

The Potential of Predatory Spiders as Biological Control Agents of Cotton Pests in Tehran Provinces of Iran



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Abstract : Spiders have a wide insect host range and thus can act as biological control agents of insect pests in agro-ecosystems. In the present study, spider fauna in the major Iranian cotton fields are being explored which are capable of controlling cotton pests. These were determined during the 2003-2004 cropping season. Effects of the spider on major cotton insect pests were studied under laboratory conditions (28 ± 2 C°, $65\pm 5\%$ RH and photoperiod of 12:12(L: D) hours). Five spider species (*Thanatus formicinus* (Clerck), *Oxyopes salticus* (Hentz), *Cheiracanthium erraticum* (Walckenaer), *Philodromus cespitum* (Walckenaer), *Thyene imperialis* (Rossi) were evaluated on four cotton pests (*Bemisia tabaci*, *Aphis gossypii*, *Empoasca decipiens* and *Nezara viridula*) and daily rate of feeding and host preference were recorded for sixty days. Results indicate the maximum predation in *T. imperialis* on key cotton pests in Tehran.

Key words : Spiders, Feeding, Host preference, Cotton, Predation, Tehran, Iran.

Introduction

Spiders are feed on insects and some other arthropods. They can play important roles in pest's control. 35000 species of spiders have been identified in the world and a total of 244 species of spiders are known in Iran (Ghavami, 2006a, 2007b). Most of investigations on spiders are in agricultural ecosystems in Iran. For instance, some researches were performed on spider fauna and abundance of rice fields (Ghavami, 2004), olive orchards (Ghavami, 2006d and Ghavami *et al.*, 2007d), Rose fields (Ghavami and Nematollahi, 2006c) citrus orchards (Ghavami, 2006 a, b) Ghavami and Ghanadamooz, 2008b and cotton fields (Ghavami, *et al.* 2007c and 2008a and Ghavami, 2007a).

To date, study about spider fauna, abundance, and quantity of feeding, host preference and their role in pest control in cotton fields in Iran is scare. Especially study on the host preference of spiders is accomplished for the first time in Iran.

However in many countries not very many studies have been carried out on this subject. Such as, predation effects of *Cheiracanthium inclusum* on the egg protein of *Helicoverpa zea* was studied in cotton fields of Georgia, USA, during the 1996 growing season. A modified ELISA was used to assay the predators. The winter spiders (*C. inclusum*) assayed, yielded the majority of positive responses (Ruberson *et al.* 1998). Predation of *Peucetia viridans* (Hentz), *C. inclusum* (Hentz), *Aysha gracilis* (Hentz) and *Neoscona arabesca* (Walck.), *Misumenops sp.*, *Tetragnatha laboriosa* Hentz and *Hentzia palmarum* (Hentz) on eggs and 1st-instar larvae of *Alabama argillacea* (Hb.) examined with labeled eggs and 1st-instar larvae with ^{32}P in a cotton field in eastern Texas in 1982 have been studied. *Misumenops sp.*, *T. laboriosa*, *A. gracilis*, *P. viridans*, and *C. inclusum* showed evidence of predation on the eggs and *P. viridans*, *C. inclusum*; *A. gracilis* and *N. arabesca* were predators of the 1st-instar larvae. The means

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for egg and small-larval predation after 48 h of exposure were 88.7 and 88.4%, respectively (Gravena & Cunha, 1991). A survey of the *C. mildei* L. Koch and *Achaearanea lunata* (C1.) (*Theridion lunatum*) preying on *Corythucha ciliata* (Say), was carried out in Yugoslavia cotton fields in 1982-83. *C. mildei* and *A. lunata* fed voraciously on the pest for 42-70 days. During this period, a single spider consumed 217-564 bugs at an average rate of 3.1-9.3/day. The average feeding rate of *C. mildei* was 8.2 specimens/day and that of *A. lunata* 3.1/day (Balarin & Polenec, 1984). A range of pest species taken as prey by 4 species of spiders on cotton in south-eastern Queensland was established from observations in the field. A direct numerical relationship was established between the spiders *C. mordax* L. Koch (diversum L. Koch) and *Oxyopes mundulus* L. Koch and larvae of *Heliothis spp.*, and these were expressed as exponential functions. No direct relationship with prey and habitat was found for the spiders *Achaearanea veruculata* (Urquhart) or *Araneus theisi* (Walck). The importance of spiders in preventing crop loss was considered by relating the abundance of spiders feeding on *Heliothis spp.* to fruit damage levels in unsprayed cotton. Damage thresholds were frequently exceeded despite predation, and it was concluded that the predacious role of spiders would have to be supplemented to ensure economic yields (Bishop and Blood, 1981). In cotton field in south-eastern Queensland, the spider species *C. mordax* L. Koch (diversum L. Koch), *Archaeearanea veruculata* (Urquhart) and *Lycosa sp.* were equally distributed in the outer, middle and inner portions. However, *A. veruculata* was more abundant in the western side of the field late in the season, apparently in response to a more favorable habitat. In sampling, the variance was greater than the mean and over dispersion was apparent (Bishop, 1981). *Philodromus cespitum* (Walckenaer, 1802) is one the most important predators of cotton pests in Chinese cotton fields (Liu and Niu,

1981). *O. salticus* (Hentz, 1802) was dominant species in Texas cotton fields (Dean *et al.*, 1982). *C. erraticum* (Walckenaer, 1802) and *C. pennyi* (Cambridge, 1873) had high population in German cotton fields. They usually see together in cotton fields (Wolf, 1990). *O. salticus* was the dominant spider species in Massachusetts cotton fields. It was 58% of collected spiders (Bradwell and Averill, 1997).

