



The Effect of Three Plant Extracts In The Control of Khapra Beetle (*Trogoderma granarium* Everts) (Coleoptera Dermestidae)

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ABSTRACT

Trogoderma granarium (Everts) is one of the world's most destructive pest of stored products (Legumes and cereals), oilseeds, dry fruits, copra and other stored products. In this research paper alternative of chemical control were applied to give a repellent effect and more safety method, however Repellent effect of acetone extracts of three medicinal plants: (Eucalyptus, Rosemary and Ginger) to the *Trogoderma granarium* (Everts) larvae (Stage 3 and 4) was evaluated under laboratory condition. There were four treatments including control and three replications in this experiment. Rotary Shaker was used for the preparation of extracts 0, 10, 14 and 18% concentrations were used in this experiment. Eucalyptus plant extracts showed good results, maximum mean repellency (6.33%) followed by Ginger (5.33 %) and Rosemary (3.00%). The results show repellency was increased with increase in concentration. The application of these plant extracts can protect stored grains against attack of *Trogoderma granarium*.

Keywords: Eucalyptus, Khapra, Mortality, Plant Extract , Stage 3

1. INTRODUCTION

During storage, grains are destroyed by many stored-grain insects that are responsible for worldwide loss up to 10 – 40% annually (Ahmad et al., 2013). *Trogoderma granarium*, sometimes known as the "khapra beetle," is a dangerous pest that attacks grains that have been stored, including groundnuts, sesame, barley, sorghum, and rice (Feroz, 2020; Yadav et al., 2021). Due to favourable climatic factors including humidity and temperature, this damaging pest is found in bins, granaries, farm homes, and godowns in various nations including India, China, Pakistan, Africa, and Turkey (Naseri and Borzoui, 2016; Mutlu et al., 2019).

The storage of food products and grains against creepy-crawly creatures that damage Among the most important insect pests that affect stored grain crops is the Hairy Grain Beetle (Khapra) *Trogoderma granarium* Everts (Coleoptera: Dermestidae), which is classified as a dangerous insect pest widespread in most regions and countries of the world. This insect is characterized by its harmful health effects, its voracious feeding on stored grains and its resistance





to manufactured insecticides. Besides, its ability to withstand food loss, drought, high and low temperatures for long periods, making it one of the most destructive store insects of grains, despite the use of many methods to control this insect, the most widespread method is the use of chemical insecticides by fumigation, such as using Bromomethane or Phosphane. However, the continuous use of these chemicals leads to the development of insect resistance in addition to health and environmental risks [Bell and Wilson (2015), Honey et al. (2017), Singh et al. (2017)]. Therefore, researchers and specialists began to search for materials that possess active biological compounds and are highly effective in controlling various insect pests. Also, protecting stored grains from infection and have no health risks to humans and the environment, including the use of plants and their metabolic products [AL-Khazraji and Shaher (2020), Salem et al. (2020)], such as the use of *Moringa oleifera* plant extracts [Salem et al. (2020)]. Due to the economic importance of the Khapra beetle and the economic damage it causes too many types of stored grains affecting its nutritional and agricultural value. Therefore, this study aimed to evaluate the efficiency of *M. oleifera* leaf crude extracts and prepared in the form of Nano-capsules (encapsulation using Nano chitosan) to be used as a safe natural alternative to chemical insecticides to protect the wheat grains inside the store from infection by *Trogoderma granarium*. The aim of this work is to evaluate the insecticidal effect of three medicinal plant extracts (*Salvia rosmarinus*, *Zingiber officinale* and *Eucalyptus obliqua*) on the 3rd and 4th larval instars of *T. granarium* and 10, 14 and 18% concentrations were used in this experiment.

2. RESEARCH METHOD

Study area

The experiment was carried out during 2019-2020 in bakrajo Technical institute laboratory of Food Industrial and Quality Control Department. **Collection of the insects:** The insect species used in the present study was the Khapra beetle, *Trogoderma granarium* (Everts). The adults and larvae of khapra beetle were collected from infested chickpea and were reared in the laboratory for a homogenous population. **Rearing of insects:** The insect culture was maintained in plastic jars (1 kg capacity). The Plastic jars were covered with muslin cloth, tightened with rubber bands to avoid the escape of insects. The insects were allowed to multiply in natural environment as in traditional structure and observed at regular intervals. The food medium was sterilized in an oven and thoroughly washed thereafter with water to remove dust and other insect present in the materials and carefully dried under sunlight, having 13-14 % moisture content. The sterilized food was then





preserved in air tight glass jars (1000 ml) in order to impede further infestation. Newly emerged 3rd instar larvae of *T. granarium* were used in the experiments Sagheer et al., 2013.

