Distribution and biocontrol potential of chosen spiders

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ABSTRACT

A regular fortnightly survey has been made in Jhalana Forest Range, Jaipur, (26Ú50'and 26Ú55'North latitude and 75Ú and 75Ú50'East longitude). The collection represented 39 species belonging to 29 genera and 16 families. The Predatory spiders and prey relationship was investigated in forest ecosystem. Spiders were found feeding upon different insects in the field. Non- web builder spiders were more predatory than web- building ones. It was also found that spiders preferred soft bodied insects than the hard cuticular insects. *Cyrtophora citricola* was found abundantly. This species is a voracious feeder of insect pests. It was reared in the laboratory on two different insect species i.e., *Drosophila melanogaster* and *Corcyra cephalonica* larvae and the feeding potential was recorded. An adult *C. citricola* consumed on an average 12.2 *C. cephalonica* larvae and 21.4 *D. melanogaster* in 24 hours.

Key words: Spiders, biocontrol agent, *Cyrtophora citricola, Drosophila melanogaster, Corcyra cephalonica*, Predatory potential.

INTRODUCTION

For the past several years, there has been increased interest in the utilization of natural enemies, particularly the predators for the management of insect pests of crops. In nature, amongst the biotic agents, spiders play a major role in keeping the pest population under check. The state of Rajasthan is situated between 23º3′ and 30º12′ latitude and 69º30′ and 78º17′ longitude. The total land area of the state is about 3, 24,239 km², out of which about 1, 98,100 km² is arid and the rest is semi arid. Forests cover only about 37,638 km² and are rich in biodiversity (Kotiya and Kumar, 2001). The study area, Jhalana forest Range is a dry deciduous type.

Aranae is the sixth or seventh largest animal order in terms of species described. About 36,000 valid described species belonging to 3,050 genera and 106 families have been described. The estimated total world spider species can only be guessed. Conniff (2001) commented that up to 170,000 species could exist. Spiders are a major component of the predatory arthropod trophic level in many ecosystems, but there has been little documentation of their impact on herbivore population or general ecology (Wise, 1993).The presence of spiders in biotic environment of insect pests greatly influence their population dynamics (Judd, 1966; Singh *et al.*, 1975; Sadana and Sandhu, 1977; Sadana and Kumari, 1977; Sadana and Kaur, 1979 ; Jackson 1992 ; Sandidaque, 2005; Rajeshwaram *et al.*, 2005; Bastawade and Khandal, 2006; Haunt *et al.*, 2005; Singh and Sihag, 2007). As of today major part of spider diversity remains undiscovered and undescribed. There is no documentation of spider faunal diversity or their habitat or general ecology in Rajasthan state (Nigam, 2004). Thus the present study has been undertaken to study spider fauna and feeding potential of selected spider species in this part of semi arid zone of Rajasthan.

MATERIAL AND METHODS

A survey of the study area was undertaken during March 2005 to February 2006. Sampling of the forest area was done following the concept of Coddington *et al.* (1991) with some modifications and included additional methods, i.e. pitfall trapping, sweep netting, cryptic searching, hand collection and vegetation beating. Sampling was performed from 7 AM to 10 AM and 5 PM to 7 PM during summer and 7 AM to 10 AM and 4 PM to 6 PM during winter.

The collected spider specimens during the survey were fixed in 70 per cent ethyl alcohol with a few drops of glycerin as described by Baldev Prashad (1971) and were identified under stereoscopic microscope on the basis of epigyne of female, eye arrangement and other characteristics with the help of keys of Pocock (1900), Tikader and Malhotra (1980), and Tikader (1977, 1987).

To study the feeding potential of particular species of spider, 10 mature spiders were kept individually in separate glass cages and each of which was marked and numbered. Each glass cage consists of a lantern chimney (10×4 inches) fixed over a petridish containing sterilized and moist sand. The chimney was covered by muslin cloth. The sand was

Table 1. Spider species collected from the Jhalana Forest Range.

