



ΠΑΝΕΠΙΣΤΗΜΙΟ  
ΘΕΣΣΑΛΙΑΣ

Παραδοτέο έργου

Παραδοτέο Π3.4. «Δημοσίευση των αποτελεσμάτων σε έγκριτα διεθνή επιστημονικά περιοδικά και συνέδρια»



DiatomiteThem

# DiatomiteThem

Τίτλος Έργου:

Προστασία των αποθηκευμένων δημητριακών με τη  
χρήση γης διατόμων

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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης



## ΠΕΡΙΕΧΟΜΕΝΑ

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### 1. Έγκριτα διεθνή περιοδικά

Τα αποτελέσματα του πειραματισμού από την ΕΕ 3 έχουν δημοσιευθεί στο περιοδικό Molecules με Impact Factor: 2.381, όπως αναφέρονται παρακάτω:

- 1.1. **Zeni, V.; Baliota, G.V.; Benelli, G.; Canale, A.; Athanassiou, C.G. Diatomaceous Earth for Arthropod Pest Control: Back to the Future. Molecules 2021, 26, 7487. (<https://doi.org/10.3390/molecules26247487>) (Impact Factor: 2.381)**



Review

# Diatomaceous Earth for Arthropod Pest Control: Back to the Future

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**Abstract:** Nowadays, we are tackling various issues related to the overuse of synthetic insecticides. Growing concerns about biodiversity, animal and human welfare, and food security are pushing agriculture toward a more sustainable approach, and research is moving in this direction, looking for environmentally friendly alternatives to be adopted in Integrated Pest Management (IPM) protocols. In this regard, inert dusts, especially diatomaceous earths (DEs), hold a significant promise to prevent and control a wide range of arthropod pests. DEs are a type of naturally occurring soft siliceous sedimentary rock, consisting of the fossilized exoskeleton of unicellular algae, which are called diatoms. Mainly adopted for the control of stored product pests, DEs have found also their use against some household insects living in a dry environment, such as bed bugs, or insects of agricultural interest. In this article, we reported a comprehensive review of the use of DEs against different arthropod pest taxa, such as Acarina, Blattodea, Coleoptera, Diptera, Hemiptera, Hymenoptera, Ixodida, Lepidoptera, when applied either alone or in combination with other techniques. The mechanisms of action of DEs, their real-world applications, and challenges related to their adoption in IPM programs are critically reported.

**Keywords:** urban pests; agricultural pests; aphids; cockroaches; kissing bugs; insect vectors; green insecticides; mosquitoes; moth pests; non-target toxicity; stored product pests; termites



**Citation:** Zeni, V.; Baliota, G.V.; Benelli, G.; Canale, A.; Athanassiou, C.G. Diatomaceous Earth for Arthropod Pest Control: Back to the Future. *Molecules* **2021**, *26*, 7487. <https://doi.org/10.3390/molecules26247487>

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## 1. Introduction

Among different types of inert materials currently adopted in pest control, diatomaceous earths (DEs) hold a prominent position, as they are apparently the most often tested material for this purpose. A search in *Journal of Stored Products Research* for published papers between January 2019 and January 2021 revealed the publication of 13 papers with “diatomaceous earth” on their title, emphasizing the utilization of DEs in stored product protection. DEs are not only used for the management of insects and other arthropods, but they also have multiple uses including the control of different pathogens, such as fungi and bacteria [1–4]. Other types of inert dusts, such as zeolites [5] or kaolin [6], have been also investigated for pest control. This work will be focused solely on the use of DEs in crop protection but also in post-harvest and urban pest control, highlighting their wide applicability.

In a recent review paper, Athanassiou et al. [7] categorized the materials that can be used in pest control and fall into the category of “nano” under the general term of nanoparticles. Although there are cases where DE particles can touch the “nano” scale, DEs are generally classified in the “micro” category and can be considered as “microparticles” in contrast with nanoparticles.

DEs are the fossilized remains of phytoplankton, which are diatoms that occurred mostly during the Miocene and Eocene periods [1]. Diatoms are unicellular eukaryotic



properties but also some properties of the commodity itself. Therefore, more specific methods of processing must be found to standardize the production of dusts bearing the most desirable features for increased insecticidal efficacy.

