Effect of different laboratory hosts on the fertility table parameters and continuous rearing of an anthocorid predator, Orius tantillus (Motsch.)

CHANDISH R. BALLAL, TRIPTI GUPTA and SUNIL JOSHI
National Bureau of Agriculturally Important Insects (ICAR) Post Bag No. 2491, H. A. Farm P. O., Bellary Road, Bangalore 560 024, India
E-mail: ballalchandish@gmail.com

ABSTRACT: Orius tantillus (Motsch.) is a potential indigenous predator feeding on different species of thrips infesting vegetables, fruits and ornamentals. Laboratory studies were conducted at National Bureau of Agriculturally Important Insects, Bangalore, to understand the effect of different laboratory hosts on the fertility table parameters and continuous rearing of an anthocorid predator, Orius tantillus (motsch.). Based on the fertility table parameters of O. tantillus, the present study concluded that eggs of Sitotroga cerealella (Oliv.) can be utilized effectively for the multiplication of this anthocorid predator. Continuous laboratory rearing for 12 generations on the alternate laboratory host eggs further indicated that S. cerealella was a more suitable laboratory host in comparison to Corcyra cephalonica Stainton.

Keywords: Corcyra cephalonica, fertility parameters, Orius tantillus, rearing, Sitotroga cerealella

INTRODUCTION

In India, different species of thrips infest vegetables, grains, fruits and ornamental crops. Thrips tabaci Lindeman, Scirtothrips dorsalis Hood, Rhipiphorothrips cruentatus Hood and Caliothrips indicus (Bagnall) are four of the thrips species which cause serious damage to different host plants. Infestation by thrips as a pest and as a vector leads to yield loss through reduction of flower and fruit set. Chemical pesticides are not very effective on thrips due to their cryptic life style, short life cycle and tendency to develop insecticide resistance.

Anthocorids are important beneficial insects as natural populations of these predators have been successful in maintaining thrips populations at low levels. World over Orius spp. are known to be potential predators of thrips. In India, Orius tantillus (Motsch.) and Orius maxidentex Ghauri are commonly recorded as predators of various thrips species viz., Haplothrips ganglbaueri Schmutz, Thrips palmi Karny, Anaphothrips sudanensis Tryb., Caliothrips graminicola (Bagn. & Cam.), Scirtothrips dorsalis Hood, Thrips tabaci Lind., Batiothrips biformis (Bagn.), Caliothrips indicus (Bagn.), Microcephalothrips abdominalis (D. L. Crawford), Megalurothrips usitatus Bagnall and Thrips hawaiiensis (Morgan) on different crops (Ananthakrishnan and Thangavelu, 1976; Kumar and Ananthakrishnan, 1984; Muraleedharan and Ananthakrishnan, 1978; Thontadarya and Rao, 1987; Men, 1999). The research work in India on the identification, production and evaluation of anthocorid predators is detailed by Ballal and Gupta (2011). O. tantillus is multiplied in the laboratory at the National Bureau of Agriculturally Important Insects, Bangalore, India, for evaluation trials against T. tabaci and S. dorsalis.

The performance of a parasitoid or predator depends to a large extent on the host on which it is being reared. Dietary differences are known to affect the longevity and fecundity of Orius spp. (Kiman and Yeargan, 1985; Bush et al., 1993; Chyzik et al., 1995; Bonte and de Clerq, 2008; 2010). Orius spp. are known to be potential predators of thrips, but rearing of thrips continuously is cumbersome, indicating the need to look for alternate laboratory hosts. Based on biological parameters, Gupta and Ballal (2006 & 2009) reported that S. cerealella is a suitable host for rearing O. tantillus and provided the protocols for the continuous rearing of this predator. However, the need was felt to confirm the results through studies on a) the effect of the two laboratory hosts Corcyra cephalonica Stainton and S. cerealella on the fertility table parameters of O. tantillus and b) the progeny production in O. tantillus when it is reared continuously for several generations on the alternate laboratory hosts.

MATERIALS AND METHODS

The studies were conducted at 26±2°C and 65±2 per cent relative humidity and 14L/ 10D hours. UV-irradiated S. cerealella eggs obtained from Biotech International Ltd., Bangalore and UV-irradiated C. cephalonica eggs obtained from the Mass Production Unit at the National Bureau of Agriculturally Important Insects (Indian Council of Agricultural Research), Bangalore, India, were utilized as laboratory host materials. O. tantillus adults and nymphs were initially collected from
maize field and acclimatized to laboratory conditions by rearing for two generations on laboratory host eggs before initiating the experiments.

