J. Plant Prot. and Path., Mansoura Univ., Vol. 5 (1): 151-157, 2014

EFFICIENCY OF THE PREDATORY MITE AGISTEMUS EXSERTUS GONZALEZ (ACARI: STIGMAEIDAE) AS BIOAGENT OF EPHESTIA CAUTELLA (WALKER) (LEPIDOPTERA : PYRALIDAE)

Halawa, A.M; Aiad, K.A and EL-Sebaey M M.
Plant Protection Research institute- Agriculture research center- Cairo- Dokki -Egypt.

ABSTRACT

The efficiency of Agistemus exsertus Gonzalez was studied on Ephestia cautella (Walker) eggs as the food source in laboratory at two temperatures 25 °C and 30°C. Although a predatory successfully completed its life cycle exclusively on this prey, the rate of predation, life cycle, and oviposition were varied under different temperatures, whereas the predation rate listed 48 egg/individual and 57.71 egg / individuals at 25 °C and 30 °C, respectively, while the life cycle period was durated 16.05 days and 11.93 days, respectively. At the same previous conditions, the oviposition rate was durated 2.28 egg/day and 3.11 egg/day, respectively. Therefore, the predatory mite could play an important role in checking the population of Lepidopteran pest.
Keywords: Biological control, Laboratory ,Stigmaeid mites, Egypt, Date palm

INTRODUCTION

Date palm trees are attacked by many insect and mite pests that cause significant losses to dates yield both quantitatively and qualitatively in the field and storage houses (Bodenheimer, 1923; Martin,1958; El-Haidari, 1981; Ben-Dov, 1985; Hammad and Kadous, 1989 and Aly and Elwan, 1995).The fig moth, E. cautella, is a serious pest of stored food products, especially of dates in the field and in storage.Due to its close association with human foods,control methods other than chemical pesticides are needed.Biological control can play an important role in controlling E. cautella, especially since it is well known now that the insect and mite pests are developing resistance to pesticides(Campos&Omoto, 2002; Cranham & Helle, 1985).

The stigmaeid mites of the genus Agistemus has gained a great economic importance as a biocontrol agent and can successfully be used in the integrated pest management programs (IPM) to control phytophagous mites and small soft bodied insects.Therefore,z these predatory mites could be used as an alternative to the miticides (Raza, 2008).

The phytoseiid mites Neoseiulus barkeri (Hughes),Typhlodromus balanites El-Badry and Amblyseius zaheri Yousef & El-Brolossy were failed to develop to adulthood when reared on E. kuehniella eggs as food source,while the stigmaeid mite Agistemus exsertus Gonzalez was successfully completed its life cycle at the same temperature degrees 30°C and 25°C. Moreover,the predator mite

A. exsertus can be successfully mass-reared at 30°c and 25°c on the E. kuehniella eggs (Momen and El-Laithy,2007 and Romeih *et al.* 2002).

The above mentioned studies depicted that stigmaeid mite A. exsertus could be used as an important biological factor in (IPM) programs. Therefore, the present study was conducted to determine the effectiveness of predatory mite A. exsertus on E. cautella eggs as new prey under 30°C and 25°C and R.H 59± 11 %.

