https://dx.doi.org/10.4314/ejppri.v7i4.9

Egypt. J. Plant Prot. Res. Inst. (2024), 7 (4): 525 - 532

وزارة الزراعة واستصلاح الأراضي
Ministry of Agriculture and Land Reclamation
ARC
مركز البحوث الزراعية
Agricultural Research Center

Egyptian Journal of Plant Protection Research Institute
www.ejppri.eg.net

PLANT PROTECTION RESEARCH INSTITUTE
PPRI

Effect of temperature on the development of Acari *Caloglyphus berlesei* (Acari: Astigmatina: Acaridae) reared on the root-knot nematode under laboratory conditions

Mohamed, A. Nawar

Animal Pest Unit, Plant Protection Department, Desert Research Center.

ARTICLE INFO
Article History
Received: 21/10/2024
Accepted: 22/12/2024
Keywords

Biology, control, mites, *Acari Caloglyphus berlesei*, nematode and root-knot.

Abstract

The research aims to find many biological properties of the mites, *Caloglyphus berlesei* (Michael) (Acari: Astigmatina: Acaridae), when reared on yeast, cheese, and *Meloidogyne* sp. at 20, 25, and 30˚C. According to the study, the incubation times of *C. berlesei* fed on various diets did not change significantly. The life cycle of female and male mites fed on nematodes was much longer than those fed on cheese. The different types of prey at different temperatures showed no discernible effects on *C. berlesei* pre-oviposition and post-oviposition times. However, there were clear variations in how the mites fed during their oviposition time on the same foods and temperatures. The study showed the longevity of *C. berlesei*. When the adult males and females dined on various diets at different temperatures, there were notable differences. Also, compared with mites given nematodes, the current study showed that feeding *C. berlesei* on cheese enhanced the number of eggs deposited by the mite female.

Introduction

The free-living, global acarid mite *Caloglyphus berlesei* (Michael) (Acari: Astigmatina: Acaridae) can be found in a range of environments, such as litter, laboratory communities of insects and fungi, stored goods, and chicken manure (Hughes, 1976; Timms *et al*., 1981; Daneshvar *et al.*, 1977; Chmielewski, 2003 and 2009 and Eraky and Osman, 2008).

Through the use of their distinctive chelate-dentate chelicerae, the majority of Astigmatina are able to eat a variety of soil-dwelling creatures as well as decaying plant debris (Krantz, 1978 and Karagoz *et al.*, 2007). Acarid mites may play a role as nematode biocontrol agents, despite their reputation as possible agricultural pests in multiple kinds of food that are kept in storage (Ramos and Castaņera, 2001; Hill and Woodland, 2002; Sell, 1988 and Abou El-Atta *et al*., 2017).

However, it has been documented to feed on a variety of invertebrates that live in the soil, such as insects and nematodes (Bilgrami, 1994; Walter *et al.*, 1986 and Walia and Mathur, 1995). Plant-parasitic nematodes constitute important pests that lower plant yields in agricultural regions worldwide. They can spread to a wide range of hosts, rendering them unfit for use as food (Szabó *et al*., 2012; Al-

Azzazy and Al-Rehiayani, 2022 and Moens *et al*., 2009).

While root-knot nematodes can be successfully controlled with nematicides, alternative approaches, such as biological control of these pests, are becoming more popular due to public concerns about pesticide residues (El-Sherif and Ismail, 2009). It has been suggested that nematophagous acarid mites are a suitable biocontrol agent for the control of nematodes that parasitize plants (Sell, 1988, and Walia and Mathur, 1995). Comprehensive investigations of their behavior and life-history characteristics when fed nematodes are required to test this theory. It has been observed that *Sancassania* sp. consumes Meloidogyne species eggs, juveniles, and females (Sell, 1988; Timms *et al*., 1981 and Karagoz *et al.,* 2007).

Thus, the current study is to investigate various biological properties of *C. berlesei* that are fed on egg masses of the root-knot nematode, *Meloidogyne* sp., baker's yeast, and dry cheese in lab conditions of 20, 25, or 30 ± 1°C.

Materials and methods

1. Acarid mites culture:

Individuals belonging to the species of acarid mite were used in biological studies after being collected from normal untreated onion soil at New Salhi, Sharkia Governorate. Mass rearing of mites on the yeast was kept in the laboratory at 20, 25 and 30 ºC and 75 + 5 % R.H.