Collection of leaves and plant parts: The leaves of eucalyptus, Rosemary were collected from bakrajo technical institute fields and ginger was purchased from the market. **Preparation of leaf extract:** The leaves were washed out in water. After shade drying the leaves were ground in electrical grinder to bring these in the form of powder. Extraction was done in 100 ml of acetone by adding 20 grams of each powder separately and continuously shaking in an electric shaker for 24 hours then transferred to water bath for 10 minutes in the degree of 100 c m after that The solution was then filtered through filter paper (Whatman No. 42). The filtration of plant extracts was repeated three times to obtain maximum filtrate. The obtained plant extracts were used for making the different concentrations Panezai et al., 2015.

Bioassay: From the stock solution, various concentrations (10, 14 and 18%) of each plant were prepared by using acetone as a diluting solvent. There were three replications of each treatment and the control was treated with only acetone. For repellency bioassay, the extracts of 10, 14 and 18% concentrations were applied to filter paper and After the evaporation of the solvent the air dried twenty larvae of *Trogoerma granarium* were used. The data of % repellency was recorded after 24, 48 and 72 hours. Analysis of variance of the collected data was carried out using Statistical software xl stat. Means of the significant treatments were compared by using Duncan at 5%. Cultures and all tested insects were maintained through the experiments under controlled conditions, i.e. $32 \pm 2^{\circ}\text{C}$ and $65 \pm 5\%$ R.H.

3. RESULTS AND DISCUSSION

Eucaliptos, ginger and rosemary leaf extracts showed insecticidal and repellent activity against *Trogoderma granarium*. Many investigators have reported repellent activity of plant eextracts against stored product pests. Hussam-Aldin A. Mohemed and Tareq S. Abbas(2017) have reported the insecticidal activity of *Eucalyptus camaldulensis* and *Artemisia herba alba*. As fumigant toxicity against larvae of third instar and adults of *Trogoderma granarium*. Omar Hamid Abdul Hadi and Hind Ibrahim Al-Khazraj(2021) evaluated the efficacy of the ethanol and hexane crude extract and the extract prepared in the form of Nanocapsules (encapsulation with the use of Nano chitosan) for *Moringa oleifera* leaves to protect wheat grains from infection with *Trogoderma granarium*. Shelan H. Younus and Batol A. Karso(2022) showed the effectiveness of the aqueous extracts of seven plant species with five different concentration in some aspects of biological performance of the Khapra beetle larvae *Trogoderma granarium* Everts.





The current study was carried out to know the mortality and repellency of acetone extracts of Eucaliptos leaf, Rosemary leaf and ginger root at different exposure time with various concentration to give results as following:

Effect of type and concetration

1=Eucaliptos, 2=Rosemary, 3=Ginger

The data given in table 1-showed the interaction between plant extracts and concentration, highest mean value of mortality was recorded by eucalyptus %18 for larval stage3 6.33 followed by Ginger extract in %18 concentration 5.33, and Eucaliptos %14 recorded 4.66 for stage 3. Zahraa Abdul Muati Al-Ghadban (2019) reported lethal activity of third larval instar and adult of khapra beetle by eucaliptos to be 80.0, 93.3 and 100 in Eucalyptus oil. And Shelan H. Younus nd Batol A. Karso (2020) recorded mortality activities of seven plant extracts among them the aqueous extract of sagebrush showed the highest lethal effect, as the mortality rate was 100% at a concentration of 5%.

