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Life cycle of *Caloglyphus betae* (Astigmata: Tyroglyphidae) fed on different kinds of food under laboratory conditions

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Abstract

Life cycle of *Caloglyphus betae* Attiah (Astigmata: Tyroglyphidae) was evaluated in the laboratory on animal feed, bean, sweet potato, mushroom, basterma and biscuit at 26 ±2°C, and 60 ± 15 % R.H. relative humidity under laboratory conditions. Total development times from egg to adult stage were 7.24 ± 0.15, 7.39 ± 0.28, 7.05 ± 0.13, 7.03 ± 0.16, 6.98 ± 0.09 and 6.40 ± 0.19 days for female, while it was 6.11 ± 0.17, 6.17 ± 0.18, 6.10 ± 0.16, 6.11 ± 0.17, 6.05 ± 0.13 and 6.00 ± 0.17 days for male, at 26 ±2°C, and 60 ± 15 % R.H. When feed on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. The pre-oviposition period was 2.00 ± 0.18, 1.94 ± 0.28, 1.62 ± 0.13, 1.69 ± 0.16, 1.69 ± 0.09 and 1.52 ± 0.22 days at 26 ±2°C, and 60 ± 15 % R.H. when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. Generation time was average 9.24 ± 0.15, 9.33 ± 0.00, 8.67 ± 0.00, 8.72 ± 0.13, 8.67 ± 0.13 and 7.93 ± 0.27 at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. Oviposition period was average 11.00 ± 3.18, 10.00 ± 3.36, 11.46 ± 3.07, 10.69 ± 2.75, 10.00 ± 2.04 and 9.79 ± 2.46 at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. Post-Oviposition period was average 7.33±4.64, 7.67±4.36, 6.54 ± 5.56, 5.62 ± 3.04, 5.43 ± 3.30, and 5.21 ± 4.41at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively.

Introduction

The stored mites influence the weight and quality of stored product, the effect depends on their density and the length of infestation. If it was evaluated separately the effect can be neglected, because the losses caused by mite contamination are quite higher and infested commodities are unsuitable for consumption due to contamination by hazardous compounds. The mites change the quality of infested food by the production of secrets and feces. The massive infestation of mites changes the smell of stored products. The stored-product mites cause hypersensitivity not only for stored grain and farm workers, millers and bakers, but they also seriously endanger the health of the city population (Luczynska *et al*., 1990 and Musken *et al*., 2003).

The astigmatid mites are considered to be economically important pests, decreasing the quality of stored grain when present in large numbers. (Hage-Hamsten and Johansson, 1992; Tee, 1994 and Miller, 1995).

Stored mites flourish in warm and damp environments where they feed on protein rich substance such as grain, fungi and other micro-organisms. Mites infested food products undergo a series of changes in their chemical composition and flour prepared from contaminated grains is more acidic, fusty smell and bitter taste. Mites of sub-order Acaridida (Astigmata) are known to infest a wide variety of stored materials throughout the world.

These mites are a major cause of qualitative and quantitative losses to theses stored materials, Nutrition is one on the important factors which has a modifying effect on growth and life span of mites, the growth of mite population is directly related with the biological as well as physical factors operating the ecosystem (Hughes, 1976 and Mostafa, 1994).

In this work, the authors studied the effects of various food type on duration and development of *Caloglyphus betae* Attiah (Astigmata: Tyroglyphidae).

Materials and methods

Mite species were collected from rice grains, wheat grains and animal feed. For obtaining pure culture female and male adults were placed in the rearing plastic blocks (3× 3 ×0.5 cm) filled with a mixture of (Cement: Charcoal in ratio of 9: 1) as a substrate. The rearing plastic for each mite species contained yeast and a drop of water as a source of food and humidity, then the cell covered to prevent mite from escaping. Thirty blocks were used for each species. Each replicate contained a singly newly deposited egg which transferring by using of a fine camel brush. Thirty replicates were investigated twice daily under a steromicroscope.

