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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;

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STUDY ON THE MORPHOLOGY, FEEDING CAPCITY AND PREY PREFERENCE OF *Neoscona crucifera* AND *N. adianta* (Orb-Weaving Spiders)

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ABSTRACT

Laboratory studies were carried out to investigate morphology, prey preference and feeding capacity of *Neoscona crucifera* and *N. adianta* (orb weaver spiders) collected from rice crop fields, bushes and houses of Azamgarh district in Uttar Pradesh (India). It was observed that these make webs between paddy plants, twigs of bushes, corners of porticos of houses mostly at night, occasionally during day time and feed on small locusts, aphids, moths, mosquitoes, house flies and other soft bodied insects entangled in the web. Coleopterans were the least preferred prey for both of the orb weavers. A single individual of *N. crucufera* can prey on about 12.10±1.52 insects/ 24h where as *N. adianta* has ability to prey on about 18.30±3.02 insects/ 24h.

KEYWORDS: *Neoscona crucifera, N. adianta,* morphology, feeding capacity

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 . A number of entomologists have acknowledged the importance of spiders as one of the major predators in regulating the pest of different crops . 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. Poison glands are found in all spiders except members of two small families. Spiders use their venom to kill the prey and as 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. All spiders are predaceous and insects constitute their main prey. 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. 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 . 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; 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 .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 (Biswas and Biswas, 2003, 2004; Patel, 2002; Gajbe, 2004; Majumder (2005 and 2007) in different regions of the country and documented 1,035 species belonging to 240 genera under 46 families from Indian Subcontinent.

From the review of literature, it is evident that role

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EFFECT OF LOW TEMPERATURE ON CERTAIN ASPECTS OF EMBRYONIC BIOCHEMISTRY OF *CORCYRA CEPHALONICA* (STAINTON) (LEPIDOPTERA: PYRALIDAE)

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ABSTRACT – Laboratory experiments were performed to study the effects of temperature on the hatching percentage, glucose and glycogen levels and acid phosphatase activity in the eggs during embryonic development of the rice moth, *Corcyra cephalonica* incubated at 30, 28, 26 and 24°C. Lowering the temperature from 30 to 24°C did not affect the hatching percentage of eggs. A significant decrease in glucose levels (mg/egg) occurred during the initial stages followed by an increase, during the later stages of embryogenesis in eggs incubated at all three temperatures, although the levels of variation decreased with decreasing temperature. Acid phosphatase activity showed a more or less, sigmoid pattern of change, with a lowering rate of increase, corresponding to decreasing incubation temperature.

Key words : *Corcyra*, Lepidoptera, temperature, hatching percentage, glucose, glycogen, acid phosphatase.

INTRODUCTION

The rice moth, *Corcyra cephalonica* (Stainton, 1866) is a notorious pest of stored commodities, especially cereal products and found in Asia, North America, Europe and other tropical and subtropical regions of the world. Its larval stages cause substantial damage to rice, gram, maize, nuts, cotton seeds, peanuts, linseeds, raisins, nutmeg, currants, chocolate, army biscuits and milled products (Atwal, 1976; Piltz, 1977). This pest is adapted for terrestrial mode of life and exists throughout the year. The effects of temperature on various aspects of *Shijimiaeoides divinus barine* have been studied by Nakamura *et al* (2008) and Koda and Nakamura (2009). Komeyama and Hoshikawa (2007) studied the effect of temperature on larval growth of *Celastrina augitanii*. Lu *et al* (2009) performed a comparative study of the temperature-dependent life histories of three economically important *Adelphocoris* species. Alexander *et al* (2003) have studied effect of temperature on embryogenesis of pea aphid (*Acyrthosiphon pisum*). Chaubey *et al* (2010) investigated effect of low temperature on various aspects of embryogenesis in the eggs of *Corcyra cephalonica*.

Insect embryogenesis is characterized by adaptations to the terrestrial mode of life. Many insects undergo a period of arrested development, called diapause, to avoid seasonally recurring adverse conditions (Alexander *et al*, 2003). Diapause is generally characterized by a slowing of metabolism, a reduction or elimination of cell division and a cessation of morphological development, evident as a 'resting stage' (Delinger, 2002).

Carbohydrates along with proteins and lipids form the principal classes of organic compounds that are found in insects and other organisms. During the embryonic development of insects, yolk carbohydrates and lipids provide the main substrates for energy production. In developing eggs, glycogen is mobilized as glucose and trehalose during embryonic development (Hill, 1945; Chino, 1958; Agrell and Lundquist, 1973; Chippendale, 1978; Bhatt and Krishna, 1982).

