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Use of some spicy powders in the control of *Sitophilus zeamais* Motschulsky [Coleoptera: Curculionidae] on maize grains

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ABSTRACT

Investigations were conducted to test the potential of three spices namely Allium sativum L., Capsicum frutescens L., and Zingiber officinale Rosc. as biopesticides against S. zeamais reared on maize grains. Doses of 1.25, 2.50 and 5.00 g powders of each of A. sativum, C. frutescens and Z. officinale and 0.30 g of Permethrin were applied to 50 g of maize grains infested with S. zeamais in small plastic bottles maintained under constant conditions of 30^{0}C and 70% R.H. The effect of the spices on adult mortality was significant ($p<0.05$) between the spicy powders and the control. Significantly ($p<0.05$) higher (10.00%) percentage grain damage was recorded with 1.25 g of A. sativum and the least (0.00%) in treatments containing 5.00 of C. frutescens. The findings of this study indicated that the selected spices showed their potential positive protectant ability of maize grain against S. zeamais. The spicy powders could be used as alternative biopesticides against S. zeamais attacking maize grains in the storage.

Key words: Control, Grain damage, Maize grain, Mortality, *Sitophilus zeamais*, Spicy powders

INTRODUCTION

Maize (*Zea mays*) is an out breeding heterogeneous crop and is a very important cereal grain in Africa where it is widely cultivated and consumed [1]. It is related to wheat, rice, oat and barley; ranking second after wheat and is followed by third-ranking rice in order of world grain production [2]. It serves as a source of dietary carbohydrate for humans [3]. It was estimated that 158 million hecters of maize were harvested worldwide and Africa harvested 29 million hecters with Nigeria as the largest producer in sub-sahara Africa (SSA) harvesting 3% [4]

Maize has the disadvantage of being harvested in the wet season and is therefore susceptible to damage by microorganisms in addition to the problems of insect infestation [5]. One of the most important insects pests associated with stored maize grains is the maize weevil, *Sitophilus zeamais* Motschulsky, a ¼ inch long, reddish brown to black snout weevil [2]. It can be found in numerous tropical areas around the world. Adult weevils and larvae feed on undamaged grains and frequently cause severe powdering, rendering the product unfit for human consumption [6]. These stored grains insect pests cause a high rate of post harvest losses in Africa [7]. Many plant powders were evaluated and found effective in the management of *S. zeamais*, attacking maize grains in the stores [2, 8, 9]. Spices are one of the important plant powders tested and found efficacious against insect pests of stored products [5, 9, 10, 11, 12]. Plant powders are cheap, easily biodegradable and readily available, that will not contaminate food in small-scale storage systems [9]. This study is aimed at testing the insecticidal effects of some spicy powders against *S. zeamais* attacking maize grains during storage.

MATERIALS AND METHODS

Rearing of *S. zeamais*

Adults of *S. zeamais* were cultured in the laboratory at 30 °C and 70% R.H. in the Biology Laboratory 1, Umaru Musa Yar'adua University, Katsina. The food media used was whole maize grains. Fifty pairs of *S. zeamais* were introduced into 1 litre glass jar containing 400 g weevils susceptible maize grains obtained from local stores. The jars were then covered with muslin cloth held in place with rubber bands and freshly emerged adults of *S. zeamais* were then used for the experiment.

Collection and Preparation of Spices

Spicy materials namely Garlic (*Allium sativum* L.), Chilli pepper (*Capsicum frutescens* L.) and Ginger (*Zingiber officinale* Rosc.) used in the experiment as well as the conventional insecticide (Permethrin) were purchased from Katsina central market. The spices were dried in a well ventilated area in the Laboratory for ten days before grinding into fine powder using a laboratory blender. The powders were separately kept in air-tight glass containers and kept under room temperature prior their use in the experiments.

