J. Plant Prot. and Path., Mansoura Univ., Vol. 4 (7): 611 - 616, 2013

FEEDING CAPACITY OF THE PREDACIOUS MITE *Neoseiulus bellinus* (WOMERSLEYI) FED ON *Tetranychus urticae* (KOCH) AT DIFFERENT TEMPERATURES

Abou Zaid, Walaa M. R.
Plant Protection Res. Inst., Agric. Res. Center, Doki, Giza, Egypt

ABSTRACT

The spider mite, *Tetranychus urticae* (Acari: Tetranychidae) is the main pest of various crops and trees. This study was conducted to evaluate the efficacy of the predacious mite, *Neoseiulus bellinus* (womersleyi) (Acari: Phytoseiidae), in checking *Tetranychus urticae* at different temperatures and 70% relative humidity. The developmental periods of different immature stages decreased with increasing temperature and the life cycle for female was 9.12±1.2 and male were 7.8 ± 0.67 days at 30°C. However the development time was 14.18 ± 1.77 for female and 12.2±1.32 for male at 20°C.The pre- and post-oviposition period and female longevity all shortened as temperature increased. The longest oviposition period was observed at 20°C as 26.62 ± 3.3 days.While at 30 ° C 24.5±2.9 days. The mated females laid an average 5.99 ± 1.39 and 11.69 ± 0.7 eggs per day, respectively. The life cycle for all immature stages tended to decrease as the light period increased indicating that immature development as well as diapause induction are affected by photoperiod and further suggest that diapause-inducing stimuli prolong the developmental period especially for the deutonymphal stage.

Keywords: Temperature- *Neoseiulus bellinus* – Development – Fecundity-photoperiod

INTRODUCTION

Phytophagous mites are becoming more aggressive as pests on vegetable crops due to environmental changes affecting cropping system. Generally, tetranychid mites are harmful and widespread pests and numerous and ornamental plants (Kasap and Atlihan 2011). They inhabit the lower side of the leaves, covering its colonies with dense webbing and it feeds on the leaf epidermis and parenchyma cellular content altering the normal transpiration and photosynthetic rates, which causes yellowish and chlorotic spots to appear on both sides of the leaf. Heavy infestations of these spider mites incombined with water stress can initiate sudden massive leaf drop (Aucejo-Romero *et al.*2004).

Spider mites have rapidly developed a resistance to a various acaricides (kim *et al.* 2006). Thus, studies of the biological control agents and integrated pest management (IPM) is important for spider mite management as well as to the control of other insect pests in agricultural fields (Gerson and Weintraub 2007; Weintraub 2007; Warner and Gertz 2008). Integrated pest management (IPM) involves different control approaches to reduce agricultural pest populations effectively, economically, and environment-friendly. The functional response can determine if a predator is able to regulate the density of its prey (Murdoch and Oaten 1975), i.e., it must show density dependence; the predator must respond to higher prey densities by consuming an increasing proportion of the available prey over a range of prey densities (Schenk and Bacher 2002). Most of the recent research on biological control of tetranychid has focused on the family Phytoseiidae, due to their frequent effectiveness in maintaining prey populations at low densities (McMurtry and Croft 1997; Croft and Luh 2004; Broufas *et al.* 2007)

The phytoseiid mite is an effective biological control agent of spider mites in various field and greenhouse crops (El Taj and Chuleui 2012).

Genus *Neoseiulus* is one of the most important predator of spider mites of the genus Tetranychus in Japan and many countries (Maeda and Hinomoto 2006). Adequate information about a biological control agent is essential before selecting bioagent in a pest management system.

The present study threw light on the efficacy of *Neoseiulus bellinus* (womersleyi) fed on *Tetranychus urticae* (Koch) at different temperature degrees.

MATERIALS AND METHODS

Culture maintenance:

The predator *Neoseiulus bellinus* (womersleyi) collected from citrus leaves, a pure culture has been prepared on leaf discs of kidney bean (*Phaseolus vulgaris* L.) infested with the two spotted spider mite *Tetranychus urticae* (Koch).

50 gravid *N.bellinus* females were used from rearing unit for each treatment of temperature and allowed to lay eggs for 12 h. 20 eggs placed in rearing cells individually and examine for the developmental stages and egg production. Rearing cells were incubated at 20±2° C and 30±2° C with relative humidity 70±5% and a photoperiod of 12 : 12 (L : D) hrs.

