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Predation by *Blattisocius tarsalis* (Acari: Ascidae) on two stored product pests mites

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Abstract
Blattisocius tarsalis (Berlese) is a predatory mite in the family Ascidae (Acari), noted for potential biological control of astigmatid stored product mites. Performance of *Blattisocius tarsalis* on immature stages of the astigmatid mites, *Tyrophagus putrescentiae* (Schrank) and *Rhizoglyphus robini* (Claparede) was investigated. In this study, the obtained data indicated that the mean incubation period of *B. tarsalis* was 2.56 and 2.35 days when the predator fed on immature stages of *T.* putrescentiae females and males individuals at 25 ºC, changed to 2.22 and 2.0 days when fed on the same prey at 35 ºC. On the other hand, the predatory mite *B. tarsalis* lasted in their incubation period 2.24 and 2.12 days; 2.2 and 1.87 days when reared on the astigmatid mite *R. robini* immature stages. However, the life cycle for both sexes was highly affected by the type of food employed and took 12.63 and 11.87 days for females when reared on *T. putrescentiae* at both 25 and 35 ºC. changed to 11.55 and 10.5 days at the same conditions when fed on *R. robini*, respectively. However, these periods lasted shortest times for male individuals of predatory mite and averaged 11.45 and 11.0; 10.5 and 10.2 days, respectively. Fecundity and the consumption capacity of predatory mites have been carried out for each temperatures at different food densities. The duration of pre oviposition, oviposition and postoviposition periods of *B. tarsalis* were also determined.

Keywords: predation, *biology, Blattisocius tarsalis, Tyrophagus putrescentiae, Rhizoglyphus robini*

1. Introduction
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 Meronuck 1995) [12]. Previous studies recorded the presence of *Blattisocius* species in different stored foodstuff: bean (Saleh, 1980) [18], wheat bran (Saleh *et al*., 1985) [19], bran (Baker, 2000) [2], Athanassiou *et al.*, 2001) [1], maize, wheat flour, wheat, broad bean and rice (El-Sayed and Ghallab, 2007) [6]. Some *Blattisocius* species found in stored foods have been studied to determine their potential as predators of pest arthropods, Halliday *et al*., (1998) [9], and Thind and Ford (2006) [20] *Blattisocius* mite species are found in several different habitats and often mentioned as predators of pests of stored food Erika *et al*., (2012) [7]. The predatory mite *Blattisocius tarsalis* (Berlese) (Acari: Ascidae) is a common predatory mite of moth eggs in storages (Hughes, 1976; Haines, 1981; Hansen and Nielsen, 2001) [14, 13, 11]. However, many studies are known related to the biology of this predatory mite in the world (Haines, 1981; Hansen, 1998; Nielsen, 1998, 1999, 2001; Hansen and Nielsen, 2001) [13, 14]. The direct damage of astigmatid mites to stored grains is through contamination and penetration in to seeds/embryo, consumption of the grain germ and some extent, the endosperm (Parkinson, 1990) which consequently decrease the vitality and germination capability of the seeds. Also, according to Canadian Grain Commission (2010) [3], the grain mites *Tyrophagus putrescentiae* attacks the germ (embryo) of seeds, which reduces. For these reasons, some efforts are being focused on the development of a biological control program using predatory mites against the astigmatid mites. The goal of this study was to determine the reproductive potential, consumption capacity, developmental time of immatures and adult longevity of *B. tarsalis* on immature stages of the acarid mite, *Tyrophagus putrescentiae* collected from date palm fruits and the acarid bulb mite, *Rhizoglyphus robini* (Claparede),

