

Growth and development of *Corcyra cephalonica* (Stainton) on natural and fortified diets and dietary effect of age-old eggs on parasitization by *Trichogramma chilonis* Ishii

SIDDHARTH TIWARI¹ and M. A. KHAN

Department of Entomology, G. B. Pant University of Agriculture and Technology, Pantnagar 263 145, Uttaranchal, India

Email: stiwari@vt.edu

ABSTRACT: *Corcyra cephalonica* (Stainton) is a laboratory host for mass production of *Trichogramma* spp. and other biocontrol agents. In the present study for rearing *Corcyra*, three diets were used as broken maize alone, broken maize + yeast (2%) and broken maize + protinex (2%). Maize + yeast combination gave the best results in terms of mean total adults emergence (2211), mean total females (985), mean fecundity (397.85) and mean duration of moths emergence (52.31 days), while average developmental period was lowest (36 days) when compared with other two diets. The effect of egg laying on parasitization by *T. chilonis* revealed that highest mean per cent parasitization of 51.96 (mean of 1st to 6th day laying) was obtained on eggs laid by moths reared on maize + yeast diet. The highest mean per cent parasitization (73.9) was obtained on 2nd day egg laying.

KEYWORDS: *Corcyra cephalonica*, natural diet, parasitization, protinex, *Trichogramma chilonis*, yeast

Corcyra cephalonica (Stainton) is used as a laboratory host for the mass production of *Trichogramma* spp. and other biocontrol agents. Since, larval stage is an active feeding stage, food greatly influences its developmental and other biological attributes. Studies have been made regarding the rearing of *Corcyra* moths in cheaper grain media such as broken sorghum grains (*Sorghum vulgare*), pearl millet (*Pennisetum typhoides*) and maize (*Zea mays*), either alone or mixed with wheat or rice bran (Krishnamurthi and Seshagiri Rao, 1945). Fortifying the natural diet with artificial sources of vitamins, proteins, lipids and carbohydrates greatly improves the nutritional

quality of the diet which in turn greatly enhances the biological attributes of the *C. cephalonica* in terms of adult longevity, fecundity, average developmental period, sex-ratio, etc. (Sanjeeva Rao *et al.*, 1980a & b). Even, the quality of parasitoids improved in terms of longevity, fecundity and sex-ratio of *Trichogramma chilonis* Ishii, when multiplied on the eggs of *C. cephalonica* reared on broken sorghum grains mixed with 8 per cent yeast (Katiyar, 1962). Hence, attempts were made in the present investigations to study the effects of fortification of maize as natural rearing media with diet supplements on the biological traits of *C. cephalonica* and subsequent effect on the parasitization by *T. chilonis*.

¹Department of Entomology, Virginia Polytechnic Institute and State University, Virginia 240 060, USA

MATERIALS AND METHODS

The experiment was conducted at Biological Control Laboratory, G. B. Pant University of Agriculture & Technology, Pantnagar. Maize grains broken to 3-4 pieces were sterilized at 110° C for 2 hours in a hot air oven. Thereafter, grains were treated with formalin (0.1%) and were kept in wooden boxes with sliding cover (40x30x15 cm). The different combinations of maize were used in this study. Three different diets used were: broken maize alone, broken maize + yeast (2%) and broken maize + protinex (2%). *Corcyra* boxes were charged at the rate of 3 kg diet/box, each diet was replicated three times. In each box, fresh eggs of *C. cephalonica* (not older than 24 hours) were mixed with grains @ 3000 eggs per 3 kg of diet. The lid of each box was secured for about 30 days and thereafter checked for moth emergence. Moths collected from each treatment were counted differently as males and females and were kept in separate ovipositional cages, provided with 50 per cent honey solution dipped in cotton swab. The eggs thus collected, were cleaned and their number was calculated volume wise (1cc =20,000). Whole set up was maintained at 28±2°C and 60±5 per cent relative humidity.

Eggs from each oviposition cage were collected daily from first day till 6th day of laying and egg cards were prepared for each day, thus the cards made on a day contained eggs that were laid on that day only. 100 eggs of *C. cephalonica* were mounted on each card piece (5x1.5 cm) with acacia gum. The egg cards were sterilized and released in glass tubes (15x2.5 cm); each treatment was replicated three times. Twenty-five healthy, fast reviving females were released into each vial containing *Corcyra* card (host: parasitoid ratio was 4:1). Adults were allowed to parasitise for 24 hours and thereafter Tricho-cards were shifted to fresh glass tubes and were kept in B. O. D., incubator at 25±2°C and 70±5 per cent relative humidity. On 4th day, the colouration of eggs changed to black that was an indication of the development of parasitoid *T. chilonis* and parasitized eggs were counted and per cent parasitization was calculated. The collected data were statistically analyzed.

