INTRODUCTION

Oligonychus biharensis is a sporadic pest of vegetables, rose, camphor, litchi and many other plants of high importance. Feeding by this mite causes characteristic bronzing on leaves and severe damage to the host plant. Severe infestation and prolonged feeding results in crinkling, subsequent drying and defoliation of affected leaves. Attack by these mites normally affects the growth and vigour of host plants. *Vigna unguiculata* (L.) Walp. (Cow peas), the current host plant proved to be a potential host for the successful establishment of *O. biharensis* throughout the year. Cow peas is one of the most important tropical multi- purpose legumes with astonishing ability to fix atmospheric nitrogen through its root nodules thereby adding to soil fertility. *V. unguiculata* is cultivated in secluded habitat may offer better chances of protection of eggs in an environmental growth chamber at 30 ± 2°C & 70 ± 5% RH. Rearing of the life stages of the mite was

Post embryonic development of Oligonychus biharensis (Hirst) was traced on cow pea in the laboratory at 30 ±2°C & 70 ± 5% RH. Rearing of the life stages of the mite was

1-MATERIALS AND METHODS

Live cultures of *O. biharensis* were maintained on cow pea in the field to observe closely the mode of infestation, progressive damage symptoms induced on the host plant and also to make quantitative estimation of damage potential of the concerned species. To achieve this objective, two mite treatments (i) *M−*, mite free plants and (ii) *M+*, plants artificially infested with mites, were included in a randomized block design plots (3 m ×3 m) which was replicated four times within a season. Cultivation of host plants was done by plant-cultivated techniques. The respective durations as recorded by Bonato et al. (1995a) on *O. gossypii* were 0.2 ± 0.2 days. Bonato and Zahir (1999) on *O. perseae* recorded 0.2 ± 0.2 days. Bonato et al. (1999a) on *O. gossypii* were 2.2 ± 0.3 days, 8.3 ± 1.3 days and 0.5 ± 0.2 days. Fecundity showed an increase on successive days of oviposition, reaching the peak levels on the 4th or 5th day and a gradual decrease from the 6th day onwards under laboratory conditions. On cow pea fecundity averaged 45.55 ± 2.2 eggs when mated and virgin females laid 50.9 ± 4.7 eggs and 40.2 ± 1.4 eggs respectively. This was in support of the findings of Bonato et al. (1995a) on *O. gossypii*, Aponte & Mc Murtry (1997) on *O. perseae*, and Chen et al. (2005) on *O. biharensis*. However, fecundity of *O. biharensis* recorded by Ji et al. (2005) (71.6 eggs/female) were significantly much higher to that recorded in the present study. The life span of *O. biharensis* on cow pea was 10.1 ± 0.18 days. The mated females recorded comparatively shorter life span of 9.9 ± 0.3 days and virgin females lived longer (Bonato & Gutierrez, 1999) up to 10.3 ± 0.2 days. Bonato and Gutierrez (1996) also observed that unmated females of *O. gossypii* infesting cow pea lived longer than the mated ones. Mean longevity of 8.2 days was recorded for *O. gossypii* on *M−* and *M+* plots. Studies on the development of *O. biharensis* were initiated in the laboratory on fresh leaves of cow pea by leaf flotation technique (Sangeetha & Ramani, 2011) in an environmental growth chamber at 30 ± 2°C & 70 ± 5% relative humidity. Observations on various aspects of development were made regularly on each culture set at 6h intervals. Each culture set consisted of 2-4 leaf bits, kept in petri dishes lined with moistened cotton pads and was treated as an experimental unit. Stock cultures of the mites were also maintained in the laboratory in the same manner so as to ensure constant supply of life stages.
3-Research Paper

Before the hatching process was initiated. This was followed by slit formation and the separation of the egg case by the forceful movements of the emerging larva. The mouth parts and the first pair of legs protruded out of the egg shell in the beginning fol- lowed by the emergence of the last two pairs of legs. Soon after hatching the larva moved away in search of food. The hatching process was completed in about 10-12 minutes. This is in confirmation with the observations reported by earlier workers (Das & Das, 1967; Aponte & Mc Murtry, 1997).

3-Duration of developmental stages Incubation period

The fresh orange coloured eggs turned brownish with age and the red eye spots clearly visible prior to hatching. Incubation period recorded was 2.66 ± 0.05 days. Ghoshal et al. (2006) and Sangeetha & Ramani (2007) reported 3.33 days on an average for the period on T. neocaledonicus.

4-Larval period

The newly emerged larva was hexapod, small, spherical and red- dish orange in colour. Change in body colour was noted with progress in feeding to dark red with dark spots on the dorsal body surface. The larva exhibited random movements on both surfaces of the leaf actively sucking the leaf sap. On cow pea, the active larval life lasted for 0.88 ± 0.05 day. In T. ludeni, Mallik & ChannaBassavanna (1981) reported 32.5 hours, in T. neocaledonius and Manjunatha & Puttswamy, (1889) and Ghoshal et al., (2006) reported 1 – 2.5 days and 3.33 ± 0.23 days respectively.

