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Rearing technology of C*onocephalus maculatus* (Le Guillou) under laboratory conditions (Orthoptera: Tettigoniidae)

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ABSTRACT: *Conocephalus maculatus* (Le Guillou) was reared on the immature flowering part of *Zea mays*, the baby corn. The insect passed through a 6-7 instar life cycle with a total post embryonic development ranging from 45-55 days. The adults matured within 12-28 days while the adult life span ranged between 50-120 days. The total life span was 95-175 days. To study the survivability, the insects were reared on three different densities in insect cage, i.e., 25 insects/cage, 50 insects/cage, and 100 insects/cage. The survivability increased with decreasing density viz., 100 insects/cage with survivability was 24.3% where as with 25 insects/cage the survivability was relatively high (56%).

INTRODUCTION

Tettigoniids are grossly understudied in India due to its practical difficulties in rearing. This certainly applies to many temperate species, since many of them have a long and uncertain period of diapause (Ingrisch, 1990; 1996). *Conocephalus maculatus* (Le Guillou) is a multivoltine and widely distributed tettigoniid species in India. *Conocephalus* species have been reported as a predator of eggs and nymphs of *Leptocorysa oratorius,* a serious rice pest in Papua New Guinea (Rothschild, 1970;

Pitkin, 1980) and as a feed for poultry (Defoliart, 1982) as well. Hence, mass rearing of *Conocephalus maculatus* gains importance from agricultural point of view. This tettigoniid species has some advantages in rearing because of its gregarious and omnivore nature. For the present study, adults were collected from grassland in Chennai (13.04′N; 80.26°E). From this nucleus, a flourishing culture has since been built up and maintained for over a year. An attempt is made in this study to describe the culturing methodology, in addition to providing a brief account of the biology of the species.

MATERIALS AND METHODS

Insects collected from the grassland in Chennai` were reared in insect cages (20 liter capacity; 30x30x30cm wooden framed with fine iron mesh cage mesh size of about 0.5mm with glass front) at 20-30°C (Mean 23°C) with 60-80% relative humidity and a photoperiod of 16:8 (L:D) hours. Newly hatched nymphs were reared singly in muslin topped 0.5-litre capacity plastic jars, at a mean temperature of 23°C and a relative humidity of 60%. They were reared on baby corn (an immature flowering part of *Zea mays*), which was cut into small pieces and kept in plastic jars for early nymphs. Placing a wet cotton wad to maintain high humidity and also provided water. However, for the later developmental stages, a single full corn was dipped in a small bottle containing water. The food was replenished every other day. Cut pieces of *Panicum maximum* immersed in Knop's solution was provided in the cage for oviposition. As the nymphs grew, they were transferred to insect cages in order to provide more moving space to reduce the incidence of malformations and wing deformities. Such malformations were prevalent among the older nymphs reared in smaller and crowded jars. Since all stages ate their own exuvia soon after moulting, the nymphs were carefully marked with red nail polish on the dorsal pronotum. The disappearance of the marking, accompanied by detectable increase in body size, confirmed moulting facilitating the recording of nymphal development periods. From third instar onwards, they were transferred to rearing cages of about 20-liter capacity.

RESULTS AND DISCUSSION

Table 1. shows the performance of *C. maculatus* under three different densities per cage viz, 25 insects/cage, 50 insects/cage and 100 insects/cage. The survivability was indirectly proportionate with the number of insects/cage. With 25 insects/cage the survivability was maximum (56%), whereas there was a decline in the percentage of survivability with 50 and 100 insects/cage (35% and 24% respectively).

Basic information on the biology of *C. maculatus* was investigated on *Zea mays*. Females oviposited in the leaf sheaths of *P. maximum*. The ovipositional site was selected by a brief mouth test i.e., superficial scarring of the leaf sheath which covers the stem with mouthparts. Then the female takes a position lengthwise of the stem, with four fore legs embracing the stem to give good purchase in the act, which follows.