2. Materials and Methods
The predacous mite, *Blattisocius tarsalis* (Fox) (Ascidae).collected from stored (Date palm fruits, anise and onion bulb) products, from Ashmoun Region at Menofia Governorate, then mites extracted by using modified Tullgren funnels. Cultures of the mite, were reared on two different foods (immature stages of the acarid mite, *T. putrescentiae* collected from date palm fruits and the acarid bulb mite, *R. robini*, (which extracted from the same samples and cultured on yeast granules). Newly emerged larvae were confined singly to plastic rings 2.8 cm in diameter and 2 cm in depth. The rings were filled up to 0.5 cm with a mixture of (cement: clay: charcoal) (7: 2: 1). A 100 replicates were used in each test conditions, survival to adulthood was determined by counting the adult individuals that survived from samples of the first 80 larvae laid, just 40 replicates were used in determining adult survival. 10 replicates groups per each treatment kept at 30+2 °C. The substratum was daily moistened. The mites were reared singly. Observations were made daily, incubation period, life cycle, longevity of adults, fecundity and food consumption were determined under 25 and 35 + 2 °C and 75 + 5 % R.H. Observation was terminated when all females had died. All presented data were subjected to one way analysis of variance (ANOVA) and means were separated by Duncan´ s multiple range test, Duncan (1955) [5].

3. Results
In this study, the different biological aspects of the predacous mite, *Blattisocius tarsalis* on immature stages of two different astigmatid mites, *T. putrescentiae* and

Rhizoglyphus robini (Claparede), were conducted under the laboratory conditions at 25 and 35 °C and 75 % R. H. Both females and males of *B. tarsalis* were found to be pass through one larval and two nymphal stages (protonymph and deutonymph) before reaching adulthood.

Incubation period: As shown in Tables (1), the incubation period of *B. tarsalis* was obviously affected when fed on the preys. The obtained data indicated that the mean incubation period of *B. tarsalis* was 2.56 and 2.35 days when the predator fed on immature stages of *T. putrescentiae* females and males individuals at 25 ºC, changed too recorded 2.22 and 2.0 days when fed on the same prey at 35 ºC. On the other hand, the predatory mite *B. tarsalis* lasted in their incubation period 2.24 and 2.12 days; 2.2 and 1.87 days when reared on the astigmatid mite *R. robini* (immature stages, Table (1).

Life cycle: From the tabulated data in Table (1), it could be observed that the duration of life cycle for both sexes was highly affected by the type of food employed. This total period averaged 12.63 and 11.87 days for females individuals when ascid mite, *B. tarsalis* reared on immature stages of *T. putrescentiae* immature stages at both 25 and 35 ºC. changed to 11.55 and 10.5 days at the same conditions when fed on immatures of *R. robini*, respectively. However, these periods lasted shortest times for male individuals of predatory mite and averaged 11.45 and 11.0; 10.5 and 10.2 days, respectively, Table (1).

Longevity

Data considering attributes of the ascid mite, *B. tarsalis* females, expressed in longevity, pre-oviposition and post-oviposition periods are tabulated in Table (1). The tabulated data in table (1) indicated that the predatory mite, *B. tarsalis* lasted 26.85 and 22.67 days for females and males individuals when fed on *T. putrescentiae* immature stages and 22.76 and 16.54 days on immature stages of *R. robni* at 25 ºC. changed to 22.8 and 20.55; 21.65 and 18.7 days when he same indivduals fed on the preys mentioned before at 35 ºC, respectively. The per-oviposition period lasted 3.21, 2.68; 2.7 and 2.14 when female indivduals fed on matures of *T.putrescentiae* and *R. robini* at 25 and 35 ºC., respectively. On the other hand, the longest period of oviposion was recorded (17.74 days) when the females fed on *T. putrescentiae* at 25 ºC.

Life span: The life span of the *B. tarsalis* as shown in Table (1) was highly affected by the kind off introduced prey. This period to 39.48 and 34.31 days when the females fed on *T. putrescentiae* and *R. robini* immature stages at 25 ºC and 34.6 ad 32.15 days when fed at 35 ºC on the same introduced prey, Table (1). However, the periods took the shortest period for males of thee same predator on the same preys**.**

Food consumption

The obtained data in this study recorded in Table (2) indicated that the number of devoured preys (*T. putrescentiae* and *R. robini*) immature stages was by thee predatory mite, *B. tarsalis* (larvae, protonymphs and deutonymphs) highly affected at different conditions. The number of consumed *T. putrescentiae* and *R. robini* were 3.5, 4.2 and 3.0, 4.0 indivduals at 25 and 35 ˚C., respectively when introduced t thee predatory mite, *B. tarsalis* males larval stage. These numbers were differed and recorded 4.2, 4.3 and 4.0, 4.2 indivduals for females of predatory mite.

