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Control of *Acanthoscelides obtectus* in black beans with diatomaceus earth

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Abstract

During the storage, the black beans is subject the infestation of pests that cause qualitative and quantitative losses reducing its nutritional and commercial value. Among the pests of stored grains, one of the main is *Acanthoscelides obtectus*, primary pest, of legumes grains, adapted to live in conditions of low humidity. Infestation of insects can cause besides the reduction of the mass and volume, heating of the grains, development of microorganisms, some of which produce micotoxins. The inert powders, based on diatomaceous earth, constitute an alternative to pests control during the storage. This work aimed to evaluate the efficacy of diatomaceous earth in the control of *A. obtectus* in black beans Rio Tibagi cultivar, for 180 storage days, as well as its effects in sensorial characteristics as visual aspect. Grains of Rio Tibagi cultivar were used 1 and 2 kg t^{-1} diatomaceous earth (Keepdry) were applied, as well as control treatment without application of inert dust. Each application was mixed manually on 1.0 kg grains and, soon after, homogenized and placed in paper bag of 2.0 kg capacity. To the 1, 45, 90 and 180 days after the treatment samples of 200 g of grains of each replicate were collected, which were placed in 200 ml glasses, where 20 adult insects of the same age were released, and maintained in acclimatized room. The evaluation of the insecticide effect was accomplished by grains sieving and counting the number of insects dead and alive. The results obtained shows: 1) doses of 1 and 2 kg t^{-1} diatomaceous earth (Keepdry) were efficient in controling *A. obtectus*, pest of common beans, during the 180 days of storage; 2) the application of diatomaceous earth gives to grains a whitish and opaque aspect, but without development of strange scents; 3) a simple wash of the beans grain before cooking can eliminate the dust completely and made the grains reacquire color and shines characteristic.

Key words: black beans, inert dust, quality, pests.

Introduction

During the post-harvest, happen great losses of grains, because in the storage period the grains are subject to the attack of insects and fungi, some of them are producers of micotoxins. Those factors contribute to quality and quantity reduction of the stored products (Puzzi, 2001). Simultaneously, the grains metabolic activity also results in quantitative and qualitative losses (Elias, 2002).

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Among the pests of grains stored, the most important is the *Acanthoscelides obtectus*, coleopteron of the family brunchidae (woodworm-pity-bean), a primary pest, mainly of leguminose grains, adapted to live in conditions of low humidity. The larva start its development feed the cotiledones opening galleries in the grains, which could provoke the complete grain destruction, and its fast development there is a high potential for the population growth, so the damages can be very extensive. The eggs are still placed in the green beans in the field or directly in the grain stored. The adults are easiness of flying and they begin the infestation coming of grocery stores, however they do not feed and has short life (Loeck, 2002; Lorini and Beckel, 2002).

The inert dust, the base of diatomaceous earth consists an alternative for seeds or grains producing and control the pests during the storage. This inert dust originating from algae fossilized diatomaceas, that possess the silica dioxido as main component with pesticide effect, and its preparation for commercial use is made by extraction, driyng and grinding of the fossil material, which results dry powder, with a fine granulometry. The silica has the capacity to dehydrate the insects causing its death in few a days. Its act about the several pests species of stored grains, causing the death with loss of water, due to the characteristics of adsorption and abrasivity. It is a safe product, with durable insecticide effect, because it does not lose the effectiveness along the time. There is not noxious effects in people, is in some countries being considered as food addictive for human consumption and in rations (Banks and Fields, 1995; Subramanyam and Roesli, 2000; Lorini, 2003; Stathers et al., 2004; Morás, 2005).

The insects that attack stored grains are a problem mainly for quantitative and qualitative damages that caused, and the control form, through chemical products highly toxicant, can propitiate resistance in the pest (Morás, 2005). The use of inert dust can be an alternative method to chemicals. It was aimed, in this work, to evaluate the efficacy of the inert dust in the control the woodworm of the bean during the storage, as well as the black consequences in characteristics of consumption of these grains.