Table 1. Mean % Mortality of *Trogoderma granarium* (Everts) larvae with The interaction between plant extracts and concentration%

Extraction*Percentage	% MORTALITY	STAGE3	STAGE4
1*4	4.444 a	6.333 a	2.333 b
3*4	3.222 bc	5.333 b	2.667 a
1*3	3.333 b	4.667 c	2.000 c
2*4	2.111 de	2.667 f	2.000 c
3*3	2.556 cd	3.667 d	0.667 f
3*2	1.667 e	2.000 g	1.333 d
1*2	1.889 de	1.667 h	1.000 e
2*3	1.444 ef	3.000 e	0.333 g
1*1	2.111 de	1.889 gh	0.056 h
3*1	2.111 de	1.333 i	0.000 i
2*1	2.111 de	1.333 i	0.000 i
2*2	0.778 f	1.000 j	0.667 f
Pr > F(Model)	0.000	< 0.0001	< 0.0001
Significant	Yes	Yes	Yes

a= more significant difference b=Moderate significant difference c= less significant difference

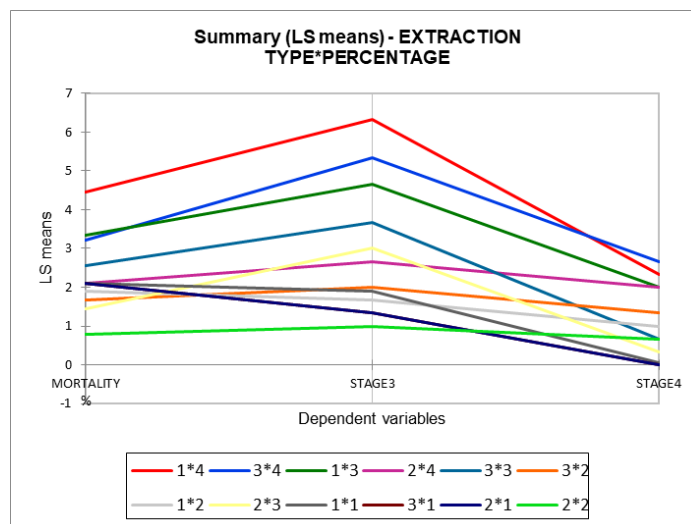


Figure 1. Means of Extraction types and Percentage

Effects of time and Extraction type

The data packed in table 2 showed the mean of interaction between hours and concentration % to obtain repellency of *Trogoderma granarium* (Everts) larvae regarding treatments. The maximum repellency was recorded in 18% concentration and 24 hours (5.66%) against 3rd larval instar followed by 18% in 48 and 72 hours (4.33%).

That have no significant difference between them. The data revealed that the mean % repellency was increased with increase in concentration.

Table 2. interaction between Mean of hours and % concentration on mortality of *T. granarium* larvae

a=	Times*Percentage	MORTALITY %	STAGE3	STAGE4
	2*4	3.556 a	4.333 b	3.000 a
	3*4	2.889 abc	4.333 b	2.667 b
	1*4	3.333 ab	5.667 a	1.333 d
	2*3	2.444 cd	3.333 d	1.333 d
	1*3	2.556 cd	4.000 c	0.333 e
	3*3	2.333 cde	4.000 c	1.333 d
	3*1	2.667 bcd	2.000 e	0.000 g
	3*2	1.556 ef	2.000 e	1.333 d
	2*2	1.556 ef	0.667 h	1.667 c
	1*1	1.667 ef	1.556 f	0.056 f
	2*1	2.000 def	1.000 g	0.000 g
	1*2	1.222 f	2.000 e	0.000 g
	Pr > F(Model)	0.000	< 0.0001	< 0.0001
	Significant	Yes	Yes	Yes

more significant difference b=Moderate significant difference c= less significant difference