The present study has demonstrated that *B. tarsal* is potentially useful for biological control of *T. putrescentiae* and *R.robini*, since females and males destroy large amounts of prey independent of the immatures of these pests.

Many studies is known related to the biology of this predatory mite in the world (Haines, 1981; Hansen, 1998; Hansen and Nielsen, 2001; Nielsen, 1998, 1999, 2001) [14, 13, 15]. *B. tarsalis* could control successfully to Mediterranean flour moth and considered good alternatives of methyl bromide in Denmark (Nielsen, 2001; Hansen and Nielsen, 2001; Cobanoglu *et al*., 2007) [13, 4]. Other studies have focused on this mite on stored product insect pests. Graham (1970) [8] reported on the regulatory effect of *B. tarsalis*, which was regarded as the major Suppressive factor in controlling an infestation of *Ephestia (Cadra) cautella* (Walker) m a warehouse in Kenya Hames (1981) [10] found that the potential rate of increase of *B. tarsalis* far exceeded that of *E cautella* at 27°

4. Table

Table 1: Biological aspects of predator mite, *Blattisocius tarsalis* females and males when reared on two astigmatid mites at 25 and 35 ˚C and 75 ± 5 % RH.

Biological aspects		25 ˚C		35 ˚C	
		T. putrescentiae	***R. robini***	***T. putrescentiae***	***R. robini***
Incubation period	♀	2.56±0.2	2.24±0.16	2.22±0.19	2.2±0.21
	♂	2.35±0.16	2.12±0.13	2.0±0.18	1.87±0.17
Life cycle	♀	12.63±4.32	11.55±3.98	11.8±3.14	10.5±1.69
	♂	11.45±1.77	10.5±1.98	11.0±2.76	10.2±1.55
Longevity	♀	26.85±3.42	22.76±3.15	22.8±4.01	21.65±3.66
	♂	22.67±2.15	16.54±1.86	20.55±2.01	18.7±1.33
Life span	♀	39.48±4.12	34.31±3.95	34.6±3.64	32.15±2.78
	♂	34.12±3.65	26.04±2.26	31.55±2.63	28.9±2.17
Fecundity		38.5±4.11	35.46±4.1	42.32±4.03	38.9±3.88
Pre-oviposition period		3.21±0.17	2.68±0.23	2.70±0.19	2.14±.016
Oviposition period		17.74±3.19	14.86±2.41	15.5±3.11	14.84±2.64
Post-oviposition period		5.87±0.88	5.17±0.73	4.66±0.65	4.55±075

Table 2: Food consumption of predator mite, *Blattisocius tar. salis* when fed on immatures of astigmatid mite, *T. putrescentiae and R. robini* at 25 and 35 ˚C and 75% R.H

Biological aspect of the predator Ascid mite stage		No of devoured preys			
		T. putrescentiae		*Rhizoglyphus robini*	
		25 ˚C	30 ˚C	25 ˚C	30 ˚C
Larva	♂	3.5±0.23	4.2±0.38	3.0±0.2	4.0±0.28
	♀	4.2±0.34	4. 3±0.33	4.0±0.37	4.2±0.32
Protonymph	♂	4.3±0.44	5.2±0.37	3.8±0.41	4.5±0.45
	♀	5.6±0.61	6..2±0.45	5.0±0.29	6.0±0.39
Deutonymph	♂	4.6±0.33	5.1±0.37	4.1±0.4	4.8±0.45
	♀	5.8±0.54	6.1±0.55	6.0±0.38	5.9±0.55
Immature stages	♂	12.4 ±2.2	14.5±3.4	10.9±4.6	13.3±3.9
	♀	15.6±3.2	16.7±4.1	15.0±4.1	14.3±4.2
Longevity	♂	45.6+3.5	55.7±4.5	55.5±5.7	60.2±5.7
	♀	68.4±4.6	70.6±6.4	70.6±6.8	80.4±6.2

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