2. Root-knot nematode culture:

A stock population of root-knot nematodes, *Meloidogyne* spp., was produced using a single egg mass grown on sunflower (*Helianthus annuus* L.) planted in 25 cm diameter pots under greenhouse conditions. Roots that contained nematode egg masses were collected in a plastic plate and cleaned with water that was distilled. After being carefully extracted from the roots, the egg masses were presented to *C. berlesei* as prey (Mowafi, 1993).

Laying eggs Meloidogyne egg masses were isolated from *C. berlesei* females at 20, 25, or 30 ºC, and they were left to lay eggs for 24 hrs. Newly deposited eggs (N = 35–40) were kept separately in rearing cells for every temperature treatment. Each of the rearing cells (2.8 cm and a depth of 2 cm covered with an outer plastic lid. Media for both nematodes and mites were prepared by adding 1 gm of agar to 100 ml. of water. Media were mixed in a boiled water bath, poured into the experimental cells, and left uncovered in a sterilized oven to prevent any contamination and to be ready for experimental work Male and female newly emerged adults were paired (N = 14–15) and monitored until they died. Every day, a drop of water and three egg masses of root-knot nematodes were introduced to each rearing cell. The leftover egg masses from the day before were taken out. Reproduction and development were noted twice daily. The duration of the girls' growth and their survival to adulthood, in accordance with Birch (1948). Each experimental unit received a daily addition of yeast and cheese.

3. Data analysis:

The SAS program was used to perform the statistical analysis (ANOVA) of the results that were obtained (SAS Institute, 1991).

Results and discussion

In this study, mites fed on three distinct diets (Baker's yeast, dry cheese, and egg masses of the root-knot nematode) were subjected to laboratory conditions of 20, 25, and 30+2 ºC and 75+5% R.H. It has previously been determined that all of the chosen diets are somewhat appropriate for mite development and survival.

1. Incubation period:

The incubation period of the mite, *C. berlesei*, when fed on several diets (yeast, cheese, and *Meloidogyne* sp.) at three different temperatures did not differ significantly, as Table (1) made evident. For females fed on both diets at different temperatures, this duration reached (1.3, 1.4, 4.1); (1.0, 1.5, 1.9), and (0.8, 0.8, 1.9) days for eggs at 20, 25, and 30 ˚C, respectively.

Results in Table (1) indicate that the incubation period of *C. berlesei* male lasted (1.2,1.0, 4.3); (0.9, 0.9,1.6), and (0.6, 0.6,1.5) days when fed on the three diets at 20, 25 and 30 ºC, respectively, with L.S.D. at 0.05 = 0.4269.

2. Lifecycle:

The life cycle period was considerably longer when mites fed on nematodes than when they fed on cheese, according to the results in Table (1). Females fed free nematodes at 20, 25, and 30 ºC showed (9.3, 6.5, 14.6); (6.8, 7.0, 8.1), and (4.0, 5.1, 7.5), days, respectively. The male of the predacious mite, *C. berlesei* completed its life- cycle in (8.5, 7.6, and 13.0) days at 20 ºC when fed on both yeast, cheese, and the *Meloidogyne* sp, respectively. However, these periods changed to (6.2, 4.9, and 7.1) days at 25 ºC and (3.61,4.6, and 6.5) days at 30 ºC, respectively. with L.S.D. at 0.05 = 0.6622.

Thus, it is evident that yeast provided at the lowest developmental time, whereas nematode egg masses provided the longest life cycle, followed by dry cheese. Eraky (1987) found similar outcomes when *C. berlesei* was raised on Drosophila, with a life cycle of 7.5 days at 26 °C. While Walia and Mathur (1998) reported that *Tyrophagous putrescentiae* (Schrank) females had a life cycle of 13.12 days when raised on juveniles of the root-knot nematode (*Meloidogyne javanica*), Woodring (1969) reported that the life cycle of *C. berlesei* averaged 6.5 days at 23ºC.

According to Chmielewski (2000), female *C. berlesei* had a life cycle of 19.90 days when fed bee bread, but in 2003, he discovered that when they were raised on buckwheat sprouts at 20°C and 95–100% relative humidity, their life cycle shortened to 17.7 days.

