Egyptian Journal of Biological Pest Control, 21(1), 2011, 245-250

Survey of Predatory Arthropods in Cotton Fields, with Special Reference to Effect of Hexalumuon on Certain Biological Aspects of the Spider Species, *Thanatus Albini* (Audouin) (Araneida: Philodromidae)

Ali M. Matar and Mervat A. A. Kandel
Plant Protection Research Institute, Agricultural Research Center, Giza, Egypt
(Received: October 12, 2011and Accepted: December 3, 2011)

ABSTRACT

A survey of spider and insect predators found in cotton fields at Qaluobia and Beni-Suif Governorates, Egypt was conducted from May through September 2009. The survey revealed the presence of 15 spider species belong to 14 genera and 8 families and insect predators belong to 8 species, 7 genera and 5 families. The spider species, *Thanatus albini* (Audouin) (Araneida: Philodromidae) was the most dominant species in both experimental locations. The insecticide Hexaflumuron, which is recommended against lepidopterous pests in cotton fields, was tested under the laboratory conditions (25±1°C and 65-70 % R.H) against egg-sacs of *T. albini,* using the LC_{50} (1.83 ppm). The spider had 7 spider ling stages, when fed on the 1st instar larvae of the pink bollworm, *Pectinophora gossypiella* (Saund.). Their durations lasted 156.16 and 98.3 days in treated and untreated females, respectively. Respective figures for males were 138.0 and 87.5 days. The life cycle of females, resulted from treated and untreated egg-sacs was 174.76 and 110.63 days, respectively, while they were 156.60 and 99.83 days for males. Some biological aspects of the spider, *i.e.,* food consumption, ovipositional periods, fecundity and longevity were also studied.

Key words: Survey, Predators, Cotton, *Hexalumuon,* Biological Aspects, Spiders, *Thanatus Albini* (Audouin).

INTRODUCTION

Extensive use of chemical pesticides for pest control resulted in some problems such as; pollution, increasing pests' resistance and destroying natural balance. The predacious insects and spiders mostly feed on wide range of insects and mites (Tawfik *et al.,* 1976 and El-Husseini *et al.,* 2000). Numerous studies were directed to survey, identification, populations and seasonal abundance of the predatory arthropods associated with the pests in cotton fields (Awadallah *et al.,* 1965 and Mohafez, 2004). Spiders are considered among the important biological control agents of arthropod pests infesting different crops and in soil (El-Erksousy, 2002; El-Erksousy *et al.,* 2002; Fawzy and El-Erksousy, 2003; Jones *et al.* 2007 and Sallam *et al.,* 2010).

The pink bollworm (PBW) *Pectinophora gossypiella* (Saunders) is an important cotton pest that causes serious losses to cotton crop due to the attack of fruitions parts. Newly hatched larvae enter fruiting parts within 30 minutes. After about 14 days the full grown larvae escape from the bolls through exit halls, drop in the ground and pupate in the leaf trash of the cotton plants. Few studies threw light on the association of the spiders with bollworms in cotton fields (El-Sayed *et al.,* 2010 and Abo-Zaid *et al.,* 2011).

The present work aims to survey the predatory arthropod complex in two Egyptian Governorates, planted with cotton, in addition to conduct laboratory studies on some biological aspect of the spider species, *Thanatus albini* when was treated by the estimated LC50 of Hexaflumuron.

MATERIALS AND METHODS

Field experiments

Field experiments were conducted at Qaluobia and Beni-Suief Governorates, Egypt during 2009 cotton growing season. The experimental area (approx. ½ fed. = ½ Acre) in each Governorate was cultivated with the Egyptian cotton *Gossypium barbadens* L., varieties Giza 85 & Giza 80, respectively, sown on March 1st. The chosen cotton area in the two locations was kept free of any insecticidal applications. Insect predators and spiders were collected weekly using sweeping-net, started from 1st May until 30th September. 100 double net-strokes/area were practiced for counting the main predators in experimented cotton fields. Collected predators were transferred to the laboratory in paper bags for counting and identification. The collected spiders were identified by the specialists in Plant Protection Research Institute, Agricultural Research Center, Giza, Egypt according to Kaston (1978).

