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Studies on the Biological Attributes of Scelionid Egg Parasitoid *Psix striaticeps* (Dodd) for the Control of Stink Bug *Canthecona furcellata* (Wolff) in Sericulture

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Scelionid egg parasitoids play an important role in biological control of some economically important pentatomids. Stink bug (*Canthecona furcellatta* Wolff.) is an important predator of Tasar silkworm larvae (*Antheraea mylitta* D.) and causes 30-40 percent loss in tasar silk industry. *Psix striaticeps* (Scelionid: Hymenoptera) has been found to be an important egg parasitoid. The parasitization potential of *P. striaticeps* is more than 60 percent and the sex ratio is female oriented. Studies indicate that the maintenance of existing scelionid population by avoiding harmful practices and the augmentation of scelionids either directly releasing them in the field or by indirectly making the field environment more favorable for them is an important aspect to control the pentatomid population in sericulture. Female bias sex ratio is advantageous to increase the parasitoid population in the field. 24-hour-old egg of stink bug and one-day old parasitoid is suitable for producing maximum progeny. 1 : 30 of parasitoid: host ratio is needed to regulate the estimated population in silkworm rearing field.

Key words : Scelionid, Egg Parasitoid, Biological control, *Canthecona furcellata*

Introduction

Earlier findings (Thangavelu and Singh, 1992, Singh *et al.*, 1992, 1995, 1996; Singh and Sinha, 1995) have shown that *Psix striaticeps* (Dodd.) (Scelionidae: Hymenoptera) is an important egg parasitoid of stink bug, *Canthecona furcellata* Wolff. (Hemiptera: Pentatomidae). It has been reported as a harmful predator against early stage larvae of tasar silkworm (*Antheraea mylitta* Drury). Sen *et al.* (1971) reported 30 - 40% crop loss in tropical tasar region of India by the attack of stink bug *P. striaticeps* has been found to be a potential bioagent against *C. furcellata* (Thangavelu and Singh, 1992). *Psix* is most diverse in the Ethiopian, Oriental and Australian regions (Johnson and Masner, 1985). Despite the strong possibility that *P. striaticeps* could be useful for biological control, the requirement of an efficient rearing method has not been established due to limited information on parasitoid behaviour. To develop efficient procedures for rearing and maintaining the colony of *P. striaticeps* in the laboratory, it is essential to determine life table characteristic of the parasitoid and to generate information on their behavioral response at various host densities. Therefore, an attempt has been made to study the fecundity, developmental period, longevity, sex ratio, percent parasitism, effect of aging parasitoid and host with a view to determine the parasitization potential of *P. striaticeps* for the biological control of stink bug in sericulture.

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Materials and Methods

Canthecona furcellata were cultured in the laboratory to ensure sustained supply of fresh eggs to the ovipositing female wasps. Egg masses were removed daily, placed in petri dishes, and kept at 20 ± 5°C until used. Egg mass of *C. furcellata* was also collected from field at about 7 days interval throughout the season from different rearing plots of tasar silkworm and kept in 30 ml plastic cups in the laboratory. The parasitoid *P. striaticeps* was reared on the eggs of *C.furcellatta* at 25 ± 2°C and 70 - 75% RH in plastic petri dishes and fed with 30% honey streaked on the lid. Fecundity and longevity of (0 - 12 h old) 10 mated females were conserved by exposing ten freshly laid egg clusters (7 - 50) of *C. furcellata*. The exposed host eggs were replaced by fresh ones every 25 hrs through out the life of the parasitoids and held singly in glass tubes (1 × 5 cm) each having a pieced of moist filter paper. The specimens emerged were sexed and counted.