During each investigation add a drop of water in each block. The different biological aspects (Incubation period, hatching, moulting, mating, (Active and quiescent) larvae, protonymph, tritonymph, adult female and male were investigated, and recorded emergence males and females were sexed and then separated for testing the longevity and of females and males, respectively. A single female and male were placed together, to notice the mating behavior and calculated the life cycle, generation time, fecundity and life span, by counting the number of eggs laid every day**.**

1. Data recording:

Development from egg to adult was monitored three times a day in 8-hrs. intervals under a standard binocular microscope. When the mites reached adulthood, daily records of pre-oviposition, oviposition and post-oviposition periods and fecundity.

2. Data analysis:

One-way analysis of variance (ANOVA) and mean comparison using Fisher’s least significant difference (LSD) were conducted for development time, the number of eggs deposited and number of preys consumed, using the Super ANOVA program (Gagnon et al., 1989). Significance level was $P \leq 0.05$. The life table parameters of *C. betae* were calculated with two sex software, developed by Chi (1988). The program calculates the intrinsic rate of increase (rm), the finite rate of increase (λ), the net reproductive rate (Ro) and the mean generation time (T). The life table was constructed according to Birch (1948).

3. Statistical analysis:

Statistical analysis of obtained data was conducted using Proc ANOVA and GLM in SAS (SAS Institute, 1998). Mean separation were conducted using Duncan Multiple Range Test in the same program.

Results and discussion

Developmental time of different stages of *Caloglyphus betae* fed on six kinds of food under laboratory conditions:

Obtained results revealed that there are significant differences between male and female duration periods for all the food types, when the individual reared on animal feed, bean, sweet potato, mushroom, basterma and biscuit 26 ± 2°C. with 60 ± 15 % R.H.

1. Incubation period:

The eggs of *Caloglyphus betae* were hatched after 2.33 ± 0.00, 2.36 ± 0.10, 2.33 ± 0.00, 2.33 ± 0.00, 2.36 ± 0.09 and 2.33 ± 0.00 days at 26 ± 2°C. with 60 ± 15 % R.H., respectively for female, while they were 2.11 ± 0.17, 2.11 ± 0.17, 2.14 ± 0.18, 2.11 ± 0.17, 2.10 ± 0.16 and 2.07 ± 0.15 days at 26 ± 2°C. with 60 ± 15 % R.H., respectively for male on animal feed, bean, sweet potato, mushroom, basterma and biscuit. There were insignificant differences among the tested food types as shown in Table (1).

2. Larval stage:

The total larval periods were 2.47 ± 0.17, 2.53 ± 0.17, 2.44 ± 0.16, 2.31 ± 0.09, 2.29 ± 0.18 and 2.00 ± 0.13 days for female, while it was 2.00 ± 0.21, 2.00 ± 0.21, 1.95 ± 0.23, 2.00 ± 0.21, 1.95 ± 0.13 and 1.93 ± 0.15 days for male when feed on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. The periods of larval stages were significantly differencing among mushroom, basterma and biscuit; being longest period was when feed on mushroom and shortest period was when feed on Biscuit.

3. Protonymphal stage:

The female protonymph Table (1) and Figure (1) lasted for 1.11 ± 0.16, 1.14 ± 0.22, 1.08 ± 0.15, 1.10 ± 0.16, 1.10 ± 0.16 and 1.00 ± 0.00 days when feed on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. at 26 ± 2°C. with 60 ± 15 % R.H. The male protonymph lasted 1.06 ± 0.14, 1.00 ± 0.00, 1.00 ± 0.00, 1.06 ± 0.14, 1.00 ± 0.00 and 1.00 ± 0.00 days at the same trend. The previous data showed that there were significant differences between the different tested diet at the protonymphal periods.

4. Tritonymphal stage:

The female Tritonymph Table (1) lasted for 1.33 ± 0.00, 1.36 ± 0.10, 1.21 ± 0.17, 1.28 ± 0.18, 1.24 ± 0.16 and 1.07 ± 0.14 days when feed on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. at 26 ± 2°C. with 60 ± 15 % R.H. The male Tritonymph lasted 0.94 ± 0.14, 1.06 ± 0.14, 1.00 ± 0.00, 0.94 ± 0.14, 1.00 ± 0.00 and 1.00 ± 0.00 days at the same trend. The previous data showed that there were significant differences between the different tested diet at the Tritonymphal periods.

