

Biodiversity of Spiders Associated with Cotton and Maize in Sharkia Governorate with a Special Reference to the Spider, *Kochiura aulica* (Koch)

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(Received: July 7, 2010)

ABSTRACT

Spiders associated with cotton and maize plants were recorded in Sharkia Governorate, Egypt, during 2009 season. Results revealed the occurrence of eighteen spider species belonging to nine families. Eight and sixteen species were collected from cotton and maize plants, respectively. *Thomisus spinifer* Cambridge was the most frequent species, with 100.00 and 20.45 % for absolute frequency and relative frequency of occurrence, respectively, while all *Erigone* sp., *Gnathonarium dentatum* (Wider), *Euryopis* sp., and *Cyrtophora citricola* (Forsk.) recorded the lowest frequency occurrence 5.5 and 1.13 %, respectively. Life cycle and female fecundity of *Kochiura aulica* (Koch) (Theridiidae) were studied when fed on *Spodoptera littoralis* (Boisd.) second instar larvae. Feeding capacity was also estimated. Obtained data cleared that *K. aulica* can be used as a biocontrol agent in integrated pest management program.

Key Words: Spiders, Biodiversity, Life cycle, *Kochiura aulica*, Maize, Cotton.

INTRODUCTION

Spiders are arachnids of widespread occurrence in nature feeding voraciously on other arthropods i.e., small insects and phytophagous mites. More than 30.000 spider species existed worldwide (Nyffeler *et al.*, (1994). Spiders may play an important role in controlling field populations of economic agricultural pests infesting some important crops. Kamal *et al.*, (1995), Asin & Pons, (1996) and Rahil 2001, revealed spiders potentials to feed on hemipteran, homopteran, lepidopteran and thysanopteran insects reducing their damage. Due to their presence in large numbers and capabilities to capture the prey, spiders inhabit certain crops can be considered as potentially biocontrol agents.

Araneida consists of 109 families of spiders; of which the family Theridiidae occupies the fifth rank from six families its number of species exceeds 2.000 species. It includes 2297 species belonging to 112 genera (Platnick 2010). One species of the genus *Kochiura* Archer is recorded, among 25 species of 10 genera of Theridiidae, in Egypt (El-Hennawy 2002 & 2006). *Kochiura aulica* (Koch) was collected from Alexandria, Nile Delta, Siwa Oasis and Wadi Natron, Egypt (El-Hennawy 2006). The first successful mass rearing and the observation of the sociality behavior were proved under laboratory condition by Abdel-Karim *et al.*, (2006).

The purpose of the present study is to provide information on incidence of spiders community associated with the two crops: cotton *Gossypium barbadense* L. and maize *Zea mays* L. in Sharkia Governorate, Egypt. Life cycle of the spider species,

K. aulica (Koch) was also studied when fed on the second instar larvae of the cotton leafworm, *Spodoptera littoralis* (Boisd.).

MATERIALS AND METHODS

Ecological studies:

The present study was carried out on cotton *G. barbadense* variety Giza 86 and maize *Z. mays* cultivated in Sharkia Governorate, Egypt during 2009 season. Spiders were collected randomly using beating net, plant shaking and hand sorting every 15 days from 1st May to 15th September (nine samples for each crop).

The collected spiders were preserved in 70% ethanol for classification.

Statistical analysis:

The occurrence of collected spiders on each crop was analyzed using two ecological parameters. There were percentages of absolute and relative frequency occurrence according to Norton (1978) as follows:

Absolute frequency of occurrence =

$$\frac{\text{Number of samples containing species}}{\text{Number of collected samples}} \times 100$$

Relative frequency of occurrence =

$$\frac{\text{Absolute frequency occurrence of a species}}{\text{Sum absolute frequency occurrence of all species}} \times 100$$

Rearing technique of spider, *K. aulica*:

Gravid females of *K. aulica* were placed in translucent plastic vials (2 cm diameter and 5 cm high), supplied with 2nd instar larvae of *S. littoralis*

as prey, closed with musline and kept under laboratory conditions ($28 \pm 1^\circ\text{C}$ & 60-70 % R.H.) to start a pure culture of the spider. Twenty newly hatched spiderlings were transferred singly to the rearing vials; each one was supplied with a known number of prey during investigation. Devoured prey were recorded and replaced by new ones. Spiders retain vials were examined every two days and monitored for moulting, survival and maturity. Life cycle duration was recorded in addition to number of egg sacs and consumed *S. littoralis* larvae.