Laboratory studies

Insecticide used

Hexaflumuron 10% (benzoylphenylurea chitin synthesis inhibitors). 1-[3, 5-dichloro-4-(1, 1, 2, 2-tetrafluoroethoxy) phenyl]-3-(2, 6-difluorobenzoyl) urea. Trade name: Consult.

Hexaflumuron was diluted by water in a series of concentrations (6.25, 3.12, 1.56, 0.78, 0.375 and 0.187 ppm).

Rearing of insect prey

A stock culture of PBW, *P. gossypiella* was

maintained in the laboratory on modified artificial diet described by Rashad and Ammar (1985) for at least 10 generations away from any treatments under constant conditions of 25±1C° and 65-75% R.H. Newly hatched larvae of PBW were used as prey for the spider.

Rearing of predatory spider

Thanatus albini was collected from the cotton fields at Qaluobia and Beni-Suif Governments. Adult females & males were confined in couples in translucent plastic containers (3 cm in diameter and 15 cm in length) until females laid their egg-sacs. The eggs were observed daily until hatching took place. The newly hatched spider lings were reared for one generation on neonate larvae of PBW before beginning the laboratory studies.

Latent effect of LC_{50} of Hexaflumuron on biological parameters of *T. albini*

A pilot study to determine the LC_{50} of Hexaflumuron 10% against egg- sacs and the subsequent progeny of *T. albini* was conducted Aqueous dilutions were freshly prepared. The egg-sacs were dipped in the prepared concentrations (6.25, 3.12, 1.56, 0.78, 0.375 and 0.187 ppm) for about 10 secondes and then held in open air for 2-3 hours for drying. Three replicates were tested per concentration; each replicate contained 3 egg-sacs. In addition, three replicates were dipped in water and used as control. The treated and the untreated egg-sacs were kept at the same controlled conditions of rearing. Percentages of hatchability/concentration were estimated. Calculated LC50 using Proban software was found to be 1.83 ppm with lower and upper limits of 0.301 & 7.529 ppm.

Three egg-sacs of *T. albini,* treated with LC_{50} of Hexaflumuron 10% (1.83 ppm) and three untreated egg-sacs, were kept single, in glass tubes (10 x 3.5cm) plugged with pieces of cotton until hatching. Newly hatched spider lings were transferred to glass tubes (7x3 cm) and fed on the newly hatched PBW larvae until reaching adult stage. The newly emerged adult females and males were confined in couples in glass tubes (15cm x 2.5cm), plugged with cotton (one couple/ tube). 15 pairs (representing 3 replicates) were used. In addition, 5 pairs of adults resulted from untreated egg-sacs were used as control. The adults were fed on the same prey. The life cycle of the spider, food consumption, ovipositional periods, longevity and fecundity for both treated and untreated replicates were recorded.

Statistical analysis

Statistical analyses were carried out using one way analysis of variance (ANOVA) and (L.S.D) determined according to Duncan (1955).

RESULTS AND DISCUSSION

Field Studies

Survey of the spider species in cotton fields at the two locations revealed the occurrence of 15 species belong to 14 genera, 8 families; *Hyposinga* sp. *Singa* sp. *Cyclosa insulana; Pterotyna* sp., *Zelotes* sp., *Bathyphantes* sp., *Gonathanarium* sp., *Hogna ferox, Pardesa* sp., *Cheiracanthium* sp., *Cheiracanthium inclusum, Philodromus* sp., *Thanatus albini, Theridion* sp. and *Thomisus* sp. (Table 1). Surveyed predatory insects were 8 species, belong to 5 families; *Coccinella undecimpunctata* L., *Hippodmia 13-punctta, Scymnus interuptus* L., *Paederus alfierii* Koch. *Chrysoperla carnea* Steph., *Orius* sp. and *Syrphus* sp.

Total population density of these predators increased gradually throughout the season, reaching maximum numbers pre-harvest in both experimental sites. In particular, *T. albini* (Audouin) (Araneida: Philodromidae) was the most dominant spider species in the two locations; Qaloubia and Beni-Suif Governorates during the experimental period.

