English Version

Control *Sitophilus zeamais* (Coleoptera: Curculionidae) in Maize (*Zea mays L.*) treated with diatomaceous eart

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Abstract

Maize (*Zea mays* L.) is one of the most important cereals grown worldwide. As the product is sold fresh, the major concern is to maintain the quality of the grain, but its storage is difficult due to wide range of pests that can attack, reducing the quality. The objective of this study was to evaluate the effect of diatomaceous earth in the mortality of maize weevil *Sitophilus zeamais* in maize grains stored in different dosages and check the exposure time of each treatment. The experimental design was completely randomized with six treatments and five replications. The treatments consisted of increasing doses of diatomaceus eart (DE), in the proportion of zero, 50, 100, 150, 200, 250 g of DE t^{-1}, all packed in plastic cups of 250 mL. In each plastic cup it was released 20 insects of *S. zeamais* and they were closed with fabric nylon fine mesh for aeration. The evaluation of insect mortality were performed at 3, 6 and 9 days after infestation (DAI), by counting the living and dead insects in the trays and the possible re-infestation. Treatment with diatomaceous earth in maize (*Zea mays)* at a dosage of 250 g t^{-1} provided better control of *S. zeamais.*

Key Words: Zea mays; maize weevil; diatomaceous eart

Introduction

Maize is one of the most important cereals grown worldwide. It is a graminoid plant of the *Zea mays* L species, a grain with high nutritional value, which have been cultivated for centuries. It is extensively used on human and domestic animal food, as well as in industry to the production of rations, glue, starch, oil, alcohol, flakes, beverage and other products (NETO E FANCELLI, 2000).

Since the product is sold "*in natura*", the main preoccupation is to maintain grain quality. Its storage is difficult due to the wide range of plagues that can attack, decreasing the quality and consequently disabling its selling. According to Lorini (1998), losses occurred by plague action in stored grains may reach 10%. Thus, it is necessary to maintain the grain intact so that the expansion is not damaged.

The maize weevil *Sitophilus zeamais* (Coleoptera: Curculionidae) is one of the main plagues of grains on the storage. They are small beetles with the approximate length of 3 mm, have four reddish spots on the elytra; their larvae have a light yellow color with a darker head and the pupae are white.

Eggs are laid on the grains and after the larvae hatch they drill the maize to feed. Besides that, weevil is a primary internal plague (it attacks whole grains, drilling them and developing itself within the same), may present cross-infection (infects grains in the fields and also on the storage), either its adults and larvae attack and damage grains and it still have various hosts (GALLO et al., 2002; LORINI, 1998).

Sitophilus zeamais (Coleoptera) is one of the most destructive plagues in grains stored worldwide. Insects considered plagues are the major cause of physical loss, and, in addition to that, they are responsible for loss in quality of grain and by-products (LORINI, 2003).

Conventionally, to protect stored grains, many chemical products are used, as pyrethroids, organophosphate and fumigants in general, all highly dangerous, and with specific waiting periods. However, there are also alternative methods to control those plagues (temperature, radiation, sound), among them the use of inert dust (LORINI, 1998).

The inert dust is not only safe because of low acute toxicity in mammals, but also do not affect grain quality. The commercial formulations of inert dust available in the Brazilian market are based on

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diatomaceous earth, are registered as insecticides, toxicological class IV (considered as low or very low toxicity), and may be used in the plague control of wheat, maize, barley, and other grains. Diatomaceous earth is a geologic deposit, which consist in petrified skeletons of numerous species of silicon and unicellular marine species and other algae (SANTOS, 1992). It is a natural product, stable, produces no toxic chemical waste and does not react with other substances. Diatomaceous earth has been studied by several researchers, aiming to protect stored grains (KORUNIC, 1998).

According to Ebeling et al. (1996) cited by Lazzari (2005), inert dust based on diatomaceous earth join the epicuticle of the insect by electric charge and act by abrasion and adsorption of epicuticular lipid. Consequently, insects dye for dehydration when approximately 60% of the water or 30% of the total corporal weight is lost.

Martins and Oliveira (2008) verified that diatomaceous earth, on the lower doses (500 g t^{-1}) provided control of 100% of *S. zeamais* on the first ten days after the exposition to the treated popcorn grains.

Junior et al. (2007), when studying the efficiency of diatomaceous earth in the control of *S. zaemais* in stored corn grains, verified 100% of mortality only 21 days after insect exposition on the treatment with doses of 500 g t^{-1}.

Thus, the objective of this work was to evaluate the initial effect of the diatomaceous on the mortality of the corn weevil *S. zaemais* in stored maize grains in different doses and to verify the exposition time of each treatment.

Material and Methods

The experiment was developed in the Laboratory of Entomology of the Faculdade Integrada de Campo Mourão – PR, in the period from October to November 2008. The maize grains and inert power Diatomaceous Earth (DE) were acquired on the laboratory, *S. zeamais* insects used on the experiment were from the maintenance rearing of the laboratory with a maximum of 5 days of emergence.

