# EFFECTIVENESS OF MAIN SOURCES OF DIATOMACEOUS EARTH FROM ROMANIA ON POPULATIONS OF *SITOPHILUS GRANARIUS* L. (COLEOPTERA: CURCULIONIDAE) UNDER CONTROLLED CONDITIONS

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**Abstract:** The efficacy of 3 samples of diatomaceous earth from Pătârlagele, Urloaia and Adamclisi sources was assessed against a standard product (PyriSec®) and an untreated control, on a population of *Sitophilus granarius* L. (Coleoptera: Curculionidae) grown on natural feed (wheat grains), under laboratory controlled conditions. Bioassays were conducted in plastic jars at a temperature of 25±2°C and relative humidity 75%, in which were introduced insects (30 individuals/replicate), on natural feed (50g wheat grains) and diatomaceous earth it was administered at a dose of 900 ppm. Observations were made at intervals of 7, 14 and 21 days after the administration of natural product, percent of mortality for each variant were recorded. The results indicate an increased mortality of weevil individuals from tested variants, compared to standard product and untreated control, the percentage values between 83.33% (Urloaia and Adamclisi sources) and 100% for Pătârlagele source. After 60 days from the beginning of the experiment was evaluated the population's ability to reproduce in the mentioned conditions and to produce offspring; the diatomaceous earth product (source from Pătârlagele) has blocked the development of insects reproduction shortly after the administration (mean ±0-1 individuals /replicate).

***Key words**: grain storage, insecticide, diatomaceous earth, Sitophilus granarius*

## INTRODUCTION

The concerns with food quality and environment protection have led to the search to found alternative and integrated insect control measures. Among several kinds of inert dusts, the diatomaceous earth has a great potential for controlling urban and stored product pests and has been studied by many researchers worldwide (Subramanyam *et al.*, 1989; Aldryhim, 1990, 1993; Arthur & Zettler, 1991; Lorini & Scheneider, 1994; Arthur, 1996, 2002; Golob, 1997; Korunic *et al.*, 1998; Rupp *et al.*, 1998; Subramanyam *et al.*, 1998; Fields, 2000; Mewis & Ulrichs, 2001).

The use of diatomaceous earth is a very efficient insect control measure in stored grain IPM due to its low cost, easy application, reduction of active ingredient residues, lower environmental contamination and operator safety (Ceruti *et al.*, 2005). According to Mital & Wrightman (1989) and Arthur (1996), the interest in diatomaceous earth has increased because the number of active ingredients for insect control in stored products is reduced to four or five products due mainly to insecticide resistance problems. Biological control is a very effective pest management strategy in warehouses and grain supply and among the new methods used, the diatomaceous earth can be an efficient alternative and cost-effective to prevent attacks from insects or pathogenic fungi and to create the conditions for safe storage of cereals (Korunic, 1998; Phillips & Throne, 2010). Diatomaceous earth biological action

occurs by rapid dehydration of pest's tissues, causing their death. The diatomaceous earth insecticidal composition vary depending on the species of mineralized diatomee, geological and geographical origin, as well as specific chemical characteristics, such as the $SiO_2$ content, the pH and the particle size.

The purpose of this study was to determine the effectiveness of main sources of diatomaceous earth from Romania on populations of *Sitophilus granarius*. PyriSec® was used as a standard product; the commercial product is a less toxic alternative to control the population of pests from the stored grain and is active against all the species of insects existing in deposits, such as coleopterans, moths and spider mites.

## MATERIALS AND METHODS

### Testing biological action of diatomaceous earth (DE)

The present study is a preliminary test of green products based on diatomaceous earth, used to prevent the attack of insect pests in grain and food warehouses. By simulating real conditions in warehouse, we have developed the working protocol and the conditions for the products application.

The experimental design was as follows:

$V_1$ – Pătârlagele (900 ppm DE)
$V_2$ – PyriSec® (900 ppm DE)
$V_3$ – Urloaia (900 ppm DE)
$V_4$ – Adamclisi (900 ppm DE)
$V_5$ – Untreated control

To test the effectiveness of DE-based products, the insect species *Sitophilus granarius* L. was chosen for which there is already a growing Bio-base at ICDPP Bucharest. In the special plastic jars were placed 50g wheat grains and by 30 adult specimens of *S. granaries*, in three replicates for each variant (Figure 1). The dishes were maintained in a room with controlled conditions at a temperature of 20$^{o}$C, a relative humidity of 25% ± 75% and a 12 hours photophase. Observations were made at intervals of 7, 14 and 21 days, insects mortality was recorded in each repetition of the above. The comparative tests on the stored grain warehouse conditions of the same variants were also performed (Figure 2).

