THE SCHOLAR JOURNAL FOR
SCIENCES & TECHNOLOGY

Efficiency of seven vegetation extracts against Khapra beetle's adult Trogoderma granarium Everts.

Prepared by

A. Prof. Dr. Batol Abdullah Karso
Shelan Hasan Younus
College of Agricultural Engineering Science Duhok University\ Kurdistan, Iraq
shelanhasan91@gmail.com

Abstract

The research demonstrated the efficiency of aqueous extracts of seven plants [Garlic buds (*Allium sativum*), leaves of Sage (*Salvia officinalis*), leaves of black arum (*Eminium spiculatum*), leaves of Thyme (*Thymus vulgaris*), fruits of hot pepper (*Capsicum annuum*), leaves of Eucalyptus (*Eucalyptus oleosa*), and seeds of Clove (*Syzygium aromaticum*)], the extract demonstrated that Black arum had the largest deadly effects, with a 50% mortality rate at 10% concentration, whereas Red pepper had the highest mortality mean of 34.45% and the overall lowest mortality is 16.67% when compared to certain other aqueous extracts.

Keywords: Khapra, Index toxicity, aqueous extracts, black arum, mortality effect.

Introduction

Khapra beetle (*Trogoderma granarium*) belongs to the family of Dermestidae: Coleoptera (Al-Shuwaili, 2020). Is one of the most important sweeping insects that infect various stored materials (Semple *et al*., 1992), causing great losses in grain and other stored materials (Pasek, 1998; Hou, *et al*., 2004), they attack spices, dried dyes, and other protein substances in both hot and dry regions as Asia and Africa (Viljoen,1990; Ghanem &Shamma, 2007). Al-Soussi, (1967) estimated that the annual losses caused by Khapra beetles on grains reached more than 30% through their feeding on the seed's contents and protein materials (Mowery, *et al*., 2002). The widespread and incorrect use of pesticides led to the emergence of many insecticide-resistant species (Belmain, *et al*., 2001), The impact of pesticides has prompted many environmentalists to request for the use of pesticides and their production to be halted. Despite this, pesticides are still a human's method of pest control (Al-Jabr, 2006; Hidalgo, *et al.*,1998). In recent years, interest in controlling stored grain pests has increased by using extraction of plants; it was set up that usage with these extracts can lead to kill insect larvae and entire insects, or delay the growth of larvae (Behal,1998; Abdallah, 2001; Singh, *et al*.,2017). Finally, plant extracts have been directed to control the pests of the stored materials, because the botanical pesticides have desirable qualities and are not available in the organic pesticide groups manufactured from them (Ratnasekera and Rajapakse, 2010). Then it is of low toxicity to humans and animals (Al-Hassani, 2003). Many studies tested the effect of plant extracts and pesticides in controlling warehouse insects, Sharshir *et al.* (2000) compare the effect of some plant extracts and insecticides in controlling the grain beetle *T. granarium* Evert., and *acarus Tyrophagous spp.*, and found that Actelic insecticide was the best toxicant, followed by the growth regulator Cascede, then vegetable oils and cottonseed oil was better than sesame oil, followed by the mineral oil Kale 2., Therefore, the importance of this study is the efficiency in searching for natural substances of plant origin that affect the Khapra beetle to replace the highly toxic chemical pesticides used as control, and studying the biological effect of some vegetable extracts on the response of the adult beetle.

Material and Methods

Khapra beetle (*Trogoderma granarium*) was developed from contaminated wheat var. Smeto, takes from the plant protection lab, Coll. of Agricultural-engineering sciences, was placed inside a vessel capacity of one kilogram, under stores condition.

Preparation of aqueous solution

Five hundred grams of fresh-tested powders [Garlic buds (*Allium sativum*), leaves of Sage (*Salvia officinalis*), leaves of black arum (*Eminium spiculatum*), leaves of Thyme (*Thymus vulgaris*), fruits of hot pepper (*Capsicum annuum*), leaves of Eucalyptus (*Eucalyptus oleosa*), and seeds of Clove (*Syzygium aromaticum*)] wash and dried at room temperature through 2 weeks then grind and pulverized product (Hiakal &Omer, 1993) to get their powders.

