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Evaluation of some plant oils against larvae of Khapra beetle (*Trogoderma granarium* E.) (Coleoptera: Dermestidae)

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Abstract: **The repellent effect of six plant essential oils against Khapra beetle larvae was studied. Furthermore, the efficacy of the most potent repellent oil in protecting wheat seeds against infestation was evaluated. Results showed Clove oil as the most potent repellent against the insects (-60%), While Fennel oil showed an attractive effect (20%). The essential oils can be organized in descending order according to the repellent effect: Clove > Camphor> Cardamon> Onion, Fennel Clove oil showed an efficacy in protecting wheat seeds against infestation, as mortality percentage increased with increasing concentrations and contact time period; it reached 91.67% at concentration 4 for 48 hrs exposure. High concentrations also protected seeds from damage; protection was 100% at 4 concentration. The seeds damage percentage decreased with increased oil concentrations. The shidy also investigated the effect of larvae on wheat seed germination; as germination increased with higher Clove oil concentration. The study showed the high efficacy of Clove oil in protecting wheat seeds against pest infestation.**

Keywords: **Khapra beetle, plant oils, Toxicity, *Trogoderma granarium*, Stored product insects.**

1. INTRODUCTION

Khapra beetle is a very destructive pest of stored grain and cereal in hot and dry climates of the world. During storage, grains are destroyed by many stored-grain insects that are responsible for world wide loss up to 10 – 40% annually (1). Khapra beetle is the major threat to stored wheat in Saudi Arabia Currently, intensive use of synthetic insecticides for the control of stored products pests has resulted in serious problems including insecticide resistance, environment contamination, unacceptable pesticide residues in food, lethal effects on non target organisms, and so on (2, 3, and4). Botanical insecticides have long been used as attractive alternatives to synthetic insecticides for insect pest management because botanicals cause little threat to the environment or to human health (5, 6 , and 1)

In the meantime, the repellent, deterrent, and biological effects of some plant materials against stored product insects have been studied by many researches (7 , 4, 8 ,9 and 10) .

Many studies have been conducted to evaluate the effectiveness of different types of plant oils and extracts against Khapra beetle (11 ,12, 13, 14)

In this present study the effects some plant oils on larvae of Khapra beetle (*Trogoderma granarium* E.) (Coleoptera: Dermestidae) were evaluated.

2. MATERIALS AND METHODS

Insect culture:

The larvae of Khapra beetle were obtained from stock culture maintained under controlled conditions of 27± 2°C and 70%RH. The insects were kept with whole wheat in plastic jars (400ml), covered with muslin cloth and tightened with rubber bands to prevent the escape of insects.

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Plant oils:

Six commercially available essential oils were tested in this study (*Clove, Syzygium aromaticum; Camphor, Eucalyptus camaldulensis; Cardamom, Elettaria cardamomum; Fennel, Foeniculum vulgare and Onion, Allium cepa L* . These oils were assayed on larvae of Khapra beetle. .

Repellency:

The repellency of the oils was assessed using on olfactometer. The olfactometer design allows insects to choose one of four arms in response to different odor stimuli. In the experiment six larvae of Khapra beetle and were used; eight replicates were done for each oil. 1 µL of each oil was a small piece of filter paper and placed in two arm while other arms remained empty. Percentage repellency values were computed using the formula by (15):

$$\text{Intensity of reaction} = \frac{S-C}{S+C} \times 100$$

S= treated arm, C= control arm

Contact toxicity:

For bioassay tests, the thin film technique described by (16) was used. Five concentrations of the Clove oil (0.1, 1, 2, 3, 4 µL/ml of acetone) were selected. One ml of each concentration was evenly spread on the bottom of the Petri-dish. The Petri-dishes used as control were treated with 1 ml acetone only. Ten mature larvae were exposed to the thin film of clove oil for 48 hours. Larval mortality counts were recorded in (6, 12, 24, 48) hours after treatment, according to the formula of (17).

