

BIOLOGICAL ASPECTS OF *LEPIDOGLYPHUS DESTRUCTOR* (SCHRANK) (ACARI: ASTIGMATA: GLYCYPHAGIDAE) REARED UNDER THREE TEMPERATURE DEGREES AND DIETS

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ABSTRACT: *The glycyphagid mite, Lepidoglyphus destructor (Schrank) individuals were extracted from wheat and broad bean hay at El-Menofia Governorate and reared on different stored hay at three temperature degrees. Biological experiments and observations were conducted in the laboratory under controlled conditions of 20 °C, 25 °C and 30 °C and relative humidity 80 % R.H. Broad bean and wheat hay were used singly and mixed with dry yeast as a mite food. The obtained results showed that developmental stages, longevity and life span and fecundity were obviously affected at different diets and temperature degrees. The highest life span period was recorded with female fed on mixture of broad bean and yeast averaged as 49.4 days at 20 °C, but the shortest period was recorded for male individuals at 30 °C when reared on the mixture of broad bean and wheat hay as 20.0 day. Mixture of broad bean hay & yeast proved to be the suitable diets resulting the highest number of deposited eggs at 30 °C recorded 159.9 eggs but the lowest number was noticed for L. destructor females at 20 °C when the individuals fed on mixture of broadbean and wheat hay (82.2 eggs) at 20 °C. The current study provided evidence of the nutritive attractiveness of broad bean hay mixed with dry yeast for L. destructor as a preferable feeding source for laboratory rearing of this astigmatid mite. The obtained results denoted that males took the shortest biological stages (incubation period, life cycle, longevity and life span) than female individuals at tested temperature degrees, where 20 °C was the suitable one and increased these periods.*

Key words: longevity, life span, life cycle, hay, mites , glycyphagid mite.

INTRODUCTION

Up-to-date dramatically increase in the population in the world requires an efficient modern human food and animal production industry and the manufacture of good quality feeds and food. Damage by insects, mites, fungi, and sprouting causes hundreds of millions of dollars of economic losses to grain producers, merchandisers, and processors each year (Harein and Meronuck1995). Stored product mites are important pests of stored food commodities and animal feed in areas with humid climates (Sanchez-Ramos and Castanera 2003). These pests negatively influence the quality of stored commodities, cause allergic reaction (Kondreddi *et al.*, 2006) and disseminate toxic moulds (Hubert *et al.*, 2004). Majority of members of the glycyphagid mites (Glycyphagidae) are

cosmopolitan, commonly known as synanthropic mite species. Of them, the mite, *Lepidoglyphus destructor* (Schrank) is one of the commonest species of stored product mites and is frequently found in association with other mites i.e. *Acarus siro* and *Cheyletus eruditus* or *C. malaccensis* (Hughes, 1976), in soil samples (Sheals, 1956), stacks of grain, straw, and hay standing in the open field or in a permanent stackyard (Griffith, 1960), linseed, rice, dried fruits, sugar beet seed (Chmielewski, 1969), dried calves stomachs, dead insects, dried mammal skins, rodent and bumble bee nests (Hughes (1976) and Post-harvest sweepings (hay, straw) from barn, Chmielewski (2001). Some studies presented results of biological investigations on *L. destructor* fed various kinds of nutrients (bee-bread, pollen, wheat germ,

yeast) (Chmielewski, 1977, 1987; Cornete and Kahl, 1996; Knulle, 1991; Matsumoto, 1963; Parkinson, 1989; Stratil *et al.*, 1980) but there are no data on its feeding and development on stored product hay. The present work aims to study the effect of different types of food on biological aspects, life cycle, longevity, life span and fecundity of astigmatid mite, *Lepidoglyphus destructor* at different laboratory conditions.

MATERIALS AND METHODS

The glycyphagid mite, *L. destructor* (Schränk) individuals were collected from wheat hay at El-Menofia Governorate (Ashmoun district). Samples of wheat hay (500 gm) were randomized obtained from open fields and different animal's stockades and put in polyethylene bags, then transferred to laboratory for extraction and identification.