Adult mortality test

Twenty gram of clean disinfested maize grains was weighed into sterilized small plastic bottles. The plant materials were applied at 1.25, 2.50 and 5.00 g per 50 g maize grains, while the synthetic insecticide, Permethrin was applied at the rate of 0.30 g/ 50 g maize grains. There was also an untreated check which did not contain any spice or synthetic chemical. Treatments containing spices and Permethrin were thoroughly mixed with the the aid of glass rod to ensure thorough admixture. Thereafter five pairs of newly emerged adult weevils were introduced into each of the treated and untreated maize in small plastic bottles. Each of the plastic bottles was covered with muslin cloth and tied with rubber band. The plastic bottles were then kept in an incubator, arranged in a Completely Randomized Design (CRD), and replicated four times. Observations were made on adult mortality daily for 28 days during which dead adults were removed. The plastic bottles were kept in the incubator at 30 ^{0}C and 70% R.H for another 28 days for damage assessment.

Damage assessment

Twenty grains were sampled randomly from each of the plastic bottles. Grains with characteristic weevil emergence hole were separated from healthy ones and counted then percentage grain damage was calculated using the following formular [13]:

$$\% \text{ Damage} = \frac{\text{Number of Grains Perforated}}{\text{Number of Grains Sampled}} \times 100$$

To determine the protectant ability of the spices, Weevil Perforation Index (WPI) was calculated using the following formula

$$\text{WPI} = \frac{\% \text{ Treated Grains Perforated}}{\% \text{ Control Maize Perforated} + \% \text{ Treated Grains perforated}} \times 100$$

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA) at 5% level of significance. Significantly different means were separated by using least significant difference (LSD).

RESULTS

Effect of different spice powders on mortality of adults of *S. zeamais* is shown in Figure 1. All the spices applied at different dosages (1.25, 2.50 and 5.00 g/50 g) caused 100% adult mortality 28 days after application, while only 5.2% adult mortality was observed in the control. The Permethrin also resulted in 100% adult mortality of *S. zeamais*, and the adult mortality was observed to be significantly different ($p<0.05$) between the spices and control.

The effect of the different spicy powders applied at varying amounts on maize grain damage caused by *S. zeamais* is presented in Figure 2. The Figure indicates that among the spicy powders, 5.00 g of *C. frutescens* resulted in the least maize grain damage (0.00%), which was similar to that of 0.30 g Permethrin, while the highest grain damage (10.00%) obtained from the spicy treatments was from maize grains treated with 1.25g of *A. sativum*. The grain

damage caused by *S. zeamais* was significantly ($p<0.05$) different between the treatments and the control (from which 35.40% grain damage was observed).

Figure 3 shows the effects of the tested spices on weevil perforation index (WPI) of *S. zeamais* reared on maize grains. The least (0.00) WPI value was obtained in the plastic bottles treated with 5.00 g of *C. frutescence* and 0.30 g of permethrin respectively, while the highest (12.80) WPI value among the grains treated with the spices was observed in 1.25 g of *A. sativum*. The WPI value obtained from the control was 50.00.