MATERIALS AND METHODS

Individuals of the predatory mite, A. exsertus were collected from weeds under eggplant farm located at Tonamel village, Dakahlia governorate in july, 2013. Individuals of the stigmaeid mite (male and female) were kept together for laying eggs on castor oil plant leaves (Ricinus communis) infested with two-spotted spider mite under laboratory conditions. Eggs were singly transferred onto *small 4 cm-diameter discs of castor leaves (Van Driesche et al.,* 2006). The leaf discs were placed on cotton pads in 9 cm-Petri dishes with the lower surface upward and surrounded by a wick of cotton. Suitable moisture was daily maintained to the cotton layer. The water level in the bottom of the dishes was checked and maintained frequently such that the disc just barely floated on the cotton/water to restrict mite movement (Adango et al., 2006). Leaf discs were replaced twice weekly to maintain the freshness of leaves. The predator effectiveness was tested under laboratory conditions at different temperatures (25°C ±2 & 30°C ±2) and relative humidity (RH 59% ± 11). Eggs were left in incubators to hatch and the incubation period was recorded. Eggs of E. cautella were introduced as prey for the predatory mite, A. exsertus Gonzalez. During life span of the predatory mite, the consumed prey eggs were replaced daily by new ones. Fifteen replicates were used for each experiment. Observations on the development, food consumption and reproduction were recorded twice a day. Individuals that escaped from leaf discs were not included in the analysis. Recorded data was statistically analyzed by F-test in SAS (SAS 2003) to compare developmental times; longevity; food consumption rate and oviposition rate between the two temperature degrees.

Data on duration of the immature stages, the preoviposition, oviposition, and postoviposition periods, food consumption and longevity were analyzed using One Way ANOVA. When statistical differences were detected due to the Treatments effect, means were compared using Duncan's test ($P<0.05$) (SAS Institute, 2003).

RESULTS

A.exsertus had five developmental stages:egg,larva, protonymph, deutonymph and adult with every active immature stage followed by a quiescent one.

The predator was able to develop (from larva to adult stage) and lay eggs, when fed on eggs of E.cautella at two temperature degrees (25°C & 30°C)and relative humidity(59% ± 11).Data in Table 1 shows that the duration of life cycle (in days)was shorter (11.93 days)at 30°C as compared to the duration of life cycle at 25°C which recorded 16.05 days with high significant differences ($F_{(1,15)}$, 0.05 = 37.55).The larval stage was the shortest among immature stages (2.75 days)at 25°C while the protonymphal stage was the shortest at 30°C (2.14 days).

Table (1): Duration of the developmental stages of the predatory mite A. exsertus when fed on E. cautella eggs at 25°C & 30°C and RH 59% ± 11

Stages	Mean ± SE 25°C	Mean ± SE at 30°C	F- value
Incubation period	5.1±0.36	3.28±0.18	15.25 *
Moving larva	2.75±0.08	2.28±0.1	12.64*
Quiescent larva	0.8±0.08	0.57±0.07	3.96
Moving Proto nymph	2.9±0.16	2.14±0.17	9.42*
Quiescent proto nymph	0.75±0.08	0.57±0.07	2.35
Moving deuto -nymph	3.1±0.14	2.4±0.25	6.03*
Quiescent deuto- nymph	0.65±0.07	0.64±0.09	0.00
Total immature	10.9±0.25	8.64±0.26	38.31*
Life cycle	16.05±0.5	11.93±0.33	37.55*
$F_{(1,15)}$ - Tabulated	4.54 at level 5%		

*** = in horizontal rows denote significant difference**
(F, P<0.05)

In contrast, data in Table 2 shows that the adult stage was the longest, 16.15 days and 14.35 days at 25°C & 30°C, respectively Within the adult stages the oviposition period was 12.5 days and 11.42 days at 25°C & 30°C, respectively and no significant differences recorded between temperatures ($F_{(1,15)}$, 0.05 = 0.33) while the shortest periods were recorded in post-oviposition and pre-oviposition, they takes 1.7 day and 1.35 day at 25°C & 30°C, respectively Life history parameters revealed that the highest mean total fecundity was achieved at 30°C (34 egg/ female with daily rate 3.11 egg / female / day) while at 25°C was 31.1 egg / female with daily rate 2.68 egg / female / day.