Application methods and systems of DEs are also an issue of major importance, requiring additional investigation. Even with the current DE formulations, different application techniques, such as using slurries or treating only partial layers of the food, should be explored. Thus, research should be conducted under a range of food-handling establishments to design effective protocols for pest management but also to determine the effects of sanitation on the performance of DE dusts. Such real-scale applications may highlight the potential of DEs and explore ways of integrating DE applications within the total pest/vector management program in food industry, agricultural and urban settings.

The data from laboratory studies underline the insecticidal and acaricidal value of DEs under a wide range of arthropods. Further analysis must be conducted toward this direction not only to identify all the target species but also to investigate the overall outcome of DEs in non-target species. Indeed, by examining the current literature, we observed that non-target effects of DE have been evaluated only on a limited number of natural enemies of crop pests, with special reference to aphidophagous coccinellids, lacewings, anthochorids, and Phytoseiidae mites, showing limited consequences for these important biocontrol agents. In this promising scenario, further research should be devoted in understanding the potential non-target effects of DE-based formulations.

**Author Contributions:** Conceptualization, G.B. and C.G.A.; Literature collection and analysis, V.Z., G.V.B., G.B., A.C. and C.G.A.; writing—original draft preparation, V.Z. and G.V.B.; writing—review and editing, V.Z., G.V.B., G.B., A.C. and C.G.A.; visualization, G.B., A.C., C.G.A.; supervision, G.B., A.C., C.G.A. All authors have read and agreed to the published version of the manuscript.

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**Conflicts of Interest:** The authors declare no conflict of interest.

**Sample Availability:** Not applicable.

## References

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



## 2. Συνέδρια

Η έρευνα δημοσιεύτηκε ως περίληψη στα πρακτικά συνεδρίου (abstract peer reviewed) και παρουσιάστηκε σε ευρύ κοινό (oral presentation).

### 2.1. Athanassiou, C.G.; Baliota, G.V.; Lampiri, E.; Bohinc, T.; Rumbos, C.I.; Batzogianni, E.N.; Trdan, S. Diatomaceous Earths in Stored-Product Protection: Assets and Liabilities. Presentation 15th Slovenian Conference on Plant Protection, 01-02 March 2022, Portorož, Slovenij. ([https://dvsr.bf.uni-lj.si/wp-content/uploads/15\\_SPVR\\_2obvest\\_2022.pdf](https://dvsr.bf.uni-lj.si/wp-content/uploads/15_SPVR_2obvest_2022.pdf))

TOREK, 1. marec – Dvorana Emerald I

Sekcija *Varstvo poljščin in krmnih rastlin*

**Delovno predsedstvo:** mag. Jože MIKLAVC, prof. dr. Mario LEŠNIK, mag. Meta URBANČIČ ZEMLJIČ

14:00 Sergeja ADAMIČ, Robert LESKOVŠEK Spremembe v plevelni semenski banki v obdobju prehoda iz konvencionalne obdelave tal v sistem konzervirajoče obdelave tal in sistem brez obdelave tal

14:15 Mario LEŠNIK, Zita FLISAR NOVAK, Slavko KRPIČ, Iris ŠKERBOT, Igor ŠKERBOT, Andrej PAUŠIČ Vpliv priprave setvišča za setev in načina uporabe herbicidov na obseg erozije v posevkih koruze na strmih

14:30 Timotej HORVAT, Boštjan MATKO, Miro MEŠL, Marjeta MIKLAVC, Leonida LEŠNIK, Tamara KOROŠEČ, Jože MIKLAVC Vpliv različne obdelave tal na učinkovitost herbicidov in pridelok koruze

14:45 Marko KOVAČIČ, Renata DEJANOVIČ, Hrvoje SAMBOLEK, Fani BOGAT, Darko TOPOLOVEC Integrated weed management (IWM platform) – four years of trials, experiences and results

15:00 Meta URBANČIČ ZEMLJIČ, Jernej LONČAR, Blaž FERJAN, Neja MAROLT, Jože MIKLAVC, Boštjan MATKO, Miro MEŠL, Marjeta MIKLAVC, Leonida LEŠNIK, Evgen PULKO, Urška ŠKRABAR, Andrej ŠUVAK, Timotej HORVAT Izkkušnje z zatiranjem boleznih v ozimnem ječmenu v letu 2021