Pure culture. For preparing pure culture of tested mites, plastic cups of (1.5 cm high x 2.5 cm in diameter) were filled up to 0.5 cm with plaster of Paris and activated charcoal in the rate of 8: 2, respectively. One adult female and male of *L. destructor* were placed in the prepared cup, supplied with food and drops of water added to maintain suitable relative humidity and kept in an incubator at 25 °C. For individual rearing, ten newly deposited eggs were transferred from the mother culture singly one to every rearing plastic cell (1.5 cm high x 2.5 cm in diameter). Each newly hatched larva was supplied with food kept till reaching maturity. Mites were examined twice daily. Observations concerning all biological aspects were recorded all over the life of mites at 20, 25 and 30 °C and 80 % R.H.

Source of food: The following diets were used in the experiments: Broad bean hay only, broad bean hay mixed with dry yeast, wheat hay only, wheat hay mixed with dry yeast and broad bean hay mixed with wheat hay.

Statistical analysis: All obtained data were subjected to one-way analysis of

variance (ANOVA) and means were separated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Habitat and behavior:

The glycyphagid mite, *Lepidoglyphus destructor* was found in large numbers association with stored wheat and broadbean hay at Ashmoun district (El-Menofia Governorate). This mite passed through four different stages before reaching adult (egg, larva, protonymphs, and tritonymph). When full-grown, every moving immature stage enter to quiescent stage in which it seeks a dry or crack in the substrate of rearing chamber and completely ceases feeding and movement. Newly emerged individual kept quite beside its old skin for a short time, then started to move actively searching its food after 8-12 minutes. Young males and females started to copulate soon after eclosion. The time of copulation was 15-20 minutes and copulation was repeated many times. The adult female of *L. destructor* began to lay eggs 5- 7 days after copulation and finished the oviposition process about 7- 8 days before their natural death.

A- *Lepidoglyphus destructor* female Incubation period:

The newly deposited eggs of *L. destructor* in cracks and rearing substrate were elongated and translucent when deposited, then changes to dark whitish color before hatching. During hatching,, the egg rupture longitudinally and larva crawled out from the medium slit with its hind legs at first, then larva move outside to search for food. The hatching process lasted about 18-20 minutes. The shortest incubation period of the mite *L. destructor* was recorded when the mite fed on broadbean hay mixed with wheat hay (3.0 days) at 30 °C, while the longest period was noticed when the mite individuals fed on broadbean hay mixed with yeast (5.5 days) at 20 °C, with L.S. D. at 0.05 = 0.06 for diets and 0.04 for temperature effect, Table (1).

Biological aspects of lepidoglyphus destructor (schrank) (acari: astigmata:....

Table (1): Mean duration of *Lepidoglyphus destructor* female when fed on different diets at temperature degrees