5-Protonymphal period

The protonymph was larger in size, reddish-orange coloured, octopod in nature with reddish-orange legs. Sexual dimorphism was apparent at this stage. Protonymph developed dark blotches on its dorsal surface with progress in feeding. The duration of active protonymphal period was 1.24 ± 0.02 days. Observations reported on mean protonymphal period of T. ludeni were 2.30 days (Puttswamy & ChannaBassavanna, 1981) and 3.80 ± 0.17 days in T. neocaledonicus (Ghoshal et al., 2006).

6-Deutonymphal period

The largest among the nymphal instars, the deutonymph was orange red coloured at the time of emergence. The colour later darkened with dark blotches on the dorsal. The hystersoma of the male and female deutonymph showed marked differences which were tapering posteriorly in the former and rounded in the latter. The duration of deutonymphal period lasted for 1.43± 0.06 days. This observation is in conformity with the reports of Manjunatha & Putsawamy (1989) and Sangeetha & Ramani (2007).

7-Quiescent Periods

A period of zero activity or quiescence was observed at the end of the active period of each developing stage, as observed in the case of other tetranychid species. The individual ceased all its visible life activities and became inactive. Selection of concealed or secluded areas especially near the petiole, mid rib or in be- tween the leaf veins in order to settle down in quiescence was a notable feature. During quiescence, the body assumed oval shape, developed a pale white covering and retracted all its legs below its body with stylets in pierced state in the leaf tissues. At the end of quiescent phase, the cuticle turned transparent and developed a slit on the dorsal region preparing itself for the molting process. The observation on the quiescence seemed to follow a common pattern as in other tetranychids as described by several authors. No significant change in the duration was recorded for the 1st, 2nd and 3rd quiescent stages of O. biharensis on cow pea and was completed in 0.55 day.

8-Moultng

Appearance of a dorsal slit marked the initiation of the process followed by widening of the slit towards either side. The division was complete and hence the molting skins were observed as two separate pieces on the leaf surface. The individual released from the exuviae moved away from the site in order to resume its normal life activities. The entire process was completed in 15 minutes for all the quiescent stages of the mite.

9-Mating

During mating, the male placed its anterior pair of legs over the dorsum of quiescent female deutonymph and awaited the female’s emergence. The process of molting was assisted by the male, helping the female to cast off its molting skin. During the act of copulation, the male moved under the posterior ventral surface of the female, arching its opisthosomal part so as to bring its aedeagus in contact with the genital aperture of the female. These observations are in agreement with the behavioural activities observed in the case of T. evansi (Qureshi et al., 1969), P. citri (Beavers & Hampton, 1971), E. orientalis (Banu & Chan- naBasavanna, 1972), T. urticae (Penman & Cone, 1972), and T. neocaledonicus (Sangeetha & Ramani, 2008). Mating lasted for 2 minutes. A single male mated with several females, though females were receptive to a single male only (Banu & ChannaBasa- vanna, 1972).

10-Parthenogenesis and Sexual development

The female of O. biharensis exhibited sexual as well as parthenogenetic reproduction. As a rule, the progeny of fertilized females produced individuals of both the sexes in the ratio 3 males: 10 females whereas the progeny of unfertilized females produced males only (Manjunatha & Putsawamy, 1989, Sangeetha & Ramani, 2007). Sex ratio therefore appeared to be female biased (Ghoshal et al., 2006). The total durations recorded averaged 6.22 ± 0.06 days (Sexual - 6.45 ± 0.05 days & Parthenogenetic - 6.0 ± 0.07 days). This duration appeared to be on the lower side as compared to 13.50 ± 0.15 days in T. neocaledonicus (Ghoshal et al.,2006), 10.9 ± 0.15 days (Sangeetha & Ramani, 2007). Tem- perature exerted a significant effect on all developmental stages of the mite (Haque et al., 2007, Sangeetha & Ramani, 2008). The shorter developmental periods averaging 6 – 12 days enabled O. biharensis in successfully completing 3 – 5 generations per month and maintain pest status. The temperature of 30°C proved to be most favoured by the mite because of the minimum time taken to complete the life cycle and high fecundity of both fertilized and unfertilized females (Gupta et al., 1971), Congdon & Logan.1983, Bonato et al., 1995a, Sangeetha & Ramani, 2011). Confirmation of this combination identified during drier and hotter months of the year in Kerala through field studies also revealed peak levels of infestation of O. biharensis on cow pea plants. Being one of the most valuable crops of our nutritional concern, this has to be considered seriously, as this major mite pest if not controlled would definitely cause heavy yield loss, branch die back and even death of the plant. A cognitive aspect that emerged from this study was the occurrence of the mite on cow pea, a so far unrecorded host for the species.

CONCLUSION

The shorter developmental periods averaging 6 – 12 days enabled O. biharensis in successfully completing 3 – 5 generations per month and maintain pest status. The temperature of 30°C proved to be most favoured by the mite because of the minimum time taken to complete the life cycle and high fecundity of both fertilized and unfertilized females (Gupta et
REFERENCES