Table (2): Effect of E. cautella eggs as food on longevity and fecundity of the predatory mite A. exsertus at 25°C & 30°C and RH 59% ± 11

Stages	Mean ± SE at 25°C	Mean ± SE at 30°C	F – value
Pre-oviposition period	1.95±0.2	1.35±0.17	4.27
Generation period	18±0.42	13.14±0.45	58.62*
Oviposition period	12.5±1.31	11.42±1.22	0.33
Post-oviposition period	1.7±0.16	1.50±0.15	0.69
Longevity	16.15±1.37	14.35±1.2	0.86
Life span	31.2±1.47	26.28±1.06	6.09*
Fecundity	31.1±1.12	34.0±1.82	2.04
Egg deposited/ female/day	2.68±0.22	3.11±0.25	1.60
$F_{(1,15)}$,-Tabulated	4.54 at 5% level		

*** = in horizontal rows denote significant difference**
(F-test, P<0.05)

The Predation rates varied with a biotic and biotic factors namely, temperature degree and predator stages. Data in table, 3 indicated that the number of prey consumed in total increased with temperature. The total number of prey eggs consumed by motile stages of A exsertus were 48 egg/individual and 57.71 eggs/ individual with high significant differences at 25°C & 30°C, respectively ($F_{(1,15)}$, 0.05 = 45.74).

The highest predation rate was recorded for the adult stage during oviposition period, ranging 22.71 egg/individual and 17.3 egg/individual at 30°C & 25°C respectively and the statistical analysis in table 3 recorded significant differences between number of prey consumed by adult stage ($F_{(1,15)}$, 0.05 = 21.68).

On the other hand the lowest predation rate was recorded by the larva stage (2.2 and 2.43 egg / individual) at 25°C & 30°C, respectively

Table (3): Food comsumption on (Eggs of E. cautella) by different tages of predatory mite A. exsertus at 25°C & 30°C and RH 59% ± 11

Stages	Mean ± SE at 25°C	Mean ± SE at 30°C	F-value
Larvae	2.2±0.2	2.43±0.29	0.44
Protonymph	3.5±0.26	5.86±0.5	18.77*
Deutonymph	7.9±0.65	7.86±0.7	0.00
Immature	13.6±0.7	16.14±0.45	7.50*
Pre-oviposition	10.2±0.46	11.14±0.5	1.80
Oviposition	17.3±0.39	22.71±1.28	21.68*
Post-oviposition	8±0.51	8±0.57	0
Longevity	34.4±1.05	41.57±0.99	22.35*
Total	48±0.98	57.71±0.96	45.74*
$F_{(1,15)}$ – tabulated	2.13 at 5% level		

*** = in horizontal rows denote significant difference**
(F-test, P<0.05)

DISCUSSION

In some previous studies, special attention was paid to the effectiveness of A. exsertus as predator on E. kuehniella eggs (Momen, 2001). In our study, the efficiency of A. exsertus was studied on eggs of E. cautella for the first time where the predator successfully completed its life cycle on E. cautella eggs as food source under two temperatures (25°C & 30 °C).

The predator efficiency were measured through three parameters namely, rate of predation, oviposition and life cycle at the previous mentioned temperature where the recorded results denoted that the rate of predation and oviposition were higher at 30°C than 25°C, while the life cycle was shorter duration at 30°C, than 25°C and consequently the generation time was lower at 30°C than at 25°C. Therefore, the predator may be able give a high number of generations at 30°C.

The laboratory observations showed that the predator larvae were observed feeding on E. cautella. This agrees with the observations reported for A. exsertus on Agrotis ypsilon, Spodoptera littoralis, Phthorimaea operculella and E. kuehniella eggs (Momen and El- Sawi, 2007). On the contrary, Khodayari et al. (2008) found that the larvae of Zetzellia mali Scheuten from the same family (Stigmaeidae) cannot feed on Panonychus. ulmi eggs and cannot develop into protonymphs but all mobile developmental stages of Z. mali fed on T. urticae eggs. These results can be compared with the findings of McMurtry et al. 1970 who reported that the larva feeding depends on the species studied while the (larval stage not appeared feeding in some phytoseiid species.

