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STORED PRODUCTS PROTECTION WITH SOME NON-TOXIC METHODS

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Abstract

The paper presents the results carried out in laboratory trials by non-toxic methods to control the Indian-meal moth (Plodia interpunctella Hb.) and bean weevil (Acanthoscelides obtectus Say), among the main pests of the stored seeds. Thus, the effect of the low temperatures on Plodia interpunctella larva was evaluated; inert dusts (bentonite, talc, silica gel, tricalcium phosphate) were used to protect the stored bean seeds by the Acanthoscelides obtectus attack.

The used methods had regarded good results; they can be recommended like alternatives to chemical control of the stored products protection.

INTRODUCTION

It is well known that the stored seeds are affected by different insect pests; so, Indian meal moth (*Plodia interpunctella* Hb.) feeding with embryos (one larva destroys 27.7 wheat embryos average during his life [5] and the weevils that feed with the endosperm of the grain are among the main stored products pests. In the same time, the infestation with these pests facilitates the developing of the pathogens like *Aspergillus* sp. that produce toxigens fungi [12].

The losses of the stored products caused by the insect pests used to diminish using pesticides, especially fumigant Methyl Bromide (MB), known to be a major contributor to the destruction of the ozone layer. As a consequence, phase-out of MB (since January 2002 for field application and January 2005 for closed space fumigation, according the OG nr. 89/1999, approved by Law nr. 159/2000, issued in Romania as a requirement of Montreal Protocol on Ozone-Layer depleting chemicals) was decided. The loss of MB has a devastating effect to the post harvest agricultural industry, especially to milling grains and stored beans and nuts, affecting both food safety and food security.

That way, finding the non-toxic, environmental friendly alternatives for the protection of the stored products is an imperative goal.

There are many papers that show the results of the studies about alternative methods to control stored products; thus, we can note a large range of papers with inert dusts [3, 7, 11], microbiological products based on *Bacillus thuringiensis* [8, 9], synthetic pheromones [4, 14, 15].

In Romania there were some trials in this field even many years ago [1, 2]; in the last years, the studies on the alternatives in stored products protection were the main concern of the researchers [6, 13].

This paper presents the latest results on the use of the non-chemical alternatives to protect the stored products.

MATERIAL AND METHODS

a) In order to evaluate the effect of the low temperatures on the Indian-meal moth (*Plodia interpunctella)* larva, two trials in the controlled conditions were carried out. Last age larva were exposed at low temperature (+ 8^{o}C and – 9^{o}C) for 2, 4, 8, 16 and 24 hours (the variants of the experiences); a variant has 4 replications with 10 larva each, placed in plastic boxes covert by a thickly sieve; the mortality after each exposure period and afterwards over 24 hours were evaluated.

b) To prevent the infestation of stored beans by the bean weevil (*Acanthoscelides obtectus* Say), inert dusts (bentonite, talc, silica gel, tricalcium phosphate) were used. Variants formed by 200 grams bean seeds treated with different doses (30, 50 and 100 g/q) for each product set up in 4 replications (800 ccm. jars). The compounds were applied onto the seeds and mixed 10 minutes, than 50 *Acanthoscelides obtectus* adults put into each jar. After 10 days the insects were extracted and percentage of mortality recorded. Monthly, the progenies at the treated variants and at the control were followed; at the interval of 3 months reinfestation was done. The experiences were carried out in the controlled conditions (25^{o}C and 55 ± 5% RH).

RESULTS AND DISCUSSION

a) The effect of the low temperatures on the Indian-meal moth (*P. interpunctella)* larva is presented in table 1. A temperature of + 8^{o}C (under the lower limits of species development) have been chosen; at such low temperature, a stress is imposed on adult moths, causing an increase in adult mortality and surviving adults exhibited decreased egg production and those eggs laid had lower viability [10]. The results presented (table 1) show that after 2 hours from the exposure, the larva had any mortality; after 24 hours from the exposure, the mortalities range between 0 and 17.4%. Following the evolution of the surviving larva, one found that after 2 hours from exposure 36.7% died, 13.6% entered in diapause, 16.7% died like a pupa and 33% became adults; after 4 hours exposure 87.7% surviving individuals transformed in adults; after 8 hours exposure resulted 81.5% moths; after 16 hours 80.3% adults appeared and after 24 hours 46% individuals became moths. It can observes that even after 24 hours, the adults appeared recorded enough amount to continue the development, so the infestation.

