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STUDY ON THE MORPHOLOGY, FEEDING CAPACITY AND PREY PREFERENCE OF ORB-WEAVING SPIDER *NEOSCONA NAUTICA* (L. KOCH, 1875).

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ABSTRACT : Laboratory studies were carried out to investigate morphology, prey preference and feeding capacity of *Neoscona nautica* (orb weaver spider) collected from various places of Azamgarh district in Uttar Pradesh (India). It was observed that it is a nocturnal species found on bushes near the crop fields, makes web at night and feeds on moths, mosquitoes, house flies and other soft bodied insects. A single individual can prey on about 19.40±2.32 insects/ 24h. Moths were the preferred prey for this species. During morphological study two pairs of pit-like spots were observed on the dorsal surface of abdomen. This feature was reported here for the first time.

Key words: *Neoscona nautica*, morphology, feeding capacity, prey preference.

INTRODUCTION

Spiders are among the most diverse groups on earth, which received the seventh ranking in global diversity after the six highest insect orders. Among various arthropods, the spiders are known for their complete dependence on predation of small insects and arachnids (Coddington and Levi, 1991). A number of entomologists have acknowledged the importance of spiders as one of the major predators in regulating the pest of different crops (Patel and Pillai, 1988). Spiders have different size and colours, and can be located easily in different habitats. They may be found everywhere, on dry leaves, on forest floor, tall grasses, underground caves, under bark, stones, logs, near water source, mountainous areas and inside human habitations. All spiders possess spinnerets and produce silk, which is mainly composed of protein called fibroin. Spiders use the silk for various purposes. A web spider uses its silk to trap the prey (Uniyal and Hore, 2006). Poison glands are found in all spiders except members of two small families. Spiders use their venom to kill the prey and as a means of defense. Generally it is believed that spiders are highly poisonous and harmful. Indeed all spiders have poison glands but few of them are dangerous to man (Gajbe, 2004).

Spiders are the abundant natural enemies in any agro-ecosystem and are found in most terrestrial habitats and often present in high numbers (Kaston, 1978). All spiders are predaceous and insects constitute their main prey (Turnbull, 1973). They are generalist predators, can kill a large number of insects per unit time and hence of great importance in reducing and even in preventing outbreaks of insect pests in agriculture (Sunderland *et al.* 1986). Spiders feed on a variety of prey. But even then, spiders mostly preferred soft bodied, immature stages with more internal body fluid, especially the homopterans (Baldev Prasad, 1985). Nyffeler *et al*. (1987) reported that spiders usually take prey ranging between 0.10 to 1.10 times their own body size.. Kim (1998) pointed out that if spiders are being used as biological control agents, it is very important to understand their life styles. Both web builders and hunters follow a foraging strategy. Song and Lee (1994) suggested that web builders such as *P. clercki* were better able to suppress insect pests than hunters such as *P. subpiraticus*. Yamano (1977) suggested that spiders are the most important biological control agents regulating insect populations in rice fields, including insect pests. The presence of spiders in biotic environment of insect pests greatly influence their population dynamics (Jackson 1992 ; Sandidaque, 2005; Rajeshwaram *et al.*, 2005; Bastawade and Khandal, 2006; Haunt *et al.,* 2005; 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 (Park *et al.,* 1972; Paik and Kim 1973; Paik *et al.,* 1974; Choi and Namkung, 1976;

Okuma *et al*., 1978; Paik *et al*., 1979; Yun and Namkung, 1979; Paik and Namkung, 1979; Kim *et al*., 1990; Kim, 1992; Lee *et al*., 1993a, 1993b; Song and Lee, 1994; Kim and Kim, 1995; Kim 1995a, 1995b, Im and Kim, 1999). However, most of these studies where limited to the identification of spiders, and to investigating the dominant spider species, their regional distribution, seasonal fluctuations 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 (Tikader, 1980; Biswas and Biswas, 1992, 2003, 2004; Vijayalaxmi and Ahimaz, 1993; Patel, 2002; Gajbe, 2003 and 2004; Majumder (2004, 2005 and 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).

From the review of literature, it is quite evident that role of spiders as bio-control agents in agriculture, poultry as well as in controlling house-hold insects 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 study has been undertaken to study morphology, feeding capacity and prey preference of a Orb-weaving spider *Neoscona nautica* (L.Koch, 1875), collected from various agricultural areas of Azamgarh district of U.P. (India).

MATERIALS AND METHODS

Collection of spiders: Individuals of *Neoscona nautica* were collected from crops, orchards, ornamental and wild plants in some habitats of Azamgarh district of U.P. (India) by following methods:

1. Direct hand picking: Collection of most web building spiders was made by direct hand picking with the help of test tubes.

2. 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 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 specimens 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 specimens. 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 collection.

Photography : Live photographs of all 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 the study. Attempts were also made to take natural photographs of spiders while they were feeding on insects.

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 Dyal (1935), Kaston (1978), Tikader (1980), Tikader and Biswas (1981), Tikader (1982), Brignoli (1983), Davies and Zabka (1989), Plantik (1989), Majumder and Tikader (1991), Biswas and Biswas (1992), Barrion and Litsinger (1995), Yin *et al.* (1997), Song and Zhu (1997), Biswas and Biswas (2003, 2004), Nentwig *et al.* (2003) and Plantik (2004), information and photographs available on internet and other relevant literature.

