FEEDING EFFICIENCY OF DIFFERENT STAGES OF THE PREDATORY, MITE, *NEOSEIULUS CALIFORNICUS* (MCGREGOR) ON THOSE OF *TETRANYCUS URTICAE* AND *PANONYCHUS ULMI* (ACARI:PHTOSEIIDAE&TETRANYCHIDAE)

HEIKAL, I. H. [1], M. H. MOWAFI[2] AND A. A. EBRAHIM[1]

1. *Plant Protection Research Institute, A R C, Dokki, Giza*
2. *Zoology and Nematology Dep., Fac. Of Agric., Al-Azhar Univ.*

(Manuscript received 14 September 2007)

Abstract

A laboratory study was conducted to evaluate the feeding efficiency of different stages of the predatory mite, *Neoseiulus californicus* (McGregor) (Acari: Phytoseiidae) on those of each of the two-spotted spider mite, *Tetranychus urticae* Koch and the European red mite, *Panonychus ulmi* (Koch) (Acari:Tetranychidae). The predator larva proved to be a feeding stage .Average consumption of eggs, larvae, protonymphs, deutonymphs and adult males and females of *T. urticae* by the predator larva were : 1.1±0.75, 1.2±0.74, 0.8±0.66, 0.5±0.58, 0.6±0.63 and 0.1±0.36 individuals, respectively. These values gradually increased in the subsequent predator stages to reach in the case of the predator adult female with average of 15.4±1.25, 16.9±1.15, 12.6±1.48, 7.2±1.07, 9.2±1.25 and 5.3±0.99 individuals from the previous prey stages, respectively. Comparatively low numbers of different stages of *P. ulmi* were eaten by the predator individuals. Average consumption of eggs, larvae, protonymphs, deutonymphs and adult males and females of *P.ulmi* by the predator larva were: 0.8±0.75, 0.9±0.66, 0.6±0.64, 0.3±0.48, 0.5±0.51 and 0.08±0.27 from the previously mentioned prey stages, respectively. Also, these values gradually increased in the progressive predator stages to reach for the predator adult female 11.8±1.38, 13.0±1.62, 9.7±1.73, 5.6±1.07, 7.1±1.52 and 4.09±1.38 from *P. ulmi* different progressive stages, respectively. Thus, *N.californicus* adult female when fed on *T. urticae* or *P. ulmi* ate more than any other predator stages.

Also, prey eggs and larvae were eaten most frequently. The foregoing results showed that *N. californicus* can play an important role as a bio- control agent of the two tetranychid mites *T. urticae* and *P. ulmi*.

INTRODUCTION

Predaceous mites of the family Phytoseiidae are known to be effective natural enemies of several phytophagous mites species (Zaher, 1989, Croft, 1994 and McMurty& Croft, 1997). Croft *et al.*, 1998 indicated that *Neoseiulus californicus* (McGregor) is a more generalist feeder than *Neoseiulus fallacies* (Garman) and added that generalist feeders can feed on pollen. Takano-Lee & Hoddle, 2002. stated that behavior of *N. californicus* suggests that it is opportunistic and capable of capturing

several different types of prey. Vilajeliu & Vilarnau, 1992 reported that *N. californicus* (=*A. californicus*) was greatest at the time of maximum activity of *Panonychus ulmi* (Koch).

The aim of this work was to study the feeding efficiency of different stages of the predatory mite *N. californicus* on those of the two-spotted spider mite, *Tetranychus urticae* Koch and the European red mite, *P. ulmi*.

MATERIALS AND METHODS

I- Feeding efficiency of different stages of *N. californicus* on those of *T. urticae*

Feeding efficiency of the predatory mite, *N. californicus* on the two-spotted spider mite, *T. urticae* were conducted in the laboratory at 25 ± 2°C and 70 ± 5% R.H. Petri dishes were used as rearing units, coated on the lower surface with fine layer of cotton and put turned over in big Petri dishes full with water to provide the rearing discs with moist continuously. Five small pieces of discs (about 2.5 cm diameter) of mulberry leaves, *Morus alba* L. were put upside down on the moist cotton. A thin layer of tangle foot was painted around each leaf disc as a barrier to confine the mites to a definite area. The discs were changed when required. One egg of *N. californicus* was put on each disc for development to the adult stage on different stages of *T. urticae* and was observed twice daily. When the *N. californicus* larvae hatched, the amount of food required by every *N. californicus* stage was determined by exposing *T. urticae* either as eggs, larvae, protonymphs, deutonymphs and adult males or females, to the different predator stages. Each treatment consisted of 4 Petri dishes, containing 5 discs and each containing a known number of a given stage of *T. urticae* on each mulberry disc. One *N. californicus* larva was liberated in each disc, and the number of prey eaten during its larval, protonymphal, deutonymphal, and adult male or female were recorded. Surplus food was provided whenever the supply became low.

