

STUDIES ON THE HABIT AND HABITAT, MORPHOLOGY, FEEDING CAPACITY AND PREY PREFERENCE OF SIX HUMPED DOME SPIDER *Cyrtophora citricola* SIMON

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ABSTRACT

Laboratory studies were carried out to investigate habit and habitat, morphology, feeding capacity and prey preference of *Cyrtophora citricola* collected from various places of Azamgarh district (U.P.). It was found on thorny bushes. It makes its web in between leaves of paddy crop plants. The females resemble a piece of dead leaf, and will sometimes hide in debris that has fallen into the web. While working on its feeding capacity it was found to prey actively on various insect pests of paddy crop fields. It was observed to prey on soft bodied insects like lepidopteran pests. It was also observed to show phenomenon of mimicry of concrete when it was disturbed. A single individual can consume about 25 to 29 insects/24h.

KEYWORDS : *Cyrtophora citricola*, Habit and Habitat, Feeding Capacity, Prey Preference, Economic Importance, Bio-control Agent

For many decades, insecticides have been widely used to control rice pests. However, the continuous use of a wide range of pesticides has caused many side effects, including loss of biodiversity, the problem of secondary pests, insecticide resistance, residual toxicity, the resurgence of insect pests, and environmental pollution. Recently, many efforts have been made to combine various non-chemical control methods with insecticides in systems of Integrated Pest Management (IPM). One such effort is the combined use of natural enemies to control agricultural pests have been reported (Van den Bosch et al. 1992).

Spiders are of major importance in ecosystems and are recognized as effective natural control agents in agroecology. They are classified into 106 families with about 40,000 species, but the actual number of species is expected to be many times higher. These are carnivorous arthropods and are found all over the world in almost every kind of habitat. They mainly prey on insects, although they may also feed on various other kinds of prey. The population densities and species abundance of spider communities in agricultural fields can be as high as in natural ecosystems (Tanaka, 1989).

Spiders play an important role in regulating insect pests in the agricultural ecosystem. There are a large number of species many of them with high population densities. They have a wide range of prey species, catch significant numbers of prey and use various foraging strategies. Most of the spiders in rice fields seem to evacuate the field after the application of insecticides and move back into the field later. Their predatory capacity can have a synergistic effect

in suppressing densities of insect pests when they are used to complement the effects of insecticides. They consume a large number of prey, and do not damage plants. They can achieve an equilibrium in pest control, after which their own numbers are suppressed by their territoriality and cannibalism. For some time, spiders have been considered important predators which help regulate the population densities of insect pests (Tanaka, 1989). In particular, spider communities in areas with a temperate climate achieve equilibrium in the control of agricultural pests. In spite of this, they have not usually been treated as an important biological control agent, because there is so little information on the ecological role of spiders in pest control (Riechert and Lockley, 1984). Song and Zhu (1997), Nentwig et al. (2003), Biswas and Biswas (2004), and Plantik (2004) have provided catalogues for identification of spiders.

Most orb weavers are nocturnal. During daylight hours, the spider may retreat to a nearby branch or leaf, but will spin a trapline from the web. Any slight vibration of the web will travel down the trapline, alerting her to a potential catch. The orb weaver possesses venom, which she uses to immobilize her prey.

Orb weaver spiders live throughout the world, with the exceptions of the Arctic and Antarctic regions. In North America, there are approximately 180 species of orb weavers. Worldwide, arachnologists describe over 3,500 species in the family Araneidae. Spiders are voracious predators of insects. They are well adapted to certain habitats because of their ability to withstand periods of low

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food availability and also to take advantage of periods of prey abundance. They are important predators of pests of cotton, rice, apple, banana and various other crops and plantations. The presence of spiders in biotic environment of insect pests greatly influence their population dynamics (Sandidaque, 2005; Rajeshwaram et al., 2005; Bastawade and Khandal, 2006; Huant et al., 2005 and Singh and Sihag, 2007).

Up until 1970, most of the research on spiders concentrated on identification. From the early 1970s, researchers began to study the basic ecological and biological characteristics of spiders as biological control agents. Spiders in rice fields have been studied more than spiders on other crops (Im and Kim, 1999). However, most of these studies were limited to the identification of spiders, and to investigating the dominant spider species, their regional distribution, seasonal fluctuation and the effect of insecticides. There were few studies on the spatial distribution of spiders, how this is related to their ecological role, and how many insect pests they consume in rice fields.

Studies on Indian spider fauna have been carried out by different workers (Biswas and Biswas, 2003, 2004; Vijayalaxmi and Ahimaz, 1993; Patel, 2002; Gajbe, 2004; Majumder, (2007) in different regions of the country and documented 1,035 species belonging to 240 genera under 46 families from Indian Subcontinent (Uniyal and Hore, 2006), Mishra et al. (2012a and 2012b) have investigated *Neoscona crucifera*, *N. adianta* and *N. nautica* and Yadav et al. (2012a and 2012b) from U.P. India.

