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Cereal Grains and Oilseeds as Preferred Host Plants for the Khapra Beetle, *Trogoderma Granarium* Everts (Coleoptera: Dermestidae)

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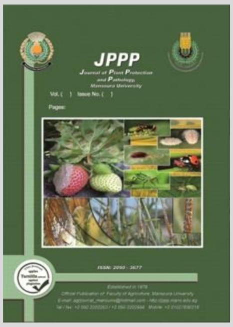

ABSTRACT

The Khapra beetle, *Trogoderma granarium* Everts (Coleoptera: Dermestidae), is a significant insect pest of grains, cereals, and other stored goods. One of the effective ecological components influencing an insect performance is the host plant. The effects of four oil seed cultivars and five cereal grains were assessed for their nutritional indices and life table parameters of *T. granarium* under laboratory conditions. The developmental time of immature stages was shorter on the oat grain (33.1±0.76 days) and longer on the flax (63.1±1.69 days) cultivars than other cultivars. The highest survival rate of larvae and pupal stages were in the wheat and oats cultivars, and the lowest was in the coconut cultivar. The pre-oviposition period increased when reared on oilseeds, while it decreased after that in the following two periods (oviposition and post-oviposition) compared to other cereal grains. Fecundity, or the number of eggs produced, increased with upbringing on cereal grains and reached 51.4±0.96 eggs when reared on oats, while was 50.8±0.88 eggs when reared on wheat.. The results of this study demonstrated that certain commodities are more attractive than others to spread *T. granarium*, a finding that should be carefully considered in the international commerce of grains. Finding the anti-digestive components in host grain through research on the nutritional physiology of *T. granarium* on various cultivars can then help genetically design crops to become resistant to this important pest.

Keywords; Development, Feeding performance; Fecundity, Survival, nutritional responses

INTRODUCTION

Globally, *Trogoderma granarium* Everts is one of the important polyphagous pests of stored cereal grains like rice, wheat, maize and barley as well as their second products (Lowe et al., 2000; Ahmedani et al., 2009; Athanassiou et al., 2016, 2019). This species is an invasive pest with a strong likelihood of spreading to other parts of the world (Burges, 2008). The khapra beetle larvae can diminish the weight, nutritional content, and germination potential of grains, which can limit their marketability (Jood et al., 1992). Additionally, the infestation of stored grains and their derivatives such as setae and other *T. granarium* larval body parts may cause gastrointestinal and allergic irritations. (Jood et al., 1992; Ahmedani et al., 2009). The khapra beetle may significantly reduce the value of the vulnerable rice cultivars when they are kept in storage for an extended period of time, particularly in conventional storage systems (references). To reduce grain losses caused by this insect, cultivars that are less nutrient-rich or resistant to *T. granarium* must be identified.

Insecticide-based approaches to controlling pests of stored goods, such *T. granarium*, have been rapidly replaced by integrated management in recent years. The continued widespread use of these insecticide to control stored grain insects is impractical due to the negative consequences of chemical pesticides, such as harm to human health, contamination of the environment, and fast pest resistance development (Throne et al., 2000; Mohandass et al., 2007; Masoumzadeh et al., 2014). Therefore, it would be important to establish an Integrated Pest Management (IPM) program for stored goods and search for new and safe alternatives to synthetic pesticides for the protection of grains (Lawrence and Koundal, 2002). According to Panda and Khush (1995), Plants that possess host plant resistance can withstand, prevent, or recuperate from the negative effects of insect pest invasion. Body size, weight, longevity, ability to reproduce, and maturity period of an insect species can all be impacted by poor host plants. (Sarfraz et al., 2006). Suitability or unsuitability of different varieties and crop cultivars for the target pest species can evaluate the resistance of those varieties and crop cultivars to insects (Tsai and Wang, 2001). According to Scriber and Slansky (1981), the quantity and quality of the food on insect consumption can significantly affect its growth, development, and ability to reproduce and these biological parameters can be used to evaluate resistance indices.

