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Effect of different diets on the biology of rice moth, *Corcyra cephalonica* (Stainton)

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Abstract
Nine experimental dietary formulations (T1-T9) were prepared which composed of rice, wheat, sorghum, rice + groundnut, wheat + groundnut, sorghum + groundnut, rice + sesamum, wheat + sesamum and sorghum + sesamum as base diet to rear and maintain the rice moth, *Corcyra cephalonica* under laboratory conditions. All the diets were fortified with baker's yeast @ 5 g, wettable sulphur @ 5 g, and Streptomycin sulphate @ 50 mg. The parameters studied in the present work were eggs hatching percentage, incubation period, larval period, pupation percentage, pupation period, total developmental period, percent adult moth emergence, percent male and female moth emergence, male and female longevity and fecundity. The Diet T6 (sorghum 1000 g + groundnut 50 g) was found to outperform other dietary formulations as it resulted in lowest larval period (30.33 days), lowest pupation period (7 days), lowest total development period (47.33 days), highest adult emergence (82%), highest adult female emergence (52.11 days), highest male longevity (8.33 days), highest female longevity (9.67 days) and highest fecundity (312.33). The obtained results provide suitable diets for mass rearing, thus contributing significantly for the large scale production of *C. cephalonica*.

Keywords: Food grains, yeast, larva, pupa, adult, *Corcyra cephalonica*

Introduction
Global warming has cautioned us and the adverse consequences of insecticide use are always alarming and also inducing pest out break because of pest resistance. These entomological backlashes have compelled the scientists to be concerned with entomologically compatible pest management programme (Shukla and Jadhav, 2014) [1]. Now days, Integrated Pest Management (IPM) is well known to all of us where all the suitable pest control techniques are being used to find ecologically sound and environmentally safe ways of pest control. Biological control should be regarded as the backbone of any IPM programme and about 90% of all potential pests are already under biological control (Shukla and Jadhav, 2014) [1]. The biological control is one of the most effective means of achieving insect control. The fundamental aim in mass production of natural enemies viz., *Trichogramma chilonis* (Ishii) in is their quality production at faster and cheaper rate. The quality of the natural enemies in the laboratory mostly depends on the quality of the host, which ultimately depends on the host nourishment. Therefore, the diet of the host is potentially of importance to the nutritional quality of host and the survival of *Trichogramma chilonis* Ishii and other egg parasitoids released in the environment as biological control agents (Finney and Fisher, 1964) [2] and (Hunter, 2003) [3]. Several food materials viz., rice (Oryza sativa L.), sorghum [*Sorghum bicolor* (L.) Moench], groundnut (*Arachis hypogaea* L.), maize (*Zea mays* L.), castor (*Ricinus communis* L.), cashew nut (*Anacardium occidental* L.), wheat (*Triticum aestivum* L.), finger millet (*Eleusine coracana* Gaertn) and bajra (*Pennisetum typhoides* L.) etc. have been tried in India for the mass production of *C. cephalonica* and workers expressed different views regarding their suitability (Ambika *et al*., 1981) [4], (Sharma,*et al*., 1982) [5], (Solayappan, 1991) [6] (Singh and Jalali, 1991 and 1994) [7] and (Kumar and Shenhmar, 2001) [8]. The results of the experiments conducted by Nathan *et al*. (2006)[9] revealed that rearing *C. cephalonica* on a high quality nutrient source resulted in high quality eggs, which ultimately resulted in high quality production of *T. chilonis* reared on such host eggs. The present investigation was therefore formulated with the aim of manipulation of *Corcyra* rearing medium for testing its suitability in getting good quality eggs through enhanced nourishment of *Corcyra* larvae. Thus, good quality egg parasitoid, *T. chilonis* could be utilized through inundative release for

the management of many lepidopterous insect pest according to Bhushan *et al*., (2012) [10] and Fand *et al*., 2013) [11].