15:15 Janja ZAJC, Metka ŽERJAV Odpornost glive *Zymoseptoria tritici*, povzročiteljice pšenične listne pegavosti, proti fungicidom iz skupine azolov

15:30 Eva PRAPROTNIK, Jernej LONČAR, Jaka RAZINGER Testiranje virulentnosti različnih vrst z žuželkami povezanih gliv na ličinkah velikega molarja (Coleoptera: Tenebrionidae) ter njihove potencialne stimulacije rasti koruze

15:45 Razprava

16:00 Odmor

**Delovno predsedstvo:** prof. dr. Stanislav TRDAN, dr. Sebastjan RADIŠEK, dr. Irena MAVRIČ PLEŠKO

16:15 Christos G. ATHANASSIOU, Georgia V. BALIOTA, Evaggelia LAMPIRI, Tanja BOHINC, Christos I. RUMBOS, Euanthia BATZOGIANNI, Stanislav TRDAN Diatomaceous earths in stored-product protection: assets and liabilities

16:30 Tanja BOHINC, Filip VUČAJNK, Stanislav TRDAN Preučevanje učinkovitosti inertnih prašiv za zatiranje koloradskega hrošča (*Leptinotarsa decemlineata* [Say], Coleoptera, Chrysomelidae) na krompirju

16:45 Dragana PREDOJEVIČ, Filip VUKAJLOVIČ, Nevena PETROVIČ, Marijana KOSANIČ, Snežana PEŠIČ Larvicidal efficacy, antifedant activity and repellency of *Lactifluus piperatus* against *Plodia interpunctella* Hübner (Lepidoptera: Pyralidae)

17:00 Primož ŽIGON, Marko PETEK, Kristina GRUDEN, Eva PRAPROTNIK, Špela MODIC, Aleks BORDON, Peter DOLNIČAR, Jaka RAZINGER Preizkušnje alternativnih možnosti obvladovanja koloradskega hrošča (*Leptinotarsa decemlineata*) z uporabo bioinsekticidov

17:15 Barbara GERIČ STARE, Uroš ŽIBRAT, Nik SUSIČ, Maja STAROVIČ, Matej KNAPIČ, Janez LAPAJNE, Saša ŠIRCA Odkrivanje gomoljev krompirja napadenega z ogoščicami koreninskih sisk *Meloidogyne luci* s hiperspektралnim slikanjem in metodami PCR v realnem času

17:30 Maja DOBRAJC, Jernej JAKŠE, Sebastjan RADIŠEK Stabilnost in prenos viroida razpokanosti skorje agrumov (CBCVd) z vodo na hmelj (*Humulus lupulus* L.)

Εικόνα 2: Απόσπασμα από την ανάρτηση του προγράμματος παρουσιάσεων του συνεδρίου



### Diatomaceous earths in stored-product protection: assets and liabilities

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*Izvečki referatov 15. slovenskega posvetovanja o varstvu rastlin z mednarodno udeležbo  
Portorož 2022*

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Diatomaceous earths (DEs) are considered promising alternatives over the use of traditional pesticides that are currently in use for stored product protection. DEs are based on the fossilized remains of phytoplanktons and act on insects' cuticle mechanically, through desiccation. Apart from the control of insects, DEs can be also effective for the control of fungi in stored products, and are regarded as functional aflatoxin binders. Earlier studies have shown that the Western Balkan area is rich of natural deposits that can be used for this purpose. In this context, there are several DE formulations that have been registered for surface treatments in storage and processing facilities or as admixture with grains. Numerous publications have clearly illustrated that the efficacy of DEs is highly moderated by a series of biotic and abiotic conditions, and, as such, any DE-based strategy should be regarded under this prism. Despite their high efficacy, the application of DEs against insects and pathogens has certain drawbacks, mostly on the physico-chemical properties of the commodity that are to be applied. In the current work, we will summarize the pros and cons of DE use at the industrial level, and the potentials of these substances in an IPM-based strategy.

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**Εικόνα 3:** Απόσπασμα από την ανάρτηση της περίληψης στο πρόγραμμα του συνεδρίου



## Diatomaceous earths in stored-product protection: assets and liabilities



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☀ Thank You



Εικόνα 4: Αποσπάσματα από την παρουσίαση στο συνέδριο