Material and methods

The experiment was accomplished in the Federal University of Pelotas, in Post-harvest and Industrial Grain Laboratory, Science and Technology Industry Department. Agronomy Faculty. Beans grains were used of cultivate Rio Tibagi (black group), started in september 2004 to March 2005. In the experiment, were used 3 treatments. The inert powder was the commercial mark Keepdry, with concentration of silic dioxide was 860 g kg^{-1} according to information the industry that produced them. The treatments constituted 1 and 2 kg t^{-1} of inert dust of diatomaceas earth (Keepdry), and the control. Each treatment was applied manually on 1.0 kg of grains and, soon afterwards, homogenized and placed in paper bag with 2.0 kg capacity, in storage room and temperature 25 °C ($\pm$ 3) and air relative humidity 70 % ($\pm$ 10). At 1, 60 and 180 days after the application were collected samples 200 g grains to each repetition, which were placed in glasses flasks, where were liberated, separately, 20 adult insects of the same age, coming from laboratory reaning. The jars were closed with filter paper being maintained in acclimatized room. The assessment of the treatments was made after 45 days of infestation by sieving the grain and counting alive insects. The sensorial evaluation was made by the visual analysis and bean grains aroma. The experimental results were submitted to the variance analysis and the averages compared to each other by the test of Tukey, to 5 % of probability ($p \leq 0,05$). The software used was SAS Institute.

Results and discussion

In Table 1 are presented the percentage of alive insects of woodworm-bean are evaluated in different times, for 6 months of storage.

In Table 1, can be verified the diatomacea earth (Keepdry) presented efficiency in control of woodworm-bean, in different applied doses on the grains, have not difference significant statistics. With these dose, the same did not appear grains attacked by insects in 45 days of evaluation after the infestation. The presence of alive insects was not also detected to 45 days after the infestation, have statistics difference of witness. That behavior finds back-up in the specialized literature in authors' citations as Fields and Korunic (2000) and Beckel et al. (2003), can be affected by the insects mobility, the number and distribution cuticle hair, the quantitative and qualitative differences in the fat cuticle that different insects species apper, the relative air humidity and for the time of exhibition that is crucial for the effectiveness of the action diatomacea earth. In the present work, the time of exhibition the insects with the treated bean grains was of 12 days. This happens because in agree with Loeck, (2002) the Acanthoscelides obtectus (Say), the adult insect has around 12 days of longevity, evolutionary cycle of 27 days, the female has posture capacity 60 eggs and the ideal temperature for your development it is at 30 ºC. Paula et al. (2002) affirm that the age of the insects used in the tests it affects the diatomacea earth efficiency. Therefore, it is very important that the insects population used in the tests were uniform and with known age.

The inert powder diatomacea earth basis by its corrosion action in waxes of the layers fat or abrasion the cuticle can be acted about adult insects in this period to 12 days, provoking the insect mortality, avoiding that happened the posture, as well as for abrasive product capacity and hygroscopic can be caused the destruction the eggs, impeding that they emerged. The dosage of inert powder used were effective in control of bean woodworm during the 180 days of storage, differing statistical witness (Table 1).

Similar results were verified by Morás (2005), where the product Keepdry was efficient in the control of the species-pests tested during the rice storage, independent of the used dose. Lorini et al. (2002), tells that the product Keepdry caused the mortality the species–tested pests, depending from the dose to be used and the exhibition period that species with product. It was verified, that the inert dust can be a good alternative as preventive grains treatment during the storage to avoid the damages caused by the woodworm-bean.

In the control, without powder application, it was observed that the grains were infested and happened the whole biological cycle insect development, causing visible damages at the grains (Figures 1 and 2).

Through the analyzes sensorial results, was verified that the grains attacked by insects present a awful visual aspect for the insects presence, perforated grains and an unpleasant smell. The treated grains with inert powder (Figure 3)

Table 1. Effects the inert dust in the control of *Acanthoscelides obtectus*, in common bean grains stored in different times of storage. Average of number of insects alive/experiment.

Treatment	Dose ($kg.t^{-1}$)	Infestation (%) – Days after infestation		
		1	60	180
		45 DAI	45 DAI	45 DAI
Control	-	35 a	38.6 a	45 a
Keepdry	1	0 b	0 b	0 b
Keepdry	2	0 b	0 b	0 b

Averages followed by same letter, in the column, don't differ statistical to each other, for the test of Tukey, to 5 % of significant.

