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SHORT COMMUNICATION

BIOLOGICAL ATTRIBUTES OF *TETRASTICHUS HOWARDI* (OLLIFF) ON SUGARCANE TOP BORER *SCIRPOPHAGA EXCERPTALIS* WALKER UNDER VARIABLE EXPOSURE REGIME

Ajay Kumar, Arun Baitha[1]*, Rajesh Kumar Pandey and Pradeep Kumar Bareliya

Abstract

The biological attributes of *Tetrastichus howardi* (Olliff) (Hymenoptera: Eulophidae) were studied at 25 ± 2°C and 65 ± 5% relative humidity in the laboratory on pupae of sugarcane top borer *Scirpophaga excerptalis* Walker (Lepidoptera: Crambidae). The number of adults emerged was maximum (88.20) in 24 h of exposure and minimum (27.16) in 120 h (5 d exposure). Thus, when the host pupa was subjected to prolonged exposure (>24h) the number of adults per pupa significantly decreased which indicated larval parasitoid mortality due to heavy superparasitism. Developmental period ranged from 17.2 to 18.4 days in 1 h to 120 h (5 days) exposure. Percentage female production was maximum (99.52) in 24 h exposure period and it declined significantly to 67.40 with increase in exposure period to 120 h. It can be inferred that higher numbers of adults in short periods of time, a strong preponderance of females when exposure period was 24 h and gregarious development make it possible to multiply *T. howardi* on sugarcane top borer pupae in the laboratory avoiding superparasitism.

Key words : Sugarcane, *Scirpophaga excerptalis, Tetrastichus howardi*, exposure period, biological attributes

Parasitoids can potentially control sugarcane borers with reduced costs and environmental risks relative to conventional methods. Sugarcane borers spend a considerable part of their life cycle within the plant making chemical control difficult (Sithanantham et al. 2013) thereby enhancing the importance of biological control. Also, feeding inside the plant makes it more difficult for parasitoids to locate and attack potential hosts. However, being part of the evolutionary game, some parasitoids have developed morphological characteristics and behavioural adaptations which allow them to utilize hosts with such concealed habits.

Tetrastichus howardi (Olliff) (Hymenoptera: Eulophidae) is a gregarious and polyphagous endopupal parasitoid of sugarcane borers (Baitha and Sinha 2005; La Salle and Polaszek 2007). It parasitizes sugarcane borer pupae (Cherian and Subramaniam 1940; Puttarudriah and Sastry 1958; Vargas et al. 2011; Sankar and Rao 2016) in their galleries in sugarcane. The success of biological control programmes depends on the mass rearing of parasitoids (Pastori et al. 2008 ; Pereira et al. 2009) and the specific hosts that are used for rearing, making it mandatory to study their biological interaction (Nakajima et al. 2012 and Kumar et al. 2016). The development of mass-rearing methods

Ajay Kumar, Arun Baitha[1]*, Rajesh Kumar Pandey and Pradeep Kumar Bareliya
Department of Entomology, Institute of Agricultural Sciences, Bundelkhand University, Jhansi 284128, India
[1]* ICAR-Indian Institute of Sugarcane Research, Lucknow 226 002, India
*Email: arunbaitha@rediffmail.com

depends on the knowledge of biological attributes i.e. sex ratio, reproductive potential, length of the life cycle (egg to adult), exposure periods of parasitoids to host and parasitoid sensitivity to abiotic factors, i.e. temperature, light, and humidity (Favero et al. 2013). The biological attributes of parasitoids require extensive study to standardize multiplication techniques and reduce the cost of parasitoid production (Pereira et al. 2009 and Favero et al. 2013). An attempt was made to study the effect of different exposure periods of T. howardi on pupae of sugarcane top borer *Scirpophaga excerptalis* Walker (Lepidoptera: Crambidae).