RESULTS AND DISCUSSION

Spiders Associated with Cotton and Maize Plants in Sharkia Governorate:

Table, 1 shows that eighteen spider species belonging to nine families were collected.

Obtained data revealed that the most frequently species were *Thomisus spinifer* Cambridge ,

Cheiracanthium isiacum Cambridge . *K. aulica*, *Thanatus albini* (Audouin) and *Plexippus paykulli* (Audouin). Their percentages of absolute frequency occurrence were 100.00, 61.11, 55.55, 50.00, and 44.44 %, respectively, while their relative frequency occurrence were 20.47, 12.51, 11.37, 10.23 and 9.09 %, respectively. Former group was followed by *Erigone dentipalpis* (Wider), *Argiope* sp., *Prinerigone vegans* (Savigny), *Dictyna* sp., *Peucetia* sp. and *Thyene imperials* (Rossi) which were represented with more or less similar values of absolute and relative frequencies of occurrence with range from 16.66 to 27.77 % for absolute and 3.44 to 5.68 % for relative frequency of occurrence. The spider species, *Erigone* sp., *Gnathonarium dentatum* (Wider), *Prinerigone* sp., *Thanatus* sp., *Philodromus* sp., *Euryopis* sp. and *Cyrtophora citricola* (Forskal) were represented by the lowest percentages of frequency occurrence with range of 5.5 to 11.11 % for absolute and 1.13 to 2.27 % for relative frequency of occurrence, respectively.

Table (1): Spiders collected from cotton and maize plants during 2009 season at Sharkia Governorate

Spider species	No. of samples containing the species	Absolute frequency occurrence %	Relative frequency occurrence %
Fam. Theridiidae Sundevall			
<i>Kochiura aulica</i> Koch	10	55.56	11.37
<i>Euryopis</i> sp.	1	5.56	1.14
Fam. Linyphiidae Blackwall			
<i>Erigone</i> sp.	1	5.56	1.14
<i>E. dentipalpis</i> (Wider)	5	27.78	5.68
<i>Gnathonarium dentatum</i> (Wider)	1	5.56	1.14
<i>Prinerigone</i> sp.	2	11.11	2.27
<i>P. vegans</i> (Savigny)	4	22.22	4.55
Fam. Araneidae Clerck			
<i>Cyrtophora citricola</i> (Forskal)	1	5.56	1.14
<i>Argiope</i> sp.	5	27.78	5.68
Fam. Oxyopidae Thorell			
<i>Peucetia</i> sp.	3	16.66	3.41
Fam. Dictynidae Cambridge			
<i>Dictyna</i> sp.	3	16.66	3.41
Fam. Miturgidae Simon			
<i>Cheiracanthium isiacum</i> Cambridge	11	61.11	12.50
Fam. Philodromidae Thorell			
<i>Thanatus</i> sp.	1	5.56	1.14
<i>T. albini</i> (Audouin)	9	50.00	10.23
<i>Philodromus</i> sp.	2	11.11	2.27
Fam. Thomisidae Sundevall			
<i>Thomisus spinifer</i> Cambridge	18	100.00	20.45
Fam. Salticidae Blackwall			
<i>Plexippus paykulli</i> (Audouin)	8	44.44	9.09
<i>Thyene imperials</i> (Rossi)	3	16.66	3.41

Table, 2 shows frequency of occurrence for spiders associated with cotton and maize. Eight species were collected from cotton fields. The most abundant species were *Thomisus spinifer* followed by *K. aulica*, *E. dentipalpis*, *P. vagans*, *P. paykulli*, *C. isiacum*, *Philodromus* sp. and *C. citricola*. Their percentages of absolute and relative frequencies of occurrence in the total samples were collected from cotton fields with range from 100 to 11.11 % for absolute frequency of occurrence and from 3.45 to 31.04 % for relative frequency of occurrence.