Emerged parasitoids were placed in small insectary covered with plastic wrap with cotton wick moistened with 50% aqueous honey solution and water. Newly emerged parasitoids were transferred daily from the plastic cups to paper cartons. One male parasitoid was left with each egg mass to fertilize the emerging females. The male and female *P. striaticeps* are easily distinguishable as they have dimorphic antennae (clubbed in the female and filiform in male). The sex ratio was calculated to the proportion of females (P) in the population. Departure from an expected sex ratio (P = 0.5) was tested by X^2 test for determining statistical significance. Seasonal variation in sex ratio was also recorded from the time of emergence till end of the seasons. The proportion of mated females in the field population was also estimated by counting these females, which produced both female and male progenies.

Results and Discussion

Age specific survival and fecundity of *P. striaticeps* on *C. furcellata* are presented in Table 1. At 25 ± 2°C, the development of *P. striaticeps* from egg to adult took 12 days. The total duration of immature stages was 10.75 days. The first mortality within the cohort occurred on the fourth day and increased thereafter. The number of female progeny produced ranged from 35 to 52 per female. The maximum mean of female progeny per day was attained on 3rd day and the production ceased by 3rd day after the first oviposition. The whole process of oviposition was completed within 35 ± 5 minutes. After host acceptance, the ovipositor insertion was repeated several times. Female parasitoids were observed to feed on the liquid exuded from host egg after ovipositional puncture. The progeny produced by *P. striaticeps* ranged from 30 to 45 individuals per female. The maximum mean female progeny per day was attained by the parasitoid on the 3rd day and the production ceased by the 7th day after the first oviposition. The aging of host eggs altered the rate of parasitism (Table 2). Percent parasitization was low in 60 h old eggs in comparison to 12 - 24 h old eggs. Maximum parasitization (19.6 ± 1.14) was recorded on 24 h old eggs. Progeny production was affected when 60 h old eggs were exposed to the parasitoids. The result indicates that 24 h old egg mass of stink bug is highly acceptable and produces 91.83% female progeny. The present study was in conformity with the observations of Alphen and Vet (1986) and Yeargan (1979). Age of the parasitoids has no apparent affect on the rate of parasitism and progeny production. The percent progeny produced by the parasitoids of different ages is not very different. It is also evident from Table 3 that there is little difference in the total number of adults emerged after parasitization by parasitoid of different ages. The results indicate that the aging of host eggs influences the progeny production, whereas parasitoid aging does not influence it. It is probably because the parasitoids rate of

Table 1. Life table statistics of *Psix striaticeps* on the eggs of *Canthecona furcellata*

Particulars	Mean
Survival (in days)	12.00
Age at first reproduction	12.00
Duration of immature stages	10.75 ± 0.35
Period of intensive egg laying (PIEL)	3.5 ± 0.15
Mean number of eggs/female (m_x)	49.80 ± 0.27
Total female offspring/female (R_0)	38.30
Mean length of the generation (T_c)	14.67
Innate capacity for increase in numbers (rc)	0.248
Now arbitary ^{r}m (rc) are 0.24 and 0.26 e − ^{r}m × l_x m_x = 1096.6 ...... rm 0.275	
Finite rate of increase in numbers / anti log e r_m	1.32
Cohort generation Time (T)	13.25
Weekly generation time r_w $(e^{rm})^7$	6.85

Table 2. Effect of *C. furcellata* egg age on the production of *P. striaticeps*

Host age (hour)	Host egg parasitized (mean ± SD)	Progeny production (mean ± SD)	Female progeny (%)
12	15.6 ± 1.14	10.6 ± 1.34	84.00
24	19.6 ± 1.14	19.6 ± 1.12	91.83
36	16.2 ± 1.48	13.2 ± 1.30	57.00
48	11.0 ± 1.00	9.4 ± 0.83	34.04
60	8.4 ± 1.14	6.0 ± 0.70	20.00

Table 3. Effect of *Psix striaticeps* female age on parasitization of *C. furcellata*

Age of female parasitoid	Parasitized eggs (mean ± SD)	Female progeny (%)
1	18.8 ± 1.30	75.00
2	19.6 ± 1.67	80.00
3	20.0 ± 2.73	81.25
4	19.8 ± 1.92	81.17
5	19.0 ± 1.00	79.31