Tetrastichus howardi was initially obtained from the mass culture facility of M/s DSCL Sugar Mill, Rupapur (Hardoi), U.P. It was maintained on field collected pupae of sugarcane top borer *Scexcerptalis*. Twenty-two hour old mated females were kept singly in test tubes (15 cm x 2.5 cm) and each individual female was provided with one pupa of field-collected *S. excerptalis* for various exposure periods, i.e.1, 2, 4, 8, 12, 24, 48, 72, 96 and 120 h. Streaks of honey solution (50%) were provided in the test tubes as food for the females and the tubes were secured with cotton swab. After the specific exposure period, the adults were removed. The experiment was conducted at 25 ± 2°C and 65 ± 5% relative humidity in a BOD incubator with 10 replications. Observations on the number of adults emerged, developmental period (days) and sex ratio (percentage of females) were recorded and the data analyzed statistically.

The number of adults emerged was maximum (88.20) in 24 h of exposure and minimum (27.16) in 120 h (Table 1). When the host pupa was subjected to prolonged exposure (>24 h), the number of adults

Table 1. Effect of duration of exposure of *Tetrastichus howardi to Scirpophaga excerptalis* pupae on progeny parameters of the parasitoid

Exposure duration (h)	No. of adults emerged/ pupa	Developmental period (d)	Female emergence (%)
1	32.46^{f*}	18.00^{abc}	84.80^{d}
2	24.83^{h}	18.40^{a}	81.70^{e}
4	75.60^{c}	18.20^{ab}	92.80^{bc}
8	63.80^{d}	17.40^{cd}	79.80^{e}
12	78.80^{b}	18.00^{abc}	93.80^{b}
24	88.20^{a}	17.20^{d}	99.52^{a}
48	64.40^{d}	17.60^{bcd}	93.86^{b}
72	56.48^{e}	17.60^{bcd}	91.43^{c}
96	55.40^{e}	18.00^{abc}	75.20^{f}
120	27.16^{g}	17.80^{abcd}	67.40^{g}
CD (0.05)	2.172	0.676	2.330

* Means followed by different letters in the same column are significantly different (P<0.05)

per pupa significantly decreased. On dissection, such pupae were observed to contain a number of partially developed parasitoids. The lowest emergence (27.16) when pupae were exposed for 5 days (120 h) indicated pupal mortality due to heavy superparasitism. Differential mortality during developmental period has been reported earlier (Flanders 1946).

Developmental period ranged from 17.2 to 18.4 days in 1 h to 120 h (5 days) exposure. The variation in developmental period may be due to nutritional content of the host on which the parasitoid was reared.

Percentage of females in the progeny was maximum (99.52) in 24 h exposure period and it declined significantly with increase in exposure period. Puttarudriah and Sastry (1958) and Moore and Kfir (1995) have reported 92.0 - 99.5% females in 24 h exposure period. Female biased sex ratio has also been reported in *T. howardi* on other host pupae with high degree of inbreeding (Cherian and Subramaniam 1940; Puttarudriah and Sastry 1958; Kumar and Baitha 2016). However, in the present study percent females declined with increase in exposure period. The sex ratio shows a marked preponderance of females, which is highly variable in parasitic Hymenoptera (Clausen 1940; Flanders 1965). Uematsu (1981) observed that parasitoids may have the ability to modify sex ratio of the progeny according to host size. Decrease in female progenies due to increase in exposure period has been reported earlier (Alphen and Nell 1982; Lawrence 1981). These workers reported that increased daughter mortality in super parasitized host is an added selective factor favoring increased laying of male eggs on those hosts.

Sugarcane borers are difficult targets for biocontrol. Use of eulophids (*T. howardi*) against sugarcane top borer *S. excerptalis* was first attempted in 1950 in South India (Puttarudiah and Sastry 1958). It was projected as an effective parasitoid against internode borer *Chilo sachhariphagus indicus* (Kapur) (Lepidoptera: Crambidae) capable of reducing the borer population by 49.28% (Sankar and Rao 2016). *Tetrastichus howardi* showed substantial promise in laboratory biological studies. Despite proving facultatively hyperparasitic under laboratory conditions, *T. howardi* has never been observed as such in its natural environment (Moore and Kfir 1995). *Tetrastichus howardi* was highly polyphagous in the laboratory but in the field has virtually always been found on stem borers (Puttarudiah and Sastry 1958). It can be inferred that higher numbers of adults in short periods of time, a strong preponderance of females at exposure periods of about 24 h and gregarious development make it possible to multiply *T. howardi* on field-collected sugarcane top borer pupae in the laboratory avoiding superparasitism.

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