Adding 100 ml distilled water to twenty-five-gram powder of each plant, mixing in grinder then stir for 1 hr. using a magnetic stirrer, at that point leaving the mixture for twenty-four hrs. at room temperature for purpose of soaking, then filtered by using a What-man Filter Papers No. 1 via Buchner funnel was used to obtain the simple extract, finally samples stored in dark bottles until dilutions were created According to Riose, *et.al*., (1987) method.

Aqueous concentrations prepare

For each extract, 5 concentrations (1.5,3,5,7.5,10) % prepared, each treatment contain twenty Khapra adults/concentrate, and the control treatment was treated with distilled water only, the experiment's repeat with three replicates per concentrate. Then calculate mortality percentage LC_{50}, and confidence limits according to Finney (1977) Al-Mallah and Aljubuory (2011) mention it, get the relative toxicity, and efficiency toxicity using the following methods:

Relative toxicity % = LC50 value of less efficient tested extracts/LC50 value of the other extracts x 100

Efficiency toxicity % =LC50 value of most efficient tested extracts /LC50 value of the other extracts × 100

Data Analysis: Experiments were analyzed by using a completely randomized design (CRD) was used to compare means employing Duncan's multi-range test (P0.05) using a computer application SAS (Dey, 2022).

Results

Table (1) demonstrates substantial differences in the treatment of Khapra beetle adults with various amounts of the aqueous extraction process of studied plants. The highest extract founded was Black arum, that had the highest mortality 50% at a concentration 10%, then red pepper aqueous extraction, which had a mortality rate at concentration of 1.5% was 46.67%, and the average mortality were 31.11 and 34.45%, correspondingly. The validates the result: its LC_{50} value of 114.174 ppm, 111.262, and slope value of 1, 0.8, indicating extraction homogeneity & responsiveness of the adults (Table 2).

The lowest mortality percentage, on the other hand, was administered with the Sage extraction, that got 6.67% at a concentration 1.5%, while mortality means was 16.76%. In general, findings showed the mortality average mean in adults Khapra regarded with aqueous extracts of red pepper reached 34.45%, while aqueous extract of Sage reached 16.76%, validates the obtained result, a value of LC_{50} 111.262 and 367.775 accordingly, demonstrating the toxicity to adults (Table 2).

Lastly, based on LC_{50} values ranging of the aqueous extracts utilized in the deadliness research for determining the relative toxicity, and efficiency toxicity, the most toxic extract was Red pepper extract on adults of Khapra beetle, achieving (1, 3.305) correspondingly. Sage was the lowest toxic shows indications of relative toxicity, and efficiency toxicity (0.49, 1.62).

Toward explain findings, the differential some plant extracts may have a deadly impact. attributed to differences of chemical elements of extracts, (1R. 5S)-Myrtenal & methyl-salicylate a wide bean-black bean combination (Hardie, *et al*.,1994). Pickett (1995) listed some most nutritious inhibitor substances were field-tested shown to be effective. Several phytochemicals have been revealed to have a role in nourishment, including two phenyl-propanoid and allylanisole-4 compounds, a repellent or inhibitor produced by conifer species that function as repellents to the pine beetle. (Hayes, *et al*.,1996). They are azdrachine, Polygodia, and acid-hop (Powell, *et al*., 1997), but so far, the azidrachine (Darwish, 1997) and drimonepolygodial chemical derived from the water pepper plant.

Table 1: The mortality effect on adults of *T. granarium* of some aqueous extract plants.