3. Longevity:

Regarding adult longevity, a statistical examination of the data obtained in Table (2) revealed that the resultant females' longevity varied greatly depending on the temperature and diet that they were fed. When the adult female fed on the cheese, yeast, and *Meloidogyne* sp. at 20, 25, and 30°C, the corresponding values were (29.4, 15.0, 30.0); (15.3, 11.5, 23.6), and (13.4, 10.2, 17.1).

According to the current findings, the longevity of the predator *C. berlesei* males took (22.4, 12.0, 24.2) days at 20, 25, and 30 °C and (11.2, 8.2, 21.4), and (9.8, 6.6, 15.4) days when fed the same meals as previously mentioned under the same laboratory settings. According to the statistical analysis of the data, L.S.D. over the life cycle period = 2.4185 at the 0.05 level (Table 1).

4. Pre-oviposition, oviposition and post-oviposition periods:

The results presented in Table (2) showed that feeding the individuals on the various introduced diets (Yeast, cheese, and *Meloidogyne* sp.) resulted in a significant alteration in the pre-oviposition and post-oviposition phases of the adult female mite, *C. berlesei*. However, when the mites were fed the same two meals during their oviposition period, which lasted (21.8, 8.2, 21.8); (11.8, 8.8, 18.0), and (8.8, 6.8, 11.8) days at 20, 25, and 30 ºC, respectively, there were clearly noticeable differences.

5. Fecundity:

Table (2) showed that the results made it abundantly evident that feeding the *C. berlesei* female yeast greatly enhanced the number of eggs the mite deposited compared to feeding her nematode. When fed cheese, yeast, and *Meloidogyne* sp. at 20, 25, and 30 ºC, the number of eggs hatched was (432, 279, 198); (527, 420, 151), and (236, 291, 118), respectively.

6. Lifespan:

Based on the information shown in Table (1), *C. berlesei* mites that were fed cheese, yeast, and *Meloidogyne* sp. at 20, 25, and 30 ºC had respective lifespans of (38.7, 21.5, 44.6); (22.1, 18.5, 31.7), and (17.4, 15.3, and 24.6) days. As with females, the life span of *C. berlesei* males fed three different diets at 20, 25, and 30 ˚C and 70% relative humidity varied considerably depending on the type of introduced rearing foods (Table 1). In that order, the life span was (30.9, 19.6, 37.2); (17.4, 13.1, 28.5), and (15.71, 14.6, 22.3), days.

With the exception of feeding on the nematode egg masses, adult male longevity followed a similar trend but was less than that of females. According to Szlendak and Boczek (1992), male *Acarus siro* L. lived for approximately 20 days at 25 ˚C and 85% RH, while females lived for approximately 15 days. However, when fed meal worms and yeast, respectively, *C. anomalus* females produced 930 and 545 eggs and lived for 23.4 and 18.5 days, according to Woodring (1969). According to Eraky's 1987 report, *C. berlesei* laid an average of 755.7 eggs in 15.9 days. When raised on root juveniles, *T. putrescentiae* females deposited an average of 171.40 eggs, according to Walia and Mathur (1998).

Nematode knot, *M. javanica*. In 2003, Chmielewski discovered that the fertility of *C. berlesei* raised on buckwheat sprouts was 237.4 eggs, while in 2000, he noted that the mean total deposited eggs per female was 221.70 when raised on beebread.

Table (1): Duration of developmental stages of *Caloglyphus berlesei* when fed on their diets at 20, 25 and 30 ºC ±2 ºC and 70 ±5 % R.H.