Percentage grain damage:

Larvae were treated with different concentrations of Clove oil. Then completed their development on clean grains Percentage grain damage was calculated on 49th days after treatment. Numbers of perforated holes were recorded and the following general formula was used to determine the percentage of grain damage (12):

$$\text{(\%) Grain damage} = \frac{\text{No. of perforated grains}}{\text{Total no. of grains counted}} \times 100$$

Percentage of germination:

Germination test was carried out to ascertain the effect of these treatments on the germination of the wheat grain infested with larvae after treatment with clove oil. Thirty grains from each treatment were placed in petri-dish containing Cotton. After 10 days, the germination percentage was calculated using the formula (12):

$$\text{(\%) Germination percentage} = \frac{\text{No. of germinated grains}}{\text{Total no. of grains in Petri-dish}} \times 100$$

3. RESULTES AND DISCUSSIONS

1 - Repellency

The repellent action of (Clove, Camphor , Cardamom, Fennel, Onion and Caraway oils) was studied against larvae of Khapra beetle. Data in (table 1) showed that Clove oil had the lead in repellent action where repellent percentage reached (-60%). Fennel and Onion oils had less repellent action (-30%) against larvae of Khapra beetle. The rest of the essential oils had a moderate repellent action. Whil, Caraway oil showed an attractive effect, Table(1). Similar data were obtained by (18, 19, 20 and 21). They proved that Clove oil had repellent effect on some stored products insects.

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Table (1): List of plant oils and repellency effects against larvae of Khapra beetle

Plant oils	The scientific name	Part of the plant	(%)Repellency
Clove	*Syzygium aromaticum*	Seeds	-60%
Camphor	*(Eucalyptus camaldulensis*	Leaves	-50%
Cardamom	*Elettaria cardamomum*	Seeds	-50%
Fennel	*Foeniculum vulgare*	Seeds	-30%
Onion	*Allium cepa L*	Onion	-30%
Caraway	*Carum carvi*	Seeds	20%

Contact toxicity:

The toxic effects of Clove oil against larvae of Khapra beetle are shown in table (2). The toxicity was increased by increasing concentrations and time of exposure. At 4µ/ml concentration after 48h , highest larvae mortality was (91.7%). Treatment of larvae with Clove oil at concentration 0.1, 1, 2, 3and 4µ/ml after 48h exposure caused mortality (5.6, 16.7, 50, 61.1 and 91.7%) respectively. Many investigators recorded the larvicidal activity of some plant extracts and oils against many stored grain insects (22, 23, 24 and 25)

Table (2): Toxicity of Clove oil to the 3rd instar larvae of Khapra beetle

Concentrations µL/ml	6h	12h	24h	48h
0	0	0	0	0a
0.1	0	0	0	5.6b
1	0	0	5.6	16.7c
2	0	0	16.7	50d*
3	0	0	22.2	61.1e*
4	0	5.6	58.3	91.7f*
LC50	0	-	-	2.7µL/M
LC95	0	-	-	3.97µL/M

Each column followed by the same letter is not significantly different from another (One-way ANOVA; Tukey test at, P<0.05)- *mean high significant difference

Biological activity of Clove oil:

Fig. 1 shows the percent pupation and adults emergence decrease from 100% in control to 91.67, 91.67, 66.67, 0 and 0% when larvae were treated with Clove oil at concentrations 0.1, 1, 2, 3 and 4µ/ml respectively. These results are in agreement with (22) who found that black seed oil and sesame oil reduced the larval pupation and adults emergence of Tribolium confusum. These results are in agreement also with (26, 27 and 28)

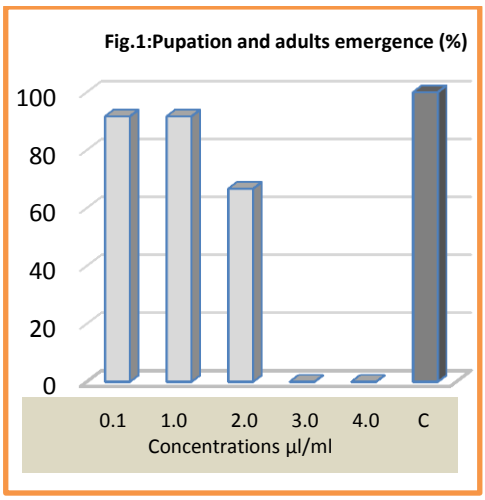

Fig.1: Effect of Clove oil on the development of 3rd larvae instar of Khapra beetle

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Percentage grain damage and germination

and germination of wheat infested by larvae which were treated with Clove oil. The percentage of grain damage and germination decreased with increasing concentrations. Fig2. (29, 30 and 12) reported that on application of some powders against Khapra beetle, the results revealed that the powders were very effective at controlling damage and positively affected seed germination of groundnut seed.