From the review of literature, it is evident that role of spiders as bio-control agents in agriculture, poultry as well as in controlling house-hold insect pests is being studied in various parts of the world, but unfortunately proper investigation regarding role of these efficient bio-control agents in India is scanty. As of today, major part of spider diversity remains undiscovered and un-described. There is no documentation of spider faunal diversity or their habitat or general ecology in U.P. (India). Thus the present investigation has been taken to study morphology, feeding capacity and prey preference of six humped dome spider *Cyrtophora citricola* (Simon), collected from various agricultural areas of Azamgarh district of U.P. (India).

MATERIALS AND METHODS

Collection of spiders

Individuals of *Cyrtophora citricola* Simon were collected from rice crop fields, orchards, ornamental and wild plants in some habitats of Azamgarh district of U.P. (India) by following methods:

Direct Hand Picking

Collection of most spiders was made by direct hand picking with the help of test tubes.

Inverted Umbrella

In this method an inverted umbrella was placed below flowering shoots and bushes and when the tree or branch was thoroughly shaken, spiders along with insects fallen to the inverted umbrella. After removing leaves, spiders were transferred into collecting tubes.

Preservation

Before the spiders were permanently preserved for morphological study, they were arranged properly. For this, collected specimens were transferred into petridish containing isopropyl alcohol. It was kept covered and undisturbed for about 2 or 3 hours in order to allow the relaxation of body muscles. The body parts like legs, abdomen and palps were then arranged in a life like manner with the help of forceps and brush. Spiders were then kept in alcohol in a closed pair of petridish overnight before transferring to tubes for permanent preservation. The glass vial containing preserved specimen were stoppered by a rubber cork to prevent evaporation of alcohol. Alternatively, glass vials were plugged by cotton and group of these tubes were then placed in large bottle containing alcohol. This was the method used for preserving most of the spider specimen. Each collecting tube enclosed a label indicating the collection data. Collection data includes the name of the collector, place of collection, date of collection and habitat of collected spider.

Photography

Live photographs of spiders were taken with the help of Web Cam of 12 mega pixel connected to computer. For taking alive photographs, the spiders were anesthetized with mild doses of chloroform in specimen tubes. Generally, major diagnostic features such as dorsal view, ventral view, ocular area and side view were taken for study.

Attempts were also made to take photographs of spiders while they were feeding on insect pests.

Identification

It was done on the basis of morphometric characters of various body parts. The help was mainly taken from the keys and catalogues provided by Nentwig et al. (2003), Biswas and Biswas (2004) and Plantik (2004).

Study of Prey Choice

Collected alive spiders were kept in rearing chambers. Each rearing chambers (9.5 cm height, 6.0 cm width) were consisted of transparent plastic containers. The lid of each container was provided with small holes for aeration. Since, spiders are highly cannibalistic, individual spiders were reared in separate rearing chambers. To study the prey choice, spiders were kept starved for 24h then each spider was supplied with various types of insect pests (5 individuals of each kind of prey in each rearing chamber) separately. After 12h, number of fed, dead and live pest individuals were counted to find out feeding capacity and prey preference of spiders. Attempts were made to take live photographs while spiders were preying.

Statistical Analyses

Each experiment was repeated six times and student's t-test was applied for comparison between two sample means.

Study Area

Spiders were collected from crop fields/ bushes and houses of various places of Azamgarh district U.P.

RESULTS

Cyrtophora citricola (Six-humped dome)

Classification

Phylum : Arthropoda, Class: Arachnida, Order: Araneae
Family: Aranidae, Genus: *Cyrtophora simon* Species: *citricola*

Habit and Habitat

It is found on thorny bushes. Although it is in the family commonly called Orb Web Spiders, this spider does not build orb webs. Their horizontal web forms a cone in the middle, with many support lines holding it. The web is not sticky and spiral and radials are constructed from the same silk. Unless in orb webs, all cells in the web are rectangular.

Description

C. citricola's color may vary greatly; whereas many sport a black and white pattern, others are brown, males sometimes appear black. The females resemble a piece of dead leaf, and will sometimes hide in debris that has fallen into the web. *Cephalothorax brownish* with yellowish patches. Very broad posteriorly, Pubescent gray thoracic region with fovea bifid posteriorly. Both the eye rows recurved; anterior medians larger than posterior medians; laterals situated on prominent tubercles. Sternum triangular. Legs short stout, brownish with yellowish patches; pubescent, hairy, and spiny; coxae light yellowish-orange. Abdomen grayish with yellow and brown patches, pubescent, hairy; one pair of shoulder humps, one pair of lateral and one pair of bifid caudal humps on dorsum with broad, grayish brown band running all along its length (Plate-01 and Plate-02); five pairs of distinct sigilla present mid-longitudinally.