Family	Spe1cies	Common name
Oecobiidae	*Oecobius putus* Cambridge	Ant eater
Eresidae	*Stegodyphus sarsinorum* Karsch	Social spider
	Stegodyphus sp.	Black and red abdomen spider
Uloboridae	*Uloborus* sp.	Without venom spider
Hersiliidae	*Hersilia savignyi* Lucas	Hunting spider
Pholcidae	*Artema atlanta* Walck.	Daddy long leg
	Pholcus phalangioides (Fuesslin)	Long bodied cellar spider
Salticidae	*Myrmarachne* sp.1	Ant mimic
	Myrmarachne sp.2	Ant mimic
	Plexippus paykullii (Savigny and Audouin)	Domestic jumping spider
	Telamonia vittata (C.L.Koch)	Red jumper
Thomisidae	*Thomisus projectus* Tikader	Crab spider
	Tmarus sp.	Twig node spider
	Xysticus minutus Tikader	Crab spider
Heteropodidae	*Heteropoda* sp.	Giant spider
Clubionidae	*Chiracanthium sp.*	Leaf role spider
Oxyopidae	*Peucetia viridana* (Stoliczka)	Green lynx spider
	Oxyopes shewta Tikader	Lynx spider
	Oxyopes sp.	Termite eater
Theridiidae	*Aroyrodes* sp.	Mercury spider
Agelenidae	*Agelena* sp.	Funnel web spider
Lycosidae	*Pardosa sumatrana* (Thorell)	Wolf spider
	Pardosa sp.	Wolf spider
	Hippasa agelenoides (Simon)	Wolf spider
	Hippasa pisaurina (Pocock)	Wolf spider
	Hippasa sp.	Wolf spider
	Lycosa sp.	Wolf spider
Araneidae (Argiopidae)	*Cyclosa* sp.	Signature spider
	Neoscona sp.	Orb web weaver
	Neoscona excelsus (Simon)	Orb web weaver
	Neoscona pavida (Simon)	Orb web weaver
	Neoscona mukerjei Tikader	Orb web weaver
	Zygeilla melanocronia (Thorell)	Orb web weaver
	Cyrtophora citricola (Forskal)	Tent orb web weaver
	Cyrtophora cicatrosa (Stoliczka)	Tent orb web weaver
	Leucauge decorata (Blackwall)	Orb weaving spider
Tetragnathidae	*Tetragnatha mandibulata* (Walckenaer)	Big jawed spider
	Olios sp.	Huntsman
Scytodidae	*Scytodes* sp.	Spitting spiders

kept moist by pouring a few drops of distilled water over it daily in order to provide humidity as the spiders do not thrive under dry conditions. Before starting the experiment, each spider specimen was starved for 24 hours. The biological characteristics of the spiders were studied using larvae and adults of *Drosophila melano gaster*, *Corcyra cephalonica*, *Musca domestica* and *Tribolium castaneum* as their alternate food. Then definite number of insects (larvae / adults) were introduced into each cage as food. Observations were made after 24 hours to record the number of insects consumed by the spider. The same experiment was repeated ten times by providing fixed number of same insects as food.

To study the predatory potential of *C. citricola* on *C. cephalonica* and *D. melanogaster*, 10 adult *C. citricola* were kept in separate glass cages. Then 20 larvae of *C. cephalonica* and 30 adults of *D. melanogaster* were introduced into each cage as food. Observations were made after 24 hours to record the number of insects consumed by the spider. The remaining food was taken out and the spiders were kept starved for another 24 hours. The same experiments were repeated ten times by providing fixed number of same insects as food.

RESULTS AND DISCUSSION

The collection represented 39 species belonging to 29 genera and 16 families (Table 1). Zafar (2001) observed diversity and relative abundance of spider species occurring on different strata of citrus trees at Samundari (Pakistan). He collected 2050 spider species belongs to 10 families, 23 genera and 45 species. Usher and Humphrey (2003) collected 76 species of spiders in pitfall traps located in four stages of the development of pinewoods at Glen Affric in UK. Bastawade and Khandal (2006) gave the systematic report on 61 spider species belonging to 18 families of Sanjay Gandhi National Park, Borivali, Mumbai (Maharashtra).

