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Parasitization Potential of *Goniozus nephantidis* (muesebeck) on *Corcyra cephalonica* (stainton) Reared on Different Rearing Media under Laboratory Conditions

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ABSTRACT: *Laboratory experiment entitled 'Parasitization potential of* Goniozus nephantidis *(Muesebeck) on* Corcyra cephalonica *(Stainton) reared on different rearing media under laboratory condition' was under taken. Eight Different artificial rearing media were evaluated to test suitability for* C. cephalonica *larvae and their effect on Parasitization potential of* G. nephantidis *in view to maximize production in terms of quality as well as quantity. The effect of each media on* C. cephalonica *larvae on biological parameters like grub production, pupation success, adult emergence, sex ratio, adult longevity and number of* Corcyra *larvae paralyzed by* Goniozus *were studied. The results revealed that, considering number of grubs produced per female of* G. nephantidis *on* Corcyra *larvae, media T4 (Wheat flour + Ground rice + Sugar) showed significantly maximum grub production (42.00). Pupation success was also significantly highest in media T4 (36.20). Maximum adult emergence was also observed in treatment T4 (35.60) which was at par with T5 (Sorghum + Kidney bean + Sugar) (30.40). Concerned with adult longevity T4 (35.60) showed better results and was at par with T5 (34.40 days). Whereas, the shortest female longevity was observed in T8 (Sorghum + Groundnut + Yeast) 19.20. Number of larvae paralyzed by* G. nephantidis *was highest in T5 (7.00) and lowest in T6 (Sorghum + Groundnut + Yeast + Sugar) 4.00. Concerned with sex ratio (male: female) the highest numbers of females were observed in treatment T6 (1:27.75) Sorghum + Groundnut + Yeast + Sugar .Treatment T2 (Sorghum + Gram + Yeast) showed very poor sex ratio 1:2.72. Overall results showed that, T4 to be an ideal medium and it was possible to improve the Parasitization potential and overall performance of* Goniozus *through host manipulation* i.e. Corcyra *larvae.*

Key words: *Parasitization potential,* Goniozus nephantidis, *host manipulation, artificial rearing media*

INTRODUCTION

Biological control of insect pests involves use of various natural enemies like parasitoids, predators, and pathogens. These natural enemies are mass produced in bio-control laboratories either on natural hosts or on factitious hosts. Normally it is observed that the growth and development of natural enemies on natural host is always better than those recorded on factitious hosts and this happens when same type of host is continuously used for natural enemies under laboratory condition. Further, the natural enemies produced under the laboratory conditions lose their potential may be because of inbreeding problems and under such condition the adults produced are mostly inferior in some of the important features like Parasitization/ feeding potential, longevity, sex ratio etc. Further, such adults when released in the field may not cope up with the natural conditions and hence the desired effects are not obtained.

In bio-control laboratory commonly used factitious host is *Corcyra cephalonica* (Stainton) and is used for mass production of various parasitoids and predators. *Corcyra* larvae are usually grown on cereal grains like rice, jawar, bajara etc. The standard rearing medum consisting of crushed jawar + Groundnut + Yeast. This diet is invariably used in all bio-control laboratories. Various workers have tried to modify this medium by adding various other ingredients in view to improve the rearing medium, so that the larvae of *Corcyra* will be improved on nutritional base to their natural enemies. This is called 'host manipulation' and was reported by earlier workers

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in case to various parasitoids and predators (Radhika and Chitra 1999, Shahyaraj and Sathiamoorthi 2002, Murthy *et al.* 2004, Mehendale *et al.* 2009).

Goniozus nephantidis (Muesebeck) an important larval ectoparasitoid of *Opisena arenosella* (Walkar) (i.e. Coconut black headed caterpillar) is easily mass produced in bio control laboratories either on *Corcyra* or *Gallaria melonella* (linn) as factitious hosts and *O. arenosella* as natural host. However, rearing of *O. arenosella* is also now possible on artificial diet. In all these cases, based on the above thought of host manipulation, one can improve the nutritional make-up of the host insect by improving its diet.