On maize, sixteen spider species were collected. The most abundant species were *C. isiacum*, *T. albini*, and *T. spinifer*, while their absolute and relative frequencies of occurrence recorded 100 to 15.25 %, respectively. Following those descendingly were by *P. paykulli*, *Argiope* sp., *Thyene imperials*, *Dictyna* sp., *K. aulica*, *Peucetia* sp., *Erigone* sp., *G. dentatum*, *P. vagans*, *Thanatus* sp. and *Euryopis* sp., with percentages of absolute and relative frequency from 11.11 to 66.67 and 1.69 to 10.17%, respectively.

Biological studies:

Developmental duration of different stages of the theridiid spider *K. aulica* fed on the second instar larvae of *S. littoralis* were studied. Egg incubation

period averaged 20 days for both female and male (Table 3), being the longest compared with data published by other workers on theridiid spiders as it ranged between 9.6 to 13.0 days on different preys (the 3rd and 4th larvae of the coleopteran, *Tribolium confusum* Jacquelin du val; cotton leaf worm *S. littoralis*; lesser wax moth, *Achroia grisella*; *Tetranychus urticae* & *Ahpis craccivora* singly or mixture according to Rahil & Hanna (2001), El-Erksousy *et al.*, (2002), Mohafez (2004), Hussein *et al.*, (2003), respectively.

The spider, *K. aulica* passed through five instars before reaching adulthood for female and male, recording 62.05 ± 1.16 and 59.09 ± 1.51 days, respectively. Female life cycle was longer than that of male, as it averaged 82.05 ± 1.16 days.

Adult female longevity recorded 109.0 ± 7.21 days, including pre-oviposition, oviposition, and post-oviposition averaging 17.00 ± 6.25 , 72.33 ± 6.66 , and 19.67 ± 7.57 days, respectively (Table 4). Average female deposited 5.00 ± 0.70 egg sacs, with 19.33 ± 2.52 eggs / each. Thus, total number of eggs/female was 107.6 ± 3.29 eggs.

Results showed that *K. aulica* female and male passed through five instars which recorded longer

Table (2): Frequency occurrence of spiders associated with cotton and maize plants during 2009 season at Sharkia Governorate.

Spider species	Cotton (N= 9)			Maize (N=9)		
	No.	Absolute frequency occurrence %	Relative frequency occurrence %	No	Absolute frequency occurrence %	Relative frequency occurrence %
<i>Erigone</i> sp.	0	0.0	0.0	1	11.11	1.69
<i>E. dentipalpis</i>	3	33.33	10.34	2	22.22	3.39
<i>Gnathonarium dentatum</i>	0	0.0	0.0	1	11.11	1.69
<i>Prinerigone</i> sp.	0	0.0	0.0	2	22.22	3.39
<i>P. vagans</i>	3	33.33	10.34	1	11.11	1.69
<i>Plexippus paykulli</i>	2	22.22	6.89	6	66.67	10.17
<i>Thyene imperials</i>	0	0.0	0.0	3	33.33	5.08
<i>Cheiracanthium isiacum</i>	2	22.22	6.89	9	100	15.25
<i>Dictyna</i> sp.	0	0.0	0.0	3	33.33	5.08
<i>Thanatus</i> sp.	0	0.0	0.0	1	11.11	1.69
<i>T. albini</i>	0	0.0	0.0	9	100	15.25
<i>Philodromus</i> sp.	2	22.22	6.89	0	0.0	0.0
<i>Thomisus spinifer</i>	9	100	31.04	9	100	15.25
<i>Kochiura aulica</i>	7	77.77	24.14	3	33.33	5.08
<i>Euryopis</i> sp.	0	0.0	0.0	1	11.11	1.69
<i>Peucetia</i> sp.	0	0.0	0.0	3	33.33	5.08
<i>Cyrtophora citricola</i>	1	11.11	3.45	0	0.0	0.0
<i>Argiope</i> sp.	0	0.0	0.0	5	55.56	8.48

N = Number of collected samples.

No. = Number of samples containing a species.