Diagnostic characters

Cephalothorax brownish with yellowish patches. Very broad posteriorly, Pubescent gray thoracic region with fovea bifid posteriorly (Plate-01 and Plate-02). Legs short stout, brownish with yellowish patches; pubescent, hairy, and spiny; coxae light yellowish-orange. Abdomen grayish with yellow and brown patches, pubescent, hairy; one pair of shoulder humps, one pair of lateral and one pair of bifid caudal humps on dorsum with broad, grayish brown band running all along its length (Plate-01 and Plate-02). During present investigation it showed the phenomenon of mimicry of dead thing (Plate-04 and Plate-05) when disturbed.

Economic Importance

It feeds on moths (Plate-03) and other insects (Table-01). Thus it can be used as a bio-control agent in controlling lepidopteran and other pests of crop fields.

DISCUSSION

Cyrtophora citricola was found on thorny bushes. Although it is in the family commonly called Orb Web Spiders, this spider does not build orb webs. Its description and diagnostic characters closely resemble to that described by Majumder (2007).

Cyrtophora citricola, also known as the Tropical Tent Web Spider is an araneid spider that occurs in the



Plate-01



Plate-02



Plate-03



Plate-04



Plate-05

Cyrtophora citricola: Plate-01: Dorsal View, Plate-02: Dorso-Frontal View, Plate-04: Feeding on Moth, Plate-05 (Dorsal View) and 18 (Ventral View): Showing Mimicry of Death

Table 1 : Feeding Potential/Prey Preference of *Cyrtophora citricola*

Type/ Number of Prey Consumed/ 24h/ Spider (Mean ± S.D.)						
S.No.	Lepidoptera	Diptera	Homoptera	Orthoptera	Coleoptera	Total
1	9	8	7	7	0	31
2	9	7	9	7	1	33
3	8	7	8	6	0	29
4	7	6	6	8	1	28
5	10	8	7	7	1	33
6	9	7	8	5	0	29
7	8	7	5	5	1	26
8	7	8	5	6	0	26
9	9	9	7	7	1	33
10	6	6	6	5	0	23
Mean±S.D.	08.20±1.23	07.30±0.95 ^d	06.80±1.32 [*]	06.30±1.06 [*]	0.50±0.52 ^a	29.10±3.45 ^a

Significance Level a0.001, b0.01, c0.05, d0.10 and * Not Significant When Compared With Adjacent Means.

warmer parts of Europe, Asia and Africa. It can now also be found in other parts, such as Florida, where it was first found in 2000. It has also been reported from India: Eastern coastal area (Dist. Vizianagran, Visakhapatnam, Andhra Pradesh); West Bengal; Karnataka; Tamil Nadu; Maharashtra; Madhya Pradesh (Majumder (2005).

Remark

This species is being reported for the first time from U.P. (India). During present investigation it showed the phenomenon of mimicry of dead thing. It feeds on larvae and adult of moths as well as other small insect pests. Thus it can also be used as a bio-control agent in controlling lepidopteran and other pests of rice field. Role of various spider species in regulating insect pest population in crop fields has also been described by Fox and Dondale (1972) and Tanaka (1989).

Cyrtophora citricola are medium in size and also reported from the mangrove and semi-mangrove area of Sunderban. These spiders feed on smaller to medium sized insects entangled by their web (Majumder, 2007).

Distribution

India: West Bengal, Uttar Pradesh (Majumder, 2007), Punjab, Karnataka, Gujarat, Maharashtra (Nasik, Pune), Madhya Pradesh (Jabalpur), Tamil Nadu (Chingleput), Andaman and Nicobar Islands, Myamar, New Guinea, Pakistan, and Austro-Malaysia (Gajbe, 2004).

Economic Importance

It feeds on various types of insect pests and act as bio-control agent. It is medicinally important spider used by the tribals of Sunderban as drug for the cure of nerve debility and chronic fever (Majumder, 2007).

Remark

It is being reported here for the first time from Azamgarh and Mau Districts of U.P. (India). It was found in paddy crop fields, citrus trees and other bushes. It fed upon small insect pests and can also be used as a bio-control agent in rice crop fields like other spiders as reported by Kim et al. (1990); Im and Kim (1999).