Predators' Population

Data presented in table (2) show the population numbers of the spiders, predatory insects and their families on untreated cotton plants in the two experimental locations. The average number of spiders' population increased monthly from May until September at Qaluobia (25-57 individuals/100 double net strokes), while at Beni-Suif, it fluctuated from (17 to 56 individual/100 double net strokes) in May to August and then decreased to 48 individual in September. Number of families recorded ranged between 5 to 8 families from May to September in the two Governorates. On the other hand, the average number of predatory insects was very low in May (9 and 16 individuals/100 double net strokes) in the two locations and then increased gradually to reach 50 and 56 individuals/ 100 double net strokes in September at Qaluobia and Beni-Suif, respectively. The number of families ranged from 3 to 5 families from May to September in the two locations.

Laboratory Studies

Incubation Period of Egg-sacs

Effect of the estimated LC_{50} (1.83 ppm) of Hexaflumuron compound on incubation period of *T. albini* eggs was presented in table (3). The incubation period averaged between 18.6 and 12.33 days for treated and untreated eggs, respectively. These data indicated that the incubation period in treated egg-sacs was 1.5 times that of untreated ones.

Duration of the Spider ling

The spider ling (7^{th} instar) lasted 156.16 days (in

Table (1): Predatory insects and spiders collected from untreated cotton fields in Qaluobia and Beni–Suif Governorates in 2009 cotton season

Spiders		Insect predators	
Family (common name)	Species	Family (common name)	Species
Arneidae (Scorpions)	*Hyposinga* sp. *Singa* sp. *Cyclosa insulana*	Coccinellidae (lady bird beetles)	*Coccinella undecimpunctata L.* *Hippodmia 13- punctta* *Scymnus interuptus*
Gnaphosidae (Ground spider)	*Pterotyna* sp. *Zelotes* sp.	Staphylinidae	*Paederus alfierii*
Linyphiidae (sheet-web spider)	*Bathyphantes* sp. *Gonathanarium* sp.	Chrysopidae (Lace wings)	*Chrysoperla carnea* (Stephens)
Lycosidae (wolf spider)	*Hogna ferox* (locas) *Pardesa* sp.	Anthocoridae (flower bug)	*Orius* spp.
Miturigidae (long-legged sac spider)	*Cheiracanthium* sp. *Cheiracanthium inclusum*	Syrphidae (Hover flies)	*Syrphus* spp.
Philodromidae (crab spider)	*Philodromus* sp. *Thanatus albini*		
Theridiiae (comb-footed spider)	*Theridion* sp.		
Thomisidae (crab spider)	*Thomisus* sp.		

Table (2): Total and average numbers of predatory insects and spiders and their families collected from untreated cotton fields in Qaluobia and Beni-Suif in 2009 cotton season

Month	Week	Qaluobia				Beni-Suif			
		Spiders		Insect predators		Spiders		Insect predators	
		No. of predators	No. of families	No. of predators	No. of families	no. of predators	No. of families	No. of predators	No. of families
May	1st	13	5	7	3	8	5	10	5
	2nd	28		6		19		16	
	3rd	23		3		20		13	
	4th	36		20		21		25	
Total		100		36		68		64	
Average		25	5	9	3	17	5	16	5
June	1st	42	7	35	3	28	7	30	5
	2nd	33		27		34		44	
	3rd	30		21		22		30	
	4th	25		25		13		32	
Total		130		108		96		136	
Average		32.5	7	27	3	24	7	34	5
July	1st	19	6	51	5	26	6	20	4
	2nd	22		56		29		33	
	3rd	33		49		35		26	
	4th	29		36		34		29	
Total		103		192		124		108	
Average		25.75	6	48	5	31	6	27	4
August	1st	34	6	50	5	44	8	59	5
	2nd	30		41		57		69	
	3rd	45		37		56		62	
	4th	43		20		67		70	
Total		152	6	148		224		260	
Average		38	6	37		56		65	5
September	1st	49	7	39	5	39	8	58	5
	2nd	58		48		46		46	
	3rd	67		53		49		53	
	4th	54		60		58		67	
Total		228		200		192		224	
Average		57	7	50	5	48	8	56	5