The aims of the present study were the investigation on quantity of feeding and host preference of five spider species in order to determine role of spiders on pest control in cotton fields located in Tehran province in 2004.

Material and Methods

Adults of *T. formicinus*, *O. Salticus*, *C. erraticum*, *P. cespitum*, *T. imperialis* were reared under laboratory conditions to evaluate their host preference in laboratory conditions (28±2°C, 65±5% RH and photoperiod of 12:12 (L: D) hours). The study was conducted in the summer and autumn of 2004 for 60 days in 10 replicates. In order to performance of determination number of feeding tests, each spiders species put on a cotton bush that cultivated in the vase and enclosed by clear isinglass's. The four cotton pests (*Bemisia tabaci*, *Aphis gossypii*, *Empoasca decipiens* and *Nezara viridula*) were collected weekly from cotton fields. They were then reared on cotton balls inside cages. A total of 10 of each of the four cotton pests was put inside cages at the ratio of 10 cotton pest to 1 spider. This was done daily and the rate of predation was taken every 24 hours to assess host preference; the four different cotton pests were put in cages with each spider species and counted number of pests that have fed by each spider species daily and calculated mean of them (Balarin and Polenec, 1984; Sebastian *et al.*, 2002).

Results and Discussion

In the present study the roles of the seven spider species on major cotton insect pests were studied in the laboratory conditions

(28±2 C°, 65±5% RH and photoperiod of 12:12(L:D) hours). The following spider species, *Thanatus formicinus*, *Oxyopes salticus*, *Cheiracanthium erraticum*, *Philodromus cespitum* and *Thyene imperialis* were studied on the cotton key pests (*Bemisia tabaci*, *Aphis gossypii*, *Empoasca decipiens* and *Nezara viridula*) in Tehran. Daily rate of feeding and host preference of them were determined and recorded for sixty days in 2004.

Assigning of host preference of spiders was accomplished for the first time in Iran in this study, to the best of author's knowledge have been depicted in Tables 1 and 2.

According to the results, when had given one kind of pests to each spider species, the maximum predation of them belonged to *E. decipiens* and the less of predation related to *A. gossypii* and when had given 4 kinds of pests together to them the most predation were belonged to *E. decipiens* and the less were related to *N. viridula*. As per, the most

predation occurred by *T. imperialis* and the less accomplished by *P. cespitum*.

According to comparison of outcomes of feeding and host preference of *C. pennyi* and *C. erraticum* on *B. tabaci*, *A. gossypii* and *E. decipiens* it was found that that *C. erraticum* had more ability in predation than of *C. pennyi*.

Therefore, we can conclude that these spider species had the most tendency to *A. gossypii* and *E. decipiens* and the fewer propensities to *N. viridula* and *B. tabaci*. Balarin and Polenec (1984) estimated quantity of feeding of *C. mildei* on cotton bugs. The average of feeding of *C. mildei* was 8.2 bugs but in this study, the average of feeding of *C. erraticum* was 7.24. In other probes, *O. salticus* was dominant species in Texas and Massachusetts cotton fields (Bradwell and Averill, 1997; Dean *et al.*, 1982). In cotton fields in the south-eastern of Queensland, the spider species *C. mordax* L. Koch had equally distributed in the outer, middle and

Table 1 : Average of feeding of five dominant spider species on 4 key cotton pests (separately) in laboratory condition in Tehran

Spider species	<i>Empoasca decipiens</i>	<i>Nezara viridula</i>	<i>Bemisia tabaci</i>	<i>Aphis gossypii</i>
<i>Thanatus formicinus</i>	8.22	6.57	7.18	6.55
<i>Oxyopes salticus</i>	9.46	5.23	10.28	5.17
<i>Cheiracanthium erraticum</i>	6.52	8.14	4.33	8.2
<i>Thyene imperialis</i>	13.55	10.1	7.34	7.26
<i>Philodromus cespitum</i>	7.32	7.9	9.1	5.94

Table 2 : Mean of feeding of five dominant spider species on 4 key cotton pests (together) in laboratory condition in Tehran

Spider species	<i>Empoasca decipiens</i>	<i>Nezara viridula</i>	<i>Bemisia tabaci</i>	<i>Aphis gossypii</i>
<i>Thanatus formicinus</i>	5.97	1.1	1.93	2.33
<i>Oxyopes salticus</i>	6.8	0.75	3.55	2
<i>Cheiracanthium erraticum</i>	2.59	2.17	0.5	3.5
<i>Thyene imperialis</i>	7.11	4.45	2.55	2.98
<i>Philodromus cespitum</i>	3.92	1.95	3	2

inner portions (Bishop, 1981). *C.erraticum* had equally distributed in the outer, middle and inner portions of Varamin cotton fields, too. *P. cespitum* was one the most important predator of cotton pests in Chinese cotton fields (Liu and Niu, 1981). This species was one of the dominant species and serious predator in Iranian cotton fields. *C. erraticum* and *C. pennyi* were detail of remarkable spider predators in German cotton fields (Wolf, 1990). Also, these species were dominant species and have an important role in pest control in Iranian cotton fields. *C. erraticum* (Walckenaer, 1802) and *C. pennyi* O.P. Cambridge, 1873 had high population in German cotton fields. They are usually seen together in cotton fields (Wolf, 1990). These two species were in Ardebil cotton fields and they have high population in these fields, too.

According to the conclusions, *T. imperialis*, *O. salticus* and *T. formicinus* are suitable for reduction cotton pests in Tehran cotton fields.

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