Table (3): Duration of *K. aulica* different spiderlings in days fed on *S. littoralis* 2nd instar larvae at 28±1°C & 60-70 % R.H.

Spider stages	♀			♂		
	Min.	Max.	Mean ± S.D.	Min.	Max.	Mean ± S.D.
Egg incubation	20	20	20.00 ± 0.0	20	20	20.00 ± 0.0
1 st instar	12	22	15.62 ± 2.5	13	18	15 ± 2.14
2 nd instar	11	16	12.38 ± 1.32	10	16	11.73 ± 1.85
3 rd instar	7	16	12.05 ± 2.06	12	16	12.82 ± 1.25
4 th instar	10	16	11.57 ± 1.69	7	12	9.09 ± 1.97
5 th instar	7	16	12.71 ± 2.57	11	16	12.82 ± 1.88
Total spiderlings	60	63	62.05 ± 1.16	55	60	59.09 ± 1.51
Life cycle	80	83	82.05 ± 1.16	75	80	79.09 ± 1.51

Table (4): Adult female longevity and fecundity of *K. aulica* fed on the 2nd instar larvae of *S. littoralis* at 28±1°C & 60-70 % R.H.

Spider female stages (days)	Mean ± S.D.
Pre-oviposition period	17.00 ± 6.25
Oviposition period	72.33 ± 6.66
Post-oviposition period	19.67 ± 7.57
Longevity	109.0 ± 7.21
Mean number of eggs/egg sac	19.33 ± 2.52
Mean total egg sacs/female	5.00 ± 0.70
Total number of eggs/female	107.6 ± 3.29

Results showed that *K. aulica* female and male passed through five instars which recorded longer durations (62.05 ± 1.16 & 59.09 ± 1.51 days at 28±1°C & 60-70% R.H.) compared with that obtained by El-Erksousy *et al.* (2002), on *Anelosemus aulicus* recording 47.2 and 44.2 days for female and male, respectively, when fed on *S. littoralis* larvae, without mention prey instar, at 26±2°C and 60-70 % R.H. Both sexes of *A. aulicus* spiderlings lasted for 33.33 and 32.62 days, respectively, when fed on 3rd and 4th larvae of *T. confusum* at 27±1°C and 57.7% R.H. (Rahil & Hanna, 2001).

Feeding capacity:

All stages of the spider *K. aulica* fed on the second instar larvae of the cotton leafworm, *S. littoralis*. Its feeding capacity generally increased parallel with the progress of spider development from first to fifth instars. Mean number of consumed prey for the first instar was 101.52 ± 3.53 and 100.73 ± 3.29 prey individuals, for female and male, respectively, while it increased to 199.95 ± 3.80 and 191.36 ± 4.43 for the fifth instar, respectively. The mean number of devoured prey individuals for total spiderlings was 599.52 ± 7.73 and 591.64 ± 7.17, for female and male, respectively (Table, 5).

Table (5): Feeding capacity of *K. aulica* different spiderlings fed on *S. littoralis* 2nd instar larvae.

Stages	Mean number of consumed <i>S. littoralis</i> 2 nd instar larvae			
	♀		♂	
	Mean ± S.D. (Min. - Max.)	Daily mean	Mean ± S.D. (Min. - Max.)	Daily mean
1 st instar	101.52 ± 3.53 (100 - 115)	6.49	100.73 ± 3.29 (95-105)	5.04
2 nd instar	60.05 ± 4.13 (55 - 70)	4.49	57.82 ± 2.52 55-60	3.21
3 rd instar	68.00 ± 3.66 (60 - 72)	5.64	69.27 ± 2.19 65-72	4.46
4 th instar	170.48 ± 3.50 (165 - 180)	13.4 6	168.64 ± 4.52 155-170	14.05
5 th instar	199.95 ± 3.80 (196 - 215)	15.7 3	191.36 ± 4.43 (186-200)	10.63
Total spiderlings	599.52 ± 7.73 (590 - 620)	9.88	591.64 ± 7.17 575-600	10.03

ACKNOWLEDGEMENT

The authors are indebted to Col. Hisham K. El-Hennawy (Cairo) who identified the reared spider species and kindly revised a draft of the manuscript.

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