Fig.2: Percentage of germination of wheat grain infested with insect larvae treated with different concentrations of Clove oil.

During the study it was observed that fungal growth occurred in petri dishes centain seeds untreated with oil and those treated with low oil concentrations. Due to damage caused by larval infestation. No fungal growth occurred in seeds infested with larvae treated with high oil concentration.Table.3; fig.3a and b.

Fig.3a: Grains infected with fungal growth due to insect infestation

Fig.3b: Using Clove oil prevented fungal growth.

Table.3: Percentage of germination and seed damage of wheat grain when larvae were treated with Clove oil

Con. µL/ml	(%) Germination	Grain damage	***Fungal growth***
0	20%a	93a	*Aspergillus niger* *Aspergillus flavus* *Peniciluim sp*
0.1	33.33%b*	83b	*Aspergillus niger* *Aspergillus flavus* *Peniciluim sp*
1	40%c*	67	*Peniciluim sp* *Rhizopous sp*
2	78.6d*	40d*	*Rhizopous sp*
3	96.7e*	6.67e*	No fungal growth
4	100f*	0f	No fungal growth

REFERENCES

[1] Ahmad, F.; Sagheer, M.; Hammad, A.; Rahman, S. M. and UL-Hasan, M. 2013. Insecticidal activity of some plant extracts against *Trogoderma granarium* E. Ascientific Journal of Krishi Foundation, 11(1): 103 – 111.

[2] White, N. D. G. and leesch, J. G. 1995. Chemical control. In: Subramanyam B, Hagstrum DW (Eds.), Integrated Management of insects in stored products. Marcel Dekker, New York: 287 – 330.

[3] Jovanovic, Z. Kostic, M. and Popovic, Z. 2007. Grain-protective properties of herbal extracts against the bean weevil Acanthoscelides obtectus Say. Ind. Crop. Prod., 26(1): 100 – 104.

[4] Lu, J.; Wu, C. and Shi, Y. 2011. Toxicity of essential oil from Artemisia argyi against *Oryzaephilus surinamenseis* (Coleoptera: Silvanidae). Afr. J. Microbiol. Res., Vol. 5(8): 2816 – 2819. .

[5] Behal, S. R. 1998.Effect of some plant oils on the olfactory responses of rice moth, Corycera cepha lonica Stainton. Annals of Plant Protection Sciences, 6(2): 146 – 150.

[6] Isman, M. B. 2006. Botanical insecticides, deterrents and repellents in modern agriculuture and increasingly regulated world. Annual Review of Entomology, 51: 45 – 66. .

[7] Al-Jabr, A. M. 2006. Toxicity and repellency of seven plant essential oils to *Oryzaephilus surinamenseis* (Coleoptera: Silvanidae) and *Tribolium castaneum* (Coleoptera : Tenebrionidae). Scientific Journal of King Faisal University (Basic and Applied Scinces), Vol. 7(1): 49 – 60.

[8] Al qahtani, A. M.; Al-Dhafar, Z. M. and Rady, M. H. 2012. Insecticidal and biochemical effect of some dried plants against *Oryzaephilus surinamenseis* (Coleoptera: Silvanidae). The Egyptian German Society for Zoology, 65: 88 – 93.

[9] Rani, P. U. 2012. Fumigant and contact toxic potential of essential oils from plant extracts against stored product pests. J. Biopest, 5(2): 120 – 128.

[10] Ileke, K. D. and Ogungbite, O. C. 2013. Entomocidal activity of powders and extracts of four medicinal plants against Sitophilus oryzae (L.), *Oryzaephilus mercator* and *Ryzopertha dominica* (F.).

[11] Nenaah, G. E. 2011. Toxic and antifeedant potato glycoalkaloids against *Trogoderma granarium* (Coleoptera: Dermestidae). J. Stored Products Insects Research, Vol.,47 (3) :185 – 190.

[12] Asawalam, E. F. and Onu, L. 2014. Evaluation of some plant powders against Khapra beetle (*Trogoderma granarium* Everts) (Coleoptera: Dermestidae) on stored groundnut. Advancement in Medicinal Plant Research. Vol., 2(2): 27 – 33.

[13] Bell, C. H. 2014. Pest control of stored food products: Insects and mites. Hygiene in food Processing (Second edition): 494 – 538.