Table 4. Effect of different parasitoid:host ratios on the parasitization and progeny production of *Psix striaticeps*

Parasitoid: Host	Host eggs parasitized	Parasitization (%)	Parasitoid no.	Female progeny
1:20	90 ± 4.50	72.00	77 ± 1.63	84.40
1:30	117 ± 3.00	78.00	106 ± 3.51	86.79
1:40	160 ± 5.00	80.00	120 ± 4.50	82.50
1:50	158 ± 2.51	63.20	139 ± 4.50	61.15

oviposition is unaffected by her age (Yeargan, 1982). The maximum parasitization of egg was recorded when one day old parasitoids and 24 h host eggs were exposed in the ratio of 1 : 40 (Table 4). But even at this ratio some stink bug nymphs were obtained due to a few eggs remaining unparasitised. However, Parasitoid: host ratio of 1 : 30 was found to be the best to obtain maximum progeny of the parasitoid and also highest proportion of females. It has been observed that female parasitoid has the ability to discriminate between the parasitized and unparasitized eggs of stink bug (Singh and Thangavelu, 1994). Okuda and Yeargan (1988) reported the intra and interspecific host discrimination in *Telenomus podisi* and *Trissolcus euschisti*.

The predominance of females over males was observed in each sample of *P. striaticeps* except in few cases, which were collected late in the seasons. From mid June onwards, the sex ratio gradually shifted towards predominance of females, which attained a peak during September to October. Thereafter, it continued to decline and then sharply fell during December (Singh *et al.*, 1994). The mean proportion of females (P) in 9 egg mass (> 50) and in all the egg mass (28) taken together was 0.74 ± 0.15 and 0.73 ± 0.25, respectively, which deviated significantly (P = 0.001) from an expected sex ratio (P = 0.50) (Singh *et al.*, 1994). The decrease of sex ratio (*i.e.*, increase of males) with an increase of parasitoid-host ratio is governed by various biotic and physiological factors. Waage (1986) reviewed the applicability of Local Mate Competition (LMC) models in various host parasitoid system. In LMC the genetic contribution to future generation may be large (Werren, 1980), therefore, a reduction in searching efficiency with increase of parasitoid-host ratio does not necessarily mean that the fitness gain per unit of the time also decreases (Alphen Van and Vet, 1986). Our findings are in agreement with these authors.

The parasitization efficiency of the parasitoid determines its potentiality against the pest in target area. In a population the number of host parasitized per time unit depends upon the number of parasitoid present and the ability of the individual parasitoids to locate and parasitize variable number of hosts. The overall parasitization rate depends on individual performance within the patch of certain host densities (Hassell, 1986). Thus a parasitoid responds by increasing the number of host that each individual destroys (functional response) or it responds to increased host densities by increasing their own number (Solomon, 1949). Numerical response is usually of more interest than the functional response because it is more often responsible for suppressing the host population (Huffaker *et al.*, 1971; Hassell, 1978), although, it has attracted much less modeling effort (Hassell, 1986). A rapid and strong numerical response is the most important attribute of a successful agent of post mortality (Coppel and Mertins, 1977). The study of numerical interactions between parasitoid and host population also provides the data for calculating the number of parasitoids needed to regulate the estimated pest population (Knipling and Gilmore, 1971). After the end of second crop rearing, population of stink bug sharply declines and accordingly the population of parasitoid changes but equilibrium is needed to regulate the parasitoid population in the rearing field. The present study reveals that aging of the host functions as a factor those influences the host finding efficiency of the parasitoid whereas her aging does not do so. In relation to a given site, the data furnish an insight into the number of parasitoids needed to regulate the estimated host population. In insectary, they can be utilized for procuring maximum yield of progeny particularly females per unit of host material from host parasitoid culture.

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