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AND FOOD TECHNOLOGIES
INOPTEP 2023**

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Dr. Milivoj Radojčin

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NATURAL PRODUCTS IN STORED PRODUCT PEST CONTROL: CHALLENGES AND OPPORTUNITIES

Sonja GVOZDENAC¹, Dejan PRVULović², Vojislava BURSIC², Snežana TANASKOVIĆ³

¹Institute of Field and Vegetable Crops, National Institute of the Republic of Serbia, Maksima Gorkog 30, Novi Sad, Serbia

²Faculty of Agriculture, University of Novi Sad, Trg Dositeja Obradovića 3, Novi Sad, Serbia

³Faculty of Agronomy in Čačak, University of Kragujevac, Cara Dušana 34, Čačak, Serbia

Contact: sonja.gvozdenac@ifvcns.ns.ac.rs

Postharvest losses of stored grains are recognized as a major constraint in food security. The losses caused by stored product pests (insects, microorganisms and rodents) amount from 20 to 80%, depending on the region, thus their reduction can increase available food supplies. The control of pests in storage and processing industry is mainly relying on the use of chemically synthesized pesticides and toxic fumigants. However, the inadequate and frequent use of these compounds has led to a development of pest resistance (to residual insecticides, fumigants and some fungicides), residues in food and feed, environmental and health hazards and other adverse impacts. The mentioned has resulted in a ban or restriction of a number of pesticide compounds in recent years, particularly insecticides, enabling the expansion of natural products (NPs) use in stored product pest management. Although NPs have long been used as pesticides and have served as an inspiration for numerous commercial synthetic products, at some point in history they were neglected. NPs originate from natural sources, and are i) mineral-derived (inert dusts: diatomaceous earth, kaolin clay, boric acid, zeolite, silver nanoparticles etc.) or ii) plant-derived compounds (terpenes, phenolics, steroids, alkaloids etc.).

A search for alternatives to chemical pesticides and fumigants resulted in an attempt to involve inert dusts (IDs) in stored product protection. IDs are mainly used as insecticides because they cause desiccation in insects by destroying the wax layer in the cuticle, causing the 60% loss of body water i.e. 30% loss of total body weight. The majority of IDs applied include natural silica (DE and zeolite) or clays, however the efficacy depend on the origin and physio-chemical characteristics. Compatibility of IDs with other control techniques, such as conventional insecticides, botanicals, aeration and heat treatment can increase their practical utilization, and this field of research is still wide open. The second most important group of NPs represents plant-derived compounds, also called botanicals. Many plant species contain secondary metabolites with biological activity against different storage pest groups (insects, mites, pathogenic fungi or bacteria). However, even after a long history of application and confirmed efficacy, at the moment botanicals, and other NPs are a small contributor to the global plant protection product market. Nonetheless, in the era of “green chemistry” as well in the light of more severe pesticide restriction, it is estimated that these products will take a higher market share in the future, if not as sole products, than as models for development of new synthetic pesticides.

This work presents the NPs with the highest applicative potential against stored product pests, and gives an insight into their mode of action, biological activity, spectra, health implications, obstacles to commercialization and scaling-up potential.

Key words: *inert dusts, botanicals, storage pests*

PRIRODNI PROIZVODI U SUZBIJANJU ŠTETOČINA USKLADIŠTENIH PROIZVODA: IZAZOVI I MOGUĆNOSTI

Sonja GVOZDENAC¹, Dejan PRVULOVIĆ², Vojislava BURSIĆ², Snežana TANASKOVIĆ³

¹Institut za ratarstvo i pivovarstvo, Institut od nacionalnog značaja za Republiku Srbiju, Maksima Gorkog
30, Novi Sad, Srbija