Biological aspect	Diets					L.S.D. at 0.05 level	
	B.b. h. + yeast	B. b. h	W.h. + yeast	W. h.	B.b h + w.h	Diets	Tem.
20 °C							
Incubation period	5.5±0.2 (5.2-5.8)	5.0±0.2 (4.7-5.3)	4.4±0.2 (4.2-4.6)	3.98±0.1 (3.8-4.2)	3.58±0.1 (3.5-3.7)	0.06	0.04
Life cycle	16.1±0.3 (15.5-16.6)	15.5±0.1 (15.3-15.6)	14.7±0.2 (14.4-14.9)	13.9±0.1 (13.7-14.1)	13.0±0.1 (12.7-13.2)	0.16	0.12
Longevity	33.3±0.7 (32-34)	31.1±0.6 (30-32)	28.0±0.1 (27.9-28.3)	27.0±0.3 (26.4-27)	25.1±0.5 (23.9-25.8)	0.35	0.27
Life span	49.4±0.5 (48.5-50)	46.6±0.6 (45.3-47.5)	42.7±0.2 (42.4-42.9)	40.5±0.4 (39.7-41.1)	38.0±0.5 (36.9-38.6)	0.37	0.29
25 °C							
Incubation period	5.15±0.1 (5-5.3)	4.52±0.1 (4.4-4.8)	4.01±0.1 (3.9-4.2)	3.79±0.8 (3.6-3.9)	3.4±0.1 (3.2-3.6)	0.06	0.04
Life cycle	15.1±0.4 (14.5-16)	14.7±0.2 (14.3-15)	13.8±0.1 (13.6-14)	12.6±0.1 (12.5-12.9)	11.6±0.1 (11.5-11.7)	0.16	0.12
Longevity	30.9±0.8 (28.9-32)	28.1±0.2 (27.9-28.6)	24.4±0.7 (24-26)	25.0±0.8 (24-26)	21.9±0.9 (20-23)	0.35	0.27
Life span	45.9±0.9 (43.9-47)	42.8±0.3 (42.5-43.5)	38.22±0.7 (37.8-39.9)	37.6±0.8 (36.6-38.6)	33.4±1.0 (31.5-34.6)	0.37	0.29
30 °C							
Incubation period	4.8±0.1 (4.7-4.9)	4.4±0.1 (4.2-4.6)	3.8±0.1 (3.6-3.9)	3.5±0.1 (3.4-3.6)	3.0±0.1 (2.9-3.2)	0.06	0.04
Life cycle	13.5±1.0 (12-15)	13.8±0.1 (13.4-13.9)	13.0±0.1 (12.8-13.1)	12.0±0.1 (11.9-12.2)	11.0±0.1 (10.8-11.2)	0.16	0.12
Longevity	28.0±0.9 (26-29)	24.9±0.7 (24-26)	21.2±1.0 (20-23)	21.9±0.7 (21-23)	19.3±0.4 (18.9-20)	0.35	0.27
Life span	41.5±1.3 (39-43)	38.7±0.8 (37.7-39.9)	33.9±0.8 (33-35.8)	33.7±0.8 (33-35.2)	30.3±0.4 (29.8-31)	0.37	0.29

B. b. h = broad bean hay W. h. = wheat hay

Life cycle:

Observations of feeding and life cycles of *L. destructor* female on different introduced diets gave evidence that these stored materials were acceptable by this mite for nourishment, Table (1). The longest duration of *L. destructor* averaged 16.1 days when the mite females fed on mixture of broadbean hay with dry yeast at 20 °C, as, it significantly decreased when mixture broadbean hay with wheat hay was introduced as feeding source for the mite recording 11.0 days at 30 °C. The statistical analysis of obtained data showed that L.S. D. at 0.05 level was 0.16 and 0.12 for effect of different diets and temperatures on the life cycle of *L. destructor*.

Longevity:

The tested temperatures and food sources were obviously affected the longevity of the adult female of *L. destructor*, Table (1). Adult female longevity decreased when temperature increased from 20 to 30 °C. It lived for 33.3 days (the longest period) at 20 °C when the mites reared on mixture of broad bean hay and yeast and decreased to recorded 19.3 days (the shortest period) when the mites fed on the mixture of broadbean and wheat hay at 30 °C. The statistical analysis of obtained data indicated that L.S. D. at 0.05 level = 0.35 and 0.27 for effect of diets and temperature on the mite female longevity, respectively.

a- Preoviposition period:

Statistical analysis of data tabulated in Table (2) proved that this period was affected by the type of food. Accordingly, this period was 6.0, 5.6, 5.1, 4.6 and 4.2 days (longest periods) when the female fed at 20 °C on broadbean mixed with yeast, broadbean hay, wheat hay mixed with yeast, wheat hay and broadbean hay mixed with wheat hay, respectively, and these periods decreased at 30 °C to recorded 4.8, 5.0, 4.1, 4.0 and 3.6 days (the shortest periods) when

L. destructor female reared on the same trend of previously mentioned diets, respectively.

b- Oviposition period:

The introduced food suitability clearly affects the oviposition period of *L. destructor*, Table (2). However, feeding of mite female at 20 °C on mixture of broadbean hay and yeast obviously prolonged the oviposition period (19.7 days) than any diets and temperatures. This period took the shortest period (11 days) when the female fed on mixture of broadbean hay and wheat hay at 30 °C. The significant differences occurred between all feeding diets at different temperature (L.S.D. at 0.05 = 0.39 and 0.30, respectively).

c- Postoviposition period:

Data concerning the response of the postoviposition period of *L. destructor* female to different feeding diets are tabulated in Table (2). The mean period of postoviposition was high when the female mites fed on broadbean hay mixed with yeast, recorded 7.7 days at 20 °C. changed to 4.7 days (the shortest period) when mites reared on the mixture of broadbean and wheat hay. L.S.D. at 0.05 level = 0.11 and 0.09 for diets and temperature effect, respectively.

