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Rearing, biology and storage of Indonesian strain of *Cotesia flavipes* (Cameron) using sugarcane stalk borer *Chilo auricilius* Dudgeon as a host

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ABSTRACT : Laboratory investigations were carried out on rearing, biology, host stage suitability and storage of Indonesian strain of larval parasitoid *Cotesia flavipes* (Cameron) using *Chilo auricilius* Dudgeon as a host. The parasitoid could be successfully reared on larvae of *C. auricilius* for 11 successive generations without affecting the biotic potential greatly. Adults of *C. flavipes* lived for 8.7 ± 3.3 (male) and 5.4 ± 2.3 (female) days. The egg + larval, cocoon and total developmental periods of the parasitoid were 15.2 ± 0.3, 8.5 ± 0.3 and 23.7 ± 0.4 days, respectively. Third to fifth instar larvae of *C. auricilius* were significantly more preferred for oviposition wherein they completed their development successfully. Three day old cocoons could be stored at 10°C for 15 days with 71.6 per cent emergence.

KEY WORDS : *Chilo auricilius, Cotesia flavipes*, host preference, rearing, storage

Cotesia flavipes (Cameron) is an endo larval parasitoid of pyralids and noctuids (Gifford and Mann, 1967). It has been recorded parasitising the larvae of sugarcane borers throughout the country (Gupta, 1954; Borah and Arya, 1995; Kalra, 1963; Kalra and Srivastava, 1966). Indigenous strain of *C. flavipes* has marked preference for *Chilo partellus* (Swinhoe) (Bindra and Chand, 1973). However, the strain from Indonesia had shown a definite preference for the host in sugarcane ecosystem in Pakistan (Shami and Mohyuddin, 1987). The rearing and biology of Indonesian strain has been investigated in Texas (Wiedenmann *et al.*, 1992) using larvae of *Diatraea saccharalis* (Fabricius). This strain has been recently introduced for field evaluation against sugarcane borers in India and results of

laboratory studies on rearing, biology, host stage suitability and storage are presented in this paper.

MATERIALS AND METHODS

Rearing and biology of *C. flavipes*

Nucleus culture of *C. flavipes* (Indonesian strain) was received from the Project Director, PDBC, Bangalore. Freshly emerged wasps were transferred into transparent plastic jars (1.5 litre capacity) fitted with brass mesh for ventilation and provided with cotton swabs soaked in 50 per cent sucrose solution as adult food. These jars were placed under optimum temperature and humidity conditions (26°C and 60-70% RH). Parasitisation was obtained by exposing 4th or 5th instar larvae of *C. auricilius* to one day old wasps in jars facing a light source. The parasitised host larvae were then transferred to vials (10 x 3 cm) containing artificial diet and reared till parasitoid cocoons were formed. Observations were recorded on per cent adult emergence from cocoons, number of progeny from each parasitised larva and sex ratio in the progeny for 11 successive generations.

Biology of *C. flavipes* was studied in glass vials (10 x 3 cm) provided with 50 per cent sucrose solution as food. A pair of freshly emerged wasps (one male and one female) was released into each glass tube along with a 4th instar larva of *C. auricilius* and placed at 23 ± 2°C and 60 per cent relative humidity. The host larva in each tube was replaced after 24 h by a healthy 4th instar larva till the female wasp died. The exposed larvae were reared individually till cocoon formation. The observations were recorded on the mortality of adults in each tube. The number of larvae parasitised by each female wasp, emergence of wasps from cocoons, number of parasitoids emerging per host larva and sex ratio of the emerging adults. This was done for forty such pairs.

Host stage preference and suitability

Host stage preference tests were performed in the plastic jars (1.5 litre capacity). In each jar, four 1-day old mated females and two larvae each of 2nd, 3rd, 4th and 5th instar of *C. auricilius* were released along with 5 g diet for 24 h. Host stage suitability tests were performed in glass tubes (10 x 3 cm). Single 1-day old mated female was released in each tube along with two 2nd to 5th instar larvae of *C. auricilius* individually and 5g artificial diet. A total of five replications were maintained and the experiments were repeated seven times for host stage preference. The exposed larvae were transferred individually in artificial diet and examined daily to record number of cocoons formed, adults emerged and sex ratio in the progeny from individual host larva of each instar. Ten replications were maintained and the tests repeated thrice.

Storage studies

Fresh, 3 and 5 day old cocoons of *C. flavipes* were stored at 10°C for 5, 10, 15, 20 and 25 days with five replications

each. The cocoons, after these periods were transferred into a BOD incubator at 23°C for emergence of adults. Observations were recorded on per cent emergence of adults from stored cocoons.