From the lab reared *O. tantillus* culture, five pairs of adults were released into each pearl pet plastic container (500 ml) i.e ovipositional container. The containers were provided with UV-irradiated *S. cerealella* eggs as feeding, bean pieces (4-5) as oviposition substrates and cotton lint to avoid cannibalism. Twelve such sets were maintained. After every 24 hr, the bean pieces with *O. tantillus* eggs were collected and observed under the microscope to record the number of eggs laid, after which they were placed in small round ventilated jewel boxes (diameter 7.5 cm and height 2.5 cm) for hatching.

When adults emerged, they were collected and observed under the microscope to differentiate the sex. Longevity of adult male and female was recorded. The age specific survival (*l*$_x$) and age specific fecundity (*m*$_x$) at each pivotal age *x* was worked out for the entire reproductive period. The number of individuals alive at age *x* as a fraction of 1 was recorded as *l*$_x$, and the number of female offspring produced per female at age interval *x* as *m*$_x$. Utilising these, the fertility table parameters were calculated based on the methods suggested by Birch (1948) and Andrewartha and Birch (1954).

Net reproductive rate (*R*$_0$) = $\sum l_x m_x$
Approximate duration of a generation (*T*$_c$) = $\sum l_x m_x / R_0$
Approximate intrinsic rate of increase (*r*$_m$) = $\log R_0 / T_c$
Precise intrinsic rate of increase (*r*$_m$) = $e^{r_m} - 1 = 1$
Net generation time (*T*) = $\log R_0 / r_m$
Finite rate of increase (*$\lambda$*) = $\log (R_0)^2$
Weekly multiplication of the population (*$\lambda$*) = ($r_m)^2$
Hypothetical F$_2$ females = ($R_0)^2$
Doubling Time (DT) = $\log 2 / r_m$
Weekly multiplication rate (WMR) = ($\lambda$)$^7$

The same procedure was followed to study the fertility table parameters of *O. tantillus* when reared on *C. cephalonica*. The effect of laboratory host on continuous rearing of *O. tantillus* was studied by using field collected adults of *Orius tantillus*. The adults were collected from the maize field and the experiment was initiated with 15 field collected adults for each treatment. One set (with four replications) was continuously reared on UV-irradiated *Corcyra cephalonica* eggs and one (with four replications) on UV-irradiated *Sitotroga cerealella* eggs. The number of adults produced in each generation was recorded and per cent increase per generation calculated. The progeny production per female was also recorded.

**RESULTS AND DISCUSSION**

Fertility table parameters for *Orius tantillus* on different laboratory hosts

Figures 1 and 2 depict the age-specific survival and fecundity of *O. tantillus* when reared on eggs of *C. cephalonica* and *S. cerealella*, respectively. When reared on *C. cephalonica* at room temperature, immature stages comprised 20 days and from the date of adult emergence, the first mortality occurred on the 2nd day and a gradual decrease in survival was observed as age progressed (Fig. 1). There was no survival beyond 25 days. Egg laying and female progeny production was initiated from the 5th day after emergence. The number of female progeny per female per day ranged from 0 to 0.66, the maximum female progeny production was recorded when the predator was 19 days old. Oviposition ceased when the predator was 20 days old (Fig. 1).

When reared on eggs of *S. cerealella*, immature stages occupied 20 days and the first mortality occurred on the 4th day after emergence and the female could not survive beyond 33 days (Fig. 2). Female progeny...
production occurred from the first day’s oviposition and continued till the female was 32 days old. Female progeny production per female per day ranged between 0 to 2.5, with peak female progeny production on the 8th day and smaller peaks were observed from 29th to 32nd days from adult emergence (Fig. 2).

The approximate duration of a generation ($T_c$) and Net generation time ($T$) of the predator when reared on *C. cephalonica* and *S. cerealella* were comparable, the $T_c$ and $T$ values being 30.04 and 27.08, respectively, on Corcyra and 31.26 and 29.01, respectively, on Sitotroga. The reproductive rate ($R_b$) = 9.97, finite rate of increase ($\lambda$ = 1.19), Hypothetical $F_2\,\varphi$'s (99.4) and Weekly multiplication rate (3.41) when reared on *S. cerealella* were higher in comparison to the corresponding values recorded when reared on *C. cephalonica* (1.31, 1.01, 1.72, 1.07, respectively). The doubling time was lower when reared on *S. cerealella* was 3.99 days, while on *C. cephalonica* it was 75.25 days.