Table (3): Durations of spider ling instars of *T. albini* resulted from egg-sacs untreated and treated with LC_{50} Hexaflumuron at 25±1°C and 60-70% R.H and fed on 1st instar larvae of *P. gossypiella*

Immature instars	LC_{50}	Duration in days ± S.E. ♀ Treated	♀ Untreated	LSD	P.	♂ Treated	♂ Untreated	LSD	P.
Incubation period of egg-sac		18.6±0.8	12.33±1.4			18.6 ±0.8	12.33±1.4		
Spider lings 1st		16.0±0.6	10.7±0.3	2.069	**	13.0±1.1[a]	9.6±0.5[b]	2.926	**
2nd		15.6±0.6[a]	8.3±0.3[b]	5.705	*	12.7±0.5[a]	6.6±0.8[b]	3.069	**
3rd		19.6±0.33[a]	13.7±0.8[b]	2.069	***	17.7±0.5[a]	11.7±0.6[b]	2.617	**
4th	1.83	28.3±1.7[a]	20.0±0.6[b]	1.850	***	25.3±0.7[a]	19.3±0.7[b]	1.308	***
5th	ppm	36.7±1.6[a]	23.0±1.1[b]	5.396	**	31.6±2.7[a]	20.3±0.3[b]	4.719	**
6th		20.3±0.89[a]	11.3±0.8[b]	1.308	***	20.0±1.1[a]	10.7±0.3[b]	2.926	***
7th		19.66±0.3[a]	10.3±0.3[b]	1.48	***	17.7±0.9[a]	9.3±0.5[b]	2.617	**
Total immature stages		156.16±2.9[a]	98.3±2.2[b]	10.95	***	138.0±47[a]	87.5±3.1[b]	9.924	**
Life cycle		174.76±4.82a	110.63±3.89b	7.261	**	156.6±5.4[a]	99.83±3.1[b]	5.983	**

*Different letters in the same row indicate significant differences at P≤ 0.05

Table (4): Food consumption of *T. albini* resulted from egg-sacs untreated and treated with LC_{50} of Hexaflumuron and untreated when reared on *P. gossypiella* at 25±1°C and 60-70% R.H.

Immature instars spiderling)	LC_{50} (ppm)	Food consumption Prey/ spider ling/day ♀♀ Treated	♀♀ Untreated	P	LSD	Food consumption Prey/ spider ling/day ♂♂ Treated	♂♂ Untreated	P	LSD
1st		5.3±1.1[b]	7.7±0.7[a]	*	1.97	3.3±0.1[a]	5.70±1.3[a]	ns	2.48
2nd		6.4±o.5[a]	8.6±0.6[a]	Ns	2.94	4.3±.3[b]	7.3±1.0[a]	**	1.009
3rd		8.6±1.3[b]	9.9±2.1[a]	*	2.17	4.8±0.2[b]	7.1±2.1[a]	**	1.152
4th	1.83	10.6±2.6[b]	11.5±1.3[a]	**	1.99	7.3±1.2[a]	8.2±0.9[a]	Ns	1.832
5th		18.3±1.8[b]	27.3±1.6[a]	*	3.532	11.7±0.9[b]	20.36±1.8[a]	***	2.41
6th		25.7±3.2[b]	30.3±1.4[a]	**	3.83	16.9±1.1[b]	26.76±1.4[a]	***	3.87
7th		35.6±4.3[b]	49.0±1.9[a]	**	9.67	20.63±2.1[b]	36.43±0.7[a]	**	4.55
Total consumed		110.5±10.6[b]	144.3±15.5[a]	**	4.569	70.3±6.3[b]	111.83±10.1a	***	6.465

*Different letters in the same row indicate significant differences at P≤ 0.05.