RESULT AND DISCUSSION

Phytoseiid mites are known to have shorter developmental times than their spider mite prey, which has the shortest developmental time among the tetranychids (Walter & Proctor 1999). *N. bellinus* strain used in this study appears to share the same short developmental time along with the other phytoseiid mites important for biological control. The developmental time of the *N.bellinus* strain at 20–30°C is almost similar with that of other *Amblyseius* species and also the use of phytoseiid mite is effective in biological control with non diapauses insects (Yvonne MH *et al*, 1995). In this study the data reported by rearing predatory mite *Neoseiulus bellinus*, feeding on spider mite under two different temperature 20 ° ±2 ° C, 30 ° ±2 ° C and RH 70%±5 with and a photoperiod of 12 : 12 (L : D) h. indicated that all immature life stages of *N. bellinus* (egg to deutonymph), developmental rates were an increasing function of temperature under 30 ° C (Table 1).

Duration of different developmental stages:

The female egg incubation period lasted 3.06 days at 30°C while non significant decreased to 1.81days at 20°C but male egg incubation period lasted 3 days at 30°C and be 1.7 days at 20°C

Table 1: Mean developmental time (days + SE) at each life stage of *Neoseiulus bellinus* male and female at temperatures 20° and 30°C

Temperature	Sex	Incubation period	Larval stage	Protonymphal stage	Deutonymphal stage	Life cycle
20 ° C	Female	3.06±0.77[a]	3.25±1[a]	4.31±0.84[a]	3.56±0.72[a]	14.18±1.77[a]
	Male	3±0.83[a]	2.9±0.66[b]	3.1±0.48[b]	3.2±0.92[a]	12.2±1.32[b]
30 ° C	Female	1.81±0.65[c]	1.9±0.67[c]	2.68±0.84[c]	2.6±0.45[b]	9.12±1.2[c]
	Male	1.7±0.6[c]	1.8±0.67[c]	2.2±0.67[c]	2.1±0.8[b]	7.8±0.67[c]
L.S.D	Female	1.066	1.72	1.25	0.906	2.279
	Male	1.73	1.59	1.06	2.05	2.49

This predator has 3 immature stages (larval, Protonymphal, Deutonymphal stages) female larval stage lasted 3.25, 1.9 days and male larval stage take 2.9, 1.8 days at 20°, 30 ° C, respectively.
Protonymphal stage for female and male lasted 4.31, 3.1, days, respectively at 20°C. However at 30°C this period lasted 2.68, 2.2 days for female and male, respectively. The Deutonymphal stage for female and male lasted 3.56, 3.2 at 20°C and at 30°C this period lasted 2.6, 2.1 days for female and male, respectively.

Life cycle duration was 14.18, 12.2 days for female and male at 20 ° C but in 30°C this period were 9.12, 7.8 days for male and female, respectively (Table 1). longevity of resulted female and male at 20°C was 39.5and 33.2 days while at 30°C was 35.8 and 28 days, respectively (Table 2).

Table 2: longevity and fecundity (days + SE) of *Neoseiulus bellinus* male and female at temperatures 20° and 30°C

Temperature	Sex	Preovi.	Ovip.	Postovi.	longevity	Fecundity	Daily rate
20 ° C	Female	5.81±1.66[a]	26.62±3.3[a]	7.06±1.97[a]	39.5±3.7[a]	233.3±40.9[b]	5.99±1.39
	Male	....	....	....	33.2±2.9[b]	....	....
30 ° C	Female	4.5±1.6[b]	24.5±2.92[b]	6.8±2.1[b]	35.8±3.3[b]	418±24.16[a]	11.69±0.7
	Male	....	....	....	28±4.14[c]	....	....
L.S.D	Female	2.435	4.67	3.03	5.29	49.62	1.64
	Male	....	....	....	7.09	....	....

Number of egg deposited by female at 20°C was 233.3 eggs but in 30°C was 418 eggs. Similar results obtained by Kazak *et al.* (2002) who studied the development time, survival and fecundity of the generalist predatory mite, *Neoseiulus umbraticus* Chant at 20°C, 25°C, and 30°C and 65 ± 10% RH. Total developmental times of males were relatively shorter at 25°C and 30°C than at 20°C. In general, preoviposition, oviposition, and postoviposition periods of *N. umbraticus* shortened as temperature increased.