More than twenty of wheat cultivars were tested for *T. granarium* resistance by Rao et al. (2004), who found that HS 240, Kalyansona, WTN 50, and UAS 2023 cultivars were the most resistant cultivars. Additionally, Sayed et al. (2006) evaluated wheat's varietal resistance to *T. granarium* and they observed that the lowest population was on Mehran-89 wheat variety. When *T. granarium* stages were raised on cracked wheat, Hosseininaveh et al. (2007) assessed the digestive proteolytic and amylolytic activities of the organisms. They found that the adult digestive system lacked enzymatic activity. According to Borzoui et al. (2015), the life history and nutritional physiology of *T. granarium* fed with different diets were analyzed, and the results showed that walnut was an unsatisfactory food for the development of this pest. The ability of an insect species to feed and develop on various host cultivars is influenced by the nutrients in the food it eats as well

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as by the physical and biochemical traits of the host plant (Joern and Behmer, 1997; Karasov et al., 2011). Growth, reproduction, and feeding habits of herbivorous insect can all be affected by the nutritional value of their host cultivars (Tsai and Wang, 2001). Studying the resistance indices of specific cultivars to insect pests can help in better understanding of how well-suited various host cultivars are suitable or not for insect development and population increase (Golizadeh and Abedi, 2016, 2017). Recent research suggests that one of the main components of an IPM program should be the assessment of the nutritional performance and digestive physiology of khapra beetle larvae fed with various grain cultivars (Naseri and Borzoui, 2016; Majd-Marani et al., 2018). It is a vital to examine the life table parameters under various experimental circumstances in order to ascertain the impact of various physiological, morphological, and biochemical properties of host plants on the performance of insect pests (Razmjou et al., 2013). According to Chi and Su (2006), the life table is an effective tool for estimating an insect's population size and survival rate in order to explain why antibiosis occurs in host plants. The intrinsic rate of natural increase is the most crucial parameter of various life table parameters to consider when analyzing how well an insect population perform under specific environmental and dietary constraints (Southwood 1966; Southwood and Henderson 2000). Conventional female age-specific life tables (Borzoui and Naseri 2017; Chi and Su 2006) exclusively represent the survivability and fecundity of females; population parameters are computed without accounting for the influence of male sex. Furthermore, to account for stage differences and the contribution of both sexes (male and female) to the rate of population increase, an age-stage, two-sex life table theory has been constructed (Chi 1988; Nikooei et al. 2015). Owing to *T. granarium* economic significance for various stored commodities, including oil seeds and cereal grains, this study sought to ascertain which host grain would be least suitable for the pest's growth by examining the effects of various commodities on *T. granarium* biological aspects, reproduction capacity, and two-sex life table parameters. Ascertaining when creating management strategies for *T. granarium*, like growing resistant hybrids to suppress the pest, it is necessary to consider the variables influencing the life table parameters of an insect species.

MATERIALS AND METHODS

Commodities cultivars and their chemical composition

Commodities of five cereal cultivars including Basmaty rice, Egyptian rice, Corn, Oat and Wheat, and other four oil seed cultivars including Sesame Flax, Soybean and Coconut were collected by the Economic Entomology Department at Mansoura University (Mansoura, Egypt), and moisture level between 11 and 14% for tested cultivars.