Table (5): Ovipostional period, fecundity, longevity and food consumption of *T. albini* spider lings, resulted from treated and untreated egg-sacs and reared on newly hatched larvae of *P. gossypiella* at 25±1°C and 60-70% R.H.

	Pre ovipostional (days)	Ovipostional (days)	Post ovipostional (days)	Fecundity Total eggs inside sac	% hatchability	Longevity (days ±SE) ♀♀	♂♂	Food consumption prey/ spider/ 2 days ♀♀	♂♂
Treated	10.36±0.9	7.3±0.7	31.3±2.4	25.1±3.2[b]	60[b]	48.9±2.1	33±3.5	94.21±11.8	80.6±9.17[b]
Untreated	9.4 ±0.4	6.3±0.6	28.6±2.1	42.6±2.1[a]	87[a]	42.9±3.6	35.1±1.2	124.9±3.2	93.6±3.6[a]
LSD	1.89	3.631	5.705	8.0144	4.83	6.832	10.25	14.574	8.77
P	Ns	ns	Ns	0.034**	0.006**	Ns	ns	Ns	0.0053**

Different letters in the same row indicate significant differences at P ≤ 0.05.

female) and 138 days (in male) in case of treated egg-sacs (Table 3). Respective values in case of untreated ones were 98.3 and 87.5 days. It was obvious that treatment of egg-sacs prolonged significantly the duration of the spider ling. In addition, highly significant differences between females and males resulted from treated and untreated egg-sacs were found. El-Erksousy and Fawzy (2001) recorded that the life cycle of *T. albini,* when fed on the 3rd nymphal instar of the aphid species, *Schizaphis graminum* was 169.87±5.29 and 148.73±3.37 days, for female and male, respectively.

Feeding Capacity

Feeding capacity of *T. albini* spider ling instars resulted from treated and untreated egg-sacs, showed a highly significant difference, when fed on 1st instar larvae of PBW (Table 4). Average daily consumption of female spider ling instars were 5.3, 6.4, 8.6, 10.6, 18.3, 25.7, and 35.6 preys in treated eggs and 7.7, 8.6, 9.9, 11.5, 27.3, 30.3 and 49 prey in untreated ones. Respective values for males were 3.3, 4.3, 4.8, 7.3, 11.7, 16.9 and 20.63 preys and 5.7, 7.3, 7.1, 8.2, 20.36, 26.76 and 36.43 preys.

Ovipostional Period

Ovipositional periods and longevity of *T. albini* females resulted from treated egg-sacs with LC_{50} dose were slightly longer than those resulted from untreated eggs (Table 5). The pre-ovipositional, ovipositional, post- ovipositional periods were 10.36, 7.30 and 31.30 days, respectively, for females resulted from treated egg-sacs compared to 9.4, 6.23 and 28.6 days for females resulted from untreated egg-sacs.

Fecundity

In untreated replicates, the gravid females of *T. albini* deposited 2-3 egg-sacs during its ovipositional period, each sac contained 40-68 eggs, while, in treated replicates, the female deposited 1-2 egg-sacs, each sac contained 24-30 eggs (Table 5). El-Erksousy (2002) recorded that the adult female of *Anelosimus oulicus* laid its eggs in sacs, each contained 15to 20 eggs. In the present study, the average number of laid eggs/female and percentage of hatchability decreased in treated egg-sacs compared to untreated ones. The average was 25.1 eggs/treated compared to 42.6 eggs/ untreated. Ibrahim and Abdel-Rehman (2009) found that female of *Enoplognth avata* (Family; Philodromidae) reproduced 2-3 eggs-sacs and each contained from 55-60 eggs. However, Putman (1967) found that female of *Philodromus praelustris* reproduced up to 12 egg-sacs containing a total of over 299 eggs.

