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Research article

ESTIMATION OF PRODUCTION POTENTIAL OF HOST INSECT *Corcyra cephalonica* (Stainton, 1865) (Lep., Pyralidae) ON DIFFERENT DIET COMBINATIONS TO PRODUCE *Trichogramma chilonis*

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ABSTRACT: Biological control of crop pest is a safe, economic and eco friendly approach in integrated pest management. Recent research emphasises the importance of mass rearing of bio control agents for augmentation & field releases. For mass production of many parasitoids and predators, *Corcyra cephalonica* has been the most suitable host insect in many laboratories (Jalai and Singh, 1992). Although there are several egg parasitoids commonly used throughout the world, *Trichogramma* have been the most extensively studied and promising. The rearing host diet is potentially importance to the nutritional quality of host eggs and the survival of parasitoids released into the environment as biological control agent (Hunter, 2003).Therefore it is necessary to study the effect of host rearing media on nutritional quality of Corcyra eggs on which *Trichogramma chilonis* is reared. In view of its potential importance to biological control programmes, an attempt was made in the present study to determine the economic efficiency of rearing media for *Corcyra* using sorghum, Pearl millet (bajra), finger millet (raagi), broken rice and foxtail millet (korra) in different combinations with the objective to study the Effect of different rearing media on growth and development of *Corcyra cephalonica* considering economy. The present experiment was conducted in the period from 02.03.2014 to 25.06.2014 at Centre for biological control (CBC), National institute of plant health management (NIPHM), Hyderabad to determine low cost, efficient rearing medium for rearing Corcyra cephalonica and to compare the diet options in terms of Biology *Corcyra cephalonica*. Experiment was conducted in controlled conditions i.e.; 25±1 ºC & 55±10% RH. The seven different rearing media were prepared by using cereal grains like sorghum, bajra, raagi (Finger millet), korra (Foxtail millet), maize & broken rice in different combinations. Seven different biological parameters of host insect have been taken under consideration to evaluate production potential of host insect influenced by diet combinations. Most of the parameters were found significantly higher in Bajra based medium T1 (Bajra+sorghum), which can be used profitably in mass multiplication of *Corcyra cephalonica* and the next best alternative being T4 (bajra+raagi) as well as T6 (Bajra+broken rice) and these two were found to perform better over other diet combinations made of maize, rice and korra grains.
Key words: Host insect, *Corcyra cephalonica, Trichogramma chilonis*

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INTRODUCTION

Biological control of crop pest is a safe, economic and eco friendly approach in integrated pest management. Recent research emphasises the importance of mass rearing of bio control agents for augmentation & field releases. For mass production of many predators and parasitoids, *Corcyra cephalonica* has been the most suitable host insect in most of the studies. *Corcyra cephalonica* Santion (Rice moth) is cosmopolitan in distribution which is stored grain pest attacks rice, millets and other cereal grains. It prefers broken grains and flour rather than whole grain. . Its amenability to mass produce throughout the year enable us to use it as host insect for mass rearing of many parasitoids and predators .The important among them are egg parasitoids – *Trichogramma* spp., egg-larval parasitoids- *Chelonus* spp., larval parasitoid- *Bracon* spp., *Goniozus spp.*,*Cotesia* spp., insect predators- *Chysoperla carnea*, predatory spiders and Reduviids. Besides some enntamophagous nematodes such as *Steinernema* spp., is also reared on *Corcyra cephalonica* [1].

In India Rice moth is being utilized in various biocontrol research, developmental and extension units for mass production of number of natural enemies [2].

Trichogramma chilonis is widely distributed in the Indian subcontinent in several crops and efficiently controls many lepidopteran insect pest by way of endoparasitisation of their eggs and playing vital role in bio control programmes [3]. Mass rearing of *T. chilonis* is carried out on eggs of *Corcyra cephalonica* in many of the laboratories. Host egg size and quality is a considerable factor which can effect developmental period, longevity, parasitism, adult emergence of parasitoids [4]. The rearing host diet is potentially importance to the nutritional quality of host eggs and the survival of parasitoids released into the environment as biological control agent [5]. In view of its potential importance to biological control programmes, an attempt was made in the present study to determine the economic efficiency of rearing media for Corcyra using sorghum, Pearl millet (bajra),finger millet (raagi),broken rice and foxtail millet (korra) in different combinations with the following objectives

1. To study the Effect of different rearing media on growth and development of *Corcyra cephalonica* in terms of average developmental period and percent adult emergence.
2. To study the effect of rearing media on fresh weight of adult moths (male & female), fecundity of females.
3. To determine food efficiency index of different rearing media considering economic efficiency of media.

