EFFECT OF DIFFERENT FOOD TYPES ON THE BIOLOGY, FECUNDITY AND LIFE TABLE PARAMETERS OF THE STORED GRAIN MITE *GOHIERIA FUSCA* (OUD.) (ACARI : ASTIGMATA : LAPIDOPHORIDAE)

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Abstract

Biological studies were carried out on the stored grain mite *Gohieria fusca* (Oud.), where it fed on three different food sources: dry yeast granules, crushed wheat and crushed maize to determine the ability of mite *Gohieria fusca* to feed on, develop, fecundity, reproduction and life table parameters as a sole food sources under laboratory conditions of 25±2 ºC and 65% R.H. Obtained results and statistical analysis showed that developmental stages, fecundity, reproduction and life table parameters of mite were affected by different food types, whereas, total immature stages lasted (31.22 & 29.92), (34.73 7 33.38) and (31.81 & 29.78) days for female and male, when mite fed on the above mentioned diets respectively. Female oviposition period lasted 26.8, 30.9 and 29.1 days, which deposited an average numbers of eggs with a daily rate (132.9 & 4.96), (111.5 & 8.87) and (91.3 & 3.14) eggs, when mite fed on dry yeast granules, crushed wheat and crushed maize respectively.

INTRODUCTION

Mites, insect and fungi infesting stored grains and other products are responsible for causing both qualitative and quantitative losses especially when stored in moist and unhygienic conditions (Sinha *et al.,* 1962). A stored grain granaries and bulk constitutes considered a biological systems with limited energy and are influenced by several a biotic and biotic factors. Stored grains are considered one of the most important sources of human food, therefore, it is necessary to study the pests which attack them causing much harmful which leading to decrease the amount of storage grains. Astigmatid mites form an important group among biotic factors although they are very small in size cause considerable damage in stored grains when high moisture content. The amount of damage caused by stored product mites has been studied by Cunnington (1972) to be roughly proportional to the size of their population. The growth of mite population is directly related with the biological as well as physical factors operating the ecosystem Maurya and Jamil (1982), El- Naggar *et al* (1989) and Taha *et al.*, (2004) had attributed the growth promoting quality to dried yeast powder.

It is well known that stored product mites greatly differ in their behavior feeding habits, Wafa *et al.,* (1966), Taha (1985), Saleh *et al.,* (1987), Fawzy (1996) and Okabe and Oconor (2001), they reported that the most of mite species belonging to sub- order Astigmata attack different stored products such as wheat-grain, flour, wheat-hay, wheat-bran, rice, horse beans, lentil, dry frits, cowpea, maize, dry dates, pepper, barley, grass-seeds, cot clover, bulbs, dried milk and others. The Lapidophorid mite *Gohieria fusca* (Oud.) is commonly found in wheat-grain and wheat-bran in Dakahlyia Governorate. The present work aims to study the effect of different food types: dry yeast granules, crushed wheat and Crushed maize at 25±2 °C and 65% R.H.

MATERIALS AND METHODS

Gohieria fusca (Oud.) was reared under controlled laboratory condition of temperature (25±2 °C) and relative humidity 65%, where mites fed on dry yeast granules, crushed wheat and crushed maize. To make a pure culture of *Gohieria fusca* using plastic block (5 × 5 × 1.5 cm) each one contained a small rearing circular chamber (1.2 × 0.5 cm), the bottom of each chamber was covered with mixture of plaster Paris charcoal and the top covered with small slide glass. Two adults (female and male) are sufficient to make pure culture were placed in rearing chamber and provided with food, with adding few drops of water by searching needle as source of humidity and then placed on an incubator at 25±2 °C and 65% R.H.Thirty replicates were used, each one have a single egg and then investigated twice daily, with adding a few pieces of different food types. The biological aspects, fecundity were recorded.

RESULTS AND DISCUSSION

In this study the investigation were conducted under laboratory conditions (25±2 °C and 65±5 % R.H.) to evaluate the different biological developmental stages, fecundity, reproduction and life table parameters of the Lapidophorid mite *Gohieria fusca* when fed on: dry yeast granules, crushed wheat and crushed maize.

Habitat and Behavior

Numerous mite individuals of *G. fusca* found infesting different stored grains and its products such a maize, wheat-grain, wheat-bran, flour.....etc. in different locations of Dakahlyia Governorate. Adult female and male are brown in color, while the immature stages are white.Laboratory observation showed that only copulated female laid eggs, while unmated female kept under observation until death did not oviposite any eggs.

