Παραδοτέο έργου

Παραδοτέο Π4.3. «Δημοσίευση των αποτελεσμάτων σε έγκριτα διεθνή επιστημονικά περιοδικά και συνέδρια»

DiatomiteThem

Τίτλος Έργου:

Προστασία των αποθηκευμένων δημητριακών με τη χρήση γης διατόμων

«Το έργο αυτό υλοποιείται στο πλαίσιο της Δράσης ΕΡΕΥΝΩ-ΔΗΜΙΟΥΡΓΩ-ΚΑΙΝΟΤΟΜΩ και συγχρηματοδοτήθηκε από το Ευρωπαϊκό Ταμείο Περιφερειακής Ανάπτυξης (ΕΤΠΑ) της Ευρωπαϊκής Ένωσης και εθνικούς πόρους μέσω του Ε.Π. Ανταγωνιστικότητα, Επιχειρηματικότητα & Καινοτομία (ΕΠΑνΕΚ) (κωδικός έργου: Τ2ΕΔΚ-03532)»

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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

ΠΕΡΙΕΧΟΜΕΝΑ

1. Έγκριτα διεθνή περιοδικά

Τα αποτελέσματα του πειραματισμού από την ΕΕ4 έχουν δημοσιευθεί στο περιοδικό Applied Sciences με Impact Factor: 2.381, όπως αναφέρεται παρακάτω:

1.1. Baliota, G.V.; Athanassiou, C.G. Evaluation of Inert Dusts on Surface Applications and Factors That Maximize Their Insecticidal Efficacy. Appl. Sci. 2023, 13, 2767 https://doi.org/10.3390/ app13052767

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Article

Evaluation of Inert Dusts on Surface Applications and Factors That Maximize Their Insecticidal Efficacy

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Simple Summary: Inert dusts including diatomaceous earths and zeolites have been proved very effective as grain protectants against stored product insects. However, little progress has been made towards the evaluation of their insecticidal activity when applied directly to different types of surfaces. In this study, we evaluated two diatomaceous earth formulations and one zeolite deposit from Greece when applied to concrete and steel against three major stored product insect pests. Based on the results, both dusts achieved complete control of all insect species within a week. The type of surface was found to not be a factor of significance for the effectiveness of the dusts. These data further encourage the exploitation of these natural insecticides for structural treatments in storage facilities, either as alternatives to residual insecticides and fumigants that have been used as essential components for stored-grain protection systems, or for integrated pest management (IPM) approaches.

Abstract: We evaluated formulations of diatomaceous earth and zeolite originated from natural deposits from Greece as insecticides in concrete and steel surfaces for the control of three major beetle species of stored products: *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae), *Rhyzopertha dominica* (F.) (Coleoptera: Bostrychidae) and *Tribolium confusum* Jacquelin du Val (Coleoptera: Tenebrionidae). The formulations were tested as dusts at 0.5 or 1 g/m^2. Our results indicated that, in most of the cases tested, the inert materials caused 100% adult mortality for all three species, even at the lowest dose, after 7 days of exposure. At the same time, there were no considerable differences in the insecticidal effect of the formulations between concrete and steel surfaces. Among the species tested, *R. dominica* was the most susceptible, followed by *S. oryzae* and *T. confusum*. Our results indicate that natural resource-based inert silicaceous deposits could be used with success in stored product protection against insects at dose rates that are comparable with other commercially available inert material-based formulations.

Keywords: diatomaceous earth; zeolite; natural insecticides; stored product insects; structural treatments

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Citation: Baliota, G.V.; Athanassiou, C.G. Evaluation of Inert Dusts on Surface Applications and Factors That Maximize Their Insecticidal Efficacy. *Appl. Sci.* **2023**, *13*, 2767. https://doi.org/10.3390/app13052767

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1. Introduction

Inert dusts, such as diatomaceous earths (DEs) and zeolites are promising alternatives to the use of traditional chemical methods in stored product protection [1]. A high number of studies have documented their efficacy against a wide range of insect species [2–6], while some studies have shown that these dusts are effective against fungi and bacteria that may co-infest the commodity along with insects [7]. In a recent review, Zeni et al. [8] illustrated the insecticidal potentials of DEs and related materials against a variety of insect taxa (Blattodea, Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera), including household or agricultural pest species but also non-target insects. Similarly, Eroglou et al. [9] reviewed the potentials of utilizing zeolites in food and agriculture including their important role in stored-pest management as inert dust applications.

From the species tested here, we can conclude that both *S. oryzae* and *R. dominica* were far more susceptible than *T. confusum* to all formulations. From the most to the least susceptible, these three species can be classified as *R. dominica* > *S. oryzae* > *T. confusum*. Earlier studies have confirmed that the species of the genus *Tribolium* are probably the most tolerant stored product beetle species to inert dusts [6,8,40]. Interestingly, *R. dominica* was the most susceptible among the three species tested, despite the fact that this species is less agile than the other two [41,42]. Both *S. oryzae* and *R. dominica* are primary colonizers and can easily infest sound grain kernels, so they are most likely to be found in bulked grains, and not in surfaces, as compared with *T. confusum*, which is mostly found in processed commodities and processing facilities, such as flour mills. The application of these dusts as "barriers" to limit the spread of primary colonizers to infest additional areas with bulked grains has been found to be a viable solution, given that the presence of inert dusts has a repulsive action in some stored product insect species [1,8,43].

The concentrations tested here are generally comparable with those that have been used in similar studies testing inert materials in surfaces against insects [44–48]. We found that the formulation DE5 was usually less effective than the other two formulations for the majority of the combinations tested. However, even in the case of DE5, adult mortality reached 100% at a relatively short period of time, suggesting that the exposed individuals were largely affected even from the first days of their contact with the DE particles. Baliota and Athanassiou [28] reported that both DE5 and DE6 were effective for the control of major stored product beetle species as grain protectants, with DE6 to be slightly superior to DE5, which stands in agreement with the current observations. Nonetheless, all three formulations were able to kill all adults for all three species tested after 7 d of exposure, while, at least for *S. oryzae* and *R. dominica*, adult mortality was 100% even after 3 d of exposure. Arthur [49] used 0.5 g/m^2 of the commercial DE formulation Protect-It, and found that after 7 d, adults of *T. confusum* were still alive and not heavily affected. Extremely low "speed of kill" after exposure to DEs is not desirable, as insects can escape from the treated area and colonize uninfested grain [1]. Nevertheless, in the case of *T. confusum*, larval mortality after exposure to inert dusts may be high [50], which can gradually eliminate the population through increased immature mortality.

The current work sheds light on the application of DEs and zeolites on surfaces. It provides evidence that, in contrast with other insecticides, the type of surface may not be an important parameter here. Our study contributes further to the exploitation of the value of certain natural deposits of silicaceous materials as a means to control stored product insect pests. Considering the need to adopt non-chemical solutions in stored product protection, and taking into account that inert materials are compatible with sustainable and organic food production, additional work is needed to quantify the effectiveness of these formulations when applied in empty storage facilities under a variety of application scenarios.

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Data Availability Statement: Not applicable.

Εικόνα 1: Ενδεικτικά η πρώτη σελίδα της δημοσίευσης και οι αναφορές στο έργο