5. Duration of total immatures:

The female immature which included (larval, protonymphal deutonymphal and Tritonymphal) stages lasted for 4.91 ± 0.15, 5.03 ± 0.30, 4.72 ± 0.13, 4.69 ± 0.16, 4.62 ± 0.12 and 4.07 ± 0.19 days, while those of male lasted 4.00 ± 0.00, 4.06 ± 0.25, 3.95 ± 0.23, 4.00 ± 0.21, 3.95 ± 0.13 and 3.93 ± 0.15 days at 26 ± 2°C. with 60 ± 15 % R.H. on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. In general, the time required for female immature stage was longer than the male immature stage at different tested diet and the differences was significant as shown in Table (1).

6. Life cycle:

The period of life cycle (which included incubation, larval, protonymphal, deutonymphal and Tritonymphal stages) was completed in 7.24 ± 0.15, 7.39 ± 0.28, 7.05 ± 0.13, 7.03 ± 0.16, 6.98 ± 0.09 and 6.40 ± 0.19 days for female, while it was 6.11 ± 0.17, 6.17 ± 0.18, 6.10 ± 0.16, 6.11 ± 0.17, 6.05 ± 0.13 and 6.00 ± 0.17 days for male at 26 ± 2°C. with 60 ± 15 % R.H. on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively (Table 1). In general, it can be concluded the Bean diet giving the longest life cycle and the differences between the rest tested diets was significant.

7. Longevity:

The longevity period Table (1). average 20.33 ± 7.23, 19.61 ± 5.62, 19.62 ± 6.45, 18.00 ± 4.17, 17.12 ± 3.63 and 16.52 ± 4.96 days for female while it was 17.00 ± 2.76, 15.67 ± 6.89, 17.43 ± 1.81, 17.00 ± 2.97, 14.86 ± 5.43 and 14.67 ± 5.89days for male at 26±2°C. and 60±15% R.H., on animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively.

In general, it can be concluded the diet animal feed for females, and the diet Sweet Potato for males giving the longest longevity and the differences between the rest tested diets was significant.

8. Life span:

The life span Table (1). averaged (Included the period of life cycle and longevity) 27.58±7.18, 27.00±5.57, 26.67±6.51, 25.03±4.16, 24.10±3.63 and 22.93±5.04 days for female while it was 23.11±2.71, 21.83±6.81, 23.52±1.76, 23.11±2.86, 20.90±5.45 and 20.67±5.96 days for male at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. In general, the time required for female life cycle, longevity and life span was longer than the male at different tested diets and the differences was significant as shown in Table (1).

9. Life table parameters

The preoviposition period Table (2). were on averaged 2.00 ± 0.18, 1.94 ± 0.28, 1.62 ± 0.13, 1.69 ± 0.16, 1.69 ± 0.09 and 1.52 ± 0.22 days respectively at 26±2°C. and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. Generation time was average 9.24 ± 0.15, 9.33 ± 0.00, 8.67 ± 0.00, 8.72 ± 0.13, 8.67 ± 0.13 and 7.93 ± 0.27 at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively.

Oviposition period was average 11.00 ± 3.18, 10.00 ± 3.36, 11.46 ± 3.07, 10.69 ± 2.75, 10.00 ± 2.04 and 9.79 ± 2.46 at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. Post-oviposition period was average 7.33±4.64, 7.67±4.36, 6.54 ± 5.56, 5.62 ± 3.04, 5.43 ± 3.30, and 5.21 ± 4.41at 26±2°C., and 60±15% R.H., when all the individual reread animal feed, bean, sweet potato, mushroom, basterma and biscuit, respectively. The previous data showed that there were significant differences between the effects of different tested temperature degrees as shown in Table (2).