Materials and Methods

The present investigation was conducted at insectary area in biological control laboratory, Entomology Section, College of Agriculture, Nagpur (M.S.), during 2015 – 16 to assess the effect of different diets on the biology of rice moth, *Corcyra cephalonica* (Stainton.) (Pyrallidae - Lepidoptera). The material used and methods used to carry out these investigations are described below:

The bold, clean grains of rice, wheat, sorghum and other oilseeds were grinded in a domestic grinder by making 2 to 3 pieces of each grain. These grains were then heat sterilized in hot air oven at 100 ºC for 30 minutes to make them free from any secondary infestation. Similarly, material was treated with streptomycin sulphate @ 50 mg per kg to prevent the bacterial infection (Rao *et al*., 1980) [12]. Material of each treatment was mixed in the proportion of the ingredients in a *Corcyra* rearing boxes was round, transparent plastic box of about 2.5 kg capacities with plastic lid (Size: diameter- 15 cm and height - 10 cm). The plastic box was cut open in the centre to make a round opening having 8 cm diameter. This opening of plastic lid was closed with iron wire mesh by heat soldering. This arrangement was made to provide sufficient aeration and light. Before adding of *Corcyra* eggs, 5 g dry powdered yeast was added in all combinations. Freshly laid 1/4th cc eggs of *Corcyra* were added in each tray and contents mixed thoroughly for uniform distribution. All the trays were daily checked for moth emergence. Emerged moths were collected separately as per respective treatment in the net house daily in the morning (Ingle *et al.*, 2000) [13]. Regarding the effects of different diets on some biological parameters of *C. cephalonica* following observations were recorded. Eggs hatching percentage: Fifty eggs were kept in petridish to observe hatching. The number of eggs hatched out of fifty was counted to determine the hatching percentage. Incubation period: The egg laid by each of ten females were transferred to 10 petriplates (10 x 2 cm) separately, using moist camel hair brush and larva emerged was observed daily. One set of ten eggs was kept for observation. Larval period: The larvae hatched from each of the petri plates were transferred to ten petri plates with the help of moist camel hair brush having 100 g rearing media. The larval period was recorded from date of hatching to till the date up to 50 percent larva spin the cocoons. The average of 10 larvae for each treatment was worked out such three replications was maintained. Pupation percentage: The same ten larvae, which were about to pupate, were kept under observation for recording the pupation percentage. Pupal period: The same ten larvae, which were about to pupate, were kept under observation for recording the pupal period. Each larva was observed till adult emergence and then average pupal period was worked out. Percent adult emergence: The actual number of moths emerged from pupae were counted and percent adult emergence was calculated. The percent of male and female adult moth emergence were also recorded. Adult longevity: The male and female moths on different diets were kept separately in plastic containers to record adult longevity. They were provided with 5 percent honey solution. The total development period: The period from egg laying to death of adult was computed by combining the data obtained from the observation of incubation period to adult longevity and given as total life cycle of *C. cephalonica*. Fecundity: The total numbers of egg laid by each female in its lifetime was recorded. During this period, the pairs were supplied with 5 percent honey solution. The average fecundity was worked out.

Statistical analysis:

The data collected on egg, larval and pupal duration, percentage of moth emergence, male and female emergence, male: female ratio, fecundity were subjected to the statistical analysis.

Results and Discussion

The effects of different rearing media on some biological parameters of factitious host, *C. cephalonica* are based on pooled results are presented Table 1. The incubation period of rice moth, *Corcyra cephalonica* (Stainton) varied from 3 to 4 days with an average of 3.49 days. The longest incubation period of 4.00 days was observed in treatment T6 (Sorghum 1000 g + ground nut 50 g) and the shorter period of 3 days was recorded on T9 (Sorghum 1000 g + sesame 50 g). The observations made in this study are somewhat correlated with those of Urs and Mookharjee (1966) [14], they reported that the incubation period on groundnut was 4.44 days. The incubation period of *C. cephalonica* on different rice varieties ranged from4.0 to 4.5 days. Similarly Kamble *et al.* (2006)[15] reported that mean incubation period was 4.40 days on different cereal grains. The hatching percentage of rice moth, *Corcyra cephalonica* (Stainton) ranged from 78 to 94 with an average of 84 percent. The maximum hatching percentage 94 was recorded from T6 (Sorghum 1000 g + ground nut 50 g) and the minimum hatching percentage of 78 was recorded with treatment T2 (Wheat 1000 g). The percent eggs hatching are more or less similar with findings of earlier authors. The percentage hatching of *C. cephalonica* on rice varieties ranged from 86.60 to 10 percent with a mean of 95.66% (Gailad. 1987) [16]. However, More (1995) [17] reported the percentage hatching from 84.99 to 95.60 on different rice varieties. Similarly, Kamble *et al*. (2006) [15] reported that mean percent hatching was 95.30 on cereal grains. The larval period of rice moth, *Corcyra cephalonica* (Stainton) ranged from 30.33 to 38.66 days with an average of 33.07 days. The longest larval period was noticed when larvae reared on treatment T8 (Wheat 1000 g + sesame 50 g) i.e. 38.66 days and the shortest period of 30.33 days was observed on T6 (Sorghum 1000 g + ground nut 50 g). Quite similar type of observations were also recorded by Bhandari *et al.* (2014)[18] and stated that Corcyra complete its larval period in the range of 29.58 to 41.08 days on different diets under laboratory condition in Chitwan, Nepal. The pupation percentage of rice moth, *Corcyra cephalonica* (Stainton.) ranged from 67.66 to 85.00. The maximum pupation percentage of *Corcyra cephalonica* (Stainton.) was recorded on the treatment T6 (Sorghum 1000 g + ground nut 50 g) i.e.85 percent, which was significantly superior over all treatments and the minimum percentage of pupation was recorded on T8 (Wheat 1000 g + sesame 50g) i.e. 67.66 percent. The percentage of pupation of *C. cephalonica* on different rearing media ranged from 64.24 to 88.20 with a mean of 75.66% (Mehendale *et al.* 2014) [19]. Thus, this results are somewhat correlated with the findings of present investigation. The pupal period of *Corcyra cephalonica* ranged from 7.0 to 14.33 days with a mean of 10.86 days. The longest pupal period of 14.33 days was observed on T5 (Wheat 1000 g + ground nut 50g) and the lowest (i.e. 7.00 days) was recorded on treatment T6 (Sorghum 1000 g + ground nut 50 g). The results obtained are in conformity with Urs and Mookharjee (1966) [14], who reported that pupal period was 10.63 days on groundnut. The