Extracts	Concentration%						Mean
	0%	1.5%	3%	5%	7.5%	10%	
Garlic	0i	26.67b-h	20d-i	40a-d	26.67b-h	30a-g	23.89bcd
Sage	0i	6.67hi	26.67b-h	10g-i	30a-g	26.67b-h	16.67d
Black arum	0i	36.67a-f	23.33c-h	36.67a-d	40a-d	50a	31.11ab
Thyme	0i	13.33f-i	26.67b-h	16.67e-i	36.67a-d	40a-d	22.22cd
Red pepper	0i	46.67ab	36.67a-f	43.33abc	36.67a-f	43.33abc	34.45a
Eucalyptus	0i	26.67b-h	43.33abc	36.67a-f	36.67a-f	16.67e-i	26.67bc
Clove	0i	36.67a-d	23.33c-h	20d-i	43.33abc	46.67ab	28.33abc
Mean	0d	27.62c	28.57bc	29.05bc	35.72ab	36.19a	

* Dissimilar letter in same sector show the presence of significantly in Duncan's test differences at the 5% level.

Table 2: The LC_{50} values, slop, and confidant limited values of some aqueous extracts plants on adults of *T. granarium*.

N.	Plant extracts	LC_{50} ppm	Slope	Confidant limited
1	**Garlic**	226.933	1.255	143.9 -595.35
2	**Sage**	367.7751	0.620	150.920-22
3	**Black arum**	114.1741	1.01	75.63-314.15
4	**Thyme**	141.728	1.287	102.25-259.71
5	**Red pepper**	111.2622	0.8	62.60-2737.152
6	**Eucalyptus**	137.320	1	93.24-313.91
7	**Clove**	115.22	1.04	82.45 - 222.46

Table 3: Relative toxicity, and efficiency toxicity for some plant aqueous extracts on adults of *T. granarium*.

N.	Plant extracts	Relative toxicity	Efficiency toxicity
1	**Garlic**	0.303	1
2	**Sage**	0.49	1.62
3	**Black arum**	0.97	3.22
4	**Thyme**	0.79	2.59
5	**Red hot pepper**	1	3.305
6	**Eucalyptus**	0.81	2.68
7	**Clove**	0.97	3.19

Conclusion

Plant aquatic extracts of (garlic, sage, black arum, thyme, red hot pepper, eucalyptus, & cloves) had perfect substantial influence on various biotic features of the adult of the Khapra grain beetle, with black arum extract being the most effective.

References

1.Abdallah, S. A., Badawy, A. A., & EL-Sabaay, T. N. (2001). E***fficacy of certain vegetable oils as wheat grain protectants against the lesser grain borer***, Rhyzopertha dominica (F.). Egyptian Journal of Agricultural Sciences, 52(1), 167-182.

2.Al-Hassani, Abdul-Jalil Hassan Muhammad (2003) The effect of some plant extracts and powders on the productivity and mortality of the entirety of the saw-breasted beetle *Oryzaephilus surinamenesis*. Master's thesis \ College of Education \ Tikrit University.

3.Al-Jabr AM (2006). Toxicity and repellency of seven plant essential oils to *Oryzaephilus surinamensis* (Coleoptera: Silvanidae) and *Tribolium castaneum* (Coleoptera: Tenebrionidae). Scientific Journal of King Faisal University (Basic and Applied Sciences), 7(1), 49-60.

4.Al-Mallah, Nazar M., and Abdul-Razzaq Y. Aljubuory, (2011). Practical applications in pesticides, Dar Al Yazouri for Scientific Publishing, Amman, Jordan, 350 p.

5.Al-Shuwaili, T. (2020). Study on comparison of biochemistry between *Trogoderma granarium* Everts and *Trogoderma variabile* Ballion (Doctoral dissertation, Murdoch University).

6.Al-Soussi, Anis (1967). stored grain pests. General Directorate of Agricultural Research and Projects, Bulletin No. 1975, p. 32.

7.Behal, S. R. (1998). Effect of some plant oils on the olfactory response of the larvae of rice-moth Corcyra cephalonica Stainton. *Annals of plant protection Sciences*, *6*(2), 146-150.

8.Belmain, S. R., Neal, G. E., Ray, D. E., & Golob, P. (2001). Insecticidal and vertebrate toxicity associated with ethnobotanicals used as post-harvest protectants in Ghana. *Food and chemical toxicology*, *39*(3), 287-291.

9.Dey TK, and Wang Y (2022). Computational Topology for Data Analysis. Cambridge University Press.