Life span:

Accordingly, the life span of the astigmatid mite, *L. destructor* female also affected by feeding on different introduced diets as shown in Table (1). The female life span of mites resulted from feeding on mixture of broadbean hay with yeast was high at 20 °C, recorded 49.4 days which remarkably decreased to 30.3 days when the mites fed on mixture of broad bean and wheat hay at 30 °C. (L.S.D. at 0.05 level = 0.37 and 0.29 in case of diets and temperature effects, respectively).

Biological aspects of lepidoglyphus destructor (schrank) (acari: astigmata:....

Table (2): Longevity and fecundity (number of eggs) of *Lepidoglyphus destructor* female when fed on different diets and temperature degrees

Biological aspect	Diets					L.S.D. at 0.05 level	
	B.b. h. + yeast	B. b. h	W.h. + yeast	W. h.	B.b h + w.h	Diets	Tem.
20 °C							
Preoviposition period	6.0±0.1 (5.8-6.2)	5.6±0.2 (5-5.9)	5.1±0.2 (5-5.5)	4.6±0.2 (4.3-4.9)	4.2±0.1 (4-4.2)	0.07	0.05
Oviposition period	19.7±0.8 (18.5-21.1)	18.5±0.8 (17.4-19.6)	16.6±0.4 (16.1-17.3)	16.2±0.5 (15.6-17.1)	15.5±0.6 (14.2-16.1)	0.39	0.30
Postoviposition period	7.7±0.4 (7-8.2)	7.1±0.2 (6.8-7.5)	6.4±0.2 (6-6.5)	5.9±0.2 (5.4-6)	5.5±0.1 (5.3-5.6)	0.11	0.09
Fecundity	133.3±4.4 (127-140)	124.8±1.3 (122-127)	109.9±1.6 (107-112)	92.4±3.5 (89-99)	82.2±1.8 (80-85)	1.06	0.82
25 °C							
Preoviposition period	5.0±0.1 (4.8-5.3)	5.2±0.1 (5-5.4)	4.6±0.1 (4.4-4.7)	4.3±0.1 (4.2-4.6)	4.0±0.1 (3.8-4.2)	0.07	0.05
Oviposition period	19.1±1.0 (16.9-20.2)	16.0±0.3 (15.8-16.5)	13.7±0.6 (12.9-15.2)	15.2±0.9 (13.9-16.3)	12.7±1.1 (11-14.1)	0.39	0.30
Postoviposition period	6.8±0.5 (6-7.6)	6.9±0.1 (6.6-7.1)	6.2±0.3 (6-6.7)	5.5±0.1 (5.4-5.6)	5.0±0.1 (4.7-5.3)	0.11	0.09
Fecundity	149.3±1.9 (146-152)	134.6±2.0 (130-137)	124.9±1.4 (122-127)	105.4±2.1 (103-109)	92.2±1.5 (90-95)	1.06	0.82
30 °C							
Preoviposition period	4.8±0.1 (4.6-4.9)	5.0±0.1 (4.8-5.2)	4.1±0.1 (4-4.3)	4.0±0.1 (3.8-4.1)	3.6±0.1 (3.5-3.7)	0.07	0.05
Oviposition period	16.7±1.1 (14.4-17.9)	13.4±0.8 (12.3-14.5)	12.1±1.1 (10.6-14.1)	12.9±0.8 (12-14.1)	11.0±0.4 (10.5-11.7)	0.39	0.30
Postoviposition period	6.5±0.1 (6.3-6.8)	6.5±0.1 (6.4-6.6)	5.0±0.1 (4.8-5.2)	5.0±0.1 (4.8-5.3)	4.7±0.1 (4.6-4.8)	0.11	0.09
Fecundity	159.9±1.3 (157-162)	144.7±1.2 (142-146)	130.4±2.1 (127-134)	110.0±1.2 (109-113)	99.9±1.0 (98-101)	1.06	0.82

B. b. h = broad bean hay W. h. = wheat hay

B- *Lepidoglyphus destructor* male Incubation period:

The respective durations of incubation period of *L. destructor* male when reared on five types of food are summarized in Table (3). Highly food type and temperature effects were observed on this period. Male mites reared on mixture of broadbean hay and

yeast had the longest incubation period, which was significantly different from those on the rest of rearing diets, where it 4.0 days at 20 °C, and remarkably decreased when fed on mixture of broadbean and wheat hay at 30 °C, and lasted 2.5 day. The statistical analysis of obtained data indicted that L.S.D. at 0.05 level for effect of different diets and

temperature was 0.06 and 0.04, respectively.