Table 2. Bioefficacy of *C. citricola* on different preys

Days	No. of prey consumed	
	D. melanogaster (adults/ day)	*C. cephalonica* (larvae / day)
1	21.4 ± 2.06	12.2 ± 1.02
2	20.1 ± 1.93	11.9 ± 1.19
3	21.6 ± 1.66	12.1 ± 0.92
4	22.9 ± 0.99	13 ± 0.90
5	22 ± 1.39	12.2 ± 0.95
6	23.1 ± 0.64	13.4 ± 0.98
7	22.9 ± 1.03	13.6 ± 0.78
8	24.3 ± 0.52	13.2 ± 0.82
9	23.6 ± 0.40	11.1 ± 1.02
10	24.4 ± 0.58	14.4 ± 0.82
Total	226.3 ± 8.46	127.1 ± 7.13

Sudhikumar *et al.* (2006 a) made pioneer study to reveal the spider diversity in Mannavan Shola Forest in Kerala state, India. They collected 72 species of spiders belonging to 57 genera of 20 families during the study. The families such as, Araneidae, Tetragnathidae, Salticidae and Thomisidae exhibited maximum population. The dominant family was Araneidae with 17 species. Sudhikumar *et al.* (2006 b) also collected 94 species of spiders from Kuttanad rice agroecosystem, Kerala, India. 70 species belonging to 17 families were recorded in Rabi season (November to March) and 94 species of 20 families in Kharif season (June to October).

Cyrtophora citricola (Foraskal) (Araneidae) was found numerically dominant and found throughout the year. This species prefers to prepare two tier web, inner medium dome shaped and the outer an irregular snare supporting the medium dome. Such nets are prepared among the smaller branches of bushes. A chain of 4-6 dirty greyish egg cocoons are normally left hanging on one side of the net. It was observed during the study that these spiders feed on small to medium sized arthropods *viz.*, water bugs, flies, wasps, thrips, small moths, small butterflies etc. Generally this species maintains a huge colony on a single plant or tree. Sometimes it coveres the whole tree by its dense web. It showed whirling movement, if any one of the individual was disturbed. Other spider species, like *Aroyrodes sp., Pholcus sp.* also live in this spider's web. It was found that *C. citricola* makes its web in trees, near the water bodies and found in huge colonies. Thus it can play a significant role in the management of insects such as, mosquitoes (*Culex* sp. and *Anopheles* sp.), flies (*Stomoxys calcitrans* (Linnaeus), *Tabanus atratus* (Fabricius) etc.) which are found near water bodies. Feeding efficacy and food preference of *C. citricola* were also studied. *C. citricola* adult consumed on an average 226.3± 8.46 adult of *D. melanogaster* in ten days (Table 2). Similarly consumption of *C. citricola* on *C. cephalonica* larvae was 127.1±7.13 in ten days.

It was also observed during present study that *C. citricola* preferred soft bodied and less active insects such as, *C. cephalonica* and *D. melanogaster*, than hard bodied insects. This view has been supported by the findings of Sadana and Kaur (1979) and Baldev Parshad (1985). They observed that this spider preferred small and medium sized insects with soft body. Furthermore, they reported that small insects with hard body and large insects with soft body were mostly rejected by the spider. Mathirajan and

Reghupati (2003) also studied the prey - preference and bioefficacy of four major spiders *viz*., *Peucetia viridana* Stoliczka, *Argiope catenulata* Doleschall, *Oxyopes javanus* Thorell and *Neoscona theisis* Walknaer in cotton plantation. They observed that the order of preference of spider was aphid > whitefly > leafhopper > caterpillar. The predatory potential was maximum for *P. viridana*. followed by *A. catenulata*, *O. javanus* and *N. theisis*.

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REFERENCES

Baldev Parshad, 1971. Setting and preservation of spiders. *Entomologist News letter*, **1** (8):2 - 3.

Baldev Parshad, 1985. Significance of spiders in relation to Agriculture. In : *Noninsect pests and predator*. (Bhanotar, R. K., Shashi Verma and Farooqi, S.I. eds.), All India Scientific Writers Society, Pushpam Vihar, New Delhi, 40 - 49 **PP**.

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.

Coddington, J. A. Griswold, C. E., Davila, D. S., Penaranda, E. and Larcher, S. F. 1991. Designing and testing sampling protocols to estimate biodiversity in tropical ecosystems. Dioscorides Press, 44 - 49 **PP**.

Conniff, R. 2001. "Tarantulas: Earth Tigers and Bird Spiders." *National Geographic*. 98 - 115.