The levels of moisture, crude protein, crude fat, ash, and crude fiber in samples were measured in compliance with AOAC (2005). According to Peterburgski (1968), total magnesium, calcium, and potassium were estimated flamephotometrically using the Ienway Flamephotometer model Corning 400. Zn and Fe were extracted from the samples by use of the microwave digestion technique. Each sample, weighing 0.1 g, was homogenized in Teflon cups using 5 ml of ultrapure nitric acid, 2 ml of 30% H2O2, and 0.5 ml of hidro floric acid. The mixture was placed in the microwave for 37 weight minutes. The mixture was built up at 50 ml with redistilled water and frozen at -10 °C for 30 minutes.The amount of total phenols found in the 2 g of powdered plant material was extracted over night at room temperature using methanol. On a rotating evaporator, the methanol extracts were mixed and concentrated while the pressure was lowered. Folin-Ciocalteu's reagent (FCR) was used to measure the total phenolic content of each plant extract in accordance with the established methodology. After combining 2.5 ml of FCR (diluted 1:10, v/v) with each sample (0.5 ml), 2 ml of Na2CO3 (7.5%, v/v) solution was added. The absorbance was then measured at 765 nm following a 90-minute incubation period at 30°C. Gallic acid equivalent (mg Gallic acid /100g dried extract) was used to express the results (Slinkard and Singleton, 1977). Grain samples (100 g) were taken in order to evaluate the oil content (%) in cultivars tested. The grains were pulverized and transported to a Soxhlet apparatus for oil extraction at 60˚C for approximately 12 hours, along with solvent (hexane) washings AOAC (2005).After a consistent weight was achieved, the hexane that had been dissolved in the extracted cultivar oil was evaporated using a boiling water bath and rotational vacuum, and then the oil percentage was then calculated. To guarantee that there are no insect infestations or any pesticide residues, all tested commodities that have been evaluated have been sterilized.

Insect rearing

The original population of *T. granarium* larvae was provided by the Plant Protection Research Institute, Agricultural Research Center, Stored Products and Grain Pests Department, at the Sakha station (Kafr El-Sheikh, Egypt). They were raised from wheat cultivar seeds and maintained at 14:10 (L:D) hours of photoperiod, 33 ± 2 °C, and 65 ± 5% relative humidity.. Each jar has two top holes, each holding 200 g of grains from a different cultivar, were lined with fine-mesh gauze. *Trogoderma granarium* was reared on each cultivar for three generations prior to the commencement of the research, and individuals from the fourth generation were used in the following tests.

Experimental design

Each experiment was carried out in a lab environment with the following specifications: photoperiod of 14:10 h (L:D), temperature 33 ± 2 °C, and relative humidity 65 ± 5%. To gather *T. granarium* eggs of the same age on each cultivar, 25–30 male–female pairs of the recently emerging beetles from the laboratory culture were reared from the same host plant and kept in containers for oviposition. Male and female adult stages were distinguished from each other using size and, more specifically, features of the antennae (Bagheri Zenouz, 1997; Kulkarni et al., 2015). In order to assess the developmental period and survival rate, sixty-one > one-day-old *T. granarium* eggs were used in the tests. The eggs were put into Petri dishes (diameter 6 cm, depth 2 cm) with corresponding cultivar grains. Every day the eggs were checked until hatching. After eclosion, each *T. granarium* larva was coded and put onto a 6 cm diameter by 2 cm deep Petri dish. Every day, each larva received one gram of grains from each related wheat cultivar (Navarro and Gonen, 1970). The development and survival of the tested larvae were monitored daily until the preimaginal stages of *T. granarium* were completed or died. The weight of the *T. granarium* pupae on each cultivar was measured 24 hours after pupation. As a result, records were made on each person's developmental progress, the length of their immature stages, and their survival.

Each couple in this arrangement received fresh food, a new tube every day, and a record of how many eggs the adults laid. This investigation was carried out until the death of the male and female subjects. Data on adult fertility and longevity were gathered for each cultivar. In this way, we evaluated the fertility of 25 adult pairs (25 replications) for each cultivar. The experiment was set up in a completely random manner. Furthermore, all of the eggs collected for this study were maintained alive for 15 days in order to measure the hatching rate, or the percentage of larvae emerging from the eggs.

Statistical Analysis

The statistical program SPSS 28.00 (IBM SPSS statistics 2021) was used to perform a one-way ANOVA analysis on all of the biological feature data of *T. granarium*. Tukey test at $\alpha = 0.05$. was used to assess statistical differences between the means. Prior to analysis, all data were checked for normality using Kolmogorove–Smirnov test.

RESULTS AND DISCUSSION

Results

Table 1 displays some physical and biochemical characteristics of tested varieties. Generally, the results of the study showed that most of the physical and biochemical characteristics (i.e. protein, fat, ash, fiber and all minerals) were high in oilseeds to varying degrees and highly significant, except in coconut seeds, while the percentages of both moisture and total carbohydrate content increased in cereal grains compared to oilseeds.