II- Feeding efficiency of different stages of *N. californicus* on those of *P. ulmi*.

The same technique was applied when rearing different stages of the predator on those of the European red mite, *P. ulmi*.

RESULTS AND DISCUSSION

I. Feeding efficiency of different stages of *N. californicus* on different stages of *T. urticae*

Average daily consumption of eggs, larvae, protonymphs, deutonymphs, adult males and females of *T. urticae* by a larva of the predator mite, *N.californicus* was 1.1±0.75, 1.2±0.74, 0.8±0.66, 0.5±0.58, 0.6±0.63 and 0.1±0.36 individuals, respectively. These values increased with the predator protonymph with average of 7.6±1.05, 8.2±1.25, 5.6±0.89, 3.2±0.85, 4.4±1.22 and 2.3±0.87 individuals from the same prey stages, respectively.The consumption of prey by the predator deutonymph averaged 9.9±1.05, 10.4±1.32, 7.6±1.23, 4.4±1.04, 7.5±0.58 and 2.8±0.85 individuals from the previous prey stages, respectively. These values greatly increased with the predator adult female to reach 15.4±1.25, 16.9±1.15, 12.6±1.48, 7.2±1.07, 9.2±1.25 and 5.3±0.99, while those for male predator were 7.8±1.14, 8.6±1.11, 4.9±1.11, 3.8±0.94, 5.2±1.01 and 4.1±0.93 individuals from the previous prey stages, respectively (Table 1). Several authors reported that the larvae, nymphs and adults had been observed feeding on all different tetranychid prey stages, (Ma and Lang 1973, Friese & Gilstrap 1985, Castagnoli & Amato 1991, Chant & McMurtry 1994, Palevsky 1997and Gotoh *et al.* 2004).

Table 1. Daily average consumption of *T.urticae* different stages by those of *N. californicus* developmental stages at 25 ± 2°C. and 70 ± 5% R. H.

Predator	No.of consumed *T. urticae* (Mean ±S.D.)					
	Eggs	Larvae	Protonymphs	Deutonymphs	Males	Females
Larva	1.1±0.75	1.2±0.74	0.8±0.66	0.5±0.58	0.6±0.63	0.1±0.36
Protonymph	7.6±1.05	8.2±1.25	5.6±0.89	3.2±0.85	4.4±1.22	2.3±0.87
Deutonymph	9.9±1.05	10.4±1.32	7.6±1.23	4.4±1.04	7.5±0.58	2.8±0.85
Female	15.4±1.25	16.9±1.15	12.6±1.48	7.2±1.07	9.2±1.25	5.3±0.99
Male	7.8±1.14	8.6±1.11	4.9±1.11	3.8±0.94	5.2±1.01	4.1±0.93

From the previous results, it could be noticed that, the predator adult female ate more than any other predator stage and the deutonymph ate more than protonyph. Also, the prey eggs and larvae were eaten most frequently. These agreed with that

obtained by Castagnoli & Amato 1991 and Gotoh *et al.* 2004 who stated that *N. californicus* showed a clear preference for *T. urticae* immature stages.

II. Feeding efficiency of different stages of *N. californicus* on different stages of *P. ulmi*

Daily average attacked eggs, larvae, protonymphs, deutonymphs, adult males and females of *P. ulmi* by *N.californicus* larva were 0.8±0.75, 0.9±0.66, 0.6±0.64, 0.3±0.48, 0.5±0.51 and 0.08±0.27 individuals, respectively. These values increased with the predator protonymph then deutonymph to reach 7.6±0.92, 8.0±0.88, 5.8±1.31, 3.4±1.21, 5.8±1.21 and 2.17±0.92 individuals, respectively. Predator female was voracious as it devoured daily average 11.8±1.38, 13.0±1.62, 9.7±1.73, 5.6±1.07, 7.1±1.52 and 4.09±1.38 individuals, while male ate 4.46±1.38, 5.09±1.09, 3.77±1.09, 2.92±1.19, 3.20±1.14 and 2.40±1.02 individuals daily from the previous prey stages, respectively (Table 2).