MATERIALS AND METHODS

Biology of *Corcyra cephalonica*:

Adult moth is light greyish-brown in colour measuring 10- 12 mm long and with a wing span of about 15 mm, without any markings on the wings but veins are slightly darkened. Head bears a projected tuft of scales. Moths are short lived but realise a fecundity of 150—200 eggs per female within a few days after emergence. Eggs are laid either singly or in clusters. Eggs are whitish, oval in shape, 0.5 mm long and having an incubation period of 3-4 days. Tiny larva after hatching is creamy-white, with a prominent head. It moves about actively and feeds on broken grains for some time and then starts spinning web to join grains. Full grown larva is pale whitish in colour, 15 mm long with short scattered hairs and no markings on body. Larval period is 25-35 days in summer and may be extended in winter. Pupation takes place inside an extremely tough, opaque whitish cocoon that is surrounded by webbed grains. Pupal period is about 10 days but may extend to 40-50 days to tide over winter months. Moths commence mating and egg laying immediately after emergence.

EXPERIMENTAL DETAILS

The present experiment was conducted in the period from 02.03.2014 to 25.06.2014 at Centre for biological control (CBC), National institute of plant health management (NIPHM), Hyderabad to determine low cost efficient rearing medium for rearing *Corcyra cephalonica* (Lep., Pyralidae) and to compare the diet options in terms of *Corcyra* Biology. The stock culture of *Corcyra cephalonica* was procured from Centre for biological control, NIPHM, Hyderabad and the experiment was done at controlled conditions i.e; 25±1ºC & 55±10% RH. The seven different rearing media were prepared by using cereal grains like sorghum, bajra, raagi (Finger millet), korra (Foxtail millet), maize & broken rice in combinations.

1) Sorghum+Bajra (1:1)
2) Maize+Sorghum (1:1)
3) Sorghum+Broken rice (1:1)
4) Raagi+Bajra (1:1)
5) Korra+raagi (1:1)
6) Bajra+Broken rice (1:1)
7) Sorghum+Bajra+Raagi+Broken rice (1:1:1:1)

Each treatment was maintained in 5 replications and compared with control rearing medium where only Sorghum grain was taken. The efficiency of treatment was analysed based on the data of biological parameters recorded *viz;* Average developmental period of Corcyra, Percent adult emergence, Fresh weight of adult moths (male & female) , Fecundity of females and Food efficiency index .With the help of following available cheap material experiment was carried out. Plastic tubs of 16’ dia, Grain material of Sorghum, Bajra, Raagi, Maize, Broken rice & korra, Muslin cloth, Plastic funnels (10’*10’) Normal mosquito net, honey, yeast extract, Vitamin E capsules, Streptomycin sulphate, Camel hair brush, Paint brush, Specimen tubes , enamil trays, rubber band, measuring cylinder, hot air oven, Sieve, absorbent cotton 10% formaldehyde , blotting paper, soap solution ,electronic balance. Plastic tubs of 16’ dia were used to maintain optimum thickness of diet. Tubs were cleaned thoroughly with soap solution in tap water followed by sun drying for 3-4 h. They are surface sterilized with 10 % formaldehyde to avoid fungal contamination.