Mating

Mating is necessary for the mite *G. fusca*, whereas copulation between male and female were occurred immediately after the emergence of female from the last quiescent period. During copulation, the male assumed a dorsoposterior position with its legs in opposite direction with female, then the aedegus inserted into the female posterior bursa copulatrix. During this action female could move, but in slow way. The matting period lasted about 15-25 minutes.

Hatching

Eggs were laid singly in cracks and scattered cells, the deposited eggs are usually spherical and translucent, then changes to white color. During hatching the shell rupture through a longitudinal slit from which larva crawls outside with its legs leaving the egg shell. This process lasted about 20 minutes. The hatching larva stayed inactive for a short period about 5 minutes, then began its activity.

Molting

Each immature stage of G. fusca when-full grow enters in quiescent period in which it seeks a dry hole cracks in the substrate of rearing cells. The legs become shrinked and contracted under the body surface, while body color becomes pale brown, the anterior part of mite body become translucent and the old skin ruptured along transversal line behind the hysterosomal region. The hind legs appear from the old skin at first, then the new stage crawls backward to get ride of the old exuvia. Newly emerged individuals kept quite beside its old skin for a short time, then started to more actively searching for food. Molting lasted about 45 minutes.

Biological aspects

Incubation period

As shown in tables (1 & 2) the incubation period of the astigmatid mite *G. fusca* female and male were significantly affected by the type of different food types at 25 ^{o}C . Female and male incubation period durated (5.0 & 4.6), (6.8 &6.1) and (5.5 & 4.8) days at the same trend.

Total immature stages

Female total immature stages stayed 13.43 , 16.5 and 20.8 days, while for male this period lasted 11.56 , 15.09 and 18.57 days. Thus, the male total immature stages being shorter than female, therefore male becoming adult before female.

The generation period

Female generation period required 40.8. 47.7 and 42.19 days, when fed on dry yeast granules, crushed wheat and crushed maize at the same pattern.

Longevity

Statistical analysis of the obtained results cleared that feeding on crushed wheat prolonged the longevity period of female (45.2 days) comparing with dry yeast granules (40.8 days) and crushed maize (42.3 days).

The oviposition period

From the tabulated results cleared highly difference in oviposition period of Lapidophorid mite *G. fusca*, whereas, feeding on dry yeast granules shortened this period (26.8 days) and longed (30.9 days) on crushed wheat, while it was intermediate on crushed maize.

Fecundity

Female fecundity of astigmatid mite *G. fusca* was affected by the different food types, thus, female fecundity decreased from 132.9 eggs on dry yeast granules to 111.5 eggs on crushed wheat and to 91.3 eggs on crushed maize, with a daily rate of 4.96, 3.6 and 3.14 eggs respectively. These results coincided with those obtained by El- Naggar *et al.,* (1989) and Taha *et al.,* (2004).

Reproduction and feeding

Three virgin females of G. fusca, with three newly emerged males were kept in glass container (5 cm in diameter) under the same laboratory conditions, whereas, each was provided with dry yeast granules, crushed wheat and crushed maize, after four weeks immixtures and adults were counted. Three replications for each types of food of their experiment were carried out.Female reproduction were individuals 428 (rang 375 – 495), 312 individuals (rang 252 – 336) and 242 individuals (rang 220 – 294). Reproduction was fond to be greatly the type of the applied diet. In this respect, feeding on dry yeast granules recorded high reproduction rates, while the least was recorded on crushed maize, however, feeding on crushed wheat supported moderate reproduction.

Life table parameters

The effect of different food types (dry yeast granules, crushed wheat and crushed maize) on the life table parameters of astigmatid mite *G. fusca* when reared under laboratory conditions of 25 °C and 65% R.H.was shown in table (4). Obtained data revealed that the net reproduction rate (R_o) which is a product of mean total fecundity. The net reproduction rate (R_o) which is a survival rate showed 71.98, 73.55 and 58.08. Expected (female / per female) when mites fed on the previously mentioned diets, while the mean generation time (T) was 43.31 , 48.59 and 44.89 at the same trend, while the intrinsic rate of increase (r_m) were 0.26 , 0.23 and 0.24 when individuals were raised on the same diets. The finite rate of increase (exp_{rm})

were 1.29, 1.26 and 1.28 when mites fed on previously diets. Obtained data revealed that survival rate sex ratio of progeny (female / total) were 0.72, 0.65 and 0.62 as the same pattern.