**Figure 1.** The experimental design of replicates and variants tested in laboratory

**Figure 2.** Aspect from the stored grain unit from Păuleşti Agrotehnic SRL

## RESULTS AND DISCUSSIONS

The results of the preliminary experiments in the laboratory conditions of the biological control of the population of pest insects by using diatomaceous earth has shown

that the insect mortality caused by this is significant at a dose of 900 ppm (500g/t seeds), very similar to that produced by standard pyrethroid based PyriSec® (Figure 3). Mortality gained after the first period of observation was between 83.33% and 100%, and at the end of the experiment it stood between 96.66% and 100% (Table 1).

**Table 1.** Diatomaceous earth influence on the *Sitophilus granarius* L. population under controlled conditions

| | % mortality at 7 days | % mortality at 14 days | % mortality at 21 days |
|---|---|---|---|
| $V_1$ - Pătârlagele | 96.66 | 100.00 | 100.00 |
| $V_2$ – Urloaia | 83.33 | 96.66 | 96.66 |
| $V_3$ - Adamclisi | 83.33 | 96.66 | 100.00 |
| $V_4$ - PyriSec® | 100.00 | 100.00 | 100.00 |
| $V_5$ – Untreated control | 2.50 | 0.00 | 0.00 |

These results are according with previous laboratory tests which indicated that the product SilicoSec® is effective against adults of *Sitophilus* related species (*S. oryzae*), (Pinto, 1994; Athanassiou et al., 2011), which at the same dose of diatomaceous earth used (900 g/t seed) showed a mortality rate of 100% after 19 days of exposure. Two factors contribute to achieving greater effectiveness namely dose and exposure time. It also notes that the decision to use a chemical product, even in combination with diatomaceous earth like PyriSec® has advantages and disadvantages of that application, both should be considered. Chemical action is undoubtedly faster, but does not exclude that the selective pressure to trigger resistance in *S. granarius* population. Another negative consequence is that the chemical, however well formulated, leaves residues in grain mass which accumulate over time and become toxic or contaminate the environment. Diatomaceous earth has nearly the same effectiveness as the chemical, although the action is slow but adsorption in grains stops the reproduction process of the pest population and thus keeps the population below harmful pest value.

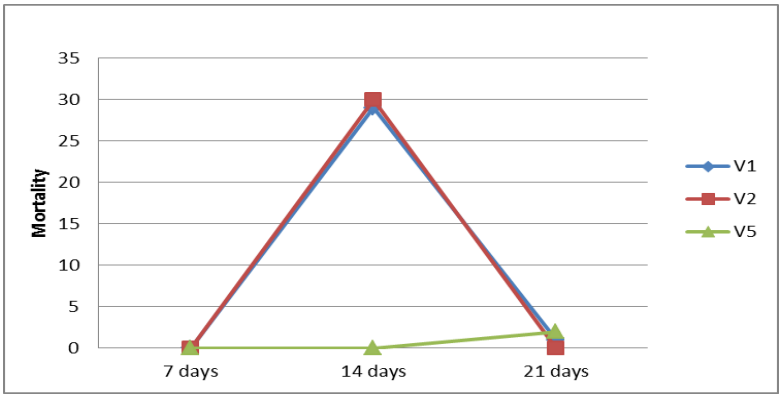


**Figure 3**. The effectiveness of diatomaceous earth from Pătârlagele compared to the PyriSec® standard and untreated control

## CONCLUSIONS

The dose of 900 ppm (900 g/t seeds) of diatomaceous earth used to control of *S. granarius* in the storage of cereals (wheat) had a maximum of efficacy (100%) after 21 days of exposure similar to the standard of chemical product (PyriSec®). The mortality of individuals of the pest population was considerable after 14 days of the application. The

mixture of diatomaceous earth with natural pyrethroids, even at low concentrations to keep the insect population density at low levels, may lead to the emergence of the resistance effect in pest population.

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