Population Density of Khapra Beetle, *Trogoderma granarium* Everts (Dermestidae: Coleoptera), on Grains and Spikes of Wheat and Barley

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ABSTRACT

This study was conducted to determine the population density of khapra beetle, *Trogoderma granarium* Everts, on grains and spikes of wheat (Adnania variety) and barely (barley hybrid, Forat × Baraka; black barley, Al-Jazera variety and White barley, Badea variety) under natural room storage condition for five months period (from July till November, 2012), in addition the loss in weight due to the infestation were evaluated. The results indicated that, for each sample of 25 gm, the average total number of all stages of insect recorded on grains at the end of storage period were 927.50 individuals and the total weight loss due to infestation were 25.68% while on spikes there were 15.42 individuals and weight losses of 0.24%. The highest mean number of all stages was 1045.50 individuals with highest weight losses of 24.6% in wheat grains and the lowest number was 8.70 individual with lowest weight losses of 0.64% in white barley grains. The interaction between the kind of storage, in grains or spikes, with the kind of grains have considerably significant effect on the mean number of different stages of insect as well as the mean weight loss.

Keywords: khapra beetle , *Trogoderma granarium*.

INTRODUCTION

Grain crops provide essential food sources to man as well as animals. They are a basic material in industries and play an important role in the economy of all countries. Grain storage is considered the basic element of the production processes especially post-harvest (Al-Iraqi, 2010).

Insect pests are the main problem that affect stored grains and their products due to the qualitative and quantitative losses. Khapra beetle causes great damages to stored grains from post-harvest till culturing which reaches up to 10% by weight. Infestation makes grains unsuitable for sowing because the insect primarily attacks the embryo of the grain (Al-Iraqi, 2002). Khapra beetle is regard as a major endemic pests in many countries in Europe, Africa, middle and southern Asia including Iraq (Al-Iraqi, 2003, Al-Iraqi and Al-Safar, 2004 and Ghosh and Durbey, 2005).

In order to use a safe method for the controlling stored product insects and reduce the dependence on the synthetic insecticides which had give rise to many ecological problems including toxic residues, harm to mammals and the accumulation of harmful residues in environment (Khan *et al*., 2005) and realization of which was mentioned in the verse 47th in the Yousef Chapter of the Glorious Koran that is recommend to store the grains in their spikes. This study was conducted to compare the effect of storing grains in their spikes as compared to

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grains alone on wheat and barley under natural room storage conditions.

MATERIALS AND METHODS

Four kinds of grains, wheat *Triticum aestivum* L. (Adndnia variety), and barley *Hordium vulgare* L.varieties; hybrid (Forat × Baraka), black (Al-Jazera variety) and white (Badea variety) alone and within their spikes have been taken from the previous study of Al-Safar (2001). Estimation of the susceptibility to infestation with khapra beetle after a storage period of five months (from July till November, 2012) under natural room conditions (30°C , 60% R.H. as average without light) was determined by evaluation of population density of the insect developmental stages and the loss of grain weight that were caused due to the artificial infestation with a primary level of 2 couples of khapra beetles/ 25 gm of grains or their spikes.

Three replicates were used for each kind of grains and spikes. Each replication included 25 gm of each kind stored as either grains or within their spike (taken from yield of 2012 with 12% moisture content) placed in a glass jar,125 ml capacity, then couples of newly emerged adults (few hours old) were transferred to jar. The adults, which were used for this purpose, were obtained by isolating many males and females pupae separately from the laboratory cultures (khapra beetle was reared on sound cleaned wheat grains *Triticum aestivum* with about 5% broken grains in a glass container of about 750 ml capacity and the mouth was covered with muslin cloth tightened with rubber band then placed in an incubator at a temperature of 33±1°C and 60±5 R.H.) in a glass Petri-dishes that maintained in incubator at 32°C and 65% R.H. with no light till the adults emerges. The mouths of the jars were covered with muslin cloth tied with rubber band. The containers were placed in the laboratory under natural room conditions.