Life cycle:

The egg-to-adult developmental duration of *L. destructor* male individuals was significantly different among the feeding sources. According to the present study, *L.*

destructor male developed faster on mixture of broadbean and wheat hay at 30 °C, and recorded 7.8 days, while it increased to the longest level when fed on mixture of broadbean hay with yeast at 20 °C, and durated 13.0 days.

Table (3): Mean duration of *Lepidoglyphus destructor* male when fed on different diets at different temperature

Biological aspect	Diets					L.S.D. at 0.05 level	
	B.b. h. + yeast	B. b. h	W.h. + yeast	W. h.	B.b h + w.h	Diets	Tem
20 °C							
Incubation period	4.0±0.1 (3.8-4.2)	3.8±0.1 (3.6-3.9)	3.4±0.1 (3.3-3.5)	3.1±0.1 (3-3.2)	2.9±0.2 (2.4-3.1)	0.06	0.04
Life cycle	13.0±0.3 (12.5-13.5)	12.3±0.2 (12-12.6)	11.4±0.2 (11-11.5)	10.4±0.2 (10-10.6)	9.4±0.2 (9-9.6)	0.11	0.08
Longevity	22.0±1.1 (20-24)	20.0±1.0 (18-21)	17.4±0.7 (16-18)	16.0±0.2 (15.7-16.3)	14.2±0.3 (13.8-14.6)	0.3	0.2
Life span	35.0±1.2 (32.5-37.0)	32.1±0.9 (30.4-33.6)	28.6±0.8 (27.4-29.5)	26.3±0.3 (25.8-26.6)	23.5±0.4 (23-24.1)	1.18	0.9
25 °C							
Incubation period	3.6±0.04 (3.5-3.6)	3.2±0.1 (3-3.4)	3.1±0.1 (3-3.2)	2.8±0.1 (2.6-3)	2.8±0.1 (2.6-3)	0.06	0.04
Life cycle	12.4±0.2 (12-12.6)	11.9±0.1 (11.8-12)	10.5±0.1 (10.3-10.7)	9.5±0.1 (9.3-9.7)	8.5±0.1 (8.3-8.7)	0.11	0.08
Longevity	18.5±0.7 (17-19)	18.0±0.7 (17-19)	15.0±0.7 (14-16)	14.8±0.1 (14.6-15)	13.5±0.3 (13-14)	0.3	0.2
Life span	31.0±0.8 (29.4-31.6)	29.9±0.7 (28.8-31)	25.4±0.7 (24.5-26.5)	24.3±0.1 (24.1-24.4)	22.0±0.3 (21.4-22.5)	1.18	0.9
30°C							
Incubation period	3.2±0.1 (3-3.4)	3.2±0.1 (3.1-3.4)	2.8±0.1 (2.7-2.9)	2.6±0.1 (2.4-2.8)	2.5±0.1 (2.3-2.7)	0.06	0.04
Life cycle	11.5±0.1 (11.2-11.7)	11.0±0.5 (10-12)	10.0±0.1 (9.9-10.4)	8.8±0.1 (8.6-8.9)	7.8±0.2 (7.4-8)	0.11	0.08
Longevity	16.9±0.4 (16-17.3)	16.0±0.2 (15.6-16.4)	13.5±0.2 (13-13.8)	13.0±0.3 (12.5-13.5)	12.2±0.4 (11.8-13.0)	0.3	0.2
Life span	28.4±0.3 (27.6-28.8)	27.0±0.6 (26-28)	23.5±0.3 (23-23.9)	21.7±0.3 (21.3-22.2)	20.0±0.4 (19.4-20.6)	1.18	0.9

B. b. h = broad bean hay W. h. = wheat hay

Longevity:

The current study (Table 3) indicated that the longevity of the astigmatid mite, *L. destructor* was highly affected in male individuals when the different types of food were used. The statistical analysis of the obtained data showed that L.S. D. at 0.05 level = 0.3 and 0.2 in case of incubation period for the effect of diets and temperature on this period, respectively. The longevity of this mite averaged the longest period when reared on mixture of broadbean hay with yeast recording 22.0 days at 20 °C, but it sharply decreased to recorded 12.2 days only when mixture of broadbean and wheat hay was introduced as food at 30 °C.