Table 1. Mean some biochemical and physical properties in cereal grains and oil seeds.

Group	Cereal grains					Oil seeds			
Cultivar	Basmaty rice	Egyptian rice	Corn	Oat	Wheat	Sesame	Flax	Soybean	Coconut
			Proximate analysis (%)						
Moisture	10.28	11.16	10.37	12.91	11.83	6.13	6.94	8.36	4.54
Protein	7.94	7.92	9.94	11.73	11.78	14.51	19.21	39.18	6.98
Fat	0.36	1.63	3.86	6.91	1.36	41.16	44.18	18.11	59.94
Ash	0.63	0.67	1.78	1.69	0.86	5.94	3.47	3.54	1.94
Fiber	1.13	1.17	2.98	3.67	0.63	4.53	10.26	5.23	13.21
Total carbohydrates	80.79	79.32	71.07	66.70	74.17	32.56	26.20	32.56	26.60
			Minerals (mg. / 100 gm.)						
P	97.16	138.86	281.21	477.57	143.97	142.11	347.11	686.24	4.61
K	93.18	167.12	269.36	349.61	129.13	102.23	754.37	721.13	31.18
Ca	9.47	16.94	21.18	53.18	23.06	276.18	243.41	246.26	23.81
Mg	23.42	76.18	47.37	113.25	0.98	27.84	341.83	171.18	321.12
Fe	3.36	3.17	2.97	3.23	0.73	3.71	5.74	10.31	0.71
Zn	2.11	4.86	5.74	12.1	1.72	4.21	3.94	3.61	0.66
Total phenol	16.86	17.94	169.26	86.73	94.18	48.16	1374.06	156.11	3116.32
Oil %	-	-	4.98	-	-	51.42	33.56	22.16	56.48

Table 2 showed the findings of the impact of several wheat cultivars on *T. granarium* development time. There were notable variations seen in the length of the egg, larval, and pupal phases across the examined varieties. Furthermore, there were differences in the immature developmental time between cultivars. The oat cultivar (33.1±0.76 days) had the shortest development time, followed by wheat (33.6±0.69 days), corn (35.3±0.81 days), and flax (63.1±1.69 days) together with other oil seed cultivars (Table 2). In detail, the egg incubation periods were equal and the pupae stage periods were very similar in all the tested varieties and this is due to the lack of nutrition and feed in both stages. Moreover, the length of the larval lifespan differed as a result of the differences in the tested varieties, and the periods increased significantly in oilseeds, and even reached twice the period in flax compared to the varieties of cereal grains.

Table 2. Developmental time (mean ± SE) of Trogoderma granarium reared on various varieties of cereals grains and oil seeds.

Cultivars	Types	Developmental time (days)			Egg-Adults
		Egg incubation	Larvae period	Pupae period	
Cereals grains	Wheat	3.6±0.16 a	24.6±0.54 c	5.4±0.34 bc	33.6±0.69
	Corn	3.6±0.16 a	25.8±0.68 c	5.9±0.41bc	35.3±0.81 d
	Egyptian rice	3.6±0.16 a	27.1±0.82 c	6.5±0.48 b	37.2±0.96 d
	Basmaty rice	3.6±0.16 a	26.9±0.81 c	6.3±0.52 b	36.8±1.01 d
	Oat	3.6±0.16 a	24.2±0.68 c	5.2±0.25 bc	33.1±0.76 d
Oil seeds	Soybean	3.6±0.16 a	37.1±1.46 bc	7.2±0.55 a	47.9±1.64 c
	Sesame	3.6±0.16 a	44.1±1.38 b	7.2±0.55 a	54.9±1.46 b
	Flax	3.6±0.17 a	52.2±1.37 a	7.2±0.59 a	63.1±1.69 a
	Coconut	3.6±0.16 a	-	-	-

Mean values in a column followed by different letters are significantly different on the basis of ANOVA with Tukey test (P < 0.05).