RESULTS AND DISCUSSION

Development period and adult emergence

The results (Table 1) showed that the average developmental period and duration of adult emergence of *Corcyra* differed significantly with different diets. The first moth emergence was delayed when *Corcyra* was reared on maize alone (47 days) while it was shortest, when it was reared on maize + yeast (36 days). Duration of moth emergence in case of maize alone and maize in combination with yeast did not differ significantly being 51.0 days and 52.3 days, respectively.

Thus, above results clearly showed that in comparison to two protein sources, yeast was quite favourable showing fast development in moths (36 days) and also moths emerged for longer duration, namely, 52.3 days. So, maize alone is not favourable, as corroborated by Pant *et al.* (1957) who reported that the developmental period of *Latheticus oryzae* Waterhouse was better on maize with yeast. Maize in combination with yeast was found to be the best among all media tested as it yielded an average of 2211 moths while lowest moth yield was in maize alone (1026 moths). The high emergence in maize with yeast is attributed to the high quality protein content of yeast compared to protinex.

Fecundity and Sex ratio

Considering the mean fecundity of the females obtained from different fortified diets, maize fortified with yeast gave highest mean number of eggs per female (397.85). While mean numbers of eggs per female did not differ significantly when *Corcyra* was reared on maize alone and maize with protinex yielding 351.24 and 351.48 eggs per female, respectively (Table 1). These results were in accordance with those of Jacob *et al.* (1966) who reported increased fecundity in protein rich diets like pulses over low-protein diets like cereals. While results of present studies are at variance with those of Rao *et al.* (1980) who reported that high protein levels were

not conducive to egg production and that the fortification of sorghum flour and rice bran with casein failed to improve the fecundity.

As far as sex ratio was concerned, preponderance of males over females was observed in all cases, except in maize with protinex. In case of maize with protinex, there were more females (692) as compared to males (667). While greatest number of females emerged from maize with yeast treatment (985) the lowest number of females was from maize along (460). Therefore, yeast besides having some ovipositional stimulus also helped in more female moths' emergence. Earlier, Uberoi (1960) reported yeast as an adequate source of protein, minerals, sterols, fat-soluble factor and B-vitamins, all essential for the normal growth of the larva of *Corcyra*.

Parasitization by *T. chilonis*

The eggs collected for 6 days from different diets, when exposed to *T. chilonis* for parasitization yielded differences in terms of percent parasitization (Table 2). Among the three treatments used, maize + yeast combination (T_3) was found most effective with overall mean parasitization of 51.96 per cent, while maize alone (T_1) and maize + protinex (T_2) provided for 50.65 and 48.92 per cent mean parasitization, respectively. There was no significant difference among the treatments. Parasitization by *T. chilonis* was maximum on the eggs laid on the second day with overall mean of 73.9 per cent parasitism, followed by first day laying (60.92%). Followed by fifth day egg laying (51.36%).

Table 1. Effect of different rearing media on biological traits of *C. cephalonica*

Treatment	Mean total adults	Mean total eggs laid	Mean total female	Mean total male	Mean Fecundity	Mean developmental period (days)	Mean duration of moth emergence (days)
Maize (T_1)	1026	161570.4	460.0	566.0	351.2	47.0	51.0
Maize + Protinex (T_2)	1359	243224.2	692.0	667.0	351.5	44.3	45.0
Maize + Yeast (T_3)	2211	391882.3	985.0	1226.0	397.9	36.0	52.31
Mean	1532	265558.9	712.3	819.7	366.9	42.4	49.4
CD (P=0.05)		1823.4					

Table 2. Dietary effect on different days egg laying by *C. cephalonica* and parasitization by *T. chilonis*

Tr. Diet	Mean per cent parasitism of eggs up to 6 days old <i>Corcyra</i> moths						Mean
	1 st	2 nd	3 rd	4 th	5 th	6 th	
T1(Maize 3 kg)	53.81 (47.19)	84.28 (67.00)	59.33 (50.51)	40.26 (39.26)	51.66 (45.95)	14.54 (22.41)	50.65 (45.39)
T2(Maize 3 kg + protinex 2%)	64.09 (53.19)	65.11 (53.85)	46.02 (42.69)	41.68 (40.18)	41.63 (40.07)	35.027 (36.28)	48.92 (44.38)
T3(Maize 3 kg + Yeast 2%)	64.86 (53.66)	72.32 (58.43)	35.63 (36.55)	33.93 (35.62)	60.80 (51.24)	44.22 (41.68)	51.96 (46.19)
Mean	60.92 (51.35)	73.90 (59.76)	46.99 (43.25)	38.62 (38.35)	51.36 (45.75)	31.26 (33.45)	