Biological aspect		22 ºC			25 ºC			30 ºC		
		Diet								
		A	B	C	A	B	C	A	B	C
Incubation period	♀	1.3±0.76	1.4±0.54	4.1±0.22	1.0±0.9	1.5±0.70	1.9±0.54	0.8±0.27	0.8±0.27	1.9±0.22
	♂	1.2±0.57	1.0±0.35	4.3±0.44	0.9±0.22	0.9±0.22	1.6±0.54	0.6±0.22	0.6±0.22	1.5±0.5
Total immature stage	♀	8.0±1.00	5.1±1.29	10.5±1.22	5.8±0.97	5.5±1.0	6.2±0.7	3.2±0.76	4.3±0.76	5.6±1.14
	♂	7.3±1.39	6.6±0.65	8.7±0.97	5.3±0.27	5.1±0.82	5.5±1.17	3.01±0.48	4.0±0.35	5.0±0.96
Lifecycle	♀	9.3±1.30	6.5±1.60	14.6±1.19	6.8±0.97	7.0±1.5	8.1±0.74	4.0±0.61	5.1±0.65	7.5±1.11
	♂	8.5±1.11	7.6±0.65	13.0±0.9	6.2±0.44	4.9±0.65	7.1±1.5	3.61±0.64	4.6±0.41	6.5±0.69
Longevity	♀	29.4±0.96	15.0±2.30	30.0±2.15	15.3±1.4	11.5±2.0	23.6±2.07	13.4±2.10	10.2±1.44	17.1±1.67
	♂	22.4±5.59	12.0±1.87	24.2±2.1	11.2±2.58	8.2±1.09	21.4±1.34	9.8±1.78	6.6±194	15.4±2.50
Lifespan	♀	38.7±1.75	21.5±2.09	44.6±2.1	22.1±2.04	18.5±3.22	31.7±2.22	17.4±2.21	15.3±1.85	24.6±2.32
	♂	30.9±5.90	19.6±2.38	37.2±2.01	17.4±2.92	13.1±1.55	28.5±169	15.71±8.07	14.6±298	22.3±5.26

A= Yeast B= Cheese B=Meloidogyne sp.

L.S.D. at 0.05 level for incubation period = 0.426, Total immature stage = 0.662. Life cycle = 1.0201, Longevity = 2.41, Life span = 3.372

Table (2): Longevity and fecundity of *Caloglyphus berlesei* female when fed on two diets at different temperatures.

Biological aspect		22ºC			25ºC			30ºC		
		Diet								
		A	B	C	A	B	C	A	B	C
Pre-Oviposition period	♀	2.0±0.70	1.2±0.44	2.0±0.70	1.3±0.44	1.5±0.70	1.6±0.54	1.0±0.35	1.4±0.41	1.1±0.22
Oviposition period	♀	21.8±1.15	8.2±1.48	21.8±1.15	11.8±1.92	8.8±1.64	18±2.44	8.8±1.30	6.8±1.30	11.8±1.48
Post-Oviposition period	♀	5.6±1.14	5.6±1.14	6.4±1.14	2.2±0.80	1.2±0.57	5.2±1.30	3.6±1.51	2.0±0.78	4.2±1.3
Fecundity	♀	432±40.9	279.45±46.9	198±4.8	527.6±72.2	420.4±53.5	151.8±7.8	236.2±39	291.4±43.2	118±4.5
		A= Yeast		B= Cheese			B=Meloidogyne sp.			

L.S.D. at 0.05 level for pre-oviposition period = 0.4452, oviposition period = 3.1731

References

Abou El-Atta, D.A.; Habashy, M.G.; Mesbah, A.E. and Tawfik, A.A. (2017): Life History of *Caloglyphus manure*, *Sancassania* (*caloglyphus*) *berlesei* and *Tyroghagus putrescentiae* (Acari: Acaridae) feeding on root knot nematodes, *Meloidogyne incognita*. Journal of Plant Protection and Pathology, 8: 69-72.

Al-Azzazy, M. M. and Al-Rehiayani, S.M. (2022): The soil mite *Cunaxa capreolus* (Acari: Cunaxidae) as a predator of the root-knot nematode, *Meloidogyne incognita* and the citrus Nematode, *Tylenchulus semipenetrans*: Implications for biological control. Acarologia, 62 (1):174-185.

Bilgrami, A.L. (1994): Predatory behaviour of a nematode feeding mite *Tyrophagus putrescentiae* (Sarcoptiformes: Acaridae). Fund. Appl. Nematol., 17:293–297.

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

Chmielewski, W. (2000): Proba hodowli rozkruszka *Caloglyphus berlesei* (Michael) na pierzdze pszczelej. Materialy XVI Naukowej Konferencji "Warroza pszczol i gospodarka pasieczna", Olsztyn Kortowo: 8-10 (In Polish).

Chmielewski, W. (2003): Effect of buckwheat sprout intake on population increase in *Caloglyphus berlesei* (Michael) (Acari: Acaridae). Fagopyrum, 18:85–88.