At the end of storage period, the numbers of all insect stages (larvae, pupae and adults) both alive and dead were recorded. In order to estimate the loss in weight of each kind of grains or spikes due to infestation, the specimen's residue (after the removal of all insect stages and refuses) were weighted and the losses in weight caused by insects feeding were calculated as %.

A completely randomized design was used and the data were subject to analysis of variance (ANOVA) and mean values were compared by Dancan's multiple range test to determine the significant levels between variance (SAS,1996).

RESULTS AND DISCUSSION

The data in table (1) revealed that the storage of grains or their spikes had a highly significant effect in the growth and development of khapra beetle which are reflected obviously in the mean number of larvae, pupae, adults, the total number of all individuals presented and the total weight loss which gave rise to the infestation. For each sample of 25 gm, of stored grains, there were 927.50 individuals including 831.75 larva, 1.91 pupa, 93.83 adult, and average weight losses 25.68% were meanwhile, in case of spikes, there were 15.42 individual including 11.50 larva, 0 pupa and 3.92 adult, and the weight losses were 0.24%. Thus, results showed that, the husks surrounding the grains in the spikes themselves provided physical protection to the grains and served as natural defense for beetle penetration to reach the grains.

Table 1. Effect of grains kinds and their spikes in population density of khapra beetle and rate of weight losses.

	Larval No.	Pupal No.	Adult No.	Total of all stage No.	Weight loss (%)
Grains	831.75 A	1.91 A	93.83 A	927.50 A	25.68 A
Spikes	11.50 B	0.00 A	3.92 B	15.42 B	0.24 B

Means within columns followed with different letters are significantly different at $P \leq 0.05$

These results in agreement with Aljbouri *et al.* (2012) who concluded that storage of seeds in spikes protected them from khapra beetle infestation, and the infestation rate was lower than 7% and continued at this low level for 13 weeks while the removal of husks led to rise of seed's infestation up to 26%. Acreman *et al.* (1986) revealed that one of springer wheat variety that spikes contain awn was more resistant to grain aphid *Sitobion avenae* in comparison with the spikes without awn. The data in table (2) showed significant effect of grain kind on the bionomics of khapra beetle and then on the mean losses of weight induced. The highest mean number of each larvae, pupae, adults and total of all stages as a whole were 987.33, 1.66, 65.50 and 1045.50, respectively in case of wheat grains whereas lowest values were observed in case of white barley and that were 6.50, 0, 2.17 and 8.70, respectively. In contrast, the highest mean weight loss was 24.60% in wheat and the lowest was 0.64% in white barley. The morphological specifications of the plant may have essential effects in the level of plant resistance to insect infestation (Dent, 2000). Gogburn and Bollich (1980) revealed that the resistance of rice to stored rice insects is due to the physical properties of spikes.

Table 2. Effect of grain kinds in population density of khapra beetle and rate of weight losses.

Grain kind	Larval No.	Pupal No.	Adult No.	Total of all stage No.	Weight loss (%)
Wheat	987.33 a	1.66 a	65.50 ab	1045.50 a	24.60 a
Barley hybrid	632.17 b	2.16 a	127.50 a	761.50 b	20.00 a
Black barley	60.50 c	0.00 b	9.67 b	70.20 c	2.64 b
White barley	6.50 c	0.00 b	2.17 b	8.70 c	0.64 b

Means within columns followed with different letters are significantly different at $P \leq 0.05$

The data in table (3) indicated that the interaction between the kind of storage, in grains or spikes, with the kind of grains have considerably significant effect on the mean number of different stages of insect as well as the mean weight loss.

Table 3. Effect of interaction between the kind of storage, as grains or spikes, with the kind of grains in population density of khapra beetle and rate of weight losses.