The maize furnished by the laboratory was contaminated with *S. zemais*, thus, to execute the experiment it was necessary to remove the insects that were present on the maize.

The experiment design was completely randomized, with six treatments and five replications. The treatments consisted of increasing doses of DE, in the proportion of zero, 50, 100, 150, 200, 250 g of DE t^{-1}. In each treatment the DE was applied over 1 kg of grains, then it was homogenized in paper bags and thereupon it was divided and packed in plastic cups of 250 mL with 200 g of maize in each cup and maintained in environment conditions of temperature and relative humidity. In each plastic cup it was released 20 *S. zeamais* insects and these were closed with fine "nylon" mesh tissue, for aeration (modified from MARTINS and OLIVEIRA, 2008).

The evaluation of insect mortality was effected on 3, 6 and 9 days after the infestation (DAI), through counting in a tray the dead and live insects, and the possible reinfestation.

Data obtained were submitted to variance analysis trough SASM-Agri program and average of the treatments compared by Turkey test with 5% of probability. To analyze the mortality the data were transformed in "arc sin ((x/100)^1/2)".

Results and discussion

The results obtained showed that there were no significant differences between the treatments on the first two evaluations to insect control. However, it can be observed a significant difference on the percentage of dead insects on the third evaluation (9 days after the treatment) (Table 1).

It also can be observed that the best treatment was T5 (250 g t^{-1}) which differed significantly from the control, obtaining 13% of mortality.

When verifying the average number of live insects on the control, it was perceived that they decreased from 85 to 79% until the second evaluation (6 DAI). On the last evaluation (9 DAI) this increased from 79 to 81%, showing the reproduction on the control, which did not happen on the other treatments in which it was used DE (Figure 1).

When evaluating the necessary time to higher

Table 1. Average percentage of live and dead insects of *S. zaemais* submitted to the application of diatomaceous earth on 3, 6, 9 days after infestation

Treatments	Doses g t^{-1}	3 - DAI		6 - DAI		9 - DAI	
		Alive	Dead	Alive	Dead	Alive	Dead
Treat. "T0"	-	85 a	13 a	79 a	6 a	81 a	0 b
Treat. "T1"	50	91 a	4 a	81 a	10 a	79 a	2 ab
Treat. "T2"	100	85 a	12 a	65 a	20 a	62 a	3 ab
Treat. "T3"	150	94 a	5 a	84 a	10 a	78 a	6 ab
Treat. "T4"	200	78 a	22 a	76 a	12 a	56 a	10 ab
Treat. "T5"	250	87 a	9 a	66 a	11 a	63 a	13 a
C.V. (%)		19,28	90,36*	30,84	96,5*	33,9	88,98*

Average followed by the same letter do not differ from each other by Tukey test with 5% of probability
(*) Data transformed to "arc sin((x/100)^1/2)"
(DAI) – Days After Infestation

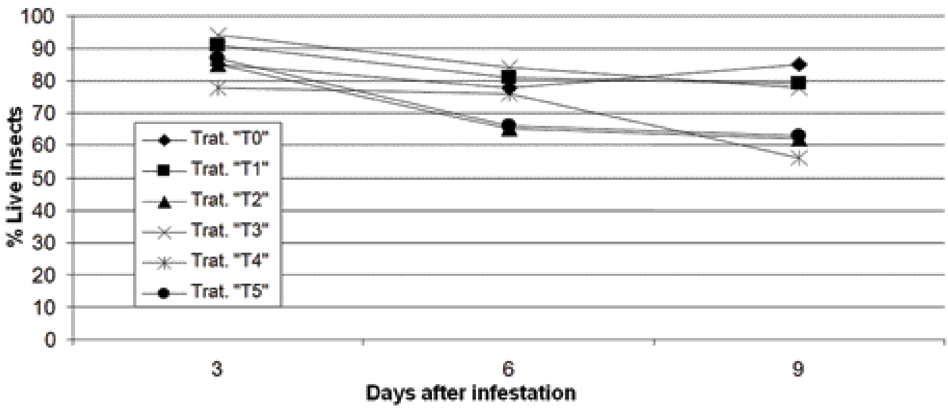

Figure 1. Graphic representation of the percentage of live insects on the control on the three evaluations

product efficiency, it can be observed that the higher the dosage is, the shorter is the time to obtain a satisfactory control of the plague insects. Athanassiou et al. (2005), cited by Junior (2007), also verified that, with low doses to achieve a satisfactory level of plague control per stored grains, a longer period of exposition was necessary.

According to Martins and Oliveira (2008), it was verified 100% of mortality of *S. zeamais* only 10 days after the exposition of insects in the treatment with the dosage of 500 g t^{-1}.

Conclusion

It was concluded that the treatment with diatomaceous earth in maize (*Zea mays*) on the dosage of 250 g.t^{-1} provided better control of *S. zeamais.*

Also it was found that the higher the dosage, the shorter the exposition time necessary to obtain efficient control.

Diatomaceous earth presents effect of mortality of *S. zeamais* only after 9 days after application.

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