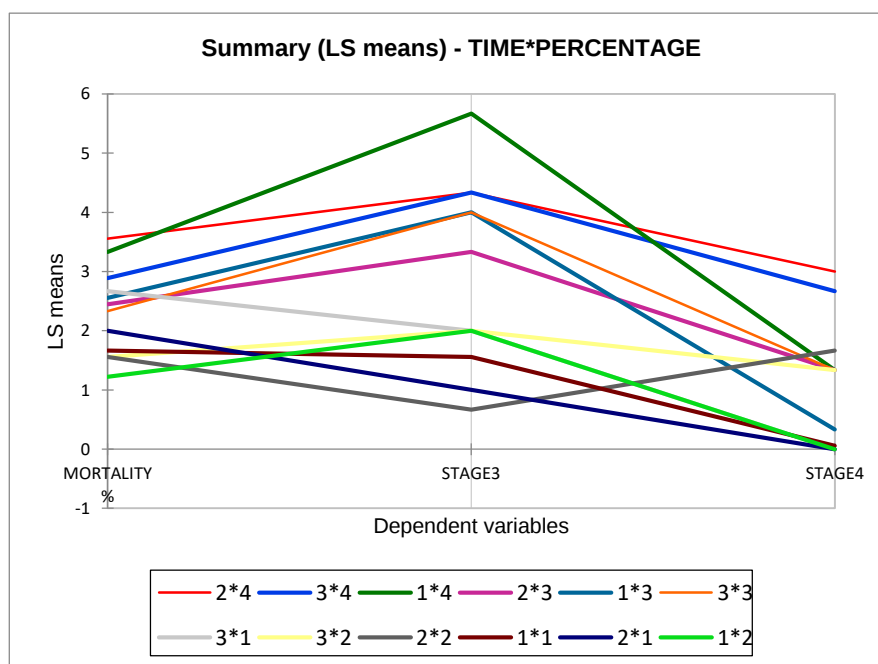


Figure 2. Means of Time and Percentage

Effect of Plant Extract and times

The data given in table 3 showed the repellent effect of interactions of plant material and hours on *Trogoderma granarium* have significant. Maximum repellency was found in eucalyptus (4.66) at 24 hours followed by Giger plant extract at 72 hours (3.75), and Rosemary (3.25) at 24 hours.

Table 3. Mean % Repellency of *T. granarium* larvae regarding interactions of Plant extracts and plant hours

Time*Extraction Type	MORTALITY%	STAGE3	STAGE4
2*1	3.167 a	3.250 c	1.750 b
3*1	2.750 ab	3.000 d	2.000 a
1*1	2.917 a	4.667 a	0.292 e
3*3	2.500 abc	3.750 b	1.000 c
2*3	2.500 abc	2.250 f	1.750 b
1*3	2.167 bcd	3.250 c	0.750 d
3*2	1.833 cd	2.500 e	1.000 c
2*2	1.500 d	1.500 h	1.000 c
1*2	1.500 d	2.000 g	0.250 f
Pr > F(Model)	0.000	< 0.0001	< 0.0001
Significant	Yes	Yes	Yes



a= more significant difference b=Moderate significant difference c= less significant difference

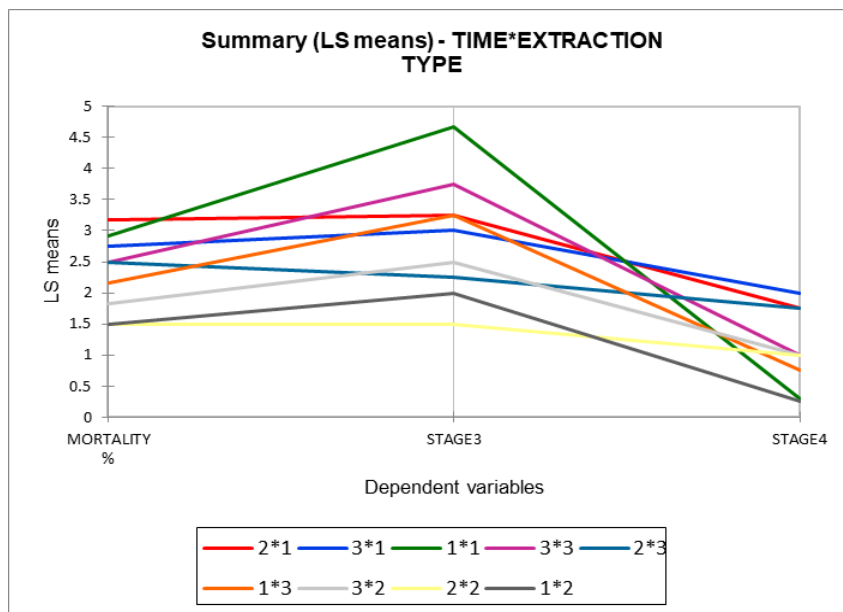


Figure 3. Means of Time and Extraction Type

4. CONCLUSIONS

This experiment conducted that different plant extracts that used in this study have repellent and insecticidal effects in various level of concentration but the different times does not have significant difference. This research showed that Eucaliptos plant extract have an insecticidal activity to repellent the larval stage (stage 3) of khapra beetle in the concentration of %18 by repellent effect of 6.33.

Botanical extracts can be used to control insects as chemical insecticide alternatives in order to minimize the negative side effects of chemical insecticides to human health and to save the environment.

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