EFFECT OF STARVATION AND INFESTATION BEHAVIOR OF LARVAE KHAPRA BEETLE, *TROGODERMA GRANARIUM* EVERTS (COLEOPTERA: DERMESTIDAE)

Pengaruh kelaparan dan perilaku infestasi larva Khapra beetle *Trogoderma granarium* Everts (Coleoptera : Dermestidae)

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Abstract: The Khapra beetle *Trogoderma granarium* Everts is very destructive pest in various stored product and nominated as one of the hundred worst invasive species in the world. The study of starvation and infestation behaviors are important for improvement of insect control method. This study represent the number of molting as fact of regressive molting in starved condition, the larva of *T. granarium* within 68 days periods can be molted 1-3 times. The infestation behavior on three diets treatment presented. In grain wheat their larva are laid off the casting skin over the surface of product and

distributed randomly in whole part of stored product. Respectively in flour casting skin are laid down in bottom of the container as effect of feeding. In flour the casting skin are laid on mostly over surface of the flour mixed with frass. In toilet tissue the infestation is present in hole over the surface and randomly position of casting skin.

Keywords: *Trogoderma granarium,* starvation, infestation behavior.

Abstrak: Khapra beetle, *Trogoderma granarium* Everts adalah hama gudang yang sangat merusak dan ditempatkan sebagai salah satu dari seratus spesies yang invasif di dunia. Studi mengenai efek kelaparan dan perilaku infestasi sangat penting dalam usaha peningkatan metode pengendalian hama. Studi ini mempelajari jumlah pergantian kulit larva *T. granarium* dalam fenomena regressive molting sebagai dampak kondisi kelaparan. Selama periode waktu 68 hari larva *T. granarium* dapat berganti kulit sebanyak 1- 3 kali. Studi ini juga mempelajari perilaku infestasi dalam tiga macam media berbeda. Pada media biji gandum larva meletakkan kulit ganti secara acak di hampir semua area dalam wadah. Serbuk gandum sebagai hasil proses infestasi terletak dibagian bawah wadah. Di media tepung, kulit ganti diletakkan di atas permukaan tepung bercampur dengan kotoran. Dalam media kertas tissue menunjukkan bahawa kertas tissue berlubang dan kulit ganti diletakkan secara acak dalam wadah.

Kata kunci: *Trogoderma granarium,* kelaparan, perilaku infestasi.

1. Introduction

Khapra beetle, *Trogoderma granarium* Everts is very destructive pest of various stored product not only grain and cereal in hot and dry

climates of the world and nominated as one of the 100 worst invasive species worldwide (Arain, 2006; Lowe *et al*. 2000; OEPP/EPPO, 2002). The environmental factors, temperature, photoperiod, food quality and quantity, rearing density, and humidity are the most common ones affecting the instar number in various insects, including T. *granarium* (Burgess, 2008; Esperk, *et.al* 2007). In condition starved, reared on poor-quality diet, or reared in groups or under conditions inducing larval diapauses the larvae of some insect, including *T granarium*. Starved condition also affected to variability of larva instar number (Esperk, *et.al* 2007). Larvae of the insect mostly eat on weakest or softest point of seed, and continuously to other part of seed. They prefer whole grain and cereal products such as wheat, barley, and rice, but also dried plant or animal matter (Szito, 2007; Harris, 2015).

The aim of this work is to study of starvation effect and infestation behavior of larvae *T. granarium* on stored product. The details of regressive molting and infestation behavior are helping the scientist to take the action in order control the pest.

2. Material and Method

The experiment conducted for 68 days (April 1st to June 7th , 2009) with ten replicates, and daily observation, where the skin molting are measured. The colony of *Trogoderma granarium* was obtain from Entomology laboratory (currently named as Economic Entomology Research Unit) Department of Plant Protecion, King Saud University, which had been rearing in grain wheat. Healthy larva from colony are separated with common sieves, where in end of sieving process, the larva will laid in the upper surface of sieves. Selected larvae are placed on nine cm diameter petridis without food. Each Petridis

contain with single larvae of *T. granarium* and observed daily. The skin molting was measured every molting happened.