The survival rate of both the larval and pupal stages differed according to the tested varieties (Fig. 1), where the highest survival rate of larvae was in the wheat and oats cultivars (94%), and the lowest survival rate was in the coconut cultivar (1%). The highest survival rate of the pupal stage was when feeding on the oats variety (100%), then wheat (98.9%), and the lowest survival rate was on the coconut cultivar (1%).

In the same context, the results show the differences between the longest longevity of both sexes (males and females) (Fig. 2), as it showed that females' longevity is longer compared to males when reared on all cultivars and also *T. granarium* had longer periods when reared on cereal grains compared to others reared on oilseeds.

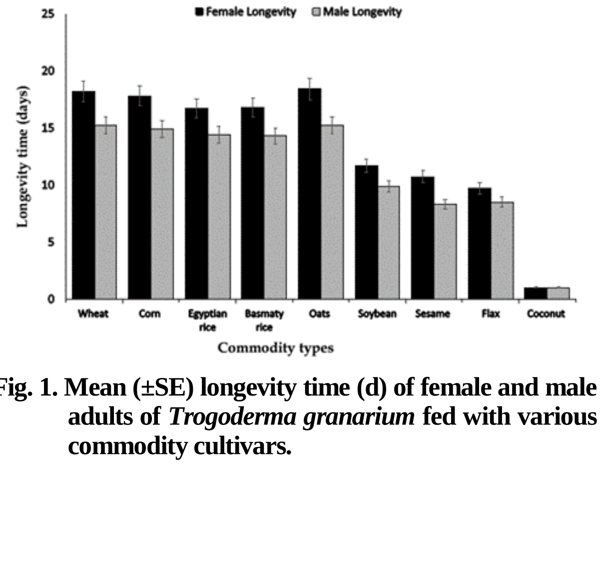

Fig. 1. Mean (±SE) longevity time (d) of female and male adults of *Trogoderma granarium* fed with various commodity cultivars.

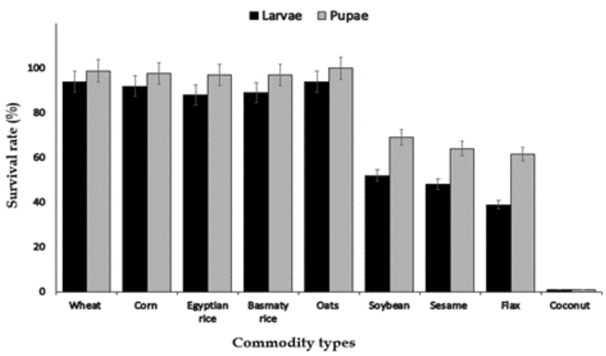

Fig. 2. Mean (±SE) survival rate of larvae and pupae for *Trogoderma granarium* on various commodity cultivars.

The egg-laying periods of the three stages (pre-oviposition, oviposition, and post-oviposition) varied according to the tested cultivars (Table 3). The pre-oviposition period increased when reared on oilseeds, while it decreased after that in the following two stages (oviposition and post-oviposition) compared to cereal grains. Rearing on cereal grains led to an increase in fecundity, represented by an increase in the number of eggs, and it reached its peak when rearing on oats (51.4±0.96 eggs), followed by wheat (50.8±0.88 eggs), then corn (41.8±1.12 eggs), which resulted in an increase in the rates of emergence of adult insects in the same order as before (oats > wheat > corn), and they were 94, 93 and 90%, respectively (Table 3).

Table 3. Ovipositional periods, fecundity (mean ± SE) and adult emergence (%) of the Khapra grain beetle, Trogoderma granarium reared on various cultivars of cereals grains and oil seeds.