There is continuous demand for *Goniozus* throughout the coconut growing area. The main aim of bio-control laboratory is timely availability of the natural enemies both qualitatively and quantitatively to the end users. A considerable work on the biology of *Goniozus* is available in India. However the literature on host manipulation in respect to this parasitoid is yet scanty. In this view, it was felt necessary to conduct a research work on mass production of *G. nephantidis*.

MATERIALS AND METHODS

The experiment was conducted to study 'Parasitization potential of *Goniozus nephantidis* (Muesebeck) on *Corcyra cephalonica* (Stainton) reared on different rearing media under laboratory condition' at the Department of Agricultural Entomology, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during March 2012 to June 2012.

The following materials were used for rearing of *C. cephalonica* and mass multification of *G. nephantidis*.

Rearing of *C. cephalonica* –Wooden rearing boxes (50 x 25 x 15 cm), Food grains (Sorghum, Kidney bean, Cowpea, Gram, Groundnut, Rice, Wheat), Eggs of *C. cephalonica,* Streptomycin sulphate, Formalin (0.1%), Yeast, Sugar, Miscellaneous.

Mass multiplication of *G. nephantidis* – Test tubes (15 x 2.5 cm)**,** Plastic vials (7.5 x 2.5 cm), Plastic trays (40 x 30 cm), Honey (50%), Cotton, Rubber bands, Muslin cloths**,** Brush, Forceps, Pins, etc.

Procurement of Insect Cultures

To start, fresh eggs of *C. cephalonica* were obtained from National Bureau of Agriculturally Important Insects, Bangalore (NBAII).

The culture of *G. nephantidis* was obtained from Biological Control Laboratory of Department of Agricultural Entomology Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli.

Preparation of Rearing Media and Maintenance of *Corcyra.*

An efficient and low cost mass rearing media for rearing of rice moth is the backbone to minimize the production cost of biological control agent and to get quantity and quality produce of the parasitoids. The grains of cereals - Sorghum, Rice, Wheat, pulses - Cowpea, Gram, Kidney bean and oilseed - Groundnut were purchased from the local market. The following precautions were taken while selecting the food grains for rearing of *C. cephalonica.*

(i) The grains should be new, bold, shiny, attractive and also suitable for human consumption.

(ii) Grains should not be infected by any store grain pest.

(iii) Grains also should not be infected by any disease or mould.

The quantity of grains and other ingredients used are shown in Table 1. All grains except Wheat were crushed into 3-4 pieces by grinding in mixer and kept ready to be filled in glass bottles. While, grains of Wheat were milled in local market. Glass bottles were washed by fresh and clean tap water and dried them into bright sunlight for 5 hours.

The required rearing medium was heat sterilized in hot air oven at 100 °C for 30 minutes to free it from any secondary infection. All sterilized rearing media were then treated with 0.1 per cent Formalin to prevent the growth of mould as well as to increase moisture which was lost during heat sterilization. Then media were air dried to remove the traces of Formalin.

Different components of rearing media (Table 1) were mixed and 1 kg of the mixture was filled in Glass bottles. Streptomycin Sulphate (0.3%) was thoroughly mixed in each bottle with grains to avoid bacterial contamination. Fresh 500 *Corcyra* eggs were sprinkled over the mixture, mixed thoroughly and lid of the bottles (having small holes for aeration) were secured tightly for 30 days. Whole set was maintained at 20 ± 2 °C and 80 ± 5 per cent relative humidity.

Fifth instar Larvae of *C. cephalonica* were used for studying parasitization potential from each treatment. Single fifth instar *Corcyra* Larva from respective medium was provided to individual female of *G. nephantidis* for parasitization. Each treatment was replicated for three times with set of 5 larvae/ replication. The paralized larve of *C. cephalonica* were removed from the vials and another larva was again provided to the same female parasitoid for parasitization till her death. Parasitized larvae were

maintained individually in a separate plastic vial for further observations. Following observations were recorded.

1. Number of Larvae parasitised per female: Out of the *Corcyra* Larvae which were reared on different rearing media and provided to each female of *G. nephantidis* for parasitization, those Larvae paralysed by adult female of *Goniozus* till her death were counted as number of Larvae parasitised per female.