²Poljoprivredni fakultet, Universitet u Novom Sadu, Trg Dositeja Obradovića 3, Novi Sad, Srbija
Agronomski fakultet u Čačku, Universitet u Kragujevcu, Cara Dušana 34, Čačak, Srbija

kontakt: sonja.gvozdenac@ifvcns.ns.ac.rs

Poslešetveni gubici uskladištenih zrnastih proizvoda prepoznati su kao glavno ograničenje u raspoloživosti hrane. Gubici koje uzrokuju štetočine uskladištenih proizvoda (insekti, mikroorganizmi i glodari) iznose od 20 do 80%, u zavisnosti od regiona, te smanjenje istih može doprineti povećanju zaliha hrane. Suzbijanje štetočina u skladišnim objektima i prehrambenoj industriji, uglavnom se zasniva na upotrebi hemijski sintetisanih pesticida i toksičnih fumiganata. Međutim, neadekvatna i česta upotreba ovih jedinjenja dovela je do razvoja rezistentnosti štetnih organizama prema rezidualnim insekticidima, fumigantima i nekim fungicidima, do pojave ostataka u hrani za ljudsku ishranu i životinje, opasnosti po životnu sredinu i zdravlje i drugih negativnih posledica. Navedeno je rezultiralo zabranom ili restrikcijom primene brojnih pesticidnih jedinjenja, posebno insekticida, usled čega se intenzivirala razvoj i upotreba prirodnih proizvoda (PP) u zaštiti od skladišnih štetočina. Iako su PP dugo korišćeni kao pesticidi i služili su kao model jedinjenja za brojne komercijalne sintetičke proizvode, u nekom trenutku u prošlosti, su zanemareni. PP potiču iz prirodnih izvora i mogu biti i) mineralnog (dijatomejska zemlja, kaolin glina, borna kiselina, zeolit, nanočestice srebra itd.) ili ii) biljnog porekla (terpeni, fenoli, steroidi, alkaloidi itd.).

Inertna prašiva (IP) su uključena u zaštitu uskladištenih proizvoda kao alternativa pesticidima i fumigantima. IP se uglavnom koriste kao insekticidi, jer uzrokuju desikaciju insekata uništavanjem voštanog sloja epidermisa, uzrokujući gubitak vode iz tela od 60%, odnosno 30% gubitak ukupne telesne težine. IP se prvenstveno primenjuju kao insekticidi i većina su u osnovi prirodni silicijum dioksid (DE i zeolit), međutim efikasnost zavisi od porekla i fizičko-hemijskih osobina. Kompatibilnost IP sa drugim tehnikama suzbijanja štetnih organizama, kao što su konvencionalni insekticidi, botanički preparati, aeracija i toplotni tretmani mogu povećati njihovu praktičnu primenu u skladištima i ovo polje je ostalo neistraženo. Druga najvažnija grupa PPa predstavljaju botanički pesticidi, jedinjenja biljnog porekla. Poznato je da brojne biljne vrste sadrže sekundarne metabolite sa biološkom aktivnošću protiv različitih grupa skladišnih štetočina (insekti, grinje, patogene gljive ili bakterije). Međutim, i pored duge istorije primene, i potvrđene efikasnosti, botanički preparati, ali i PP uopšte, trenutno čine mali udeo u globalnom tržištu sredstava za zaštitu bilja. No, u eri „zelene hemije“, kao i u svetlu predstojećeg ograničenja primene raspoloživih pesticida, procenjuje se da će PP zauzeti veći tržišni udeo u budućnost, ako ne kao komercijalizovani proizvodi, onda kao model molekuli u razvoju novih sintetičkih pesticida.

Rad ima za cilj da prikaže prirodna jedinjenja sa najvećim aplikativnim potencijalom u suzbijanju štetočina uskladištenih proizvoda, dajući uvid u njihov način i spektar delovanja, biologiju aktivnost, tehniku aplikacije, zdravstvene aspekte primene, prepreke u komercijalizaciji i potencijal za širu primenu.

Key words: inertna prašiva, botanički preparati, skladišne štetočine