Cultivars	Types	Oviposition periods (days)			Fecundity (No. egg)	Adult emergence (%)
		Pre-Oviposition	Oviposition	Post- Oviposition		
Cereals grains	Wheat	4.6±0.16 a	10.6±0.37 a	3.01±0.8 a	50.8±0.88a	93a
	Corn	5.2±0.2 a	9.9±0.55 a	2.7±0.26 a	41.8±1.12b	90a
	Egyptian rice	5.2±0.44 a	9.1±0.71 a	2.4±0.34 a	25.9±1.98c	85a
	Basmaty rice	5.1±0.33 a	9.4±0.71 a	2.4±0.31 a	26.5±1.86c	86a
	Oat	4.6±0.16 a	10.8±0.39 a	3.1±0.42 a	51.4±0.96a	94a
Oil seeds	Soybean	6.1±0.48 a	4.8±0.55 b	0.8±0.25 b	7.1±0.42d	36b
	Sesame	5.9±0.46 a	4.2±0.51 b	0.6±0.22 b	6.8±1.04d	31b
	Flax	6.1±0.44 a	3.3±0.37 b	0.4±0.22 b	3.2±0.66d	24b
	Coconut	-	-	-	-	-

Mean values in a column followed by different letters are significantly different on the basis of ANOVA with Tukey test ($P < 0.05$).

Discussion

Food macronutrients, particularly those high in protein and carbohydrates, might modify the digestive physiology of post-harvest insects like T. granarium, hence affecting the appropriateness of the food for them (Bernardi et al., 2012; Naseri and Borzoui, 2016).

The findings of this study showed that *T. granarium* was able to feed on, survive, and develop on the seeds of nine cultivars of common cereal grains and oilseeds and that the type of host plant might have a significant impact on the organism's ability to develop, survive, reproduce, life table, and nutritional indices. The results align with the earlier research conducted on *T. granarium* (Seifi et al., 2015; Borzoui et al., 2015). Our results show that development periods increased in oilseeds compared to cereal grains (Table 2), and by taking the physical and biochemical analysis into account, it can be confirmed that as the contents of ash, fiber, fats, oil% and total phenol increase, the palatability of insects to the food hosts decreases, thus increasing the period for them to obtain the food necessary for their transition from one stage to the next stage. Differences in macronutrients, particularly starch, and inhibitors may be the cause of variations in the length of *T. granarium's* immature stages (Borzoui and Naseri, 2016). The available data unambiguously demonstrate that there was no direct and consistent correlation between population growth and grain size, grain protein, or oil content of grains, even though these parameters might occasionally have an impact (Ram and Singh, 1996; Khattak et al., 2000; Rao et al., 2004; Rajput et al., 2015). As for the differences in nutrition between grains, *T. granarium* needs lipids, carbohydrates, and protein for growth and development. For instance, the development of *T. granarium* was negatively affected when natural aminoacids were substituted for artificial ones in the diet, despite the fact that it has been shown that individuals in this species are capable of synthesizing both essential and non-essential aminoacids (e.g., proline, tyrosine, glycine, aspartic acid, alanine, and glutamic acid) (Bhattacharya and Pant, 1968). When lipids were absent from meals, larvae either never reached adulthood or just a small percentage of them did so after a protracted developmental period (Bhattacharya and Pant, 1969).

The duration of *T. granarium* larval and pupal stage can be influenced by differences in secondary chemicals or nutritional quality among the cultivars that have been evaluated. According to reports, body weight and food quality and amount are related (Li et al., 2004; Liu et al., 2004). Different diets have an impact on the weight of *T. granarium* larvae and pupae, as demonstrated by Borzoui et al. (2015). In the current study, the range of pupal weight of *T. granarium* on different cultivars evaluated was smaller than those reported by Seifi et al. (2015). This disparity could be explained by genetic variances in the populations under study, or by changes in the cultivars and experimental setup that are employed to feed the pest. Basic features of insect biology are directly impacted by the type and amount of food consumed (Bentancourt et al., 2003). Differences in the nutritional composition of different host plants are probably the reason for discrepancies in the findings of various research. According to Borzoui et al. (2015), heavier pupae on a particular diet may directly affect adult fertility and lifespan. Accordingly, this characteristic may be the best measure to assess whether a particular host plant is suitable for a particular insect (Salas et al., 1993). The results of the current study showed that the most suitable and preferred cultivars for *T. granarium* were the oats and wheat cultivars, and this is what the measurements and survival rates of the larvae and pupae showed. Several authors have investigated this pest's susceptibility and resistance to various wheat varieties. When wheat varieties were evaluated against *T. granarium,* Sharma et al. (1988) discovered that the cholesterol content of the insects was greater on resistant cultivars. Similar investigations by Khattak et al. (2000) identified the progeny of *T. granarium* in various wheat lines and revealed notable variations in the quantity of insects produced in various wheat lines. Golizadeh and Abedi (2016), unequivocally stated that among the examined cultivars, Mehran-89 and Condor had the highest host resistance and had the most potential for use in the integrated control of *T. granarium*. Based on this observation, Bhattacharya and Pant (1969) concluded that lentil's low lipid content made it unsuitable for *T. granarium* larvae as feeding. According to Agarwal (1970), cholesterol is also required for the proper development of larvae, pupation, and adult emergence. While the extraction of albumins, gliadins, and globulins from wheat has a detrimental effect on larval survival, low protein confinement can significantly impair the development of this species' larvae (Nawrot et al., 1985). According to a recent study by Borzoui et al. (2015), rye and wheat provided *T. granarium* with higher fecundity and immature survival rates than rice and barley.