2. Number of grubs produced per female: After paralysing the *Corcyra* Larvae, the eggs were laid on body of *Corcyra* Larvae by each *Goniozus* female eggs hatched within 2-3 days and the grubs were emerged from eggs which remained attached to the body of Larvae Such grubs from each female were counted and taken as number of grubs produced per female. The grubs were counted under the 10x lens.

3. Number of pupae produced per female: Number of pupae formed by the grubs was counted to determine number of pupae produced, per *Corcyra* Larvae per female.

4. Number of adults produced per female: The newly emerged males and females of *G. nephantidis* from the pupae were considered as adults and counted as number of adults produced per female.

5. Sex ratio (Male: Female): The newly emerged adults of *Goniozus* in individual vials were distinguished on the basis of their morphological characteristics to determine sex ratio (male : female). The Females were larger than the males with tapering abdomen.

6. Female longevity: The longevity of the parasitising female was counted from her emergence from pupa till death, in presence of her host.

RESULTS AND DISCUSSION

The results of the said experiment are presented and discussed under following headings.

Number of grubs produced per female of *G. nephantidis* on larvae of *C. cephalonica* reared on different rearing media

The results revealed that, the treatment T4 (42.00) was superior treatment and was at par with treatment T2 (33.60). Both were best suitable media for highest grub production from eggs of *G. nephantidis* on larvae of *C. cephalonica*. Further it was revealed that, treatment T2 was at par with T5 (33.40), T7 (29.20), T3 (28.60) and T8 (28.00). Further, treatment T3 was at par with T8, T6 (25.20) and T1 (24.20).

From above results it was indicated that, the treatment T4 and T2 were best suitable media for *Corcyra* rearing to increase the grub's production of *G. nephantidis*.

Radhika and Chitra (1999) revealed that, the highest numbers of grubs / larvae of parasitoid *G. nephantidis* were obtained from the *Corcyra* larvae reared on Sorghum + Glucose + Groundnut.

According to Chandrika and Shameer (2003), the numbers eggs of *Goniozus* per host were 11.56 ± 2.29, 10.3 ± 2.91 and 10 ± 2.4 on *O. arenosella, C. cephalonica* and *Galleria melonella* (Linn), respectively. According Raut *et al.* (2010), the number of eggs laid by single female on *C. cephalonica* larvae ranged from 12 to 32 with a mean of 22. The maximum numbers of eggs laid by single female were 32, 32 and 31 observed from T2 (Whole wheat flour + Ground rice + Sugar), T7 (Sorghum + Tapioca + Rice germ + Milk powder), and T10 (Sorghum + Groundnut + Yeast), respectively and these treatments were at par with each other.

Number of pupae produced per female of *G. nephantidis* on *C. cephalonica* larvae reared on different rearing media

Data indicated that, the T4 (36.20) was significantly superior treatment over all the remaining treatments. This was followed by treatment T2 (30.80) which was at par with treatment T5 (30.40). Next treatments to follow were treatment T8, T3, T7 and T6 with respective values of 25.40, 25.20, 23.80 and 23.20. Further T7, T6 and T1 (21.20) were also found at par.

From above results it was revealed that, diet like T4 (Wheat flour + Ground rice + Sugar) was the best diets for successful pupation of *G. nephantidis*. However, next better diets were T2 and T5 which were also found effective for successful pupation of *G. nephantidis* grubs.

According to Radhika and Chitra (1999) pupae formation of parasitoid *G. nephantidis* on *C. cephalonica* were highest observed (120.56) when *Corcyra* larvae were reared on sorghum + glucose + groundnut.

Number of adults produced per female of *G. nephantidis* on *C. cephalonica* larvae reared on different rearing media

The data are presented in Table 2. The data revealed that, in the impact of different diets on adult emergence of the *G. nephantidis,* treatment T4 (35.60) was best suitable medium which was at par with T5 (30.40).

Further, T5 was at par with T2 (29.80). The next treatments in the order were T3, T8, T7 and T6 with corresponding values of 25.00, 24.80, 23.60 and 23.00 adults, respectively.