Among the eggs laid on second day, maximum parasitization (84.28%) was recorded on those obtained from maize diet, which showed that supplementary incorporations into diet (yeast or proteins) has no effect on the level of parasitization by *T. chilonis*. Parasitization decreased as the egg laying advanced irrespective of the diet on which the host was reared. Parasitization was lowest on eggs laid on 6th day with 31.26 per cent, which showed that as moths grew older, they start loosing vigour, vitality and lay less number of eggs, which was inimical for the parasitoid *T. chilonis*. In another similar study, it was found that the older eggs are less prone to the parasitization by *T. chilonis* (Tiwari and Khan, 2002).

Thus from the present study it may be concluded that neither the natural nor fortified diet contributed to variations in parasitization levels by *T. chilonis*. Irrespective of the diet used for rearing, eggs laid on 3rd day onwards affected parasitism levels and decreased as the days advanced. Eggs laid on second day were more prone to parasitization than those laid on other days. However, supplementary incorporation of diet significantly altered the biological traits of *C. cephalonica* in terms of total moth emergence, fecundity, average developmental period and duration of moth emergence. Hence, maize with yeast (2%) diet may be preferred for mass rearing of *C. cephalonica*, since there is higher adult emergence, fecundity and no significant variation in parasitization by *T. chilonis* as compared to other diets

ACKNOWLEDGEMENTS

The authors are highly thankful to the G. B. Pant University of Agriculture and Technology, Pantnagar for providing necessary facilities and the Department of Biotechnology, Ministry of Science & Technology, Government of India, New Delhi and Indian Council of Agricultural Research, Krishi Bhavan, New Delhi for providing necessary facilities and financial assistance for the investigations.

REFERENCES

- Jacob, A., Dass, N. M. and Nair, M. R. G. K. 1966. Studies on the feeding media for the mass rearing of *Corcyra cephalonica* (Stainton). *Agricultural Research Journal of Kerala*, 3: 82-85.
- Katiyar, R. N. 1962. Effect of nutrition on the fecundity, longevity and sex ratio of *Bracon gelechia* and *Trichogramma evanescens minutum* Riley using *Corcyra cephalonica* (Stainton) as their host reared on various synthetic diets. *Agra University Journal of Research*, 11: 17-21.
- Krishnamurthi, B. and Seshagiri Rao, D. 1945. Alternate media for large scale rearing of the rice moth (*Corcyra cephalonica* Stainton) in the work of mass production of the egg parasite *Trichogramma minutum* Riley. *Current Science*, 14: 10.
- Pant, N. C., Gupta, P. and Nayar, J. K. 1957. On the nutritional physiology of *Latheticus oryzae* Waterhouse. *Indian Journal of Entomology*, 19: 279.
- Rao, J. G., Rao, P. K. and Murthy, M. S. 1980. Record of *Trichogramma australicum* (Hymenoptera: Trichogrammatidae) as a parasite of *Acherontia styx* Westwood (Lepidoptera: Sphingidae). *Entomon*, 5: 83.
- Sanjeeva Rao, P., Perraju, A. and Krishnamurthy Rao, B. H. 1980a. Effect of fortification of natural rearing media with casein, cholesterol and glucose on *Corcyra cephalonica* (Stainton): I. Laval Growth. *Indian Journal of Entomology*, 42: 218-222.
- Sanjeeva Rao, P., Perraju, A. and Krishnamurthy Rao, B. H. 1980b. Effect of fortification of natural rearing media with casein, cholesterol and glucose on *Corcyra cephalonica* (Stainton): II Development Period and Fecundity. *Indian Journal of Entomology*, 42: 444-447.
- Tiwari, S. and Khan, M. A. 2002. Studies on the differential parasitism by *Trichogramma chilonis* Ishii on *Spilosoma oblique* Walker eggs. *Pestology*, 27: 29-31.
- Uberoi, N. K. 1960. Nutritional requirements of the larva of rice moth, *Corcyra cephalonica* (Stainton): Basic food requirements. *Indian Journal of Entomology*, 22: 265-271.