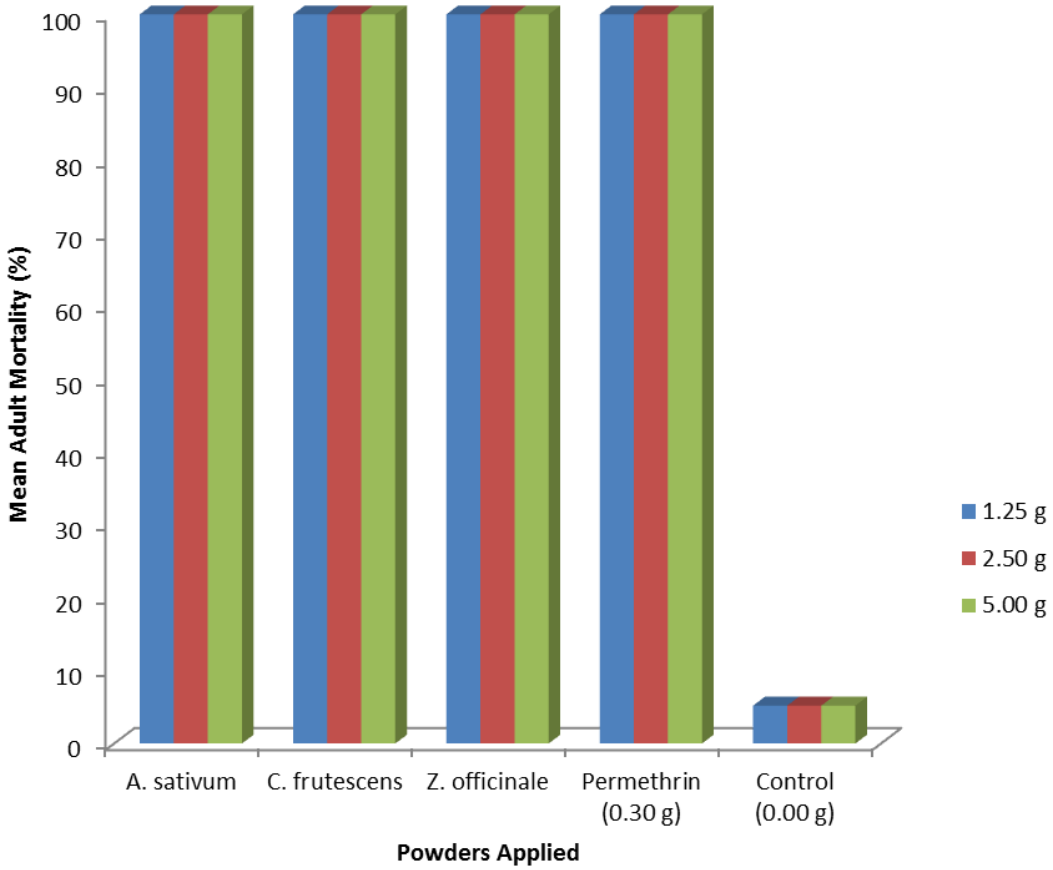

Fig. 1: Effects of Some Spicy Powders on Adult Mortality of *S. zeamais* on Maize Grains

DISCUSSION

The results obtained shows that all the spicy powders used resulted in 100% mortality of adult *S. zeamais* 28 days after treatment. It was reported that *A. sativum* gave 90% mortality at 1.5 g per 50 g of maize grain, followed by *Z. officinale* with 86% at 7 days after application [5]. *A. sativum* may have been very potent because of its strong odours which might have exerted a toxic effect by disrupting normal respiration of the weevils. For the effectiveness of *C. frutescens*, the present findings of this study agree with a report of 100% mortality of *T. granarium* 14 days after application of *C. frutescens* [7]. The application of 0.4 g of *C. frustecens* was also reported to have caused 75% mortality on adult *S. zeamais* in 20 g maize grains [11]. Reports confirmed the effectiveness of powders from *Z. officinale* on the mortality of *S. oryzae* [14]. They reported 88.70% adult mortality of *S. oryzae* at seven days after

treatment. The ability of these plants to cause mortality of *S. zeamais* adult on maize grains might be attributed to the contact toxicity of powder on the weevil as well as blockage of the respiratory openings.