In the present study, detailed observations reported the cannibalism phenomenon when we observed the larva cannot distinguish between the E. cautella eggs and eggs of its own species, and therefore it devoured both of them during three cases in daily examination. Similar results of cannibalism were reported (MacRae and Croft, 1993) for Metaseiulus occidentalis, Typhlodromus pyri, and Z. mali (MacRae and Croft, 1993; MacRae, 1994). Several authors reported similar response of predatory species to temperature and relative humidities (Romeih et al., 2004) who reported that the predatory mite A. exsertus completed its life cycle on Corcyra cephalonica and E.kuehniella eggs as food source at two tested temperatures (25°C and 30°C) but its fitness on E. kuehniella eggs was higher at 30°C while Amblyseius californicus failed to feed on C. cephalonica eggs at the two tested temperatures (25 °C and 30 °C) and could not complete its life cycle. Similarly, Gihan and Halawa (2007) found that A. exsertus successfully completed its life cycle when fed on Tetranychus urticae Koch eggs, the purple scale insect, Lepidosaphes becki (Newm.) eggs and pollen grains of the date palm at 28°C, and they reported that the longest developmental time and decrease in reproduction was recorded when fed on date palm pollens. Similar results were obtained by Momen (2001) who noticed that development was faster and reproduction was higher when A. exsertus fed on eggs of E. kuehniella at 30 °C.

This study showed that A. exsertus can be used an effective biological control agent because it can survive on several alternative foods when its preferred prey is not present. Our findings also show that E. cautella can be effectively controlled by the stigmaeid predators such as A. exsertus.

REFERENCES

Adango E. A.; A. Onzo.; R. Hanna.; P. Atachi.; and B. James (2006).Comparative demography of the spider mite, Tetranychus ludeni,on two host plants in West Africa. Journal of Insect Sciences . (6): 1-9.

Aly A.G. and A. Elwan. (1995) Survey of insect pests and mites infesting palm trees in Oman Sultanate. Egypt Journal Applied Sciences., 10(4) 261-264.

Ben-Dov Y. (1985) Further observations on scale insects (Homoptera :Coccoidea) of the Middle East Phytoparasitica, (13):85-192.

Bodenheimer F.S. (1923) Observations about some scale insects from El-Arish (Sinai) and Transjordania. Bulletin de la Société Entomologique d'Egypte (16): 121-124.

Campos, F.J. & C. Omoto. 2002. Resistence to hexythiazox in Brevipalpus phoenicis (Acari: Tenuipalpidae) from Brazilian citrus. Experimental and Applied Acarology. (26): 243-251.

Cranham J.E.; W. Helle (1985) Pesticide resistance in Tetranychidae. In: Helle W. and Sabelis MW, editors. Spider mites: their biology, natural enemies and control, (1B): 405–421. Elsevier pp.

El- Haidari, H.S. (1981) New records of mites and insets infesting date palms in the Near East and North Africa. Date palm Journal 1(1):133-136.

Gihan M.E. and A.M. Halawa (2007). Effectof prey type on the biological aspects of the predatory mite.Agistemus exsertus. Journal of Agriculture science. V.(32) : 623-629.

Hamad S. M. and A. A. Kadous (1989).Studies on the biology ecology of date palm pests in the Eastern province, Kingdom of Saudi Arabia. King Abdul-Aziz city for science and Tecnology.

Khodayari S.; K. Kamali and Y Fathipour.(2008). Biology, life table, and predation of Zetzellia mali (Acari:Stigmaeidae) on Tetranychus urticae (Acari: Tetranychidae Acarina (16):191-196.

MacRae I.V. (1994) Interspecific predation and cannibalism of immatures by adult female Metaseiulus occidentalis, Typhlodromus pyri (Acari: Phytoseiidae) and Zetzellia mali Scheuten (Acari: Stigmaeidae).Ph.D. dissertation, Oregon State University, Corvallis, USA.