The middle region of the body is now arched in a semicircle, bringing the apex of the abdomen forward beneath the body until the tip of the ovipositor reaches the scar on the stem beneath the thorax. As soon as the tip of the ovipositor comes in physical contact with the stem, the female begins to pull the legs and push with the ovipositor, resulting in a great pressure being applied on the ovipositor so as to insert it into the stem. The blade like ovipositor is adapted for such an unique oviposition behaviour. The egg is released in-between the guides of the ovipositor, and after the egg release, the ovipositor is withdrawn, leaving the egg with its head-end near the puncture and rest of it extending away from the puncture in a direction opposite to that in which the female was facing. Then, moving forward slightly, the body is again arched, the ovipositor feels for the egg puncture and, if successful in finding it, is sunken through the same aperture but the egg is directed this time in the opposite direction. After the egg is laid and the ovipositor removed, the insect again turns to face in the opposite direction, splinters the stem above the puncture more and then, advancing slightly, thrust the ovipositor a third time through the original aperture and places a third egg by the side of the first one laid. This process of laying eggs directed alternately up and down the stem, and each deposition followed by splintering the stem above the puncture, continues until ten to twelve eggs are laid during a single puncture. In case of such heavy deposition the interior of the stem gets packed with eggs. It is believed that the toughness and pliability of the eggshell prevents the ovipositor from breaking eggs, already laid, by its subsequent thrusts. The ovipositor may also be sensitive to the presence of eggs in the stem and avoid thrusting directly into them. The eggs present in the stem were detected with the help of light (i.e., under the light, the eggs present, arrangement of eggs in the sheath are seen). Then the eggs were collected from the leaf sheaths with the help of fine brushes. The eggs were thoroughly washed in sterile water, air dried, placed in damp filter paper in petri dishes (to avoid fungal infections) and incubated at 23 ± 2 °C. High humidity was maintained by keeping the filter paper always wet, for the incubation of eggs.

Eggs were usually laid in 6-8 batches in the lifetime of a female with about 7-9 eggs per batch. The eggs are thin and cylindrical 5-6mm long, and 0.2-0.3mm in wide. The incubation period ranged between 14-39 days under the conditions described above. On hatching, the first instar nymph is green, and measured about 5-7mm long. There are 6-7 nymphal instars, and the total postembryonic developmental period is 45-55 days (Table 2). During the post embryonic development, they exhibited a colour change viz., on hatching the nymphs were green, and during the course of development, some of them tend to turn brown in colour, while few among them revert back to green at the end of the post embryonic development. But in the field populations, green as well as brown nymphs are distinct and probably the colour may be influenced by many factors like background colour, genetics, temperatue, light etc. The morphometric characters are as follows viz. the total body length of adult - 16-19mm (Female), 16-18mm (Male); the wing length 14-21mm (Female), 13-19mm (Male); and ovipositor length 6-8mm. The preoviposition period ranges from 12-28 days with the total life span of adults (both male and female) ranged between 50-120 days.

During the course of rearing, some of them tend to be cannibalistic. If fresh food is provided, cannibalism occur only during moulting. During moulting, when the tettigoniids are extracting itself from their old skin, it is liable to be eaten by its congeners. As a result of such cannibalism a considerable reduction in population results. Avoiding over-crowding, minimises cannibalism, there by providing greater chances of undisturbed moulting and survival.

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Table 1. The influence of crowding on the survivability of *C. maculatus.*

Insects / cage	Percentage of insects survival to adult	Range of percentage of survival to adult	Mean percent of survival to adult
25	42/75 (56.0%)*	52-60%	56.0 ± 3.3%
50	53/150 (35.3%)	30-40%	35.3 ± 4.1%
100	73/300 (24.3%)	22-26%	24.3 ± 1.7%

* Each experiments is replicated three times

Table 2. Life cycle of *C. maculatus* fed on *Zea mays* (Baby corn)

Egg incubation	Total Instars	Instars (Range)	Post embryonic development	Mature adults	Life span of adult	Total life span
14-39	6-7	I = 6-9 II = 6-7 III = 6-9 IV = 6-8 V = 6-9 VI = 8-9 VII = 8-10	45-55	12-28	50-120	95-175

Values are represented in days. Mean of three replicates