The life table parameters of *Carpoglyphus lactis* were affected by different types of food (Taha *et al*., 2019). Effect of food and temperature on developmental stages and fecundity of the grain mite, Dermatophagoides farinae Hughes (Acari: Acarididae: Pyroglyphidae) (Taha *et al.*, 2002). Effect of different food types, on the biology, fecundity and life table parameters of the stored grain mite, Gohieria fusca (Oud.).

Table (1) : Developmental time of different stages of *Caloglyphus betae* fed on six kinds of food at 26 ±2°C, and 60 ± 15 % R.H.

Food type	Duration time of adult female *Caloglyphus betae* (Days)			
	No.	Mean ± SD	Max.	Min.
	Pre-oviposition period			
Animal feed	(15)	$2.00 \pm 0.18_a$	2.33	1.67
Bean	(14)	$1.94 \pm 0.28_a$	2.33	1.67
Sweet Potato	(13)	$1.62 \pm 0.13_{bc}$	1.67	1.33
Mushroom	(13)	$1.69 \pm 0.16_b$	2.00	1.33
Basterma	(14)	$1.69 \pm 0.09_b$	2.00	1.67
Biscuit	(14)	$1.52 \pm 0.22_c$	2.00	1.33
	Generation time			
Animal feed	(15)	$9.24 \pm 0.15_a$	9.33	9.00
Bean	(14)	$9.33 \pm 0.00_a$	9.33	9.33
Sweet Potato	(13)	$8.67 \pm 0.00_b$	8.67	8.67
Mushroom	(13)	$8.72 \pm 0.13_b$	9.00	8.67
Basterma	(14)	$8.67 \pm 0.13_b$	9.00	8.33
Biscuit	(14)	$7.93 \pm 0.27_c$	8.33	7.67
	Oviposition period			
Animal feed	(15)	$11.00 \pm 3.18_a$	14.00	2.00
Bean	(14)	$10.00 \pm 3.36_a$	13.00	4.00
Sweet Potato	(13)	$11.46 \pm 3.07_a$	14.00	4.00
Mushroom	(13)	$10.69 \pm 2.75_a$	14.00	6.00
Basterma	(14)	$10.00 \pm 2.04_a$	13.00	6.00
Biscuit	(14)	$9.79 \pm 2.46_a$	13.00	4.00
	Post-oviposition period			
Animal feed	(15)	$7.33 \pm 4.64_a$	13.00	0.00
Bean	(14)	$7.67 \pm 4.36_a$	12.00	0.00
Sweet Potato	(13)	$6.54 \pm 5.56_a$	13.00	0.00
Mushroom	(13)	$5.62 \pm 3.04_a$	10.00	0.00
Basterma	(14)	$5.43 \pm 3.30_a$	13.00	1.00
Biscuit	(14)	$5.21 \pm 4.41_a$	11.00	0.00

Means followed by a different subscript letter only within each period are significantly different ($P \leq 0.05$).

Table (2): Life table parameters of *Caloglyphus betae* feeding animal feed, bean, sweet potato, mushroom, basterma and biscuit.