percent adult emergence of rice moth, *Corcyra cephalonica* (Stainton) ranged from 60.66 to 82 with a mean of 72.96. The maximum percent adult emergence (i.e.82 percent) was observed on T6 (Sorghum 1000 g + ground nut 50 g) and the minimum percent adult emergence was on T5 (Wheat 1000 g + ground nut 50g) i.e. 60.66 percent. The observations made in this study are in agreement with the findings of Kamble *et al.* (2006) [15], who mentioned that mean percent adult emergence was 43.92 percent on different cereal grains. The percentage of male moth emergence of rice moth, *Corcyra cephalonica* (Stainton) ranged from 47.89 to 55.92 with a mean of 52.54. The treatment T8 (Rice 1000 g + sesame 50 g) showed the maximum male moth emergence i.e. 55.92 percent, which was significantly superior over the treatments and the lowest percentage of male moth emergence (i.e. 47.89 percent) was observed on T6 (Sorghum 1000 g + ground nut 50 g). Similar observations were also recorded byRizwana Begum and Ayesha Qamar (2015) [20], who reported that the male emergence percentage of *Corcyra cephalonica* (Stainton) was ranged from 42.89 to 58.27 on different cereal grains and gave support to the data. The percentage of female moth emergence of *Corcyra cephalonica* ranged from 44.06 to 52.11 with a mean of 47.47. The treatment T6 (Sorghum 1000 g + ground nut 50 g) showed the maximum female moth emergence i.e. 52.11 percent, which was significantly superior over the treatments and the lowest percentage of female moth emergence (i.e. 44.06 percent) was observed on T8 (Rice 1000 g + sesame 50 g). Similar observations were also recorded by Satpathy *et al.* (2002) [21] who noticed that the total female emergence percentage was low with high egg densities reared on fortification of diet with yeast. However Kamble *et al.* (2006) [15] reported that the percent female obtained from different cereal grains varied from 13.20 to 38.70 on different cereal grains. But this investigation was not exactly correlated with the present experiment. The longevity of adult male rice moth on different diets was ranged from 5.33 to 8.33 days with a mean of 7.30 days. The longest male longevity (i.e. 8.33 days) was observed on T6 (Sorghum 1000 g + ground nut 50 g) and the shortest (5.33 days) was on T5 (Wheat 1000 g + ground nut 50g). The results obtained are in conformity with the findings of Pathak *et al.* (2010) [22], who reported that adult longevity was 8.36 days (male) and 91.3 days (female) on sorghum and gave support to the data. The longevity of adult female rice moth on different diets was ranged from 6.33 to 9.67 days with a mean of 8.77 days. The longest female longevity (i.e. 9.67 days) was observed on treatment T6 (Sorghum 1000 g + ground nut 50 g) and the shortest (i.e. 6.33 days) was on T5 (Wheat 1000 g + ground nut 50g). The results obtained are in conformity with Urs and Morkharjee (1966) [14], who reported that adult longevity was 7 (male) and 13 (female) on groundnut. Cox *et al.* (1980) [23] reported that rice moth adult male tended to emerge earlier and live longer than unmated females i.e. 5 days. Etman *et al.* (2009) [24] also observed that adult longevity was 9.1 and 7.0 days for mated and virgin females, respectively, on wheat flour medium. The fecundity of *Corcyra* females are ranged from 177 to 312.33 with an average of 260.52. The treatment T6 (Sorghum 1000 g + ground nut 50 g) produced maximum and significantly superior eggs per female (i.e. 312.33) and the minimum fecundity was recorded on T8 (Wheat 1000 gm + sesame 50g). The observations of the present study are in agreement with those of Ayyar (1934) [25], who mentioned that the fecundity of rice moth was varying from 89 to 191 with an average of 156. The total developmental period of rice moth, i.e. from egg laying to death of adult moth ranged from 47.33 to 64.33 with a mean of 54.20 days. The longest developmental period of 64.33 days) was observed on treatment T5 (Wheat 1000 g + ground nut 50g) and the minimum developmental period of 47.33 days was on T6 (Sorghum 1000 g + ground nut 50 g). The treatment T6 was found to be best treatment by recording minimum development period, which was significantly superior over all other treatments. The observations made in the present study are in conformity with the findings of Urs and Mokharjee (1966) [14]. They reported that the development period of61.42 and 89.00 days on groundnut and til. Kamble *et al.* (2006) [15] also recorded duration of life cycle from 67.6 to 88.6 days on broken grains of different food material.