From the previous results, it could be noticed that, the predator adult female ate more than any other predator stages and that deutonymph ate more than protonymph. Also, the prey eggs and larvae were eaten most frequently

Present as well as previous studies indicated that *N. californicus* can play a good role in the control of *P. ulmi* (Villaronga and Garcia, 1988, Vilajeliu and Vilarnau 1992) and can reduce its population densities as a generalist tetranychid predator (McMurtry & Rodriguez 1987, McMurtry & Croft 1997 and Croft *et al.* 1998). This species can survive and reproduce on different mite and insect species and pollen (Castagnoli & Falchini,1993; Sabelis & Van Rijn ,1997 and Croft *et al.*,1998).

Table 2. Daily average consumption of *P.ulmi* different stages by those of *N. californicus*, at 25 ± 2°C. and 70 ± 5% R. H.

Predator	No.of consumed *P. ulmi* (Mean ±S.D.)					
	Eggs	Larvae	Protonymphs	Deutonymphs	Males	Females
Larva	0.8±0.75	0.9±0.66	0.6±0.64	0.3±0.48	0.5±0.51	0.08±0.27
Protonymph	5.8±1.03	6.3±1.24	4.3±1.18	2.5±0.98	3.4±1.21	1.78±0.70
Deutonymph	7.6±0.92	8.0±0.88	5.8±1.31	3.4±1.21	5.8±1.21	2.17±0.92
Female	11.8±1.38	13.0±1.62	9.7±1.73	5.6±1.07	7.1±1.52	4.09±1.38
Male	4.46±1.38	5.09±1.09	3.77±1.09	2.92±1.19	3.20±1.14	2.40±1.02

REFERENCES

1. Castagnoli, M. AND F. Amato. 1991. Laboratory studies on the interaction between the predator *Amblyseius californicus* (McGregor) (Acarina: Phytoseiidae) and its prey *Tetranychus urticae* Koch (Acarina: Tetranychidae). Redia. 74(1): 77 – 85.
2. Castagnoli, M. and L. Falchini.1993.Suitabilityof Polyphagotarsonemus latus (Bank) (acari : Tarsonemidae) as prey for *Amblyseius californicus* (McGregor) (Acari : Phytoseiidae) .Redia,76(2),273-279.
3. Chant, D. A. and J. A. McMurtry. 1994. A review of the subfamilies Phytoseiinae and Typhlodrominae (Acari: Phytoseiidae). Int. J. Acarol. 20: 223 – 310.
4. Croft, B. A. 1994. Biological control of apple mites by a phytoseiide mite complex and Zetzella mali (Acari :Stigmaeidae): Long –term effects and impact of azinophosmethyl in colonization by *Amblyseius andersoni* (Acari: Phytoseiidae).Environ. Entomol., 23(5): 1317-1325.
5. Croft, B. A., L. N. Monetti and P.D. Pratt. 1998. Comparative life histories and predation types: are *Neoseiulus californicus* and N. fallacis (Acari:Phytoseiidae) similar type 11 selective predators of spider mites. Environ. Entomol. 27: 531-538.
6. Fries, D. D. and F. E. Gilstrap. 1985. Prey requirements and developmental times of three phytoseiid species predaceous on spider mites. South western Entomologist. 10 (2): 83 – 88.
7. Gotoh, T., M. Nozawa and K. Yamaguchi. 2004. Prey consumption and functional response of three acarophagous species to eggs of the two-spotted spider mite in the laboratory. App. Entomol. And Zoology, 39 (1): 97 – 105.
8. Ma, W. L. and J. E. Laing. 1973. Biology, potential of increase and prey consumption of *Amblyseius chilenensis* (Dosse) [Acarina: Phytoseiidae]. Entomophaga 18: 47 – 60.
9. McMurtry, J. A. and B.A. Croft. 1997. Life styles of phytoseiid mites and their roles in biological control. Annu. Rev. Entomol. 42: 291 – 321.
10. McMurtry, J. A and J. G. Rodriguez. 1987. Nutritional ecology of phytoseiid mites, pp.609-644. In F. Slansky, Jr. and J. G. Rodriguez [eds], Nutritional ecology of insects, mites, spiders and related invertebrates. John Wiley, New York.
11. Palevsky, E. 1997. Development of a program for integrated management of the European red mite, *Panonychus ulmi,* for the main apple cultivars in Israel. Environ. Entomol. 27 (1): 148 – 153.