	Grain kind	Larval No.	Pupal No.	Adult No.	Total of all stage No.	Weight loss (%)
Grains	Wheat	1957.33 a	3.33 a	107.67 b	2068 a	48.84 a
	Barley hybrid	1251.33 b	4.33 a	249.00 a	1504.66 b	47.60 a
	Black barley	108.33 c	0.00 b	16 .00 c	124.33 c	5.16 b
	White barley	10.00 d	0.00 b	2.66 c	12.66 c	0.96 b
Spikes	Wheat	17.33 d	0.00 b	5.33 c	22.66 d	0.40 b
	Barley Hybrid	13.00 d	0.00 b	5.33 c	18.33 d	0.28 b
	Black barley	12.67 d	0.00 b	3.33 c	16.00 d	0.16 b
	White barley	3.00 d	0.00 b	1.67 c	4.66 d	0.08 b

Means within columns followed with different letters are significantly different at $P \leq 0.05$

Wheat grains showed the highest number of larvae (1957.33) compared to wheat spikes (17.33) and the white barley spikes gave the lowest number of larvae (3.00). On the other hand, infestation also had a clear effect on the adults number. The highest number was 107.67 in wheat grains while it was 1.67 in white barley spikes. Also, interaction highly influenced the total number of all stages as a whole. The highest number (2068) was observed in wheat grains followed by barley hybrid grains (1504.66). The statistical analysis showed significant difference between them while showed no significant differences in the total number of all stages between the white barley grains and spikes of all kinds. The husks covering the barley grains influenced the growth and development of the insect like the spikes in addition the hardness of barley grains while the wheat grains are smooth and without husks. The total number ranged between 22.66 individuals in the wheat spikes and 4.66 individuals in white barley spikes. Panda and Khusk (1995) mentioned that the repellent and feeding deterrent substances in the husks covering the grain or in the spikes play an important role in the decreasing of attacking the grains within the spikes.

Otherwise, the total weight losses were 48.84, 47.60% in wheat and barley grains, respectively, and the statistical analysis showed no significant differences between them while differed significantly with the values of black barley grains, white barely grains and spikes of all kinds of grains. The value of weight losses in spikes did not exceed more than 0.5%. this pest have ability to tolerate starvation and inverse conditions like crowding, unfavorable food, unsuitable temperature and enter diapauses in larval period and live without food for a long period, more than 13 months. The adult have a short lifespan of 7-12 days and not feed, the damage caused by the larvae (karnavar, 1973).

From the previous results we can conclusion that the storage of grains within spikes, especially wheat, protect them from khapra beetle infestation and the weight losses was lower than 0.5% for a period of five months at natural room storage conditions. Barley, especially white barley, grains was very less susceptible to infestation by khapra beetle than wheat and we can store barley as grains without concerned from this insect.

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كثافة خنفساء الخابرا (*Trogoderma granarium* Everts (*Dermestidae : Coleoptera*

على حبوب الحنطة والشعير وسنابلهما

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ملخص

أجريت هذه الدراسة لمعرفة كثافة عشيرة خنفساء الخابرا على حبوب وسنابل الحنطة (صنف عدنانية) والشعير (الهجين، فرات × بركة والشعير الأسود صنف جزيرة والشعير الأبيض صنف بادية) تحت ظروف خزن الغرفة الطبيعية ولمدة استمرت خمسة أشهر من حزيران لغاية تشرين الثاني من العام 2012 إضافة إلى تقدير الفقد في الوزن الناجم عن الإصابة. أوضحت نتائج الدراسة، لكل عينة مكونة من 25غم، أن المجموع الكلي لعدد أطوار الحشرة المسجلة على الحبوب في نهاية فترة التخزين بلغ 927.50 فرداً وأن الفقد الكلي في وزن الحبوب نتيجة الإصابة بلغ 25.68% بينما على السنابل بلغ المجموع الكلي لعدد الأطوار 15.42 فرداً والفقد الكلي في وزن الحبوب بلغ 0.24%. بلغ أعلى معدل للعدد الكلي للأطوار 1045.50 فردا مع أعلى فقد في الوزن بلغ 24.6% في حبوب الحنطة وأن اقل عدد كان 8.70 فردا مع اقل فقد في الوزن بلغ 0.64% في حبوب الشعير الأبيض. أظهر التداخل بين نوع التخزين، كحبوب أو كسنابل، مع نوع الحبوب تأثيرا معنويا عاليا على معدل عدد الأطوار المختلفة للحشرة وكذلك على معدل الفقد في الوزن.

الكلمات الدالة: خنفساء الخابرا ، *Trogoderma granarium*.

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