Research using both histochemical and biochemical methods to map enzyme patterns in developing has been carried out previously. The wide occurrence of phosphatases in animal tissues is thought to be associated with the (a) transport of metabolites, (b) metabolism of phospholipids, phosphoproteins, nucleotides and carbohydrates and (c) synthesis of proteins. The importance of these enzymes in embryonic tissues has also been pointed out by Moog (1946) and Boell (1955). Using histochemical techniques, Yao (1950) reported that acid phosphatase is present in all developmental stages of *Drosophila*, but they found no apparent changes in this enzyme throughout embryogenesis. Biochemical studies on the activities of acid and alkaline phosphatases have been carried out on the eggs of silkworm (Fitzgerald, 1949), grasshopper (Chino, 1961; Sridhara and Bhat, 1963), termite *Odontotermes* (Banerjee, 1964), rice moth (Chaubey and Bhatt, 1988 and Chaubey *et al*, 2002) and house fly (*Musca domestia*) (Ribolla *et al*, 1992), during

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TEMPERATURE INDUCED CHANGES IN EMBRYONIC BIOCHEMISTRY OF *CORCYRA CEPHALONICA* (STAINTON) (LEPIDOPTERA: PYRALIDAE)

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ABSTRACT

Effect of temperatures (30, 28, 26 and 24°C) on live weight, water content and activity of alkaline phosphatase in the eggs during embryonic development of the rice moth, *Corcyra cephalonica* was studied. A significant increase occurred in the duration of embryonic life with decrease in temperature. Incubated at 30°C, wet weight and water content of eggs significantly decreased up to 36-48 h and 32-40 h respectively. The rate of decrease in live weight and water content lowered with decrease in incubation temperature. The activity of alkaline phosphatase was lowest in newly laid eggs (0-6h), but as embryogenesis proceeded, a significant and continuous increase in its activity was observed till 60, 72, 108 and 144 h followed by a continuous fall till hatching in the eggs at 30, 28, 26 and 24°C respectively.

KEY WORDS: *Corcyra*, Lepidoptera, temperature, duration of embryonic life, live weight, water content, alkaline phosphatase

INTRODUCTION

Many insects undergo a period of arrested development, called diapause, to avoid seasonally recurring adverse conditions (Alexander *et al.*, 2003). Diapause is generally characterized by a slowing of metabolism, a reduction or elimination of cell division and a cessation of morphological development, evident as a 'resting stage' (Denlinger, 2002).

The rice moth *Corcyra cephalonica* (Stainton, 1866) is a notorious pest of stored commodities, especially cereal products in Asia, North America, Europe and other tropical and subtropical regions of the world. Its larval stages cause substantial damage to rice, gram, maize, nuts, cotton seeds, peanuts, linseeds, raisins, nutmeg, currants, chocolate, army biscuits and milled products (Atwal, 1976; Piltz, 1977). This pest is adapted for terrestrial mode of life and exists throughout the year. The effects of temperature on various aspects of *Shijimiaeoides divinus barine* have been studied by Nakamura *et al.* (2008) and Koda & Nakamura (2009). Komeyama & Hoshikawa (2007) studied the effect of temperature on larval growth of *Celastrina augitanii*. Lu *et al.* (2009) performed a comparative study of the temperature-dependent life histories of three economically important *Adelphocoris* species. Alexander *et al.* (2003) have studied effect of temperature on embryogenesis of pea aphid (*Acyrthosiphon pisum*). Investigations on various aspects of the embryonic biochemistry of *C. cephalonica* have also been performed (Chaubey & Bhatt, 1988; Chaubey *et al.*, 2002; Chaubey & Misra, 2004; Chaubey, 2007; Chaubey *et al.*, 2008 and Chaubey *et al.*, 2010).

Insect embryogenesis is characterized by adaptations to the terrestrial mode of life. Terrestrial propagation requires protection of the eggs against desiccation (Sander

Table 1: Effect of temperature on duration of embryonic development in *Corcyra cephalonica* (Mean ± S.D.).

Temperature of incubation (°C)	Duration of embryonic life (h after oviposition)
30 ± 0.5	72 ± 4
28 ± 0.5 [b]	96 ± 3 [a]
26 ± 0.5 [b]	144 ± 5 [a]
24 ± 0.5 [b]	192 ± 4 [a]

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

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Studies on the effect of low temperature on the duration of embryonic life, hatching percentage, wet weight, water and glucose levels and acid phosphatase activity during embryogenesis in eggs of *Corcyra cephalonica* (Stainton) (Lepidoptera: Pyralidae)

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ABSTRACT

Laboratory experiments were performed to study the effects of low temperature on the duration of embryonic life, hatching percentage, wet weight, water content, glucose levels and acid phosphatase activity during embryonic development in the rice moth, *Corcyra cephalonica*. A significant increase occurred in the duration of embryonic life with decreasing temperature. Lowering the temperature from 28°C to 24°C did not affect the hatching percentage of eggs. However, when incubated at 28°C, wet weight and water content of eggs significantly decreased with advancing egg age up to 40-48 h and 32-40 h respectively. Moreover, the rate of decrease in wet weight and water content lowered with decreasing incubation temperature. A significant decrease in glucose levels (µg/egg and µg/mg wet weight of egg sample) occurred during the initial stages followed by an increase, during the later stages of embryogenesis in eggs incubated at all three temperatures, although the levels of variation decreased with decreasing temperature. Acid phosphatase activity showed a more or less, sigmoid pattern of change, with a lowering rate of increase, corresponding to decreasing incubation temperature.

Keywords: Acid phosphatase, *Corcyra*, duration of embryonic life, glucose, hatching percentage, temperature, water content, wet weight.