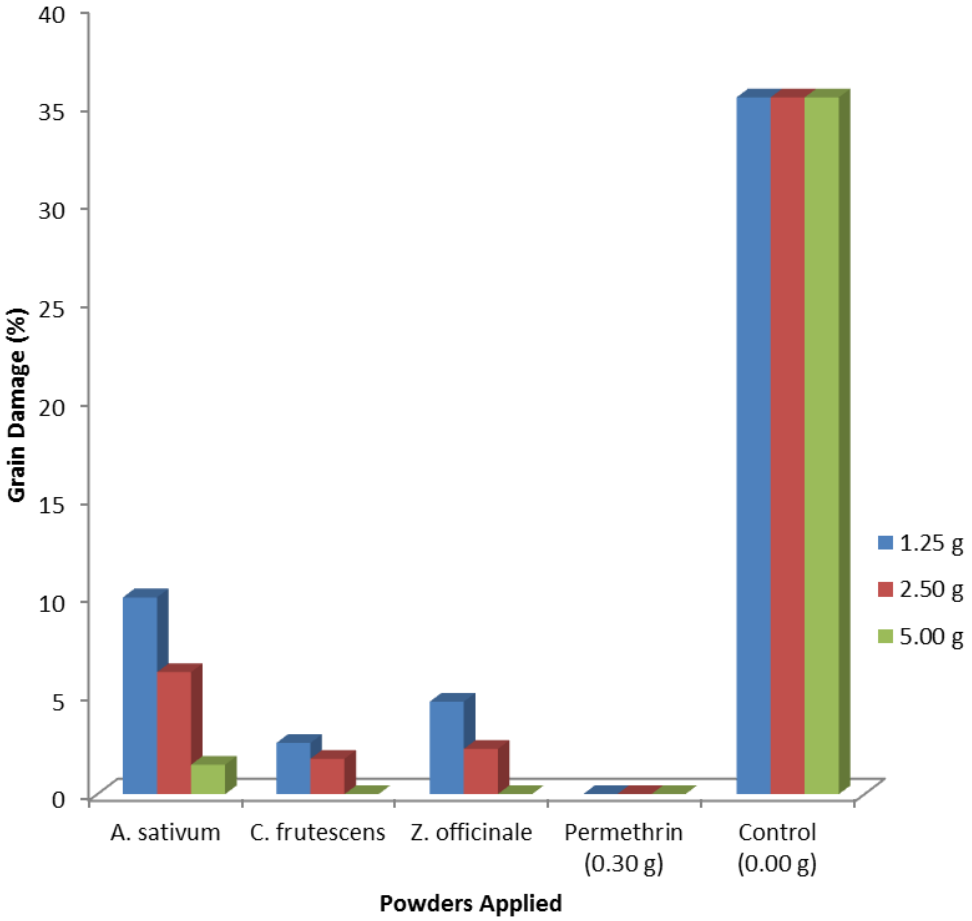

Fig. 2: Effects of Some Spicy Powders on Maize Grain Damage Caused by *S. zeamais*

The spicy powders applied during this study were found effective in reducing grain damage, especially at the higher dose, caused by *S. zeamais*. Among the spices applied *C. frutescens* was found to be most effective in reducing grain damage, while *Z. officinale* was observed to be the second most effective plant powder that caused reduction in the grain damage that might have been caused by *S. zeamais* on maize. *A. sativum* was also found promising in reducing grain damage. This is in conformity with the findings which revealed that 2.81% grain damage of maize was obtained when 1.5 g of *A. sativum* was applied [15]. The insecticidal effects of *A. sativum* on *S. zeamais* could be due to the strong aroma of the powder which might have served as feeding deterrent to the weevils leading to their death. The reduction in grain damage increased with the increase in the amount of the spicy powders applied.

The results obtained showed that all the three spices applied had positive protectant ability of maize grains against *S. zeamais*. *C. frutescens* was found to be the most effective spice in protecting maize grains against *S. zeamais*, and when used at higher dose of 5.00 / 50 g maize grains it resulted in similar effect to that of the conventional insecticide.