Table 1: Effect of different diets on the biology of rice moth, *Corcyra ccephalonica* (Stainton).

Sr. No.	Treatments	Incubation Period (In days)	Total larval period (In days)	Pupal Period (In days)	Eggs hatching percentage	Pupation percentage	Percent adult emerged	Percent male emerged	Percent female emerged	Male longevity	Female longevity	Fecundity No. of eggs/ female	Total developmental period
1	T_1	3.6	31.66	8.33	84	79.33	78.36	52.25	47.95	8.33	9.19	287.66	49.36
2	T_2	3.3	33.00	13.39	78	76.33	64.49	54.03	45.97	6.67	7.00	204.66	62.49
3	T_3	3.6	35.33	11.10	80	69.33	76.49	54.24	45.72	7.67	8.76	225.66	51.99
4	T_4	3.3	31.33	12.67	88	82.33	81.66	54.16	45.84	8.00	9.33	303	49.66
5	T_5	3.6	32.33	14.33	80	78.33	60.66	53.26	46.72	5.33	6.33	250.33	64.33
6	T_6	4.0	30.33	7.00	94	85.00	82	47.89	52.11	8.33	9.67	312.33	47.33
7	T_7	3.6	34.00	10.00	86	81.33	76	51.43	48.57	7.69	8.67	296.77	53.00
8	T_8	3.3	38.66	9.67	84	67.66	74	55.92	44.06	7.22	8.33	177	52.00
9	T_9	3	31.00	11.33	84	71.66	63	49.69	50.31	6.86	7.67	287.26	57.66
	Range	3-4	30.33-38.66	7.00-14.33	78 – 94	67.66-85.00	60.66 - 82.00	47.89 – 55.92	44.06 – 52.11	5.33 - 8.33	6.33 - 9.67	177-312.33	47.33 – 64.33
	Mean	3.49	33.07	10.86	84	76.81	72.96	52.54	47.47	7.30	8.77	260.52	54. 20
	'F'test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
	SE(m)±	0.05	1.67	0.281	0.83	0.53	1.52	0.63	0.92	0.377	0.308	4.89	1.43
	CD at 5%	0.15	5.00	0.842	2.49	1.59	4.56	1.89	2.76	1.13	0.924	14.67	4.27

Conclusion

C. cephalonica is polyphagous storage and grocery pest. Among treatments, sorghum and groundnut were superior to all the other diets. In some parameters, T4 (Rice 1000 g + ground nut 50 g) or T_1 (Rice 1000 g) or T3 (Sorghum 1000 g) were found almost equally effective to standard media T6 (Sorghum 1000 g + ground nut 50 g) for the mass production of rice moth in the laboratory. The fecundity is considered as prime importance because of its utilization on egg parasitoid *T. chilonis*. High quality and quantity of eggs of *C. cephalonica* was obtained on sorghum + groundnut and rice + groundnut hereby recommended for mass production purpose. Hence, from the study, it is evident that the sorghum + groundnut is economically and biologically proved better option in production of robust eggs of *C. cephalonica*.

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