[14] Mustafa, B. M. ; Kadir, F. A.and Ameen, H. N. 2014. Efficacy of three kinds of plant oils against Cowpea weevil (*Callosobruchus maculatus*), Khapra beetle (*Trogoderma granarium*) and Red flour beetle (*Tribolium castaneum*). J. Tikrit university for agriculture sciences. Vol., 14(2): 195 – 204.

[15] Gunn.D.L, and C.A. Cosway. 1938. The temperature and humidity reactions of the cockroach.V. Humidity Preference, J. Exp. Biol., 16: 555 – 565 .

[16] Iwuala, M. O. E. ; Osisiogu, I. U. W. and Agbackwuru, E. O. P. 1981. Dennettia oil, a potential insecticide: Tested with adults and nymphs of Periplanata Americana and Zonocerus variegates. J. Econ. Entomol., 74: 249 – 252.

[17] Abbott, W. S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 18: 265 – 267.

[18] Mahfuz, I and Khalequzaman, M. 2007. Contact and fumigant toxicity of essential oils against *Callosobruchus maculatus*. Univ. J. Zool. Rajshahi. Univ. Vol. 26: 63 – 66

[19] Zeng, L. ; Lao, C. Z.; Cen, Y. J. and Liang, G. W. 2010. Study on the insecticidal activity Compounds of the essential oil from *Syzygium aromaticum* against stored grain insect pests. 10th International working Conference on stored product protection: 425.

[20] Fouad1, H. A. 2013. Effect of five essential oils as repellents against the Cowpea beetle *Callosobruchus maculatus* (F.). Bull. Env. Pharmacol. Life Sci. Vol. 2(5): 23 – 27.

[21] Fouad, H. A. 2013. Bioactivity of five essential ols against *Bruchidius incarnatus.* (Bohemann,1937). Not. Sci. Biol., 5(3): 345 – 359. .

[22] Abdel Fattah, H. M. and Al Ghamdi, F. G. 2005. Biological and histopathological effects of the Black seed oil and Sesame oil on the fourth instar larvae of the confused flour beetle , *Tribolium confum* (Duval) (Coleoptera : Tenebrionidae). J. Egypt. Acad. Soc. Environ. Develop., (A – Entomology). Vol. 6, No. (3): 79 – 91 .

[23] Kim. S.; Ahn, Y. J. and Wook Kwon, H. 2011.Toxicity of aromatic plants and their constituents against Coleopteran stored products insect pests. New perspectives in plant protection.: 93 – 120. .

[24] Madkour, M.; Zaitoun, A. A. and Singer, F. A. 2013. Repellent and toxicity of crude plant extracts on Saw-toothed grain beetle *Oryzaephilus surinamenseis*. J. of Food, Agriculture and Environment, Vol.11(2): 381 – 384.

[25] Karso, B. A. and Al Mallah, N. M. 2014. Effect of mixing ratio and oil kind toxicity activation of acetamprid against *Trogoderma granarium* larvae. IOSR Journal of pharmacy, Vol.,4 (5) :35 – 40.

[26] Abdel Azeem, E. M. and Abdel Fattah, H. M. 2001. Biochemical and biological perturbation induced by some plant volatile oils in *Callosobruchus chinensis.* (Coleoptera : Bruchidae). J. Egypt. Acad. Soc. Environ. Develop., (C-Molecular Biology). Vol. 1(1): 23 – 40.

[27] Al-Moajel, N. H. and Al-Dosary, M. M. 2002. Mesquite plant *prosopis julifora* (SW) powders as protectants of many bean, *Vigina unguiculata* L. Walp. Against *Callosobruchus maculatus* (Fab.) infestation. J. Egypt. Ger. Soc. Zool., 39 (E.): 67 – 77.

[28] Mhemed, A. 2011. The efficacy of four seed powders on some biological aspects and mortality of Khapra beetle. The Iraqi Journal of Agricultural Science, 42(6): 112 – 123.

[29] Musa, A. K. 2013.Influence of plant powders on infestation by adults and larvae of Khapra beetle, Trogoderma granarium Everts (Coleoptera : Dermestidae) is in stored groundnut. Austr J. Basic. And Appl Sci, 7(6): 427 – 432.

[30] Asawalam, E. F. and Igwe, U. O. 2011. Potentials of Cucuma longa and Cymbopogon citratus extracts against Khapra beetle, (*Trogoderma granarium*) on stored groundnut. Agric Sci Res J., 38: 44 – 51.