*DAI = Days after the infestation of 20 adult insects for portion.

presented original characteristic smell the black bean (Figure 4), meantime in visual aspect relation, the grains presented a whitish and opaque aspect for the powder presence. Those facts are important for cultural habits consumers bean, that are associated with the acceptability. In the market, when the bean is packed in order to commercialization, the characteristic that more consumer observes it is the visual grains aspect, that should be exempted of sludges, damaged grains and that present original coloration and smell characteristic variety.

For small producings, that use the bean for own consumption, the inert powder becomes an excellent alternative of conservation improvements, because it is efficient the insects control, presents low cost and is an inert material, does not cause health damages, and for your removal it is just to wash the grains before the hydration and subsequent cook.

When the bean destines to commercialization, to put at the market, will need to pass for a cleaning process for powder removal or should consist in the packing that the bean was treated with inert powder and your characteristics, in order to avoid rejection the bean for consumer part.

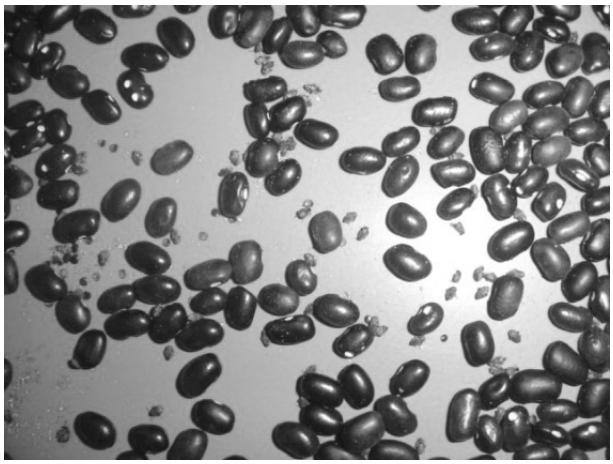

Figura 1. Bean infested by *Acanthoscelides obtectus.*

Figura 2. Damages caused for *Acanthoscelides obtectus.*

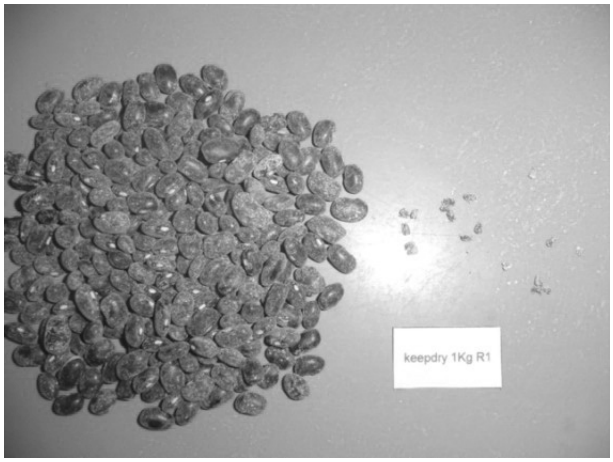

Figure 3. Black beans treated with inert dust.

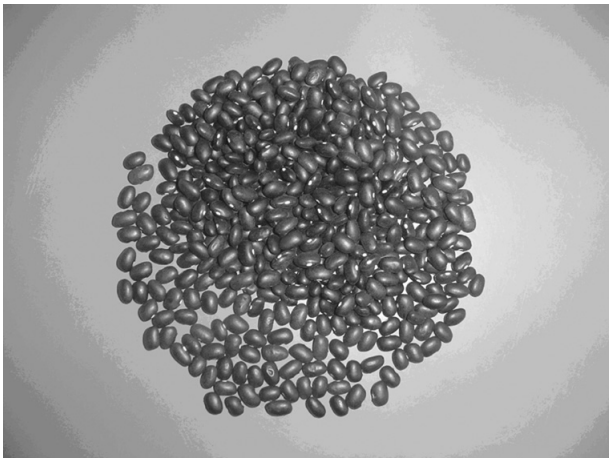

Figure 4. Black beans without treatment.

Conclusions

In the conditions in which work was accomplished it is possible to conclude that:

1) doses 1 and 2 kg t^{-1} of inert powder of diatomaceous earth (Keepdry) are efficient in *Acanthoscelides obtectus* control, during the 180 days of storage;

2) the application of diatomaceous earth gives to the grains a whitish and opaque aspect, but without development of any smell;

3) a simple bean wash before the cooking eliminates the powder completely and makes the grains reacquire original coloration and the characteristic shine.

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