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EFFICACY OF SOME AQUATIC PLANT EXTRACTS ON THE KHAPRA BEETLE *TROGODERMA GRANARIUM* EVERTS

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ABSTRACT

Khapra beetle is one of the dangerous pests that infests fields and warehouses, and using safe alternatives such as plant extracts is one of the options. The efficacy of aqueous extracts of *Achillea fragrantissima* and *Chenopodium album* (5, 10, 15%) at different exposure durations (48, 96, and, 144 hr) has been evaluated in this study. Mortality of fifth-instar larvae and adults was observed, and it was shown that an exposure period of 144 hr was superior with hot and coldwater extracts of *C. album*. The results also showed that maximum mortality of fifth instar larva (65,000 and 92,405%), respectively, was at a concentration of 15% for the cold and boiling water extracts. Mortality of adults was maximum with cold and hot water extracts of the *C. album*, at an exposure period of 144 hr, as well as at 15% (36,809 and 55,671%, and (51,299 and 74,671%, respectively). Thus the results showed that *C. album* extract was superior, there existed a significant effect of the interaction between (extract type, concentration, and treatment duration) on the mortality of larvae and adults.

Key words: *Trogoderm granarium*, stored grains, Achillea fragrantissima, Chenopodium album, plant extracts, dose, duration of exposure, mortality, fifth instar larva, adult, hot and coldwater extracts,

Trogoderma granarium Everts is among the most dangerous store insects and the most widespread, which were more common in grain stores and food products (Yadav et al., 2022). The danger of this pest lies in the multiplicity of its plant families, including grains and their products (Athanassiou and Arthur, 2018). Stored wheat grains are exposed to significant storage losses in terms of nutritional, economic, and marketing value (Ismail, 2014). The widespread and indiscriminate use of chemical pesticides causes environmental hazards (Hamel et al., 2020). Using natural pesticides extracted from some plants is an ecofriendly alternative (Mahmoud et al., 2015). These extracts could also kill larvae and adults or inhibit the growth of their larvae (Singh et al., 2017). Resistant strains rarely appear when plant extracts are used with natural pesticides (Khalique et al., 2018). Younus and Karso (2022) have evaluated the effect of some aqueous plant extracts on khapra beetle like that of *Salvia officinalis* giving 100% mortality at 5%. Lavender cotton *Achillea fragrantissima* is an aromatic tree plant with medicinal importance. Goosefoot *Chenopodium album* is an annual herbaceous plant containing compounds, such as saponins and nitrates, and is rich in vitamin C (Zhao, 2017). This study evaluates the efficacy of different concentrations of aqueous extracts of the these against the last larval stage and adults of *T. granarium* at different exposure periods in the laboratory.

MATERIALS AND METHODS

A colony of *T. granarium* was obtained from infected wheat seeds in the laboratories of the Seed Examination and Certification Department in Al-Qadisiyah Governorate, which is affiliated with the General Authority for Seed Inspection and Certification, Iraqi Ministry of Agriculture. Wheat seeds from the local market and placed in the freezer at 20°C for two weeks was infested with adults of *T. granarium* (25 males and females each) in 600 ml glass bottles suitably provided with vents and covering with cloth and sealed with rubber bands. These bottles were incubated (30± 2C°, 70± 5% RH) (Karso, 2023). Eggs were observed to be laid on broken wheat seeds, lifecycle was followed up it until it maintained the colony for one generation. Plant material of *Achillea fragrantissima* and *Chenopodium album* were collected in May 2022 during the flowering period from different regions in the southwestern desert of Al-Muthanna Governorate, Iraq. Preparation of aqueous extracts from flowers of *A. fragrantissmia* and leaves of *C. album* were made with the plant samples dried in shade, crushed, and then ground with an electric

grinder. Extracts were prepared by placing 400 g of each ground plant separately in a 2 l conical flask, adding 1 l of cold and hot distilled water to it separately, and then shaking it well in a magnetic stirrer for 24 hr at 25°C. The extract was then filtered using a Buechner funnel on filter paper, and then centrifuges at 13,000 rpm for five min; the sediment was excluded, and the filtrate concentrated using a rotating evaporator device at a temperature not exceeding 40 °C for 24 hr. The resultant was collected and dried. To test the effect of the extract on the dry material, 10 g was dissolved it in 100 ml of distilled water, and concentrations of 5, 10, and 15% prepared (Mukhlif, 2012). The effect of plant extracts on the 5th larval instar, with the cold and hot water extracts were accomplished by observing mortality, comparing with control treatment (distilled water) at three exposure times 48, 96, and 144 hr; 10 g of wheat seeds handled with extracts gave these observations. The experimental samples were incubated (CL011 made in Bulgaria) at 30± 2°C and 70± 5%RH, with % of mortality of larvae and adults observed in the treatments. These data were subjected to Abbot's correction before statistical analysis (Shaaban and Al-Mallah, 1993) and interpreting interaction using CRD ($p>0.05$) with GenStat software.