At the exposure of - 9 °C of the Indian-meal moth (*Plodia interpunctella)* larva (table 1) 100% mortality was recorded for all the variants, just after exposure.

To be efficient, it is recommended to expose the stored infested products to below 0 °C temperatures.

Table 1

The effect of low temperatures on *Plodia interpunctella* last stage larva

Temp. (°C)	Exposure time (hours)	Mortality (%)		Evolution of the larva exposed			
		Just after exposure	After 24 hours from exposure	Dead larva (%)	Diapaused larva (%)	Dead pupa (%)	Adults (%)
+8°C	2	0	0	36.7	13.6	16.7	33.0
	4	0	5.6	6.7	-	-	87.7
	8	0	7.2	-	1.3	6.7	81.5
	16	0	13.0	3.3	3.4	-	80.3
	24	0	17.4	20.0	6.6	10.0	46.0
-9°C	2	100	-	-	-	-	-
	4	100	-	-	-	-	-
	8	100	-	-	-	-	-
	16	100	-	-	-	-	-
	24	100	-	-	-	-	-

b) The graphics from 1-4 figures present the results of the inert dusts (silica gel, bentonite, talc and tricalcium phosphate) to protect the stored bean seeds by the *Acanthoscelides obtectus* attack.

It can observe that silica gel (figure 1) had good effect even at 30 g/q assuring protection of the seeds almost 400 days; at 50 g/q dose any weevil appeared from the beginning to almost 2 years.

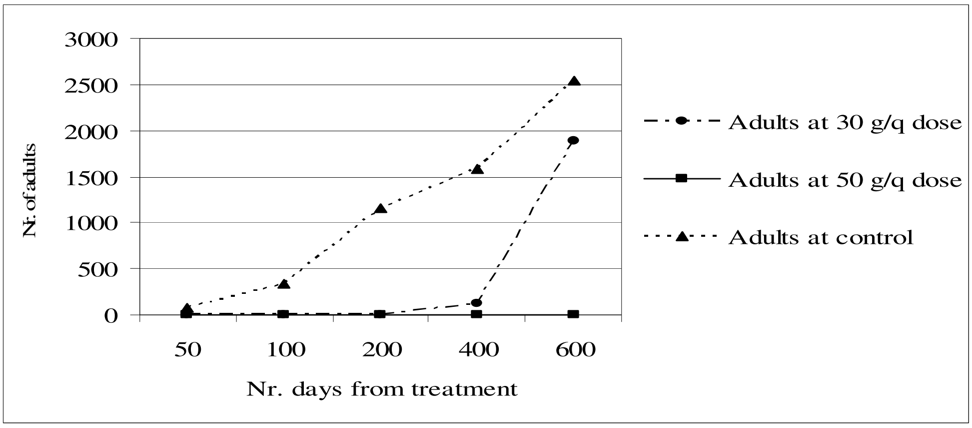

Fig. 1. The effect of silica gel on bean weevil *Acanthoscelides obtectus*

The bentonite (figure 2) was inefficient at 50 g/q dose; at 100 g/q assured the protection 200 days, than the population became to recover.

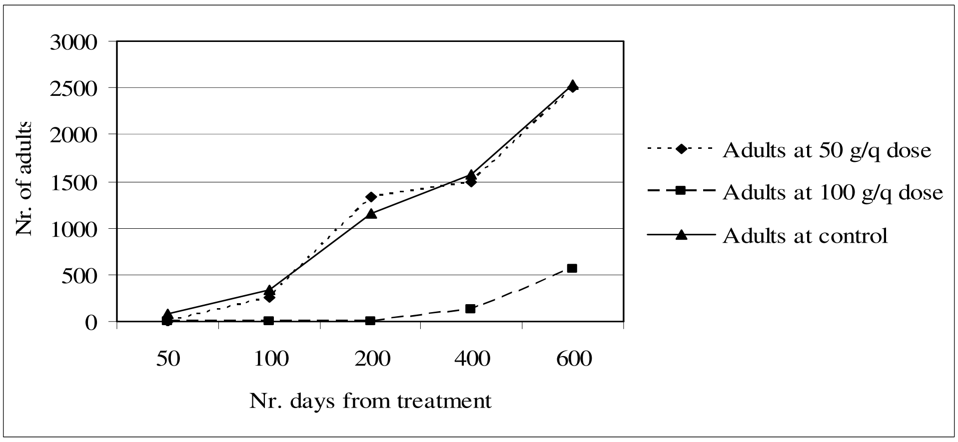

Fig. 2. The effect of bentonite on bean weevil *Acanthoscelides obtectus*

The talc (figure 3) recorded inefficient results for the protection of the stored bean seeds against bean weevil *Acanthoscelides obtectus,* the population of the pest recovering after 50 days from treatment, the same like in control variant.