Adult longevity

Females and males resulted from treated egg-sacs lived for an average of 48.9 and 33.0 days, respectively, compared to 42.9 and 35.1 days in untreated ones (Table 5). Adult female and male consumed an average of 94.21 and 80.6 preys in tow days, respectively, compared to 124.9 and 93.6 preys in untreated. El-Erksousy and Fawzy (2001) recorded food consumption of males and females of *T. albini* as 1727.21 and 1899.0 individuals of the 3rd instar nymphs of the aphid, *Schizaphis graminum.*

REFERENCES

Abo-Zaid E. A.; A. M. Kalil and H. A. Azouz 2011. Feeding capacity of the spider *Anelsimus studiosus* (Arachnida: Theridiidaae) fed on different larvae of lepidopteraus pests (Gelechiidae and Noctuidae). J. Plant Prot. and Pathology, Mansoura Univ., 2(5): 543-548.

Awadallah, K. T.; M. F. S. Tawfik and I. I. Ismail 1965. Seasonal changes in the abundance of certain aphids and their predators in Giza. Bull. Soc. ent. Egypt, 44: 11-24.

Duncan, B. D. 1955. Multiple ranges and multiple F- test. Biometrics, 11-42.

El-Erksousy, M. H. 2002. Studies on some true spiders in Egypt. Ph. D. Thesis, Fac. Agric. Al-Azhar Univ., 123pp.

El-Erksousy, M. H. and M. M. H. Fawzy 2001. Biological studies on the true spider *Thanatus albini* (Audouin) (Family: Philodromide) on wheat aphid *Schizaphis graminum* (Rondani). Ann. Agric. Sci., Moshtohor, 39 (1) 645-649

El-Erksousy, M. H.; Amira, A. Shoeib, and H. F. Dahi 2002. Studies on biological control using the spider *Anelosimus oulicus* (Theridiidae). 2nd International Conference, Plant Protection Research Institute, Cairo, Egypt, 21-24 December.

El-Husseini, M. M.; E. A. Agamy and S. M. M. Sayed 2000. Migration of anthocorids from clover to cotton and its importance for stripe technique in traditional and organic cotton production. Egypt. J. Biol. Pest Cont. 10 (2): 75-79.

El-Sayed, A. A. A.; A. M. Khalil and E. A. Abo-Zaid 2010. Effect of prey on some biological aspect of the true spider *Thomisus spinifer* Camberidge. Egypt. J. of Appl. Sci., 25 (8B): 281-288

Fawzy, M. H. and M. H. El-Erksousy 2003. Biology of the spider, *Theridion egyptium* (Araneae: Thomisidae) fed on *Spodoptera littoralis* larvae. Egypt. J. Appl. Sci., 25 (8B): 281-288

Ibrahim, A. A. and I. S. Abd El-Rahman 2009. Laboratory study on the web-weaver solder, *Enopolognatha ovata* (Clareck 1957) (Araneida:

Theriidae) as a biological control agent. Agric. Sc., Moshtohor, 47 (2): 25-31.

Jones, J. C.; S. E. Riechert; S. E. Dalrymple and P. G. Parker 2007. Fostering model explains variation in levels of sociality in a spider system. Animal Behavior, 73: 195-204.

Kaston, B. J. 1978. How to know the spiders. Wc. Brown Co., Dubugues Iowa, USA, 272 pp.

Mohafez, M. A. M. 2004. Ecological and biological studies on spiders in Egypt. Ph. D. Thesis, Fac. of Agric., Al- Azhar Univ. 178pp.

Putman, W. L. 1967. Life histories and habits of two species of *Philidromus* (Araneida: Philodromidae) in Ontario. Can. Entomol., 99: 622-63.

Rashad, A. M. and E. D. Ammar 1985. Mass rearing of the spiny bollworm, *Earias insulana* on semi- artificial diet. Bull, Soc. ent. Egypt, 65: 239- 244.

Sallam, M. E. Gehan; Abdel-Azeim, Nahla and H. M. G. El-Kawas 2010. Biodiversity of spiders associated with cotton and maize in Sharkia governorate with special reference to the spider *Kochiura aulica* (Kooh). J. of Appl. Sci., 16(9): 267-276.

Tawfik, M. F. S.; S. I. El-Sherif and A. H. El-Heneidy 1976. Seasonal abundance of certain insect predators and parasites in Egyptian clover field in Giza region. Egypt. Bull. Soc. Ent. Egypt, 60: 335- 383.