RESULTS AND DISCUSSION

Biological effect of plant extracts on the fifth larval stage of the *T. granarium* as given in Table 1 show that the cold and hot water extracts of both plants have a significant effect on the mortality at all the tested concentrations and exposure periods; coldwater extract, gave maximum mortality of fifth instar larvae (41,093 and 56,808%) at a period of exposure of 144 hours, with cold and hot water extract of *A. fragrantissima)* respectively; maximum (58,617 and 81,107%) was at a concentration of 15% of cold and hot water extract. Maximum mortality (45,065- 65,896%) was at an exposure period of 144 hr; highest rate of killing the fifth instar larvae of the insect was (65,000 and 92,405%) at a concentration of 15% for the cold and hot water extract of *C. album*, respectively, Thus cold and hot water extract of *C. album* was superior over that of *A . fragrantissima.* Thus mortality increase with concentrations and durations of exposure. Ghani (2014) observed similar effects with coldwater extract of the leaves of the *Sesbania sesban* against larvae and adults of *T. granarium*. Al-Mansour and Al-Farhani (2016) also showed in their study on the effect of oil extracts of bitter melon and *nigella sativa*, the superiority of black seed oil extract against *T. granarium* larvae. Asiry and Zaitoun (2020) observed mortality of 73.3 and 81.1% after 6 days at 400 ppm of aqueous and ethanolic extracts of plant extracts of *Lantana camara* and *Ruta chalepensis*. The compounds may affect the neural tissues of the larva, leading to paralysis and then failure to continue growth (Nikolaou et al., 2021).

The observations with the adults of T. granarium reveal that the cold and hot water extracts of both plants showed a significant effect on the rates of killing insect adults for all tested concentrations and exposure durations; hot water extract was superior over the cold water extract.; maximum mortality (26,497 and 42,227%) was at a period of exposure of 144 hr, of cold and hot water extract of *A . fragrantissima*, respectively. Maximum mortality (36,809 and 55,671%) was at exposure of 144 hours to cold and hot water extract of *C. album*, respectively; and mortality was 51,299 and 74,557% at a concentration of 15% of the cold and hot water extract of the *C. album*, respectively. Thus cold and hot water extract of the *C. album* was superior. These results corroborate with those of Ghani (2014) on the cold aqueous extract of the leaves of the *Sesbania sesban*. Al Hamdani et al. (2019) explained in his study that oily plant extracts were effective against *T. granarium*, and castor oil was superior.

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AUTHOR CONTRIBUTION STATEMENT

AHA, MKA and MHH conceived of the original idea. AHA and MKA developed the theoretical and performed the statistical analysis for experimental data. MKA and MHH verified the analytical methods. AHA, MKA and MHH worked for lab analysis and supervises the project. AHA, MKA and MHH discussed the results and contributed to the wrote the manuscript.

CONFLICT OF INTEREST

No conflict of interest

Table 1. The effect of aqueous extracts of the *A. fragrantissmia* and *C. album* on *T. granarium*

Plant	Extract type	Time/ hr	Extract concentration				% Rate of kill
Fifth-instar larvae			% 0	% 5	% 10	% 15	
A. fragrantissmia	Coldwater	48	0.000	16.578	20.383	49.723	21.671
		96	0.000	24.638	31.209	59.144	28.748
		144	0.000	39.977	54.014	66.983	41.093
		Rate	0.000	27.064	35.202	58.617	
	Hotwater	48	0.000	33.163	33.163	74.402	38.119
		96	0.000	42.935	53.165	80.907	44.252
		144	0.000	60.957	74.961	88.011	56.808
		Rate	0.000	45.685	57.678	81.107	
C. album	Cold water	48	0.000	22.0338	27.843	57.932	26.953
		96	0.000	30.066	36.164	65.033	33.659
		144	0.000	44.117	60.035	72.035	45.065
		Rate	0.000	32.074	41.347	65.000	
	Hotwater	48	0.000	45.071	56.921	87.498	48.112
		96	0.000	53.471	66.413	91.152	53.767
		144	0.000	73.043	85.955	98.565	65.896
		Rate	0.000	57.195	69.763	92.405	
LSD ($p<0.05$)	concentration effect 0.397		extract 0.0798	treatment duration 0.3435		interference effect 0.398	
Adults							
A. fragrantissmia	Coldwater	48	0.000	6.733	10.674	20.022	9.357
		96	0.000	14.553	20.044	33.506	17.026
		144	0.000	22.447	33.108	50.432	26.497
		Rate	0.000	14.578	21.275	34.653	
	Hotwater	48	0.000	13.112	26.233	36.889	19.059
		96	0.000	24.811	40.517	56.910	30.559
		144	0.000	36.712	60.089	72.107	42.227
		Rate	0.000	24.873	42.279	55.302	
C. album	Cold water	48	0.000	14.100	20.401	38.504	18.251
		96	0.000	22.212	30.823	52.380	26.356
		144	0.000	34.033	50.186	63.015	36.809
		Rate	0.000	23.448	33.803	51.299	
	Hotwater	48	0.000	26.112	42.663	63.072	32.962
		96	0.000	40.599	53.811	74.209	42.155
		144	0.000	62.241	74.053	86.391	55.671
		Rate	0.000	42.984	56.423	74.557	
LSD ($p<0.05$)	concentration effect 0.290		extract 0.241	treatment duration 0.304		interference effect 0.468	