Food type	Duration time of adult female *Caloglyphus betae* (days)			
	No.	Mean ± SD	Max.	Min.
	Pre-oviposition period			
Animal feed	(15)	$2.00 \pm 0.18_a$	2.33	1.67
Bean	(14)	$1.94 \pm 0.28_a$	2.33	1.67
Sweet Potato	(13)	$1.62 \pm 0.13_{bc}$	1.67	1.33
Mushroom	(13)	$1.69 \pm 0.16_b$	2.00	1.33
Basterma	(14)	$1.69 \pm 0.09_b$	2.00	1.67
Biscuit	(14)	$1.52 \pm 0.22_c$	2.00	1.33
	Generation time			
Animal feed	(15)	$9.24 \pm 0.15_a$	9.33	9.00
Bean	(14)	$9.33 \pm 0.00_a$	9.33	9.33
Sweet Potato	(13)	$8.67 \pm 0.00_b$	8.67	8.67
Mushroom	(13)	$8.72 \pm 0.13_b$	9.00	8.67
Basterma	(14)	$8.67 \pm 0.13_b$	9.00	8.33
Biscuit	(14)	$7.93 \pm 0.27_c$	8.33	7.67
	Oviposition period			
Animal feed	(15)	$11.00 \pm 3.18_a$	14.00	2.00
Bean	(14)	$10.00 \pm 3.36_a$	13.00	4.00
Sweet Potato	(13)	$11.46 \pm 3.07_a$	14.00	4.00
Mushroom	(13)	$10.69 \pm 2.75_a$	14.00	6.00
Basterma	(14)	$10.00 \pm 2.04_a$	13.00	6.00
Biscuit	(14)	$9.79 \pm 2.46_a$	13.00	4.00
	Post-oviposition period			
Animal feed	(15)	$7.33 \pm 4.64_a$	13.00	0.00
Bean	(14)	$7.67 \pm 4.36_a$	12.00	0.00
Sweet Potato	(13)	$6.54 \pm 5.56_a$	13.00	0.00
Mushroom	(13)	$5.62 \pm 3.04_a$	10.00	0.00
Basterma	(14)	$5.43 \pm 3.30_a$	13.00	1.00
Biscuit	(14)	$5.21 \pm 4.41_a$	11.00	0.00

Means followed by a different subscript letter only within each period are significantly different ($P \leq 0.05$).

References

Birch, L.C. (1948): The intrinsic rate of natural increase of an insect population. J. Anim. Ecol, , 17: 15–26.

Chi, H. (1988): Life-table analysis incorporating both sexes and variable development rates among individuals. Environ. Entomol., **17**: 26–34.

Gagnon, J.; Roth, J.M.; Carroll, M; Haycock, K.A.; Plamondon, J.; Feldman, D.S. and Simpsoon, J. (1989): Super ANOVA accessible general linear modelling. Abacus Concepts, Berkeley, CA.

Hage-Hamsten, M. and Johansson, S. G. O. (1992): Storage mites. Exp. App. Acarol., 16: 117-128.

Hughes, A. M. (1976): The mites of stored food products and houses. Tech. Bull., Min. Agric. and Fisheries in London, 63: 105-110.

Luczynska, C. M.; Griffun, P.; Davies, R. J. and Topping, M.D. (1990): Prevalence of specific IgE to storage mite (*A. siro*, *L. destructor* and *T.*

longior) in an urban population and cross reactivity with the house dust mite (*D.mpteronyssinus*). Clinida and Experimental Allergy., 20: 403- 406.

Miller, D. J. (1995): Fungi and mycotoxins in grain: Implication for stored product research. J. Stored Prod. Res., 31: 1-16.

Mostafa, A. M. (1994): Biology of *CaIoglyphus betae* Attiah (Acaridae: Astigmata) when fed on yeast granules. Egypt. J. Appi. Sci., 9 (8):740-744.

Musken, H.; Franz, J.T.; Wahl, R.; Paap, A.; Cromwell, O.; Masuch, G. and Bergmann, K.C. (2003): Sensitization to different mite species in German farmers: in vitro analyses. J. of investigational Allergology and Clinical Immunology, 13(1): 26-35.

SAS Institute (1988): SAS/STAT user's guide, 6.06 ed. SAS Institute, Cary, NC.

Taha, H. A.I.; Mahmoud, H.I.; Hassan, M.I.; Omar, N. R. and Nasr, H. M. (2019): Biological studies on the stored grain mite, *Carpoglyphus lactis* (Linne.) (Acari: Astigmata:Carpoglyphidae). Egypt. J. Agric. Res., 97 (1): 167-177.

Taha, H.A.; Abou- El-Ela, K.A.; El-Sandy, K. and Mariam, A. (2002): Effect of food and temperature on developmental stages and fecundity of the grain mite, Dermatophagoides farinae Hughes (Acari: Acarididae: Pyroglyphidae). Egypt. J. Agric. Res., 82 (3): 1121-1126.

Tee, R. D. (1994): Allergy to storage mites. Clin. Exp. Allergy., 24: 636-640.