Table 1
Different Rearing Media for *Corcyra cephalonica* (Stainton)

Treat.	*Treatment Combinations*
T_1	Sorghum (750 gm.) + Cowpea (250 gm.) + Yeast (5 gm.)
T_2	Sorghum (750 gm.) + Gram (250 gm.) + Yeast (5 gm.)
T_3	Sorghum (750 gm.) + Kidney bean (250 gm.) + Yeast (5 gm.)
T_4	Wheat flour (750 gm.) + Ground rice (250 gm.) + Sugar (5 gm.)
T_5	Sorghum (750 gm.) + Kidney bean (250 gm.) + Sugar (5 gm.)
T_6	Sorghum (750 gm.) + Groundnut (250 gm.) + Yeast (5 gm.) + Sugar (5 gm.)
T_7	Only Sorghum (750 gm.)
T_8	Sorghum (750 gm.) + Groundnut (250 gm.) + Yeast (5 gm.) (Standard diet)

Table 2
Parasitization Potential of *Goniozus nephantidis* (Muesebeck) on *Corcyra cephalonica* (Stainton) Reared on Different Rearing Media under Laboratory Condition

Treatment	*Mean number of grubs produced*	*Mean number of pupae produced*	*Mean number of adults produced*	*Mean adult longevity (days)*	*Mean no. of Corcyra larvae paralysed*	*Sex ratio (Male:Female)*
T_1	24.20 (5.01)	21.20 (4.71)	20.80 (4.66)	27.40	5.00 (2.42)	1:10.55
T_2	33.60 (5.88)	30.80 (5.64)	29.80 (5.54)	25.80	4.60 (2.34)	1:2.72
T_3	28.60 (5.44)	25.20 (5.11)	25.00 (5.10)	25.40	4.80 (2.38)	1:4.54
T_4	42.00 (6.55)	36.20 (6.09)	35.60 (6.05)	35.20	7.00 (2.83)	1:15.18
T_5	33.40 (5.85)	30.40 (5.60)	30.40 (5.60)	34.40	7.00 (2.83)	1:8.50
T_6	25.20 (5.10)	23.20 (4.91)	23.00 (4.89)	25.40	4.00 (2.22)	1:27.75
T_7	29.20 (5.40)	23.80 (4.97)	23.60 (4.95)	26.00	4.80 (2.38)	1:8.33
T_8	28.00 (5.37)	25.40 (5.13)	24.80 (5.07)	19.20	5.00 (2.42)	1:9.41
S.Em±	0.24	0.13	0.11	4.08	0.15	
CD at 5 %	**0.69**	**0.38**	**0.32**	**11.74**	**0.42**	

(Figures given in parentheses are "n+1 transformation)

However, treatment T7 was further remained at par with T6 (23.00) and T1 (20.80).

From the above results it could be clear that, treatment T4 was again superior in producing maximum number of adult's progeny/ larvae/ female of parasitoid. This further stood parallel with T5. Remaining treatments though superior were not as effective as these two treatments.

Radhika and Chitra (1999) revealed that, the highest adult parasitoids of *G. nephantidis* (115.13) were obtained from the *Corcyra* larvae reared on sorghum + glucose + groundnut. According to Kamble *et al.* (2006) maximum per cent adult emergence (90.72 per cent) of *T. chilonis* was recorded on eggs of *Corcyra* reared on sorghum.

Adult longevity of *G. nephantidis* on larvae *C. cephalonica* reared on different rearing media

The data revealed that, the adult longevity in the treatment T4 (35.20 days) was superior and at par with T5 (34.40 days), T1 (27.40 days), T7 (26.00days), T2 (25.80days), T6 (25.40days) and T3 (25.40days). However, the data further revealed that there was no statistical difference in the adult duration of treatments *Viz.*, T1, T7, T2, T6, T3 and T8 (19.20 days).

According to Paul *et al.* (1979) the adult female life span of *G. nephantidis* was 30.7 days in groups reared on *C. cephalonica*. Whereas, compared with *O. arenosella* it was 14.5 days.