INTRODUCTION

The rice moth *Corcyra cephalonica* (Stainton, 1866) is a notorious pest of stored commodities, especially cereal products and found in Asia, North America, Europe and other tropical and subtropical regions of the world. Its larval stages cause substantial damage to rice, gram, maize, nuts, cotton seeds, peanuts, linseeds, raisins, nutmeg, currants, chocolate, army biscuits and milled products (Atwal, 1976; Piltz, 1977). This pest is adapted for terrestrial mode of life and exists throughout the year. The effects of temperature on various aspects of *Shijimiaeoides divinus barine* have been studied by Nakamura *et al.* (2008) and Koda & Nakamura (2009). Komeyama & Hoshikawa (2007) studied the effect of temperature on larval growth of *Celastrina augitanii*. Lu *et al.* (2009) performed a comparative study of the temperature-dependent life histories of three economically important *Adelphocoris* species. Biochemical investigations of various aspects of the embryonic biochemistry of *C. cephalonica* have also been performed (Chaubey & Bhatt, 1988; Chaubey *et al.*, 2002; Chaubey & Misra, 2004; Chaubey, 2007; Chaubey *et al.*, 2008).

Insect embryogenesis is characterized by adaptations to the terrestrial mode of life. Terrestrial propagation requires protection of the eggs against desiccation (Sander *et*

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EFFECT OF STARVATION ON THE WET & DRY WEIGHTS OF THE BODY AND LEVELS OF PROTEIN AND ACTIVITY OF ACID PHOSPHATASE ENZYME OF THE FAT BODY OF THE LARVAE OF *CORCYRA CEPHALONICA* STAINTON (LEPIDOPTERA : PYRALIDAE)

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ABSTRACT– A continuous and significant reduction in the body weight (wet and dry) and wet weight and percent proportion of the fat body was observed in the starved larvae with prolongation of starvation period. The percent proportion of fat body did not change significantly in starved larvae until 4th day of starvation but it reduced markedly in the larvae of 6th day of starvation. A significant decrease in the concentration and total amount of protein in the fat body of *C. cephalonica* with the prolongation of starvation period was found. Activity of acid phosphatase enzyme increased significantly in the fat body of starved larvae with the prolongation of starvation period.

Key words : *Corcyra*, body weight, fat body, protein, acid phosphatase.

INTRODUCTION

The developing insect larvae, in contrast to the eggs and pupae, depend on continuous supply of food for their growth and development. Usually the rate of weight increase is greater in the later instars (Chapman, 1982a). A physiologic nonfeeding period occurring at the end of each larval prior to moulting is characteristic of most insects (fasting). By contrast, in order to starve an insect, the food must be denied during the feeding phase of the stadium when they would eat the feed if, it were available (Woodring, 1984). Starvation has been used as a means of investigating insect metabolism (Moreau *et al*, 1984).

The fat body of insects is of major importance as a centre in which many metabolic processes occur. It serves primarily as a store of food reserves, which are of particular importance to the insects during non feeding periods whether these are of short or long duration and whatever may be their cause (Chapman, 1982c). Starvation induced biochemical variations have been studied in the fat body and other tissues of *Tenebrio* (Melamby, 1932; Lecierq, 1949 and Gourdoux, 1979), *Phormia* (Lafon, 1941), *Bombyx* (Duchateau and Florkin, 1959; Horie, 1960; Saito, 1963; Baud, 1968 & 1972 and Baud and Pascal, 1977), *Coccinella* (Sakuri, 1969), *Locusta* (Goldsworthy, 1969; Engelmann, 1970; Hill and Goldsworthy, 1977; Moreau *et al*, 1984), *Anthronomus grandis* (Nettles *et al*, 1971), *Manduca sexta* (Dahlman, 1973) and *Oxya japonica* (Lim and Lee, 1981). Some aspects regarding embryonic biochemistry of *C. cephalonica* have been studied by Chaubey and Bhatt (1988); Chaubey *et al* (2002); Chaubey and Misra (2004); Chaubey (2007) and Chaubey *et al* (2008).

On the basis of above findings, in the present investigation, it has been proposed to find out the effect of starvation on the weight (wet and dry) of the whole body, wet weight and percent proportion of the fat body and concentration as well as total amount of protein/larval fat body and activity of acid phosphatase in the fat body of control and variously starved larvae of *Corcyra cephalonica*, a serious pest of stored commodities (Ayyar, 1919; Piltz, 1977).

It is hoped that the study will provide some better insight about the role of fat body reserves during the periods of starvation as well as changes occurring in the functioning of this physiologically/metabolically important tissue in the larvae of this holometabolous pest at such a transitory developmental phase (prior to pupation).

MATERIALS AND METHODS

Corcyra cephalonica were reared in the laboratory as described by Chaubey and Bhatt (1988). Larvae used in the present investigation were always obtained from the fresh batch of eggs laid by newly emerged adults. Freshly hatched larvae were reared on culture medium for their normal growth. On completion of 20 d of normal post-embryonic development the larvae were separated from the culture medium for experimental use. In order to minimize the mixing of different instars the larvae of