Cereal grains were cleaned to separate physical impurities and ground into broken grains with the help of blender. After that they were sterilized in hot air oven at 100ºC for 1 h to kill other insects if any and cooled down to room temperature. For each rearing tubs 1 kg grain, 2 g yeast and 0.2 g Streptomycin sulphates were added and stirred well. Streptomycin was used to avoid bacterial contaminations. Fresh Eggs of 0-24 h old have been collected in glass vials after sieving and cleaning with camel hair brush to remove moth wing scales and leg parts. The rate of hatching is more with fresh eggs. As the recommendation of standard protocol, 0.2 cc (2500 eggs) of *Corcyra* eggs per each tub have been taken with measuring cylinder and sprinkled in the medium evenly and the tubs have been covered with muslin cloth, secured by rubber band tightly. Tubs were checked after 3-4 days for webbing and maintained undisturbed up to 30 days at 25±1ºC & 55±10%RH. Ants were taken care with cypermethrin 5% chalk and all precautions were taken to prevent entry of *Bracon* spp and lizards by keeping the tubs in separate room having double door entry. After 30 days of egg charging, all the rearing tubs were observed every day for adult emergence. Freshly emerged *Corcyra* adults have been collected manually with small injection vials into oviposition cages made up of plastic funnel stitched with mosquito net (Fig.1). 50% diluted honey solution (50ml water+50ml honey+ 5 cap. Vitamin E) was offered with small cotton swab as feed to these adults regularly. These were maintained at 25±1ºC & 55±10%RH. Eggs have been collected from the oviposition cages every day in the morning with the help of paint brush into blotting paper and cleaned by using sieve and camel hair brush to remove scales and leg parts of adult moths**.** The cleaned eggs have been maintained in glass vials for recording observations.

Fig.1 Low Cost Oviposition Cage

PARAMETERS RECORDED

1) The Rearing tubs of all treatment have been observed for adult emergence every day from 3 to 4 days after egg charging. The first day of adult emergence was recorded separately which was varying in different treatments there by the developmental period from egg to adult emergence was compared in different rearing media.

2) Freshly emerged adults were collected in small glass vials from all the treatments separately and weighed in live condition. For this observation, a total of 30 males & females each from each treatment have been weighed in analytical balance and the mean fresh weight of individual adult male and adult female were obtained and compared among the treatments. Female and Male moths were identified by means of morphology of labial palpi which is projected forward in females moths (Fig.2).

3) 20 pairs of adults from each treatment have been collected in separate oviposition cages and maintained for 5 consecutive days by giving 50% honey solution mixed with vitamin E. Eggs have been collected every day and measured in cc with the help of measuring cylinder. Mean fecundity per female was compared in different treatments.

4) Feed efficiency index with different treatments was calculated by using the following formula, FEI = Percentage of adult emergence X 100egg weight/ Average development period. Percentage emergence of moths was calculated as Total no. Of moths emerged*100/ Total no. Eggs used per tub. Average developmental period = (X1 x Y1)+ (X2 x Y2)+...+(X45 x Y35)/(X1+X2+...+X35) Where, X1=number of days from egg charging to first day of adult emergence,Y1=number of adults emerged on the first day of emergence. (Kumar and Kumar, 2002) First day of moth emergence from each tub was considered for developmental period. Average developmental period was calculated by multiplying the development period with the no. Of moths emerged that day. The product of these two was summed up for thirty five days and divided by total no. Of moths emerged in thirty-five days.

Fig.2 Female moth with projected labial palpi and male with reduced labial palpi

RESULTS AND DISCUSSION

The present experiment was conducted in the period from 02.03.2014 to 25.06.2014 at Centre for biological control (CBC), National institute of plant health management (NIPHM), Hyderabad.

Adult Moth Emergence

Daily collection of adult moths from all the treatments was recorded for 35 days starting from 1st day of adult emergence. The no. of adults emerged everyday is the measure of egg production. Weekly cumulative data of adult emergence has been obtained after analysis. It was observed that the daily collections were the highest in T1 (Bajra+sorghum) and least results were obtained with T5 (Korra+raagi). The larval development was more favoured on the Bajra based treatments i.e highest in T1 (Bajra+sorghum) followed by T6 (Bajra+broken rice).

Percent Adult Moth Emergence

Percent adult emergence is the no of adults emerged from the no. Of eggs inoculated in media. It shows the effect of larval feed on survival and development Bajra base media T1(Bajra+sorghum) & T6 (Bajra+Broken rice) allowed good percent adult emergence which was recorded for 35 days after egg charging i.e. 42.48% and 39.68% respectively which were significantly different from others. It was also observed that the daily collections were progressive after 2 weeks of adult emergence in all the treatments and showed progressive decrease after 30 days from the first day of adult emergence. Results are in agreement with findings of Marak [6] where in diet prepared from bajra in combination with groundnut has resulted in highest per cent adult emergence.