Mehendale *et al.* (2009) revealed that, the longevity of female parasitoid *Trichogramma chilonis* (Ishii) was

the maximum from eggs of *Corcyra* female emerged from Sorghum + Groundnut + Yeast (4.47 days), Sorghum + Cowpea + Powdered Yeast (4.33 days) and Sorghum + Gram + Powdered Yeast (4.33 days).

Number of *Corcyra* larvae paralysed by *G. nephantidis*

The follow up of data revealed that, the maximum number of larvae paralysed by the female was significantly maximum in treatment T5 (7.00) which was further observed to be at par with treatment *viz*., T4 (7.00), T8 (5.00), T1 (5.00).

Further treatment T8 was also found at par with the remaining treatments like T1 (5.00), T7 (4.80), T3 (4.80), T2 (4.60) and T6 (4.00). This clearly indicated that, the rate of parasitization by the *Goniozus* female was maximum and significant in case of larvae reared from the media *viz*., T4, T5, T8 and T1 as compared to remaining media.

In a similar study, earlier taken by Kamble *et al.* (2007) it was revealed that, *G. nephantidis* could paralysed as many as 6 larvae of *C. cephalonica*. Further according to Raut *et al.* (2010) the results revealed that, female *Goniozus* paralysed maximum 5 larvae reared from media T2 (Whole wheat flour + Ground rice + sugar) and T10 (Sorghum + Groundnut + Yeast). Mehendale *et al.* (2009) revealed that, the per cent egg parasitization by *T. chilonis* on *Corcyra* eggs obtained from female emerged from different media was highest in T_3 (Sorghum + Groundnut + Yeast) 94.70 per cent, T_4 (Sorghum + Gram + Powdered Yeast) 92.65 per cent and T6 (Sorghum + Cowpea + Powdered Yeast 90.48 per cent.

Sex ratio (Male : Female) of *G. nephantidis* on larvae of *C. cephalonica* reared on different rearing media

Data represented in Table 2 indicated that, the sex ratio of *G. nephantidis* (Male: female) on larvae of *C. cephalonica* reared on different rearing media was Female based *i.e.* the highest numbers of females were observed in treatment T6 (1:27.75). This treatment was significantly superior over rest of all the treatments. This was followed by treatment T4 (1:15.18). Treatment T2 (1:2.72) showed very poor sex ratio as compared to all the remaining treatments.

From above data it was realized that, the *Corcyra* larvae reared out from medium T6 could support emergence of maximum females in the progeny of parasitoid this was followed by medium T4. Thus the aim of getting maximum female parasitoid in the laboratory colony could be achieved in media like T6 and T4.

Murthy *et al.* (2004) studied the development of *G. nephantidis* in *O. arenosella* reared on artificial diet. They revealed that, sex ratio of *Goniozus* male : female was 19.2 : 1.0 ± 0.302 and 15.4 : 1.0 ± 0.8860 on *O. arenosella* larvae reared on semisynthetic diet (Toddy palm leaf powder + defatted soya + kabuli gram) and other ingredients or coconut leaves, respectively.

Mehendale *et al.* (2009) revealed that, maximum per cent female emergence of egg parasitoid *T. chilonis* from the eggs of *Coryra* obtained T_6 (80.55%), T_4 (79.71%) and T_3 (69.50%) i.e. Sorghum + Cowpea + Powdered Yeast, Sorghum + Gram + Powdered Yeast and Sorghum + Groundnut + Yeast, respectively. Also the sex ratio revealed female preponderance in T6 (1 : 4.06), T4 (1 : 3.94) and T3 (1 : 2.28).

CONCLUSION

It is possible to improve the parasitization potential and overall performance of *Goniozus* through the *Corcyra* larvae which were reared on different rearing media.

Among various rearing media evaluated, rearing media T4 *i.e.* Wheat flour + Ground rice + sugar seems to be an ideal medium for development of laboratory culture of *Corcyra,* as the biological parameter of *Goniozus viz*., grub production, pupation success, adult emergence, sex ratio, adult longevity and number of *Corcyra* larvae paralyzed were almost significant in case of *Corcyra* larvae reared from this medium. Thus the medium T4 would be suitable medium in mass production of *Goniozus.*

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