Metwally *et al.* (2005) studied the life table and prey consumption of the predatory phytoseiid mite *Neoseiulus cydnodactylon* (Shehata and Zaher) as affected by feeding on the motile stages of the olive bud mite *Aceria oleae* Nalepa, the olive rust mite *Tegolophus hassani* Keifer (Acari: Eriophyidae) and nymphs of the two-spotted spider mite *Tetranychus urticae* Koch (Acari: Tetranychidae) and they found the rise of different temperatures and relative humidities from 15°C and 50 % to 25°C and 70 % and 31°C and 80 % RH. shortened development and increased reproduction and prey consumption. Both eriophyid and tetranychid mites are thought to be profitable prey species of *N. cydnodactylon* as a facultative predator.

liza *et al.* (2006) studied the life history characteristics and predation of the Japanese *Neoseiulus californicus* (McGregor) strain on the two-spotted spider mite, *Tetranychus urticae* Koch. Developmental time from egg to adult emergence decreased when temperature increased. A gravid *N. californicus* female consumed more eggs, larvae and nymphs than adult male or female of *T. urticae*.

female phytoseiid mites required multiple matings to attain their full reproductive potential, so the amount of sperm is critical in egg production (Amano & Chant 1977)

The developmental periods for the deutonymphal and the total immature stages were longer in diapaused females than non-diapaused females. Taken together, the data indicated that the developmental delay observed in the short light periods was probably due to metabolic suppression related to diapause-inducing stimuli rather than a direct effect of photoperiod and that the effects of the stimuli might mainly appear during the deutonymphal stage (Maqsood S., *et al*, 2011)

The results of (Lee & Ahn 2000) study indicated that *A. womersleyi* appears better adapted to higher temperatures, and may be a useful biological control agent for spider mites in greenhouse horticultural crops, and in field horticultural crops during summer.

Conclusion

These results were used to assess the effectiveness of phytoseiid mite *Neoseiulus bellinus* as an important biological control agent against *T. urticae* in suitable temperature around 30 ° C. and a photoperiod of 12 : 12 (L : D) h compared with 20 ° C

REFERENCES

Amano, H., Chant, D.A. (1977) Life history and reproduction of two species of predacious mites, *Phytoseiulus persimilis* Athias-Henriot and *Amblyseius andersoni* (Chant) (Acarina: Phytoseiidae). *Canadian Journal of Zoology*, 55: 1978–1983.

Aucejo-Romero S, Go´mez-Cadenas A, Jacas-Miret JA (2004) Effects of NaCl-stressed citrus plants on life history parameters of Tetranychus urticae (Acari: Tetranychidae). Exp Appl. Acarol. 33:55–68.

Broufas GD, Pappas ML and Koveos DS. (2007) Development, survival and reproduction of the predatory mite *Kampimodromus aberrans* (Acari: Phytoseiidae) at different constant temperatures. *Environmental Entomology* 36:657-665.

Croft BA, Luh HK. (2004) Phytoseiid mites on unsprayed apple trees in Oregon, and other western states (USA): distribution, life-style types and relevance to commercial orchards.*Experimental and Applied Acarology* 33: 281-326.

El Taj HF, Chuleui J (2012) Effect of temperature on the life-history traits of *Neoseiulus californicus* (Acari: Phytoseiidae) fed on *Panonychus ulmi* Exp Appl Acarol (2012) 56: 247-260.

Gerson U, Weintraub PG (2007) Mites for the control of pests in protected cultivation. Pest Manag Sci 63:658-676.

Kasap I, Atlihan R. (2011) Consumption rate and functional response of the predaceous mite Kampimodromus aberrans to twospotted spider mite Tetranychus urticae in the laboratory. Experimental and applied Acarology 53(2): 253-261.

Kazak, C., K. Karut, I. Kasap, C. Kibritci and E. Sekeroglu.(2002) The potential of the Hatay population of Phytoseiulus persimilis to control the carmine spider mite Tetranychus cinnabarinus in strawberry in Silifke-Icel, Turkey. Phytoparasitica 30(5): 451-458.

Kim Y, Park H, Cho J, Ahn Y (2006) Multiple resistance and biochemical mechanisms of pyridaben resistance in Tetranychus urticae (Acari: Tetranychidae).J Econ Entomol 99:954-958.

Lee, J.H. & Ahn, J.J. (2000) Temperature effects on development, fecundity, and life table parameters of *Amblyseius womersleyi* (Acari: Phytoseiidae). *Environmental Entomology*, 29 (2), 265–271.

Liza J. Canals, Hiroshi Amano, Noriaki Ochiai and Makio Takeda (2006). Biology and predation of the Japanese strain of *Neoseiulus californicus* (McGregor) (Acari: Phytoseiidae). *Systematic & Applied Acarology* (2006) 11, 141–157.