Fresh Weight of Adult Moths

Fresh weight of adult females indicates its size, robustness and egg producing ability as well as fecundity. In general lepidopteron females are heavier than males, even *Corcyra cephalonica* is not exception for that. It was observed that fresh weight of both female (0.038 g) and male (0.025g) were significantly higher in T4 (Bajra+raagi) and lowest in T2 (Maize+sorghum). Bernardi *et al.* (2000) stated in his findings that fresh weight of females was greatly influenced by diet and was found highest in diet combinations wheat germ+yeast (33.73 mg) and rice bran+yeast media (32.39 mg).

Fecundity of Adult Female

Fecundity of females is important parameter for estimating egg production. It was observed that Bajra based medium T1 (Bajra+sorghum) has resulted significantly higher fecundity of each female (0.027cc), followed by T4 (Bajra+raagi) (0.026cc) and T6 (Bajra+broken rice) (0.026cc). The lowest fecundity was observed in T3 (Sorghum+Brokenrice) (0.017cc) and T2 (Maize+sorghum). These results are comparable to finding of Bhandari *et al.* [7] where bajra based medium was found effective in terms of robust female moths with high fecundity. Bernardi *et al.* [8] found that fecundity of female moths varied greatly in different diet combinations and recorded better in rice bran with yeast combination medium. Mehendale *et al.* [12] in his experiment observed that diet offered to host had significant effect on number of eggs produced per female and he found sorghum+groundnut+yeast medium as best performer with a mean fecundity 24.73 per female.

Feed Efficiency Index

Feed efficiency index was computed based on average development period, 100 egg weight and percent adult emergence data which was found highest (6.545) with Bajra based media T4 (Bajra+raagi), similarly 6.531 with T1 (Bajra+sorghum) and it was least with T3 (Sorghum+Broken rice). Feed efficiency index of a rearing medium depicts the economic efficacy of feed which is paramount important in mass production of *Corcyra cephalonica*. However in a study conducted by Kumar and Kumar [9], The FEI was highest in case of sorghum followed by pearlmillet.

Average Developmental Period

The Rearing tubs of all treatment have been observed for adult emergence every day from 3 to 4 days after egg charging. Average development period was faster (11days) in T5 (Korra+Raagi) which is a desirable character followed by 22 days in T3 (Sorghum+Broken rice) showing that the larval development is faster in those diet combination. Where as in T1 which is a bajra based diet combination (Bajra+sorghum), it was recorded as 32 days. Jagadish *et al.* [10] found larval development period ranging from 28 to 36 days on foxtail millet. Similar trend of 28 to 36 days of larval duration was reported by Manjunath [11]. Whereas Bhandari *et al.* [7] found that larval developmental period ranged from 29 to 41 days on different diets with longer duration on rice (41.08) and shorter duration on Corn+ groundnut (29.58) in days.

SUMMERY AND CONCLUSIONS

Percent adult emergence is the no of adults emerged from the no. of eggs inoculated in media. It shows the effect of larval feed on survival and development. In this study it was observed that Bajra base media T1(Bajra+sorghum) & T6 (Bajra+Broken rice) allowed good percent adult emergence which was recorded for 35 days after egg charging i.e. 42.48% and 39.68% respectively which were significantly different from others. Average development period was faster (11days) in T5 (Korra+Raagi) which is a desirable character followed by 22 days in T3 (Sorghum+Broken rice) showing that the larval development is faster in those diet combination. Where as in T1 which is a bajra based diet combination (Bajra+sorghum), it was 32 days. Development of Corcyra was considerable in all the media tested however percent adult emergence was recorded highest with significant difference with T1 (Bajra+sorghum) and lowest with T6 (Bajra+broken rice). Fecundity was observed significantly highest with T1 (Bajra+sorghum) followed by T4 (bajra+raagi). Fresh weight of adult moths. Feed efficiency index was calculated based on percent adult emergence, 100 egg weight & avg.devolopment period, Feed efficiency index was higher with T4 (bajra+raagi) & T1 (Bajra+sorghum). However most of the parameters were found significantly higher in Bajra based medium T1 (Bajra+sorghum), which can be used profitably in mass multiplication of *Corcyra cephalonica* and the next best alternative to this combination is both T4 & T6 as these two are on par with T1 in majority of parameters. Further research may be continued with evaluation of field efficacy and adult survival of *Trichogramma chilonis*.

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