Table 1. Duration of different stages of Gohieria fusca female when fed on different food sources at 25 + 2 °C and 65 + 5 % R.H.

Stage		Dry yeast	Crushed wheat	Crushed maize	L.S.D.
Incubation period		5.17 ± 0.55^b	6.77 ± 0.43^a	5.48 ± 0.49^b	0.34
Larva	A	7.39± 0.55^b	8.73±0.46^a	7.43±0.58^b	0.43
	Q	7.22±0.38^a	2.36±0.49^a	2.29±0.45^a	0.36
Protonymph	A	8.22±0.49^a	9.05±0.38^a	8.38±0.49^b	0.36
	Q	2.17±0.35^a	2.41±0.50^a	2.33±0.47^a	0.36
Tritonymph	A	8.44±0.46^b	9.32±0.48^a	8.52±0.49^b	0.38
	Q	2.83±0.38^a	2.91±0.29^a	2.86±0.35^a	0.26
Total immature		31.22+0.85^b	34.73±0.94^a	31.81±1.26^b	0.82
Life cycle		36.39+0.98^c	41.41±0.79^a	37.29±1.45^b	0.89
Generation period		40.80±1.16^b	47.7±1.07^a	42.19±1.32^b	1.47
Longevity		37.80 ± 5.2^b	45.20±2.69^a	42.30±1.25^a	4.29
Life s[pan		74.0 ± 4.85^c	86.40±2.84^a	79.20±1.93^b	4.25

- A = Active stage
- Q = Quiescent stage
- L.S.D. = Least significant differences at 0.05

Table 2. Duration of different stages of Gohieria fusca male when fed on different food sources at 25 + 2 °C and 65 + 5 % R.H.

Stage		Dry yeast	Crushed wheat	Crushed maize	L.S.D.
Incubation period		4.58±0.51^b	6.13±0.28^a	4.78±0.49^b	0.45
Larva	A	7.17±0.39^b	8.13±0.28^a	7.11±0.51^a	0.45
	Q	2.17±0.39a	2.25±0.37^a	2.00±0.00^a	0.35
Protonymph	A	7.83±0.39b	9.0±0.00^a	7.89±0.51^b	0.51
	Q	1.92±0.29a	2.00±0.00^a	2.00±0.00^a	0.19
Tritonymph	A	8.42±0.51b	9.38±0.41^a	8.33±0.43^b	0.51
	Q	2.42±0.51a	2.63±0.41^a	2.44±0.45^a	0.51
Total immature		29.92±1.08b	33.38±1.04^a	29.78±1.11^b	1.20
Life cycle		34.4±1.24b	39.50±1.04^a	34.56±1.14^b	1.28
Longevity		37.30±3.74b	44.60±2.91^a	40.20±2.15^b	3.73
Life s[pan		71.67±5.47b	84.17±3.87^a	75.17±2.86^b	7.15

- A = Active stage
- Q = Quiescent stage
- L.S.D. = Least significant differences at 0.05

Table 3. Adult female longevity and fecundity of Gohieria fusca when fed on different food sources at 25 + 2 °C and 65 + 5 % R.H.

Diet	Average duration (days)			Longevity	Fecundity		Sez ratio
	Preoviposion	Oviposition	Postoviposition	(days0	Eggs/female	daily rate	(%females/total)
Dry yeast	4.50±0.53^{a}	26.8±4.47^{b}	7.50±2.01^{a}	38.8±5.20^{b}	132.90±17.03^{a}	4.96	72 %
Crushed wheat	5.20±0.63^{a}	30.90±2.18^{a}	9.10±1.19^{a}	45.20±2.69^{a}	111.50±8.87^{b}	3.60	65 %
Crushed maize	4.90±0.74^{a}	29.10±1.37^{a}	8.30±0.67^{a}	42.30±1.25^{a}	91.30±8.33^{c}	3.14	62%
L.S.D.	0.79	3.69	1.74	4.29	12.76	-	-

- L.S.D. = Least significant differences at 0.05

Table 4. Effect of different food sources on life table parameters of Gohieria fusca at 25 +2 °C and 65 + 5 % R.H.

