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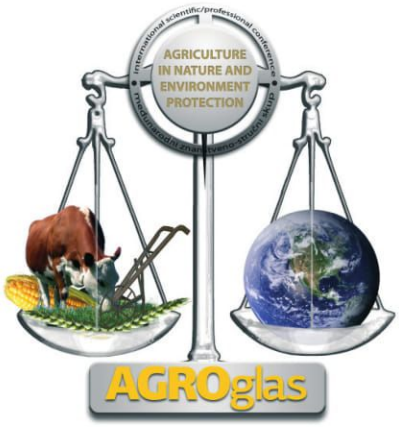

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Znanstveni rad

Insecticidal efficacy of rapeseed extract in lesser grain borer (*Rhyzopertha dominica* Fab.) suppression

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Abstract

Lesser grain borer (*Rhyzopertha dominica* Fab.) is a storage pest of the Bostrichidae family. Insecticidal efficacy of rapeseed (*Brassica napus* L.) extract was investigated on four types of surfaces: ceramics, glass, treated and raw wood. Mortality rate of lesser grain borer was observed through three different exposures (4, 24 and 48 h) with the aim of determining the influence on insecticidal activity regarding different surfaces and exposures. The highest mortality rate was achieved on glass surface at the highest exposure (48 h) which was significantly higher in comparison with other surfaces. Given that the insecticidal effect was achieved on all surfaces, particularly satisfactory on glass surface, the rapeseed extract has a high potential in suppressing storage insects.

Keywords: Rapeseed, lesser grain borer, extract, insecticidal potential, surface

Introduction

Today's tendencies in agricultural production and plant protection are focused on reducing the use of chemical insecticides. Regardless of the high efficacy of chemical insecticides they cause a number of negative effects such as pest resistance, environmental pollution and negative impact on non-target organisms (Ducom, 2012). Use of chemical pesticides cannot be completely eliminated but new non-chemical agents with equal effect can be developed which should be emphasized. It is known that storage insects relatively quickly gain resistance to chemical pesticides such as fumigants so there is a great and urgent need to develop new natural insecticides, preferably with multiple mechanisms of action to reduce pest resistance (Dal Bello et al., 2017). One of the most common pest in storages is the lesser grain borer *Rhyzopertha dominica* (Fab.) (Bostrichidae: Coleoptera), it is a very important insect as it is destructive as both larval and adult stage (Toews et al., 2000). The adults are not very agile but they migrate very much thus causing rigorous losses of grain quantity and quality (Atwal, 1994). Furthermore, infested grain is then susceptible to secondary pests and fungi (Mukherjee and Nandi, 1993; Ahmad et al., 2016). Investigations were carried out with the aim to test rapeseed extracts against lesser grain borer.

Material and methods

Rape seed (*Brassica napus* L.) was collected in the area of Osijek-Baranja county and Vukovar-Srijem county. The collected material was dried in a laboratory dessicator. After drying, the seeds were milled in laboratory ball mill Retsch® PM 100 which is suitable for grinding plant parts to fine particles. Plant extracts were prepared separately on the basis of water and alcohol (2-propanol) in the following manner: rapeseed powder with particle size up to 150 µm mixed with water (70-80 °C) and mixed with 2-propanol respectively. The mixing ratio (g:ml) of both plant powder with water and plant powder with 2-propanol depended on the obtained consistency of the extract. The goal was to get a 'soft paste'. The extraction was performed in high glass containers and lasted 4 days. Every 24 h the extract was stirred with glass sticks to prevent the separation of solvent from plant powder. Thereafter, the extracts were sifted twice through a sieve with an opening of 150 µm. Finally the water extract and alcohol extract were mixed together in a ratio of 1:1. Rapeseed extract was applied with Kartell micropipette at a concentration of 20 ml m^{-2} on four different surfaces: glass, ceramic plates, raw wood and treated wood. After application, the extracts were brush-dispersed in a thin layer on a surface of 78.54 cm^2 per sample, and after 60 s of application 20 adults (Lesser grain borer) of both sexes were introduced per treatment. The treated area was covered with Petri dishes with appropriate dimension to keep the insects on the treated surface. The control treatment was set without the application of extract with the same number of adults. Mortality rate was determined through three different exposures: 4, 24 and 48 h after the introduction of insects. Test insects were breeded under controlled conditions (29±1 °C; 70-80 % RH; in darkness) on wheat with 13.5 % moisture content. The results of the experiment were statistically analyzed by one-way ANOVA with SAS/STAT Software 9.3 (2013-2014), with the relevant test of significance (LSD test, probability level of 0.05).