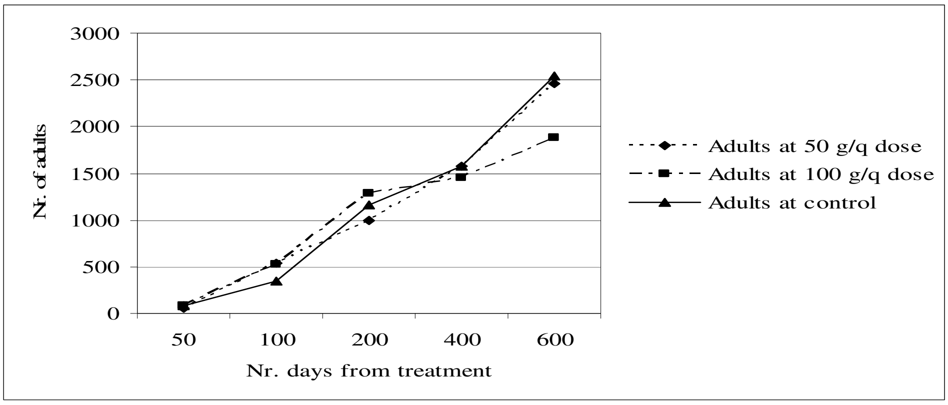

Fig. 3. The effect of talc on bean weevil *Acanthoscelides obtectus*

The treatment with tricalcium phosphate (figure 4) protected the stored bean seeds at 100 g/q dose for almost 400 days; 50 g/q dose were inefficient.

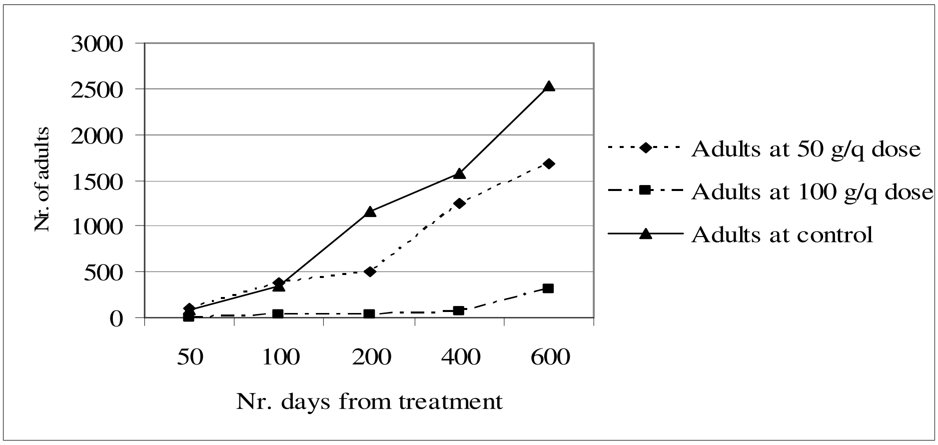

Fig. 4. The effect of tricalcium phosphate on bean weevil *Acanthoscelides obtectus*

CONCLUSIONS

1. The exposure to low temperatures of the stored products infestated with Indian-meal moth (*Plodia interpunctella)* can diminish the losses.
2. The exposure of - 9 ^{o}C was totally lethal just after exposure; at + 8^{o}C, even after 24 hours from the exposure the adults appeared recorded enough amount to continue the development of the population, so the infestation.

3. To be efficient, it is recommended to expose the stored infested products to below 0 °C temperatures.
4. The use of natural products to control various stored-product insects, including bean weevil is an alternative to chemical treatments and fumigation.
5. The results on the inert dusts (silica gel, bentonite, talc and tricalcium phosphate) used to protect the stored bean seeds by the *Acanthoscelides obtectus* attack show the following: silica gel had good effect even at 30 g/q dose; bentonite at 50 g/q assured the protection 200 days; talc recorded inefficient results, the population of the pest recovering after 50 days from treatment; tricalcium phosphate protected the stored bean seeds at 100 g/q dose for almost 400 days.

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