10.Finney, D J. (1977) Phytochemical methods, Halsted Press. John wieley and Sonns, New York. 278 P.

11.Ghanem, I., & Shamma, M. (2007). Effect of non-ionizing radiation (UVC) on the development of Trogoderma granarium Everts. *Journal of stored products research*, *43*(4), 362-366.

12.Hardie JR, Isaacs JA, Pickett LJ, Wadhams and Woodcok CM (1994) Methyl salicylate and (-)-(1R,5S)-myrtenal are plant-derived repellents for black bean aphid, Aphis fabae Scop. (Homoptera: Aphididae). Journal of Chemical Ecology, 20: 2847- 2855.

13.Hayes JL, Meeker JR, Foltz JL and Storm BL (1996) Suppression of bark beetles and protection of pines in the urban environment: A case study. Journal of Arboriculture, 22: 67-74.

14.Hiakal MA & Omer AA (1993). Medicinal and aromatic plants. Escandrya, Egypt. *514p*.

15.Hidalgo, E., Moore, D., & Le Patourel, G. (1998). The effect of different formulations of Beauveria bassiana on Sitophilus zeamaisin stored maize. *Journal of Stored Products Research*, *34*(2-3), 171-179.

16.Hou, X., Fields, P., Flinn, P., Perez-Mendoza, J., & Baker, J. (2004). Control of stored-product beetles with combinations of protein-rich pea flour and parasitoids. *Environmental Entomology*, *33*(3), 671-680.

17.Mowery, S. V., Mullen, M. A., Campbell, J. F., & Broce, A. B. (2002). Mechanisms underlying sawtoothed grain beetle (Oryzaephilus surinamensis [L.])(Coleoptera: Silvanidae) infestation of consumer food packaging materials. *Journal of Economic Entomology*, *95*(6), 1333-1336.

18.Pasek, J. E. (1998). Khapra beetle (Trogoderma granarium Everts): pest-initiated pest risk assessment. *USDA APHIS, Raleigh, NC*, *32*.

19.Pickett JA, Wadhams LJ and Woodcock CM (1995) Exploiting chemical ecology for sustainable pest control. British Crop Protection Monograph No. 63, Integrated Crop Protection: Towards Sustainabilities. British Crop Protection Council, Farnham, Pages 353-362.

20.Powell G, Hardia J and Pickett JA (1997) Laboratory evolution of antifeedant compounds for inhibiting settling by cereal aphids. Entomologia experimentalis et Applicata, 84: 189-193.

21.Ratnasekera, D., & Rajapakse, R. H. S. (2010). Repellent properties of plant oil vapours on pulse beetle (Callasobruchus maculatus L) (Coleoptera: Bruchidae) in stored green gram (Vigna radiata Walp.). *Tropical Agricultural Research and Extension*, *12*(1).

22.Riose, J. 2.; M C. Recio and A. Villar (1987) Antimicrobial activity of selected plant Emplyed in the Spanish mediiterranean area. Journal of Ethnopharmacology, 21: 139- 152.
23.Semple, R. L., Hicks, P. A., Lozare, J. V., & Castermans, A. (1992). Towards integrated commodity and pest management in grain storage. A training manual for application in humid tropical storage systems. Proceedings and selected papers from the Regional Training Course on Integrated Pest Management Strategies in Grain Storage Systems, conducted by the National Post Harvest Institute for Research and Extension (NAPHIRE), Department of Agriculture, June 6-18, 1988 Philippines.
24.Sharshir, F. A. Helal; R. M., Tadros; M. Sand N. Yossef (2000). Biological and toxicological studies on two pests of stored products mites *Tyrophagus ptrascentiae* (Schrank) and insect *Trogoderma granarium* (Everts) Atkafr, El – Shekh Minufiya J. *Agriculture Research*. 4 (1): 843 – 865.
25.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.
26.Viljoen, J. H. (1990). The occurrence of Trogoderma (Coleoptera: Dermestidae) and related species in southern Africa with special reference to T. granarium and its potential to become established. *Journal of Stored Products Research*, *26*(1), 43-51.