MacRae I.V. & B.A. Croft. (1993) Influence of temperature on interspecific predation and cannibalism by Metaseiulus occidentalis and Typhlodromus pyri (Acarina: Phytoseiidae). Environment. Entomology. (22):770-775.

Martin H. (1958) Pests and diseases of date palm in Libya. FAO Plant Protection. Bulletin , (6):120-123.

McMurty J.A.; C.B. Huffaker and M Van De Varie.(1970).Ecology of tetranychid mites and their natural enemies: Areview1. Tetranychid enemies: Their biological characters and the impact of spray practices. Hilgardia (40):331-390.

Momen F.M. (2001) Effects of diet on the biology and life tables of the predacious mite Agistemus exsertus (Acari: Stigmaeidae). Acta Phytopathologica et Entomologica Hungarica (36):1-2.

Momen F. M. & A. Y. El-Laithy (2007) Suitability of the flour moth Ephestia kuehniella (Lepidoptera:Pyralidae) for three predatory phytoseiid mites (Acari: Phytoseiidae) in Egypt International Journal of Tropical Insect Science (27):102-107.

Momen F.M and S.A El- Sawi.(2007) Agistemus exsertus (Acari: Stigmaeidae) predation on insects: life history and feeding habits on three different insect eggs (Lepidoptera: Noctuidae and Gelechiidae). Acarologia. V.: (46) Issue: (3-4): 203-209 pp.

Raza A. M. (2008).Biodiversityof Amblyseius berlese and Neoseiulus Hughes (ACARINA: PHYTOSEIIDAE) of Punjap-Pakistan. PhD thesis, University of Agriculture, Faisalabad 198pp.

Romeih A. H. M. (2002) Biological, morphological genetic studies on some predaceous mites and their prey .Ph.D. Thesis. Faculty of Agriculture., Cairo University .208pp.

Romeih A. H.;. E. M. A. El-Saidy, and S.A.El Arnaouty.(2004) Suitability of Ephestia kuehneilla and Corycera cephalonica Eggs as Alternative Preys for Rearing Predatory mites. Egyptian Journal of Biological Pest Control; (14); 101-105. SAS (2003). The SAS System for Windows, Version 9.1. SAS Institute Inc.

Van Drieche R.G.; S. Lyonand and C. Nunn (2006) Compatibility of spinosad with predacious mite (Acari:phytoseiidae) used to control western flower thrips (Thysanoptera: Thripidae) in greenhouse crops Florida Entomologist 89(3):396- 401.

كفاءة المفترس الاكاروسى Agistemus exsertus Gonzalez كاحد عوامل المكافحة الحيوية على حشرة(Ephestia cautella (walker

علاء محمد حلاوه و خالد عبدالعزيز عياد و ممدوح محمد السباعى
معهد بحوث وقاية النباتات – مركز البحوث الزراعية

تمت دراسة كفاءة المفترس الاكاروسى A. exsertus على بيض حشرة E. cautella فى المعمل على درجتين حرارة 25 م° و 30 م° ورطوبة نسبية 59±11 وقد اوضحت النتائج نجاح المفترس الاكاروسى فى إتمام دورة حياته كما اوضحت الدراسة ان معدل الافتراس ودورة الحياة والخصوبة تاثرت تاثيرا مباشرا بدرجة الحرارة حيث كانت 57,53 بيضة و 16 يوم و 31,1 ± 1,129 بيضة على درجة 25 م° بينما سجلت 59,14 ± 1,162 بيضة و 11,78 ± 0,378 يوم و 34 ± 1,829 بيضة على درجة 30 م° على التوالى ويتضح من هذه الدراسة ان حشرة E. cautella فريسة جديدة لهذا النوع من المفترسات فى مصر .

قام بتحكيم البحث

أ.د/ عمرعبد الحميد نصار	**كلية الزراعة - جامعة المنصورة**
أ.د/ مراد حسن فهمى	**كلية الزراعة - جامعة القاهره**