Parameters	Dry yeast	Crushed wheat	Crushed maize
Net reproduction rate (R0)	71.98	73.55	58.86
Mean generation time (T)	43.31	48.59	44.89
Intrinsic rate of increase (rm)	0.26	0.23	0.24
Finite rate of increase (expm)	1.29	1.26	1.28
Sea ratio (% female/total)	0.72	0.65	0.62

Fig. (1) : Duration of different stages of Gohleria fusca females when fed on different food sources at 25°C and 65 % R.H.

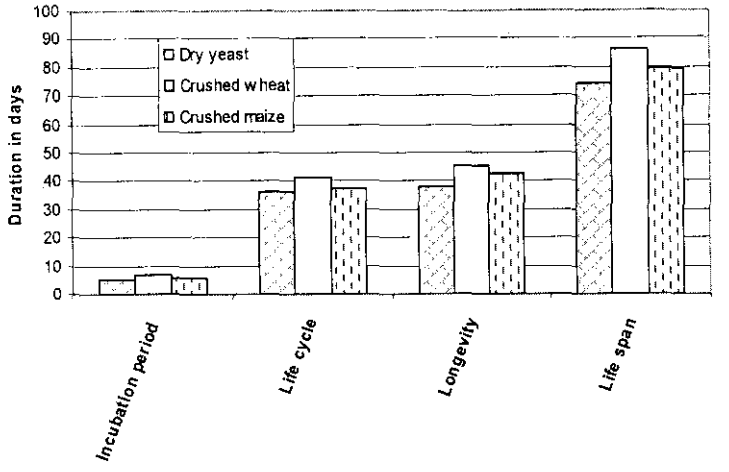


Fig. (2) : Duration of different stages of *Gohieria fusca* males when fed on different food sources at 25°C and 65 % R.H.

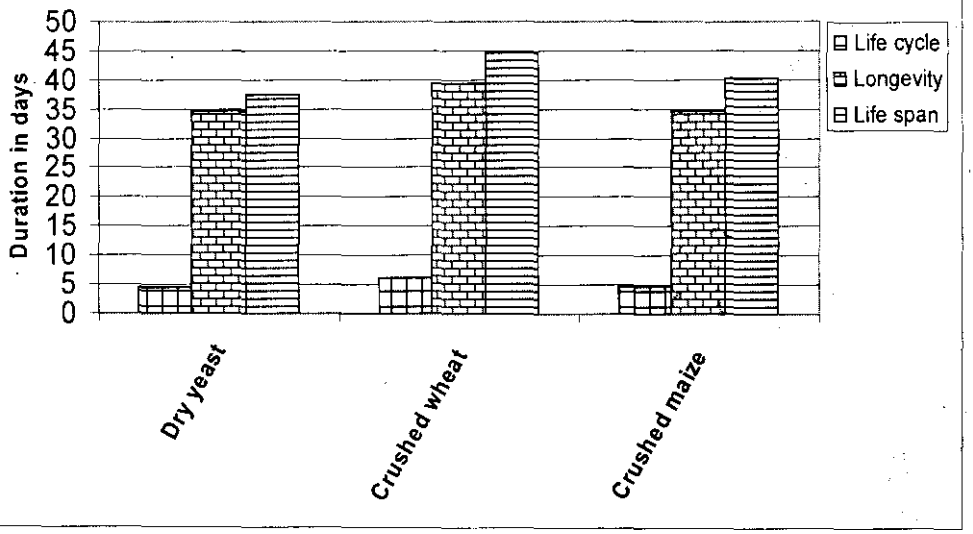


Fig. (3) : Adult female longevity of *Gohieria fusca* when fed on different food sources at 25 C and 65 % R.H.