Our findings demonstrate that, in some situations, *T. granarium* can multiply quickly, reaching high numbers in as little as sixty days following medium-sized larvae's contact with the goods. As a result, when cargoes that are carrying a small number of *T. granarium* individuals arrive at their destination, they may quickly encounter a large population of this bug. The results of this study indicate that certain commodities are more likely than others to support the population growth of *T. granarium*; this is a fact that should be carefully considered when examining and treating grains and related amylaceous products for international trade. Our results can better understand population dynamics and possibly create a more effective control program for *T. granarium* if we have knowledge about the quality of tested cultivars and how it affects the pest's demographic parameters. In addition, a survey on *T. granarium's* reaction to digestive enzyme activity is unavoidably advised for the control of this pest in subsequent research.

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الحبوب والبذور الزيتية كعوائل نباتية مفضلة لحشرة خنفساء الخبرا *Trogoderma granarium* Everts (Coleoptera: Dermestidae)

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الملخص

خنفساء الخابرا افة حشرية هامة على الحبوب والمنتجات المخزونة الأخرى ان اى مكون إيكولوجي مؤثر لأداء الآفات الحشرية هو العائل النباتي. نتائج الدراسة الحالية تشير الى أن تاريخ الحياة والصفات البيولوجية لحشرة خنفساء الخابرا تأثرت بأختلاف العائل النباتى وقد وجد أن أقصر فترة نمو كانت على حبوب الشوفان (33.1 ± 0.76 يوم) يليها القمح (33.6 ±0.69 يوم) وكانت أطول فترة نمو على صنف الكتان (63.1 ± 1.69يوم) . وقد كان اعلى معدل بقاء لاطوار اليرقات والعذارى على حبوب القمح والشوفان وان اقل معدل للبقاء كان على جوز الهند وقد زادت فترة ما قبل وضع البيض عندما يتم تربية الحشرة على البذور الزيتية بينما تناقصت فترة وضع البيض وفترة ما بعد وضع البيض عليها مقارنة بالحبوب . أن التربية على الحبوب أدت الى زيادة خصوبة الاناث حيث وجدت زيادة في عدد البيض الموضوع وقد وصلت ذروة لها عندما تم التربية على حبوب الشوفان (51.4 ±0.96 بيضه) عليها حبوب القمح (50.8 ± 0.88 بيضه) نتائج هذه الدراسة أوضحت أن هناك بعض المنتجات أكثر فاعلية لانتشار خنفساء الخابرا من غيرها من المنتجات وهذة الحقيقة يجب أن تؤخذ في الاعتبار في التجارة الدولية للحبوب ولهذا تعتبر دراسة فسيولوجية التغذية لحشرة خنفساء الخابرا على حبوب محاصيل مختلفة مفيدة في توصيف المركبات المثبطة للهضم في الحبوب العائلة للحشرة التي يمكن بالتعبير عنها في الهندسة الوراثية للمحاصيل لاظهار المقاومة للافة الرئيسية