Maeda T, Hinimoto N. (2006): Effect of laboratory rearing conditions on the predatory mite *Neoseiulus womersleyi* (Schicha) (Acari: Phytoseiidae): I. genetic diversity. International Journal of Acarology 32(1): 93-98.

Maqsood Shah, Takeshi Suzuki, Noureldin Abuelfadl Ghazy, Hiroshi Amano and Katsumi Ohyama. (2011). Effect of photoperiod on immature development and diapause induction in the Kanzawa spider mite, Tetranychus kanzawai (Acari: Tetranychidae). Exp Appl Acarol (2011) 55:183–190.

McMurtry JA, Croft BA. (1997) Life-styles of Phytoseiid mites and their roles in biological control. *Annual Review of Entomology* 42: 291-321.

Metwally, A. M., Abou-Awad, B. A. and Al-Azzazy, M. M. (2005) Life table and prey consumption of the predatory mite *Neoseiulus cydnodactylon* Shehata and Zaher (Acari: Phytoseiidae) with three mite species as prey. Z. Pflanzenkrankh. Pflanzensch. 112: 276–286

Murdoch WW, Oaten A. (1975) Predation and population stability. *Advances in Ecological Research* 9: 2-131.

Schenk D, Bacher S. (2002) Functional response of a generalist insect predator to one of its prey species in the field. *Journal of Animal Ecology* 71: 524-531.

Walter, D.E. & Proctor, H.C. (1999) *Mites: ecology, evolution and behavior.* UK, CABI Publishing, 322 pp.

Warner KD, Gertz C (2008) A socio-economic analysis of the North American commercial natural enemy industry and implications for augmentative biological. Biol Cont 45: 1-10

Weintraub PG (2007) Integrated control of pests in tropical and subtropical sweet pepper production. Pest Manag Sci 63:753-760

Yvonne M.van Houten, Pam van Stratum, Jan Bruin and Alfred Veerman. (1995) Selection for non-diapause in *Amblyseius cucumeris* and *Amblyseius bakeri* and exploration of the effectiveness of selected strains for thrips control. Entomological Experimentalis et Aplicata 77:289-295.

القدره الافتراسيه للمفترس الاكاروسى *Neoseiulus bellinus* عند تغذيته على العنكبوت الاحمر العادى على درجات حراره مختلفه.

ولاء محمد رشدى ابوزيد

معهد بحوث وقايه النباتات- مركز البحوث الزراعيه- الدقى- جيزه- مصر

يعتبر العنكبوت الاحمر العادى افه لمعظم المحاصيل و الاشجار و تهدف هذه الدراسه لتوضيح القدره الافتراسيه للمفترس الاكاروسى عند تغذيته على العنكبوت الاحمر العادى وتاثير درجتى حراره هما ٢٠ و ٣٠° مئويه ورطوبه نسبيه ٧٠% على تطور المفترس. فى حاله زياده درجه الحراره جميع مراحل الحياه للمفترس استغرقت وقت اقصر اما عن دوره حياه المفترس قد استغرقت ٩.١٢ للاناث و ٧.٨ للذكور فى درجه حراره ٣٠ مئويه. لكن فى درجه حراره ٢٠ مئويه امتدت دوره الحياه الى ١٤.١٨ يوم للاناث و ١٢.٢ يوم للذكور.

وقد ادت زياده درجه الحراره على انقاص فترتى ما قبل و ما بعد وضع البيض و لقد لوحظ ان اطول فتره لوضع البيض كانت ٢٦.٦٢ يوم عند درجه حراره ٣٠ درجه مئويه و كان متوسط وضع البيض ٥.٩٩ بيضه/يوم عند ٢٠ درجه مئويه و ١١.٦٩ بيضه/يوم عند ٣٠ درجه مئويه

ولقد لوحظ بشكل عام ان دورات الحياه للاطوار الغير كامله استغرقت و قت اقل عند و جود فترات اضاءه اطول مما يعنى ان اطوار الحياه الغير كامله و فترات السكون البينيه تتاثر بمده الاضاءه و هذا يوءكد ان الزياده فى فترات السكون البينيه قد تطيل من فترات التطور اللازمه لكل طور من اطوار الحياه خاصه طور الحوريه الاخير.

قام بتحكيم البحث

أ.د / عمر عبد الحميد السيد نصار	**كلية الزراعة – جامعة المنصورة**
أ.د / محمود السيد النجار	**مركز البحوث الزراعيه**