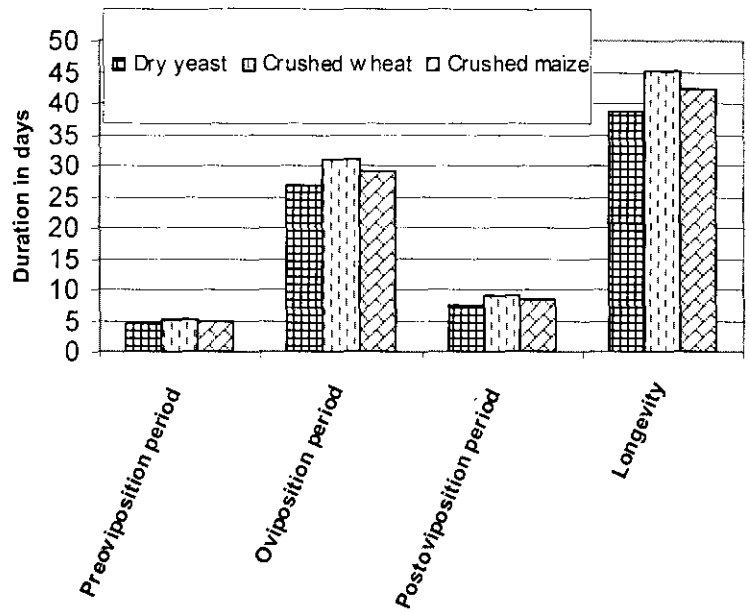
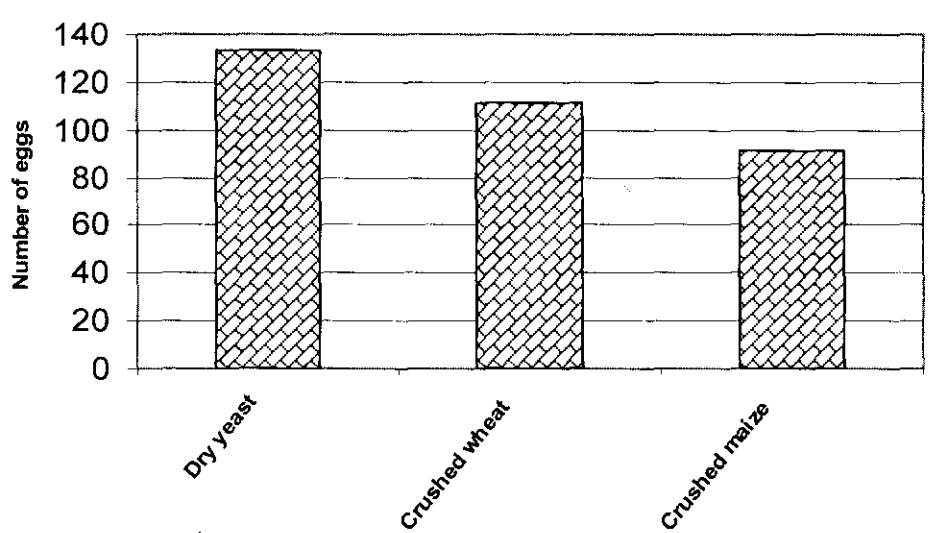


Fig. (4) : Effect of different food sources on *Gohieria fusca* female fecundity produced at 25 C and 65 %. R. H.



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تأثير أنواع مختلفة من الغذاء علي بيولوجية وخصوبة وجداول الحياة لحلم الحبوب المخزونة

Gohieria fusca (Oud.) (Acari: Astigmata : Lapidophoridae)

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أجريت دراسات بيولوجية لحلم الحبوب المخزونة *Gohieria fusca* تحت ظروف معملية عند درجة حرارة ٢٥°م ورطوبة نسبية ٦٥ % لدراسة تأثير ثلاثة أنواع من الغذاء هي : الخميرة الجافة المحببة وجريش القمح وجريش الذرة علي تطور وخصوبة وجداول الحياة .حيث أوضحت النتائج أن الحيوان يمر بطور البيضة – اليرقة – الحورية الأولي والثالثة ثم الحيوان البالغ ذكر وأنثي كما أن هذه الأطوار قد تأثرت بنوع الغذاء حيث أن مرحلة الأطوار الغير كاملة استغرقت (٣١،٢٢ & ٢٩،٩٢) ، (٣٤،٧٣ & ٣٣،٣٨) ، (٣١،٨١ & ٢٩،٧٨) يوما لكل من الأنثى والذكر عند التغذية غلي أنواع الغذاء المذكورة علي الترتيب كما أن مرحلة وضع البيض للأنثى استغرقت ٢٦،٨، ٣٠،٩ ، ٢٩،١ يوما وكان متوسط معدل وضع البيض للأنثى خلال هذه الفترات بمعدل يومي (١٣٢،٩ & ٤،٩٦) ، (١١٥،٥ & ٨،٨٧) ، (٩١،٣ & ٣،١٤) بيضة عند التغذية علي الخميرة الجافة وجريش القمح وجريش الذرة علي الترتيب.كما أن مرحلة البلوغ للذكر استغرقت ٣٧،٣ ، ٤٤،٦ ، ٤٠،٢ يوما عند التغذية علي الأغذية المذكورة علي الترتيب .