When the fertility table parameters were worked out for *O. tantillus* on two different laboratory hosts, it clearly indicated that *S. cerealella* was a more suitable host for the laboratory production of *O. tantillus*. This is in conformity to the results reported by Gupta and Ballal (2006), where the biological parameters of *O. tantillus* were superior when reared on *S. cerealella*. On *S. cerealella*, oviposition was observed from the first day after emergence, while on *C. cephalonica*, from the fifth day. The oviposition period lasted longer when fed on *Sitotroga*. Tommassini *et al.*, (2004) reported that oviposition began 2 to 5 days after emergence in *Orius* spp., although sporadic cases of earlier oviposition were observed. They also reported that oviposition rates of *Orius* spp. varied depending on the host fed, with a longer oviposition period on suitable hosts.

The intrinsic rate of increase of *O. tantillus* recorded in this study (0.079) when reared on *Sitotroga* is comparable to the $r_m$ values of *Orius laevigatus* (Fieber) and *Orius majusculus* (Reuter) when reared on *Frankliniella occidentalis* (Pergande) and *Ephestia kuehniella* Zeller, respectively (Tommassini *et al.*, 2004).

Kawamoto *et al.*, (1999) reported that *Plodia interpunctella* (Hubner) eggs were suitable for rearing *O. tantillus* and the net reproductive rate, the mean generation time and intrinsic rate of increase were 15.87, 30.28 and 0.0987, respectively. In our study the corresponding figures were 9.97, 29.01 and 0.079, respectively, when reared on the suitable host egg *S. cerealella* in the laboratory at 26±2°C and 65±2% RH. The higher reproductive rate reported by Kawamoto *et al.*, (1999) could have been due to the different host eggs utilized and the studies were conducted at a constant temperature of 25°C, while our studies were conducted under normal laboratory conditions with fluctuating temperature regimes.

It is important to compare the fertility table parameters of the pest with that of the natural enemy so that the efficacy of the predator against the target pest could be predicted to some extent. Madadi *et al.* (2006) reported that the intrinsic rate of increase ($r_m$) of the target pest *T. tabaci* was 0.296, 0.158 and 0.234 on host plants like cucumber, sweet pepper and aubergine, respectively, while the finite rates of increase were 1.334, 1.171 and 1.264, respectively. Murai (2000) had reported an $r_m$ value of 0.1709 for *T. tabaci*. The reproductive rates and rates of increase of *O. tantillus* were lower than that of *T. tabaci* and the generation time was longer. However, the finite rate of increase and doubling time of *O. tantillus* at 24°C were comparable to those reported for *T. tabaci* on sweet pepper by Madadi *et al.* (2006).

**Continuous laboratory rearing of *Orius tantillus* on UV irradiated *Sitotroga cerealella* eggs in comparison to rearing on *Corcyra* eggs**

When reared on Corcyra, maximum adults were recorded in the 1st and 2nd generations with more than 100 per cent increase per generation (Fig 3). After the 3rd generation, there was a drastic reduction in adult
emergence with a production of only 5 to 29 adults per generation. The progeny production per female ranged from 0.7 to 4.5. When *O. tantillus* was reared on *Sitotroga* eggs, from the 15 field collected females, more than 100 adults (116 to 179) were obtained from each generation till the 5th generation. From the 6th to the 11th generation, 271 to 468 adults could be obtained per generation. A slight decline was observed in the 10th generation and a sharp reduction in progeny production in the 12th generation. The progeny production per female ranged from 0.4 to 15.5 per female, when reared on *S. cerealella*. The very high progeny production in the first laboratory generation when reared on *S. cerealella* also indicates the suitability of this host in comparison to *C. cephalonica*. The decline in progeny production observed in both the batches in the 12th generation (which was in the months of November-December) was probably due to the low humidity conditions during that period. This experiment indicated that if we start a culture with with field collected adults *O. tantillus*, they could be reared successfully on *S. cerealella* eggs for up to 11 generations, after which wild culture could be collected and mixed with the laboratory culture for rejuvenation.

The present study clearly indicates that *O. tantillus* is amenable to production on the UV irradiated eggs of alternate laboratory host insect, *S. cerealella*. This anthocorid can thus be produced in sufficient numbers for field releases in order to target thrips infesting different crops.

**ACKNOWLEDGEMENTS**

The authors are grateful to the Director, NBAII, Bangalore, for the facilities provided.

**REFERENCES**


Kumar, N. S. and Ananthakrishnan, T. N. 1984. Predator thrips interactions with reference to *Orius maxidentex* Ghauri and *Carayonocoris indicus* Muraleedharan


MS Received : 2 June 2012
MS Accepted : 15 June 2012