The data on host stage preference test, suitability test and storage of cocoons were subjected to ANOVA.

RESULTS AND DISCUSSION

Rearing and biology of *C. flavipes*

Laboratory rearing of *C. flavipes* through 11 successive generations on the larvae of *C. auricilius* indicated that the parasitoid could be reared successfully without affecting much its biotic potential. Sex ratio (male : female) and number of the adults emerging from each parasitised host larva ranged from 1: 0.8 to 1: 2.6 and 17.5 to 28.7, respectively (Table 1). It was observed that successful emergence of parasitoids occurred from 31.2 to 60 per cent of the parasitised host larvae up to the 8th generation after which a declining trend was noticed.

In continuous rearing in the laboratory, it was found that though the parasitoid appeared to have parasitised the host, neither cocoons were formed nor host larvae pupated. Interference in the development of parasitoid egg inside the host body due to host immune response might have resulted in low emergence of wasps. Host immune responses have been observed due to the development of

Table 1. Parasitisation potential of *C. flavipes*

Generation	Parasitised hosts showing emergence of wasps (%)	Adult emergence from cocoon (%)	No.of adults/ parasitised host larva	Sex ratio in progeny (M:F)
I	46.3	84.6	18.4	1 : 0.8
II	36.9	95.7	23.0	1 : 1.0
III	47.2	87.2	21.7	1 : 1.3
IV	60.0	90.7	25.4	1 : 1.6
V	31.2	92.2	25.9	1 : 1.1
VI	39.2	94.3	28.7	1 : 2.6
VII	38.1	96.9	24.3	1 : 1.7
VIII	41.8	91.1	19.2	1 : 1.4
IX	30.7	86.7	17.5	1 : 1.5
X	25.6	92.4	19.5	1 : 1.6
XI	26.3	91.7	19.3	1 : 1.3
CD (P = 0.05)	20.96	NS	NS	NS

parasitoid inside the host body (Vinson and Iwantsch, 1980). Varying degrees of encapsulations of *C. flavipes* was reported in *Diatraea grandiosella* Dyar (Overholt and Smith, 1990 ; Wiedenmann *et al.*, 1993) and *D. sachharalis* (Wiedenmann *et al.*, 1992). Anonymous (1993) reported that when this species was reared on *C. partellus* it produced more progeny (52.8 ± 12.4) and higher parasitisation (67.4 ± 4 %) was noticed, but the sex ratio was male biased (1: 0.413).

Males and females lived for 8.7 ± 3.3 and 5.4 ± 2.3 days, respectively. Freshly emerged adults mated soon after emergence and mating could be induced by providing light. Multiple mating was observed in both sexes. No oviposition was observed on the first day of emergence at 23°C whereas at 26°C oviposition was observed in 10 per cent of females. Eggs were laid inside the host body. The mean egg + larval, cocoon and total developmental periods of the wasps were 15.2 ± 0.3, 8.5 ± 0.3 and 23.7 ± 0.4 days, respectively. The developmental period of the Indonesian strain of *C. flavipes* on *C. partellus* from egg to cocoon formation and pupal period was reported to be 13.54 ± 0.89 and 7.2 ± 0.3 days, respectively (Anonymous, 1993).

Host stage preference and suitability

Host stage preference tests indicated that the 2nd instar larvae of *C. auricilius* were significantly less preferred (3.9%) for oviposition by *C. flavipes* than the 3rd (12.5%), 4th (9.6%) and 5th (11.8%) instars which were all on par. The first instar larvae were not accepted by the wasp for egg laying (Table 2).

Table 2. Host stage suitability of *C. auricilius* for development of *C. flavipes*

Host instar	Proportion of hosts producing parasite cocoons	Mean production from each successful parasitised larva			
		No.of cocoons produced	Adult emergence from cocoons (%)	No.of parasitoids emerged	Sex ratio (M : F)
2nd	0.72 ± 0.13	18.73 ± 1.97	89.56 ± 3.91	16.52 ± 1.95	1: 2.67 ± 0.54
3rd	0.93 ± 0.12	25.66 ± 2.57	89.86 ± 2.29	23.55 ± 2.58	1: 4.40 ± 0.84
4th	0.93 ± 0.11	25.62 ± 1.89	83.40 ± 4.59	22.33 ± 2.30	1: 4.73 ± 1.15
5th	0.96 ± 0.12	21.57 ± 1.68	87.94 ± 2.75	18.73 ± 1.51	1: 2.94 ± 0.59
CD (P = 0.05)	NS	NS	NS	NS	NS

Figures shown are the mean (SEM)

Host stage suitability tests indicated that the wasps were able to complete their development on 2nd to 5th instar larvae of *C. auricilius*. Proportion of host larvae producing cocoons, number of cocoons formed, adult emergence from cocoons, number of adults emerged and sex ratio of progeny per parasitised host larva were not significantly different among 2nd to 5th instar larvae.