Life span:

During the course of the present investigation, the life span of *L. destructor* male when fed on the previously mentioned diets lasted the shortest period when fed on the mixture of broadbean and wheat hay at 30 °C and recorded 20 days, as, this period was obviously increased to reached the longest period when the male reared on broad bean hay mixed with yeast used as food at 20 °C. The statistical analysis of obtained results indicated that L.S.D. at 0.05 for effect of diets and temperature was 1.18 and 0.9, respectively, Table (3). Generally, the male individuals took the shortest biological stages (incubation period, life cycle, longevity and life span) than female individuals at different used temperature, and 20 °C increased these periods. Under controlled conditions about 20 °C and 85 % R.H., Chmielewski (2001) used bruised buckwheat grains as a mite food for *L. destructor*. The life cycle lasted about 17.7 days and the female laid 78.1 eggs per whole lifespan. The results obtained by Cusack *et al.*, 1976; Hallas, 1981; Matsumoto, 1963; Parkinson, 1989; Rack, 1978, Sinha, 1964a,b, 1966; Stratil *et al.*, 1980 give evidence that *L. destructor* accepts not only the grain, seed parts and foodstuffs, but also mycelia of fungi infesting

them (mouldy products) and might be a vector for saprophytic and pathogenic microorganisms. In this study, from the above mentioned results it can be concluded that the best diets for mass culturing acarid mite, *L. destructor* is a combination of freshly broadbean hay + yeast.

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المظاهر البيولوجية للاكاروس *Lepidoglyphus destructor* (Schrank) (Acari: Astigmata: Glycyphagidae) على ثلاث انواع من الغذاء ودرجات الحرارة

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الملخص العربى

تم تربية الاكاروس *L. destructor* المنتمى لعائلة Glycyphagidae والذي تم جمعه من التين المخزون للقول البلدى والقمح بمحافظة المنوفية وذلك على درجات حرارة مختلفة 20 و 25 و 30 م° ورطوبة نسبية 80 % عند التغذية على تبن الفول البلدى وتبن القمح بصورة منفردة وفى صورة خليط معا او مع الخميرة الجافة حيث تشير النتائج المتحصل عليها ان فترات النمو والخصوية (عدد البيض) للاكاروس *L. destructor* قد تاثرت بنوع الغذاء المستخدم ودرجات الحرارة. وتشير النتائج المتحصل عليها ان اطول مدة لحياة الاكاروسية الكلية Life span قد سجلت زما مقداره 49.4 يوما عندما تغذت الافراد الاناث على مخلوط تبن الفول البلدى مع الخميرة عند درجة حرارة 20 م° واقل الفترات المسجلة كانت عند تربية الافراد الذكور على مخلوط تبن الفول البلدى مع تبن القمح عند درجة الحرارة 30 م° مسجلة زما مقداره 20.0 يوما ولقد اثبتت الدراسة ان مخلوط تبن الفول البلدى مع الخميرة الجافة كانت افضل التغذية المستخدمة لوضع البيض عند 30 م° حيث وضعت الانثى عليه عددا مقداره 159.9 بيضة واقل الاغذية كانت مخلوط تبن الفول البلدى مع تبن القمح ووضعت الانثى عليه 82.2 بيضة فقط عند التربية على 20 م°. وبوجه عام اتضح ان الافراد الذكور تستغرق زما اقل من الاناث لهذا الاكاروس اثناء الفترات المختلفة من حياته وان درجة الحرارة 20 م° قد اطالت هذه الفترات ولكنها قلت بصورة واضحة عند تربية الاكاروس عند درجة الحرارة 30 م°.