12. Sabelis, M. W. and P. C. G. Van Rijn. 1997. Predation by insects and mites. In: Lewis T. (ed.), Thrips as Crop Pests. CAB International, Wallingford, pp. 259 – 354.
13. Takano-Lee, M. and M. Hoddle. 2002. Predatory behaviors of *Neoseiulus californicus* and *Galendromus helveolus* (Acari: Phytoseiidae) attacking *Oligonychus perseae* (Acari: Tetranychidae). Exp. Appl. Acarol. 26: 13 – 26.
14. Vilajeliu, M. and A. Vilarnau. 1992. Feasibility of summer releases of beneficial mites of the family Phytoseiidae to promote biological control of European red mite *Panonychus ulmi* (Koch) in commercial apple orchards in Girona, Spain. Boletin de Sanidad Vegetal, Plagas. 18 (1): 123 – 132.
15. Villaronga, P. and M. E. Garcia. 1988. The tetranychid mites and their natural enemies of hazelnut cultivation in Catalonia. Boletin de Sanidad Vegetal, Palgas. 14(1): 39 – 44.
16. Zaher, M. A . 1989. Mites of Egypt and their role in agriculture.1st Conf. of Econ. Ent., Egypt, 3: 48-82.

الكفاءة الإفتراسية لأطوار المفترس الأكاروسى نيوسيولس كاليفورنيكس *NEOSEIULUS CALIFORNICUS* (MCGREGOR) عند تغذيته على أطوار العنكبوت الأحمرذى البقعتين والاكاروس الأحمر الأوربي *Tetranychus urticae* Koch and *Panonychus ulmi* (Koch)(ACARI:PHTOSEIIDAE&TETRANYCHIDAE)

إبراهيم حسن هيكل[١] ، مصطفى حلمي موافي[٢]، أحمد عبد الحميد إبراهيم[١]

١.معهد بحوث وقاية النبات – مركز البحوث الزراعية – جيزة

٢.قسم الحيوان الزراعي والنيماتودا – كلية الزراعة – جامعة الأزهر

أجريت دراسة معملية لتقييم ا لكفاءة الإفتراسية لأطوارالمفترس الأكاروسى *californicus* (McGregor) *Neoseiulus* عند تغذيته على الأطوار المختلفة لكل من العنكبوت الأحمر ذى البقعتين Koch *Tetranychus urticae* و الأكاروس ألأحمر الأوربى *Panonychus ulmi* (Koch)وجد أن يرقة المفترس طور متغذي . كما وجد أن متوسط الإستهلاك اليومى من البيض واليرقات والحوريات الأولى والحوريات الثانية والأطوار الكاملة لـذكور وإناث العنكبوت الأحمر *T. urticae* بواسطة يرقات المفترس *N.californicus* كانت كالآتي : ١,١ و١,٢ و٠,٨ و٠,٥ و٠,٦ و٠,١ فرداً،على التوالي. وقد إزدادت تلك القيم بالتدريج في أطوار المفترس التالية لتصل في حالة إناث المفترس إلى:١٥,٤ و١٦,٩ و١٢,٦و٧,٢ و٩,٢ و٥,٣ فرداً من الفرائس السابقة ،على التوالي.

وقد تم لأفراد المفترس استهلاك أفراد أقل نسبيا من أطوار النوع *P. ulmi*.وقد كان متوسط استهلاك كل من البيض واليرقات والحوريات الأولى والحوريات الثانية وذكور وإناث *P. ulmi* بواسطة يرقات المفترس هو: ٠,٨ و٠,٩ و٠,٦و٠,٣ و ٠,٥ و ٠,٠٨ فرداً للأطوار السابقة، على التوالي. وأيضا فإن هذه القيم قد ازدادت بالتدريج في أطوار المفترس التالية لتصل عند تغذية أنثى المفترس إلى: ١١,٨ و١٣,٠ و٩,٧ و٥,٦ و٧,١ و٤,١ فرداً من أطوارالفريسة، على التوالي. ولذلك فإن إناث المفترس تغذت أكثر من الأطوار الأخرى. وكذلك فإن بيض ويرقات كل من النوعين *T. urticae* و *P. ulmi* يتم أكلها بشكل متكرر أكثر من الأطوار الأخرى.وتدل الدراسة السابقة على أن المفترس الأكاروسى. *N. californicus* يمكن أن يقوم بدور هام كأحد عوامل المكافحة الحيوية للعنكبوت الأحمر ذى البقعتين *T. urticae* و الأكاروس الأحمرالأوربى *P. ulmi*.