Storage of cocoons

Three day old cocoons of *C. flavipes* were found more suitable for storage at 10°C than fresh and 5 day old cocoons and could be stored for 15 days with 71.6 per cent adult emergence (Table 3).

Studies revealed that this exotic strain can be successfully multiplied on *C. auricilius* in the laboratory and can be stored at 10°C for 15 days.

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REFERENCES

Anonymous. 1993. Annual Report of All India Co-ordinated Research Project on biological control of crop pests and weeds for the year 1992-93. *Technical Document* No.40, p.43.

Bindra, O. S. and Chand, N. 1973. Studies on the life history of *Apanteles flavipes* (Cameron) and trial with it for

Table 3. Effect of storage of different age group cocoons of C. flavipes on adult emergence at 10°C

Age of cocoon	Per cent emergence of wasps from cocoons after storage for 5 days	10 days	15 days	20 days	25 days
Fresh	59.4[a] (50.83)	54.2[a] (47.57)	4.66[a] (5.77)	0.5[a] (2.03)	0.0
3-day old	94.8[b] (78.64)	77.8[a] (63.17)	71.60[b] (59.31)	17.2[b] (21.75)	0.0
5-day old	86.9[b] (73.11)	65.1[a] (55.13)	16.70[a] (20.18)	6.3[ab] (12.54)	0.0
SEM ±	10.96		14.52	9.93	
CD (P=0.05)	16.18	NS	20.21	14.67	

Figures in parentheses are arcsine transformed values
Means followed by similar letters are not different statistically in columns

controlling the Gurdaspur borer of sugarcane, *Bissetia steniella* (Hampson) in the Punjab. *Indian Sugar*, **23**:55-59.

Borah, B. K. and Arya, M. P. S. 1995. Natural parasitisation of sugarcane plassey borer (*Chilo tumidicostalis* Hmpsn.) by braconid larval parasitoid in Assam. *Annals of Agricultural Research*, **16**:362-363.

Gifford, J. R. and Mann, G. A. 1967. Biology, rearing, and a trial release of *Apanteles flavipes* in the Florida Everglades to control the sugarcane borer. *Journal of Economic Entomology*, **60**:44-47.

Gupta, B. D. 1954. A note on the scope of biological control of sugarcane pests. *Proceedings of the Second Biennial Conference of Sugarcane Research and Development Workers, Jallundur*, **2**:229-235.

Kalra, A. N. 1963. Annual Report of Indian Institute of Sugarcane Research,1962-63, p.19.

Kalra, A. N. and Srivastava, R. C. 1966. Biology of *Apanteles flavipes* (Cam.) (Braconidae, Hymenoptera), a parasite of moth borers of sugarcane, under micro ecological conditions. *Proceedings of 5th All India Conference of Sugarcane Research and Development Workers, Coimbatore*, December 1964, pp.605-609.

Overholt, W. A. and Smith Jr., J. W. 1990. Comparative evaluation of three exotic insect parasites (Hymenoptera : Braconidae) against the southwest corn borer (Lepidoptera) in corn. *Environmental Entomology*, **19**:1155-1162.

Shami, S. and Mohyuddin, A. I. 1987. Host selection by Indonesian strain of *Apanteles flavipes* (Cam.) and its suitability for various graminaceous borers in Pakistan. In *Proceedings of Annual Convention, Pakistan Society of Sugar Technologists*, **23**:286-291.

Vinson, S. B. and Iwantsch, G. F. 1980. Host regulation by insect parasitoids. *Quarterly Review of Biology*, **55**:143-165.

Wiedenmann, R. N. and Smith Jr., J. W. 1993. Function response of the parasite *Cotesia flavipes* (Hymenoptera : Braconidae) at low densities of the host *Diatraea saccharalis* (Lepidoptera : Pyralidae). *Environmental Entomology*, **22**:849-858.

Wiedenmann, R. N., Smith Jr., J. W. and Darnell, P. O. 1992. Laboratory rearing and biology of the parasite, *Cotesia flavipes* (Hymenoptera : Braconidae) using *Diatraea sachharalis* (Lepidoptera : Pyralidae) as a host. *Environmental Entomology*, **21**:1160-1167.