Haunt, Y., Delme, J., Legal, L. and Williams, T. 2005. Host selection by a kleptobiotic spider. *Naturissenschaften* **92** (2): 95 - 99

Jackson, R.R. 1992. Predator- prey interactions between web-invading jumping spiders. *Journal of Zoology*, **228** (3): 509 - 520.

Judd, W.W.1966. Spiders and their insect prey (Diptera: Hemiptera: Hymenoptera) from heads of oxeye daisy, *Chrysanthemum bevanthemum* L. in Southern Western Ontario. *Proceedings of Entomological Society of Out.*, **95**: 137 - 139.

Kotiya, A. and Kumar, A. 2001**.** Biodiversity of the Indian Desert and its value. In: From soil to cell-a broad approach to plant life, (Bender, L. and Kumar, A. eds.). GieBen Ele ctronic Library (GEB). *www. Bibd. Uni-giessen de.* 1 - 13.

Mathirajan, V.G. and Reghupathy, A. 2003. Prey preference and predatory potential of spiders in cotton ecosystem. *Journal of Entomon*, **28** (1): 9-14.

Nigam, V. 2004. Bibliography of Rajasthan fauna. Zoological Survey of India. 1 - 352.

Pocock, R. I. 1900. The fauna of British India including Ceylon and Burma, Secretary of State for Indian council, London, 279. The fauna of British India, Arachnida, London, 1-279 **PP**.

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.

Sadana, G. L. and Kaur, K. V. 1979. Feeding intensity and food preference of the Salticid spider, *Marpissa tigrina* Tikader. *Science and Culture*, **46**: 114 - 115.

Sadana, G. L. and Kumari, K. 1977. Predaceous spiders of cotton pests and their extent of feeding. *Proceedings of 64th Indian Science Congress*, 182 **P.**

Sadana, G. L. and Sandhu, D. 1977. Feeding intensity of development instars of the spider *Marpissa ludhianansis* on the fulgorid pest of grapevines. *Science and Culture*, **44** (12): 550 - 551.

Sandidaque, J. 2005. Predation by cosmopolitan spiders upon the medically significant pest species *loxosceles recluse* (Araneae : Sicariidae): limited possibilities for biological control. *Journal of Economic Entomology*, **97** (2)**:** 230 - 234.

Singh, N.P. and Sihag Vijay. 2007. Seasonal variation in spider fauna in different habitats of Jhalana forest range. *Entomon*, **32** (3) : 153 - 159.

Singh, B. Battu, G. S. and Atwal, A. S. 1975. Studies on the spider predators of the maize borer *Chilo partellus* Swinhoe in Punjab. *Indian Journal of Entomology*, **37** (1) : 72 - 76.

Sudhikumar, A.V. Mathew, M. J. Sunish, E. and Sebestian, P. A. 2006a. Seasonal variation in spider abundance in Kuttanad rice agroecosystem, Kerala, India (Araneae). *Acta Zoologia Bulgeria*, 181- 190.

Sudhikumar, A.V., Mathew, M. J. Sunish, E., Murusegan, S. and Sebestian, P.A. 2006. Preliminary studies on the spider fauna in Mannavan shola forest, Kerala, India (Araneae). *Acta zoologia Bulgeria*, 319 - 327.

Tikader, B. K. 1977. Description of two new species of jumping spiders of genus *Phidippus* (Salticidae) from India. *Entomol.*, **2** (1) : 97 - 99.

Tikader, B. K. 1987. Handbook of Indian spiders, Zoological Survey of India, Calcutta, India.

Tikader, B. K. and Malhotra, B. 1980. Fauna of Indian spider (Araneae), Vol.I, Thomisidae. 1 - 258 **PP**.

Usher, M.B. and Humphrey, J. W. 2003. The pine forests of Glen Affric: the diversity of their arachnids. *Scottish-Forestry*, **57** (3): 133 - 140.

Wise, D. H. 1993. Spiders in Ecological Webs. Cambridge University Press, Cambridge, UK and New York. 328 **PP**.

Zafar, A. 2001. Diversity and relative abundance of spider species occuring on different strata of citrus trees at Samundari (Pakistan). *Faisalabad (Pakistan).* UAF. 90. **P**.

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