In infestation behavior, the larvae are treated on three kinds of diet; wheat flour, grain and tissue papers. The diets are placed on 250 ml jar, with diet ¾ part of container. The colony of larva are placed to jars covered with cheese cloth and tied with rubber band. Each treatment conducted in single replicate and single control. The containers were placed on the incubator under 25 ± 1 °C temperature, in dark condition. The treatments are conducted for two months long with observation every two weeks.

3. Results and Discussion

Within 68 days, the larva of *Trogoderma granarium* has varies number of molting. A part of them are 3 times molting and another 2 times molting, a few are once molting. The appearance of larvae become small time by time. These phenomena shown the regressive molting in larvae of T. *granarium.*

The regressive molting mainly caused by the availability of food or starved. The skins are released to manage energy inside the body in order to survive. The differences time of molting each larvae individual showed differences response of larvae in starved condition and may genetically factor. It's reason agree with Higgins (1993) where environmental factors influence life history of insect including the larval stage and examination of whether the parameters are phenotypically plastic, responding to the environment, or are genetically determined. The size of molting skins generally indicated that the larvas are become smaller time by time or minimally same as before. It is also give an fact that larva's are different number of instars, or extension of larval time. The number of instars in

T.*granarium* is affected by environmental condition. It's also agree with Esperk *et.al* (2007) particularly, low humidity, the presence of injuries and low food quality and quantity increase the number of instars in several insect species.

Table 1. Molting time in *T. granarium* larvae

	Time molting time (days)			Molting skin size (cm)		
Replication	1	2	3	1	2	3
1	20	15	22	-	0.5	0.4
2	11	12	20	0.6	0.4	0.4
3	12	12	40	0.5	0.4	0.4
4	11	13	-	0.5	0.45	-
5	9	30	17	0.5	0.4	0.4
6	13	42		0.55	0.6	-
7	13	41	_	0.5	0.4	
8	6	43	_		0.4	
9	6	27	27			0.4
10	8	5	8	0.55	0.45	

Infestation behavior of T. *granarium* larva according to visual observation of laying position molting skin within the container. The infestation behavior experiment shown, that larva's are laid their skin in different way. In grain wheat their laid skin randomly inside the grain and some of them in upper surface of the grain. Another evident is the grains are become caved. It means the larva's are feed on inside the grain and throw the flour as result of feeding. These fact shown if the larvae are feed on pericarp and weak layer of the

grain (Szito, 2007; Harris, 2015). In flour, the larva are quiet different with the grain diet. Their laid the skin mostly over the surface of flour. The skins are dark brown color with long hair and clearly appearance in upper surface of the flour. The frass also are found it in upper surface and mixed with the flour (OEPP/EPPO, 2002). It is behavior give a fact that the larva are tried live in good and clean conditions. In toilets tissue, infestations are appears as irregular hole over the surface of tissues with randomly position of casting skin. Some of cave are covered with casting skin. This indicated that the larva are feed on the toilet tissue. The larva of T. *granarium* are not feed on only on the grain and flour but the toilet tissue that be produced from dried material plants (Szito, 2007; Harris, 2015, Jood *et.al*, 1993). Those behaviors shown the larva are wide range host that can be reached for surviving the live. In grain and flour the sugar contains higher than toilet tissue. In high sugar content or mostly carbohydrates the level of attack are more than in low level sugar (Jood, *et.al*.,1993). In this case, the number of casting skin which fact of the attacking, are higher in flour and grain while in toilet tissues are lower. An fact many kinds of the stored product can be infested by T. *granarium* and many plant products such as tissue paper.

4. Conclusions

Starved condition on larva of T. *granarium* causing regressive molting in various way of molting and during 68 days periods are able to survive. The larva of T. *granarium* are able to infest many types of the stored product and plants base product. The infestation behaviors of larva T. *granarium* are laid off the casting skin far way mostly over surface of the products.

Acknowledgement

I would like to express a great gratitude to Prof. Dr. Yousif Al Dryhim for laboratory work information and guiding experiment. We would also like to give our gratitude to Head Depertment of Plant Protection for his great help in facilitate this study. Special appreciation is extended to all the members of Economic Entomology Research Unit, Plant Protection, College of Food and Agricultural Sciences, King Saud University.

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