *Callosobruchus maculatus* (Fab.) Walp. Journal of Agricultural Technology 8(1), 493-499.
- Adetumbi JA, Olakojo SA.** 2010. Storage potentials and tolerance of high protein maize (hpm) and quality protein maize (qpm) to seed storage pests in controlled environment. Journal of Plant Protection Research 50 (1), 67 – 71.
- Asawalam EF, Emosairue SO, Ekeleme F, Wokocha RC.** 2007. Insecticidal effects of powdered parts of eight Nigerian plant species against maize weevil *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae). Electronic journal of Environmental, Agriculture and Food Chemistry 6 (11), 2526-2533.
- Babarinde SA, Babarinde GO, Olasesa OA.** 2010. Physical and biophysical deterioration of stored plantain chips (*Musa Sapientum* L.) due to infestation of *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae). Journal of Plant Protection Research 50(3), 302 – 306.
- Busungu DG, Mushobozy DMK.** 1991. The efficacy of various protectants against *Zabrotes subfasciatus* (Boh) Coleoptera: Bruchidae in common beans. Bean Research 6, 62–67.
- Dales MJ.** 1996. A Review of Plant Materials used for control using insect pest of stored Product. NRI Bulletin 65 Chaltham, UK. 84.
- Epidi TT, Nwani CD, Udoh S.** 2008. Efficacy of some plant species for the control of Cow pea weevil (*Callosobruchus maculatus*) and maize weevil (*Sitophilus zeamais*). International Journal of Agriculture and Biology 10, 588–590.
- Epidi TT, Odili EO.** 2009. Biocidal activity of selected plant powders against *T. castaneum* (Herbst).in stored groundnut (*Arachis hypogaea* L.).

African Journal of Environmental Science Technology **3**, 1–5.

Gomez KA, Gomez AA. 1994. Statistical procedures for Agricultural Research (Second Ed.), John Wiley and Sons, Inter. Sci. Pub. New York, 457 – 463.

Gupta AK, Behal SR, Awasthi BK, Verma RA. 1999. Screening of some maize genotypes against *Sitophilus oryzae*. Indian Journal of Entomology. **61**, 265-268.

Hasan M, Sagheer M, Ullah A, Wakil W, Javed A. 2006. Response of *Trogoderma granarium* (Everts) to different doses of *Haloxylon recurvum* extract and Deltametrin. Pakistan Entomology **28**, 25–29.

Haq T, Usmani NF, Abbas T. 2005. Screening of plant leaves as grain protectants against *Tribolium castaneum* during storage. Pakistan Journal of Botany **37**, 149–153.

Husain A, Virmani OP, Popli SP, Misra LN, Gupta MM, Srivastava GN, Abraham Z, Singh AK. 1992. Dictionary of Indian Medicinal Plants. CIMAP, Lucknow, India. 546.

Joy PP, Thomas J, Samuel M Skaria BP. 1998. Medicinal Plants, Kerala Agricultural University, Aromatic and Medicinal Plants Research Station, India. 131.

Maurya P, Sharma P, Mohan L, Batabyal L, Srivastava CN. 2009. Evaluation of larvicidal nature of fleshy fruit wall of *Momordica charantia* linn. (Family: Cucurbitaceae) in the management of mosquitoes. Parasitology Research **105(6)**, 1653 – 1659.

Obeng-Ofori D, Reichmuth CH, Bekele J, Hassanali A. 1997. Biological activity of 1, 8 Cineole, a major component of essential oil of *Ocimum kenyense* (Ayobangira) against stored

product beetles. Journal of Applied Entomology **121**, 237–243.

Ogunleye RF. 2000. Effectiveness of some plants against *callosobruchus maculatus* (F) (Coleopteran: Bruchidae). Applied Tropical Agriculture **5**, 1: 72 – 76.

Patil DS, Chavan NS. 2009. Bioefficacy of some botanicals against the sugarcane woolly aphid, *Ceratovacuna lanigera* Zehnter. Journal of Biopesticides **2(1)**, 44-47.

Rahman A, Talukder FA. 2006. Bio efficacy of some plant derivatives that protect grain against the pulse beetle, *Callosobruchus maculatus*. Journal of Insect Science **6**.

Rahman MM, Islam W, Ahmed KN. 2009. Functional response of the predator *Xylocoris flavipes* to three stored product insect pests. International Journal of Agriculture and Biology **11**, 316–320.

Risk SA, Haiba MI, El-Sinary NH. 2001. Combined effect of gamma irradiation and ten plants on potato tuber moth *Phthorimaea operculella* (Zeller) larval mortality. Pakistan Journal of Biological Science **4**, 1228–1231.

Schoonhoven VA. 1978. Use of vegetable oils to protect stored beans from bruchid attack. Journal of Economic Entomology **71**, 245–256.

Sharaby A. 1988. Evaluation of some murataceae: Plant leaves as protectant against infestation by *Sitophilus oryzae* L. and *Sitophilus granaries* L. Insect Science Applied **9**, 405-468.

Sule H, Ahmed BI. 2009. Effect of plant product, application rates and grain type on the control of red flour beetle *Tribolium castaneum* Herbst (Coleoptera: Tenebrionidae), on stored millet (*Pennisetum glaucum* (L.) R.Br.). Academic Journal of Entomology **2**, 22 – 30.

Tapondjou LA, Alder C, Bouda H, Fontem DA. 2002. Efficacy of powder and Essential oil from *Chenopodium ambrosioides* leaves as post-harvest grain protectants against six-stored product beetles. *Journal Stored Product Research* **38**, 395 – 402.

Udo IO. 2000. Efficacy of Candlewood *Zanthoxylum xanthoxyloides* (Lam) for the Control of Three Stored Product Pests. M. Ph. Thesis, University of Ghana, Legon, 79.

Udo IO. 2005. Evaluation of the potential of some local spices as stored grain protectants against maize weevil *Sitophilus zeamais* Mots (Coleoptera: Curculionidae). *Journal of Applied Science and Environmental Management* **9**, 165–168.

Yusuf SR, Ahmed BI. 2005. Effects of application rates of some plant materials in the control of maize weevil (*Sitophilus zeamais* Mots.) in stored maize. *Journal of Pure and Applied Sciences.* **8(2)**, 180-187.

Yusuf SR, Ahmed BI, Galadima B. 2006. Control of *Sitophilus zeamais* Mots. adults population and damage on grain maize (*Zea mais* L.) by two plant products compared with pirimiphosmethyl. Pages 621-624. In: S. O. Adepoju and P. B. Okuneye (eds.). *Technology and Agricultural Development in Nigeria*. Conference Proceedings of the 20th annual conference of the Farm Management Association of Nigeria, held at the Federal Collage of Forestry, Jos, Plateau State, from 18th to 21st of September, 2006.

Yusuf SR, Muhammed YS. 2009. Potentials of Bitter Melon (*Momordica balsamina* L.) and Asthma Plant (*Mitracarpus villosus* L.) Leaf Powders in the Protection of Stored Cowpea [*Vigna unguiculata* (L.) Walp.] Against Cowpea Bruchid [*Callosobruchus maculatus* (F.)] Damage. *Savannah Journal of Agriculture* **4**, 54-61.

Warrier PK, Nambiar VPK, Ramankutty C. 1995. *Indian Medicinal Plants*. Vol. 1-5. Orient Longman Ltd., Madras.