Results and discussion

The results of the tested rapeseed extract on four different surfaces (ceramic plates, treated wood, raw wood and glass) indicate different insecticidal activity on lesser grain borer depending on the type of surface and exposure. The highest mortality rate (58.3 %) was achieved at the longest exposure (48 h) on glass surface, significantly higher than on treated wood (13.3 %), ceramic plates (8.3 %) and raw wood (3.3 %). Mortality rate on glass surface was also significantly higher than on other surfaces at the exposure of 24 h, while there was no significantly different mortality rate at the shortest exposition (4 h) comparing all surfaces. Mortality rate was the highest on ceramic plates (8.3 %) at the exposure of 4 h but it did not change by prolonging the exposure. Significantly higher mortality rate was achieved on glass surface by prolonging the exposure from 4 to 24 h.

Table 1.Insecticidal efficacy of rapeseed extract against lesser grain borer after 4, 24 and 48 hours of exposure on four different surfaces

Mortality rate (%)±StD1,2							
Treatment	Exp. (h)	Surface				F	P
		Ceramic plates	Treated wood	Raw wood	Glass		
Control Ø	4	0,0±0,00 aA	0,0±0,00 aA	0,0±0,00 aA	0,0±0,00 aA	0,00	<.0000
	24	1,6±2,88 aA	0,0±0,00 aA	0,0±0,00 aA	0,0±0,00 aA	1,00	<.4411
	48	1,6±2,88 aA	0,0±0,00 aA	0,0±0,00 aA	0,0±0,00 aA	1,00	<.4411
	F	0,50	0,00	0,00	0,00		
	P	<.6297	<.0000	<.0000	<.0000		
Rapeseed	4	8,3±2,88 aA	5,0±8,66 aA	1,6±2,88 aA	1,6±2,88 aB	1,22	<.3630
	24	8,3±2,88 bA	11,6±12,58 bA	1,6±2,88 bA	48,3±22,54 aA	7,72	<.0095
	48	8,3±2,88 bA	13,3±15,27 bA	3,3±2,88 bA	58,3±18,92 aA	12,66	<.0021
	F	0,00	0,38	0,33	9,41		
	P	<1.0000	<.7023	<.7290	<.0141		

[1]Mean values in the same raw at the same exposure which are marked with the same small letter are not significantly different (Tukey's HSD, P<0.05)

[2]Mean values in the same column for a particular type of surface which are marked with the same capital letter are not significantly different(Tukey's HSD, P<0.05)

The tested rapeseed extract achieved insecticidal activity on lesser grain borer on all surfaces but was significantly higher on glass. The lower mortality rate on wooden surfaces could be because of the faster extract absorption into wood than other surfaces, so that the full insecticidal potential did not occur because of the absorption (Adeduntan, 2015).Gwinneret al. (1996) state that all insecticides are more persistent on smooth and concrete surfaces. Above all tested surfaces glass is the smoothest, while the other surfaces are very rough (even the treated wood). Relating to their claim it could be the reason why the highest mortality rate was achieved on glass. Popoola (2013) states that the insecticidal properties of certain plant species become more intense after a certain period of time if they are viable. Similar results regarding insecticidal activity on glass surface were recorded by Lucić et al. (2018).

Conclusion

Rapeseed extract achieved insecticidal effect on all surfaces, especially on glass surface. It can be concluded that rapeseed extract has high insecticidal potential on smooth surfaces in control of storage insects and is also environmentally acceptable.

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Insekticidni učinak ekstrakta uljane repice na žitnog kukuljičara (*Rhyzopertha dominica* Fab.)

Sažetak

Žitni kukuljičar (*Rhyzopertha dominica* Fab.) je skladišni štetnik iz porodice Bostrichidae. U istraživanju je testiran insekticidni učinak ekstrakta uljane repice (*Brassica napus* L.) na četirima vrstama građevinskih površina: keramika, staklo, obrađeno i neobrađeno drvo. Mortalitet žitnog kukuljičara je praćen kroz tri različite ekspozicije (4, 24 i 48 h) s ciljem utvrđivanja utjecaja različitih površina i ekspozicija na insekticidni učinak. Najviši mortalitet je postignut na staklenoj površini pri najduljoj ekspoziciji (48 h) i to statistički značajno viši u odnosu na ostale površine. S obzirom da je insekticidni učinak postignut na svim površinama,posebice zadovoljavajući na staklenoj površini, ekstrakt uljane repice ima visoki potencijal u suzbijanju skladišnih kukaca.

Ključne riječi: Uljana repica, žitni kukuljičar, ekstrakt, insekticidni potencijal, površina