Chmielewski, W. (2009): Phoretic mites (Acarina) on earwigs, *Forficula auricularia* L. (Insecta, Dermaptera), found in apiaries. J. Apic. Sci., 53:75–80.

Daneshvar, H.; Rodriguez, J.G. and Rodriguez, L.D. (1977): Monoxenic culture of *Caloglyphus berlesei* (Acarina: Acaridae) on fungi. J. Invertebr. Pathol., 30:175–180.

El-Sherif, A. G. and Ismail, F A. (2009): Integrated management of *Meloidogyne incognita* infecting soybean by certain organic amendments, *Bacillus thuringiensis*, *Trichoderma harzianum* and oxamyl with reference to NPK and whole chlorophyll status. Plant Pathology Journal, 8(4):159-164.

Eraky, S. A. (1987): Observation on the biology of two species of acarid mites. Folia Ent. Hung., 48: 21-27.

Eraky, S. and Osman, M. A. (2008): Some biological aspects and life table parameters of *Caloglyphus manuri* Eraky & Osman (Acaridida-Acaridae) fed on different kinds of food. Acarines, 2: 45-48.

Hill, J. and Woodland, W. (2002): An evaluation of foreign fieldwork in promoting deep learning: a preliminary investigation. Assessment and Evaluation in Higher Education, 27: 539-555.

Hughes, A.M. (1976): The mites of stored food and houses. Technical Bulletin no. 9 (2^{nd} edn.). Ministry of Agriculture, Fisheries and Food, London.

Karagoz, M.; Gulcu, B.; Cakmak, I.; Kaya, H.K. and Hazir, S. (2007): Predation of entomopathogenic nematodes by *Sancassania* sp. (Acari: Acaridae). Exp. Appl. Acarol., 43:85–95.

Krantz, G.W. (1978): A manual of acarology. Oregon State University Bookstores, Corvallis.

Moens., M.; Perry, R.N. and Starr, J.L. (2009): Meloidogyne species-a diverse group of novel and important plant parasites. In: Perry RN, Moens M, Starr JL (eds) Root-knot nematodes. CABI Publishing, Wallingford, pp 1–17.

Mowafi, M. A. (1993): Studies on some important economic predaceous mites in Egypt. Ph. D. Thesis, Fac. Agric., Al-Azhar University.

Ramos, I.S. and Castañera, P. (2001): Development and survival of *Tyrophagus putrescentiae* (Acari: Acaridae) at constant temperatures. Environmental Entomology, 30(6):1082–1089.

SAS, Institute (1991): SAS Language and Procedures: Usage 2, Version 6, 1st edt. SAS Institute, Inc., Cary, NC, USA.

Sell, P. (1988): *Caloglyplus* sp. (Acarina: Acaridae) an effective nematophagous mite on root-knot nematode (*Meloidogyne* spp.). Nematologica, 34:246–248.

Szabó, J.K.; Butchart, S.H.M.; Possingham, H.P. and Garnett, S.T. (2012): Adapting global biodiversity indicators to the national scale: A Red List Index for Australian birds. Biological Conservation, 148: 61-68.

Szlendak, E. and Boczek, J. (1992): Population development of the grain mite *Acarus siro* L. (Acari: Acaridae). Bulletin of the Polish Academy of Sciences/Biological Sciences, 40 (1): 73-79.

Timms, S.; Ferro, D.N. and Emberson, R.M. (1981): General biology and nomenclature of *Sancassania berlesei* (Michael). Acarologia, 22:385–390.

Walia, K.K. and Mathur, S. (1995): Predatory behavior of two nematophagous mites, *Tyrophgus putrescentiae* and *Hypoaspis calcuttaensis*, on root-knot nematode, *Meloidogyne javanica*. Nemato. Mediter., 23 (2): 255–261.

Walia, K.K. and Mathur, S. (1998): Reproductive behavior of two nematophagous mites, nematodes and alternate diet. Ann. Pl. Protect. Sci., 6 (2): 178–181.

Walter, D.E.; Hudgens, R.A. and Freckman, D.W. (1986): Consumption of nematodes by fungivorous mites *Tyrophagus* spp. (Acarina: Astigmata: Acaridae). Oecologia, 70:357–361.

Woodring, J. P. (1969): Observation on the biology of six species of acarid mites. Ann. Ent. Soc. Amer., 62 (1): 102–108.