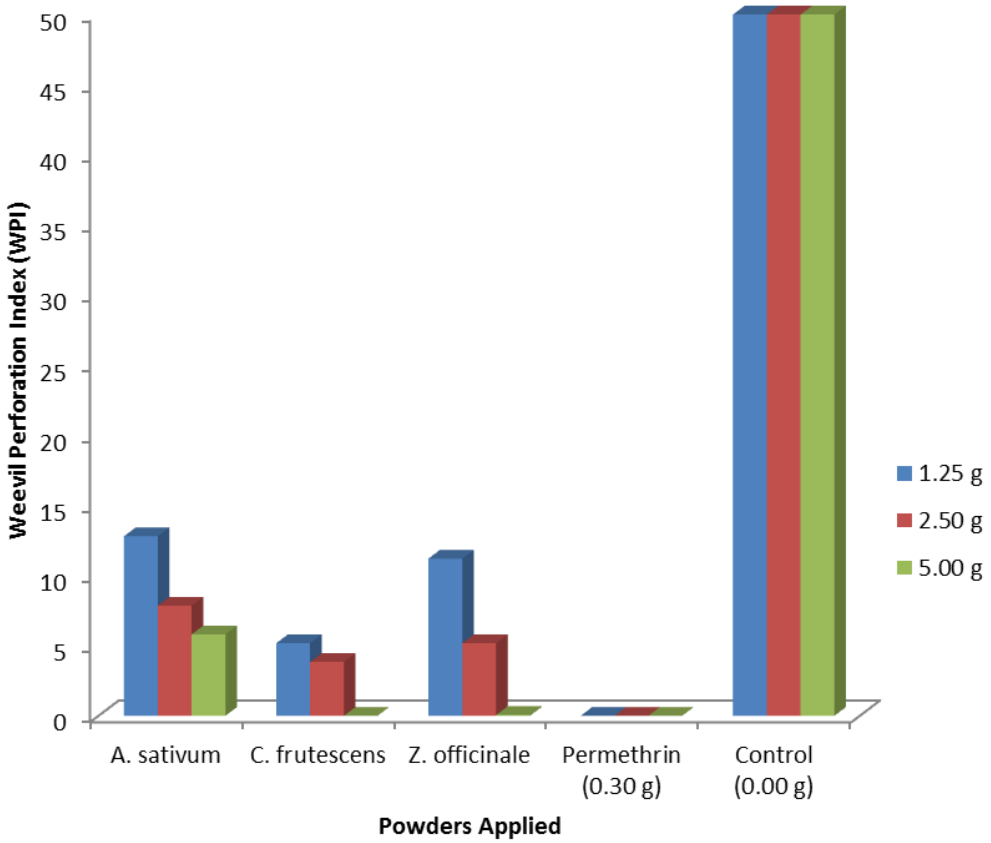

Fig. 3: Effects of Some Spicy Powders on Weevil Perforation Index (WPI) on Maize Grains

CONCLUSION

The findings of this research have revealed that the three spicy powders were effective in reducing maize grains damage caused by *S. zeamais* and had positive protectant ability against the weevil. In addition, the spices used are edible since they are used either as ingredients for soup or medicinal preparations. Therefore, they could be used as alternative insecticides against *S. zeamais* attacking maize grains.

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REFERENCES

[1] G. Rounanet, *Maize. The tropical Agriculturist CTA.* Macmillan, London, **1987**, 102pp.
[2] A.M. Parugrug, C. Roxas, *KMITL Sci. Tech. J.*, **2008**, **8**(1): 24 – 38.
[3] I.C. Onwueme, T.D. Sinha, *Field crop production in tropical Africa*, **1999**, 480pp.
[4] FAO, *Training series*, **2007**, No.10. Rome, Italy. 122pp.
[5] B.J. Danjumma, Q. Majeed, S.B. Manga, A. Yahaya, M.C. Dike, L. Bamaiyi (2009), *American-Eurasian Journal of Scientific Research*, **2009**, **4**(4): 313 – 316.
[6] T.I. Ofuya, J.E. Idoko, L.A. Akintewe, *Nigerian Journal of Entomology*, **2008**, **25:** 34 – 39.
[7] N.H. Al-Moajel, *Journal of Biological Sciences*, **2004**, **4**(5): 592-597.
[8] J.D. Kabeh, M.G.D.S.S. Jalingo, *International Journal of Agriculture and Biology*, **2007**, **9**(3): 452 – 454.
[9] D.A. Ukeh, G.A. Arong, E.I. Ogban, *Journal of Entomology*, **2008**, **5**(4): 295 – 299.
[10] T.I. Ofuya, J.M. Osadahun, *Zoological Research*, **2005**, **26**(6): 603 – 608.
[11] E.F. Asawalam, S.O. Emosairue, F. Ekeleme, R.C. Wokocha, *Electronic Journal of Environmental, Agricultural and Food Chemistry*, **2007**, **6**(11): 2526 – 2533.
[12] R.H.S. Rajapakse, D. Ratnasekera, *Tropical Agricultural Research and Extension*, **2008**, **11:** 69 – 71.
[13] M.O. Fatope, A. Mann, Y. Takeda, *International Journal of Pest Management*, **1995**, **41:** 84 – 86.
[14] K. Govindan, S.J. Nelson, *Journal of Biopesticides*, **2009**, 2**(2)**: 169 – 172.
[15] S.T. Arannilewa, T. Ekrakene, J.O. Akinneye, *African Journal of Biotechnology*, **2006**, **5**(21):2032 – 2036.