Study of prey choice : To study the prey choice of the collected spiders, adult house flies, rice moth, mosquitoes and their larvae and small insects were supplied to spiders which were kept under rearing chambers.

Each rearing chamber (9.5 cm height, 6.0 cm length and width) was 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 kept in separate chambers.

To study prey choice, spiders were kept starved for 24 h, then each spider was supplied with larvae and adults of rice moth (*Corcyra cephalonica*), house flies and mosquitoes along with small insects (ten individuals of each kind of prey in each rearing chamber) separately. After 12h number of fed and live prey individuals were

Neoscona nautica : **Fig. 01:** Dorsal view of cephalothorax, **Fig. 02:** Dorso-lateral view, **Fig. 03:** Postero-dorsal view, **Fig. 04:** Ventral view and **Fig. 05:** Feeding on adult of rice moth (*Corcyra cephalonica*).

Table 1 : Prey preference and feeding capacity (Prey consumed/ 24h) of *Neoscona nautica* (Orb weaving spider).

Type /Number of prey consumed /24h						
S. No.	**Larvae**	**Adult moths**	**Houseflies**	**Mosquitoes**	**Others**	**Total**
1	1	8	5	7	0	21
2	0	7	3	5	1	16
3	2	7	5	6	0	20
4	3	6	5	5	3	22
5	2	6	4	4	0	16
6	0	7	6	7	0	20
7	3	5	5	5	1	19
8	0	8	5	6	2	21
9	1	5	4	7	0	17
10	4	5	5	6	2	22
Mean±S.D.	1.60±1.42	6.40±1.17[a]	4.70±0.82[a]	5.80±1.03[b]	0.90±1.10[a]	19.40±2.32

Significance level [a] 0.001 and [b] 0.01 when compared with adjacent means.

counted to find out preference of their prey. Attempts were also made to take live photographs while spiders were preying.

***C**orcyra cephalonica* and house flies were reared in the laboratory according to the method of (Chaubey and Bhatt, 1988) and (Vijayalakshmi and Ahimaz, 1993) respectively. Mosquitoes, moths and small insects pests were collected from houses, paddy crop fields and surroundings.

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 in the Azamgarh district of U.P.

RESULTS AND DISCUSSION

***Neoscona nautica* (L.KOCH, 1875)** (Orb-weaving spider)

Classification

Phylum : Arthropoda, Class : Arachnida, Family: Araneide, Genus: *Neoscona*, Species**:** *nautica*

Feeding capacity and prey preference of *Neoscona nautica* studied during present investigation have been given in Table1.

Habit and habitat: These are nocturnal, smaller in size prepare small snares along with rolling of smaller to medium size leaves centric or eccentric place of the web and hide in the rolling of leaf. Web may be of considerable height above the ground. It becomes difficult to notice and collect the spider from such types of nests in the collection field. Prey on smaller insects entangled by their nest as has also been described by Majumder (2007).

Description: Cephalothorax longer than wide, blackish; cephalic region darker; thoracic region near posterior end brownish and excavated (Fig. 01). Chelicerae blackish, outer margin with four teeth and inner margin with three teeth, fang smaller. Sternum blackish with a brownish median longitudinal marking, posterior half only slightly narrowed. Labium much shorter, blackish, distal margin whitish. Maxillae much longer compared to labium, blackish, inner margin whitish. Legs blackish, anterior legs more blackish, while posterior two legs with greyish bands at the proximal end of tibia and metatarsus (Fig. 02).

Dorsum of abdomen velvety black, with a mid-dorsal slightly paler region with two lateral projections. A pair of whitish or greyish spots on the anterior half present. Longer than wide, somewhat heart shaped, a few whitish isolated bristles stand out from dorsum (Fig. 03). Ventrum with blackish broad patch bordered at each postero-lateral angle with a white spot (Fig. 04).

Diagnostic characters: Cephalothorax yellowish brown, longer than wide, thoracic region provided with distinct longitudinal groove. Anterior row of eyes more recurved than the posterior row (Fig. 01). Chelicerae strong. Legs long and strong. Abdomen triangular in shape (Fig. 02). Similar description has also been made by Majumder (2007). As is clear from Fig. 03 that there are two pit-like structures present on each dorso-lateral side of the abdomen. This character is being reported here for the first time.

Economic importance: As is clear from Table1, *N. nautica* preferred to prey on soft bodied and actively flying insects like adults of rice moth, house flies, mosquitoes and other smaller insects entangled in its web.

Song and Lee (1994) suggested that web builders such as *P. clercki* were better able to suppress insect pests than hunters such as *P. subpiraticus*. Yamano (1977) suggested that spiders are the most important biological control agents regulating insect populations in rice fields, including insect pestsPreference of soft bodied insects by spiders has also been reported by Baldev Prasad (1985). Acts as bio-control agent for insect pests in the crop fields. During present study, it was seen feeding on adult moths (Fig. 05), house flies, mosquitoes and other smaller insects, entangled in its web. Spiders have been considered important predators by Pickett *et al*. (1946); Dondale (1956); Duffey (1962); Kajak *et al*.(1968); Fox and Dondale (1972) and Tanaka (1989) , Uniyal and Hore (2006).

Remark: This spider species is being reported here for the first time from Sidhari and Chandeshwar areas of Azamgarh district in Uttar Pradesh (India).

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