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REFERENCES

- Bastawade D. B. and Khandal D., 2006. Arachnida :Araneae (spiders). Fauna of Sanjay Gandhi National Park (Invertebrates), Conservation area series, Z.S.I. **26** :139-184.
- Biswas B. K. and Biswas K., 2004. Araneae: Spiders. In; Fauna of Manipur, State Fauna Series, 10, Zoological Survey of India, 25-46.
- Fox C.J.S. and Dondale C. D., 1972. Annotated list of spiders (Araneae) from hayfields and their margins in Nova Scotia. Canadian Entomologist. **104**: 1911-1915.
- Gajbe P., 2004. Spiders of Jabalpur, Madhya Pradesh (Arachnida: Araneae). Zoological Survey of India, Kolkata. : 1-154.
- Haunt, Y., Delme, j., Legal, L. and Williams, T., 2005. Host selection by a kleptobiotic spider, Naturwissenschaften, **92** (2), 95-99.
- Im M.S. and Kim S.T., 1999. Studies on the ecological characteristics of the spiders as natural enemy for rice insect pest at rice paddy field in Koesan area, Chungcheongbuk-do. Journal of Development of Agricultural Resources. Kontuk Univ. **21** : 57-66.
- Kim H. S., Lee Y. I. and Lee H. P., 1990. Influence on the levee- burning on the fauna of insect pests and their natural enemies. Kor. Jour. Appl. Entomol. **29** (3): 209-215.
- Majumder S. C., 2005. Studies of some spiders from eastern coastal region of India. Men. Zool. Surv. India. **20**(3), 1-57.
- Majumder S. C., 2007. Pictorial Handbook on Spiders of Sunderbans West Bengal, 1-137. (Published by the Director, Zool. Surv. India, Kolkata).

- Mishra R. S., Ahmad G. and Chaubey S. N., 2012. Study on the morphology, feeding capacity and prey preference of *Neoscona crucifera* and *N. adianta* (Orb-weaving spiders). *Indian Journal of Life Sciences*, **1**(2), 29-34.
- Mishra R. S., Chaubey S. N. and Ahmad G., 2012. Study on the morphology, feeding capacity and prey preference of orb-weaving spider *Neoscona nautica* (L. Koch, 1875). *Journal of Experimental Zoology India* **15**(2), 467-472.
- Nentwig W., Hänggi A., Kropf C. and Blick T., 2003. Central European Spiders Determination Key. www.araneae.unibe.ch (assessed 8.12.2003).
- Patel B.H., 2002. A preliminary list of spiders with description three new species from Parambikulam Wild Life Sanctuary, Kerala Zoos' Print Journal, **18**(10):1207-1212.
- Plantick N. J., 2004. The World Spider Catalog, Version 5.0. American Museum of Natural History Online at [http:// research.amnh.org/entomology/spiders/catalog/index.htm](http://research.amnh.org/entomology/spiders/catalog/index.htm).
- Rajeshwaram J., Duraimurugan P. and Shanmugam P. S., 2005, Role of spiders in agriculture and horticulture ecosystem. *Journal of Food, Agriculture and Environment* **3**(3&4), 147-152.
- Riechert S. E. and Lockley T., 1984. Spiders as biological control agents. *Annual Review of Entomology* **29**, 299-320
- Sandidaque J., 2005. Predation by cosmopolitan spiders upon the medically significant pest species *Loxosceles reclusa* (Araneae : Sicariidae): limited possibilities for biological control. *Journal of Economic Entomology* **97**(2): 230 - 234.
- Singh N. P. and Sihag V., 2007. Seasonal variation in spider fauna in different habitats of Jhalana forest range. *Entomol* **32** (3), 153 - 159.
- Song D. S. and Zhu M. S., 1997. *Fauna Sinica: Arachnida: Araneae: Thomisidae, Philodromodae*. Science Press, Beijing, China, 1-256.
- Tanaka K., 1989. Movement of spiders in arable land. *Plant Protection* **43** (1): 34-39
- Uniyal V. P., 2006. Records of Spiders from Indian Trans-Himalayan Region. *Indian Forester* **132** 12(a), 117-181.
- Van den Bosch R., Messenger P. S. and Gutierrez A. P., 1992. *An Introduction to Biological Control*. Plenum Press, New York, USA. 247 PP.
- Vijayalakshmi K. and Ahimaz P., 1993. *Spiders: An Introduction*. Published by: Cre-A: 268 Royapettah High Road Madras 600014. Printed: at Sudersan Graphics Madras 600017 : 1-112.
- Yadav A. Chaubey S. N.* and Beg, M. A.**, 2012. *Hippasa holmerae* Thorell (Garden wolf spider) as bio-control agent for insect pests of crop fields collected from Azamgarh and Mau districts (U.P.) India. *Journal of Experimental Zoology India* **15**(2), 495-498.
- Yadav A., Chaubey S. N.* and Beg M. A., 2012. Morphology, prey preference and feeding capacity of decorative spider, *Leucauge decorata* (Blackwall) from Azamgarh India. *Journal of Applied Bioscience* **38**(1), 63-67.