REFERENCES

Athanassiou C G, Arthur F H eds. 2018. Recent advances in stored product protection (p. 273). Berlin, Germany: Springer.

Al Hamdani A H, Mubasher M K, Shamkhi J A. 2019. The biological effect of three aromatic Plant oils to control some of the life stages of the *Trogoderma granarium* (Everts) (Coleoptera: Dermestidae). Plant Archives 19(1): 495-500.

Al-Mansour N A, Al-Farhani I M O. 2016. Evaluation of some oil extracts on the life of the khapra insect, *Trogoderma granarium* (Coleoptera: Dermastidae). Basrah Journal of Science 28(1): 73-81.

Asiry K A, Zaitoun A A. 2020. Evaluation of the toxicity of three plant extracts against the Khapra beetle *Trogoderma granarium* Everts (Coleoptera: Dermestidae) under laboratory conditions. Revista de la Sociedad Entomológica Argentina 79(1).

Ghani S W. 2014. Study of the effect of coldwater extract of the *Sesbania*

sesban L. plant on the larvae and adults of the hairy grain beetle *Trogoderma granarium* (Evertes) (Coleoptera: Dermestidae). Journal of the University of Kufa/ Pure and Applied Sciences 2(22): 72-731.

Hamel D, Rozman V, Liška A. 2020. Storage of cereals in warehouses with or without Pesticides. Insects 11(12): 846.

Ismail I Y. 2014. Pests of stored materials. College of Education - University of Mosul. pp. 357-399.

Karso B A. 2023. Evaluating the susceptibility of some wheat varieties to infestation of khapra beetle (*Trogoderma granarium* Everts) under storage conditions. Basrah Journal of Agricultural Sciences 36(1): 140-148.

Khalique U, Farooq M U, Ahmed M F, Niaz U. 2018. Khapra beetle: A review of recent control methods. Current Investigations in Agriculture and Current Research 5(5): 666-671.

Mahmoud A K, Bedawi S M, Satti A A. 2015. Efficacy of some botanical extracts in the control of khapra beetle (*Trogoderma granarium*). Journal of Science 5(4): 213-217.

Mukhlif A F. 2012. The biological effect of the extract of four plants on the stages of the Culex mosquito, *Chironomus ninevah*, on non-target mosquitoes and Culex pipiens larvae. Journal of Al-Rafidain Sciences 23 (2): 23-35.

Nikolaou P, Marciniak P, Adamski Z, Ntalli N. 2021. Controlling stored products' pests with plant secondary metabolites: A review. Agriculture 11(9): 879.

Shaaban A D, Abdel Aziz O F, Al-Mallah N M. 1991. Study of some volatile and fixed oils extracted from some plants in the southern cowpea beetle *Callosobruchus maculata*. Al-Rafidain Agriculture Journal 2(23): 179-148.

Singh A, Chand P, Vishwakarma R, Singh C K. 2017. Khapra beetle (*Trogoderma granarium* Everts): A food security threat. Bulletin of Environment, Pharmacology and Life Sciences 6(11): 1-6.

Yadav S K, Bhowmik S, Yadav P C, Sharma K C. 2022. Identification and control of *Trogoderma granarium* (Coleoptera: Dermestidae), a potential threat to stored products and international trade. International Journal of Tropical Insect Science 42(2): 999-1017.

Younus S H, Karso B A. 2022. Bio Effect of Seven Aqueous Plant Extracts Against Khapra Beetle Trogoderma Granarium Everts (Coleoptera: Dermestidae). NTU Journal of Agricultural and Veterinary Sciences 2(1).

Zhao Z. 2017. Encyclopedia of medicinal plants. World Publishing Corporation.

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