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Effect of magnetic field and different diets on the biological parameters of rice moth, *Corcyra cephalonica* (Stainton)

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Abstract
The present experiment was conducted at laboratory of Entomology, Dr. PDKV Akola, during July 2016-17, to find out the "Effect of magnetic field and different diets on the biological parameter of the *Corcyra cephalo*nica in Factorial Complete Randomized Design. The four main treatments were exposure of *Corcyra* larvae to magnetic field for 0 hrs, 2 hrs, 4 hrs and 6 hrs duration and four sub treatments were rearing of the larvae on different diets that is sorghum, sorghum and bajra, sorghum and maize and sorghum and wheat diet. Observations were recorded on, larval weight, larval length, mortality of *Corcyra*. The result showed that, rearing of *Corcyra* in magnetic field for two hrs recorded maximum larval weight 1.52 mg in M_2 and M_0, and maximum larval length 4.50 mm in treatment M_4. Magnetic treatment of 2 hr had positive effect and more than 4 hrs had negative effect on *Corcyra* larvae on the parameter under study and was at par with control. The interaction effect of magnetic field and diet also indicates that there was good effect of 2 hrs magnetic field and sorghum diet on *Corcyra*. The study indicates that exposure period to magnetic field plays an important role on biology and the results provide suitable diets for mass rearing, thus contributing significantly for the large-scale production of *C. cephalonica.*

Keywords: *Corcyra cephalonica*, magnetic field, different diets, factorial complete randomized design

1. Introduction
Corcyra cephalonica (Stainton) a stored grain pest belonging to genus *Corcyra*, Tribe Tirathabini, sub-family Galleriinae, family Pyrallidae and order Lepidoptera [12]. *Corcyra* also known as "Rice moth" or the "Flour moth" has the origin in Greece, Island known as Corfu [9]. It was first observed to cause heavy losses to stored grains. Rice moth, *Corcyra cephalonica* is being utilized in various bio-control research, developmental and extension units for mass production of number of natural enemies [5]. Thus, it is a suitable host for commercial mass multiplication of parasitoids like *Trichogramma* spp., *Bracon* spp., and predator like *Chrysoperla carnea*, etc. [3]. Especially it is one of the most factitious hosts for *Trichogramma* production. *Trichogramma* species are used worldwide in biological control against insect pests, and hence the mass production of rice moth is very important. For the mass production of rice moth nutritional requirements have to be taken into account because nutritional deficiencies have been linked with such vague symptoms like poor growth rate, lowered fecundity or reduced body weight. There are different diet formulations for rearing *C. cephalonica* in the laboratory, so as to permit the rearing of this host for parasitoid mass production. Rearing of *C. cephalonica* on a high-quality nutrient source resulted in high quality eggs, which ultimately resulted in high quality production of *Trichogramma* reared on such host eggs [8]. *C. cephalonica* is industrialized for many of the natural enemies, mass bred in the laboratory for use in field against crop pests. hence the host rearing diet is potentially important to better nutritional quality of host eggs and the survival of parasitoids released into the environment as biological control agent. Taking into consideration these points the present study has been framed with an aim to evaluate the effect of magnetic field and different diet combinations on *C. cephalonica.*

2. Materials and Methods
The present experiment was laid out in Factorial Completely randomized design during the year 2015-2016 in laboratory at Entomology Section, College of Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, with the objectives to know the effect of short duration

magnetic field exposure on *C. cephalonica*, effect of sorghum mixed diet on the development of *C. cephalonica* and the cumulative effect of magnetic field and diet on *C. cephalonica.*

The material used and the methods followed to carry out these investigations are described below.

2.1 Main Treatment

Exposure of *C. cephalonica* to magnetic field:

1. Zero Hour - M_O
2. 2 Hours - M_2
3. 4 Hours - M_4
4. 6 Hours - M_6

2.2 Sub treatment: Diet

Four diets as detailed above were prepared by the procedure given by Ingle [4] and Gandhi [2].

1. Sorghum (5 kg) + Bajra (5 kg) + Groundnut (400 gm) + Yeast (20 gm) + Sulphur (20 gm) + Streptomycin (0.5 gm) + Distilled Water (100 ml)
2. Sorghum (5 kg) + Maize (5 kg) + Groundnut (400 gm) + Yeast (20 gm) + Sulphur (20 gm) + Streptomycin (0.5 gm) + Distilled Water (100 ml)
3. Sorghum (5 kg) + Wheat (5 kg) + Groundnut (400 gm) + Yeast (20 gm) + Sulphur (20 gm) + Streptomycin (0.5 gm) + Distilled Water (100 ml)

Each of the diet was properly mixed and equal quantity of diet was filled in the containers on which just hatched *Corcyra* larvae were released directly. Then Corcyra larva containing containers kept in permanent magnetic field, in magnetic chambers which were prepared by fixing magnets around the box. The magnets were fixed in such a way that the North pole was facing towards the diet kept in the containers. Observations were recorded on weight and length of *Corcyra* larvae after 8, days from egg hatching with the help of digital weighing balance and scale. Also, observations on mortality percent were recorded.

3. Statistical Analysis

The data collected on egg hatching, larval weight and length, mortality were subjected to the statistical analysis, for the test of significance after appropriate transformations [9].

4. Results and Discussion

4.1 Effect of Magnetic Field (After 8 Days from Egg Hatching)

4.1.1 on weight of *Corcyra* larvae (Factor A)

Magnetic field had significant impact on larval weight. A significantly minimum larval weight of *Corcyra* after 8 days from egg hatching was observed in the treatment M_6 recording 1.04 mg. Maximum larval weight 1.52 mg was recorded in treatments M_2 and M_0 i.e. 2 hours magnetic field treatment and control or non-magnetic field treatment where the larval weight was same.

4.1.2 on length of *Corcyra* larvae (Factor A)

Significantly maximum larval length of *Corcyra* after 8 days from egg hatching was observed in treatment M_4 (4.50 mm) and was at par with treatment M_2 recording 4.38 mm larval length. Significantly minimum larval length over all the treatments was recorded in the treatment M_0 i.e. control recording 4.27 mm and was found at par with M_6 and M_2 recording 4.29 and 4.38 mm larval length, respectively.

4.2 Effect of diet (after 8 days from egg hatching)

4.2.1 on weight of *Corcyra* larvae (Factor B):

Significantly maximum larval weight 1.75 mg over all treatments was recorded in treatment SS (Sorghum diet). Treatments SB (Sorghum + Bajra diet) and SM (Sorghum + Maize diet) was the next best treatments, recording 1.33 mg and 1.21 mg larval weight, respectively and were found at par with each other.

Significantly minimum larval weight over all the treatments was recorded in treatment SW (Sorghum + Wheat diet) (1.01 mg).

4.2.2 on length of *Corcyra* larvae (Factor B):

Significantly minimum larval length of *Corcyra* after 8 days from egg hatching over all the treatments was recorded in the treatment SW (4.13mm). However, it was found at par with treatment SM and treatment SB. Both the treatments recorded 4.38 mm of larval length.

Significantly maximum larval length was observed in treatment SS recording 4.55 mm.

4.2.3 Cumulative effect of magnetic field & diet on weight of *Corcyra* larvae (Factor A x B)

In the interaction study, significantly maximum larval weight after 8 days over all the treatments was observed in 2 hrs magnetic field on sorghum diet (M_2SS) i.e. 2.00 mg and lowest larval weight after 8 days was observed in the treatment M_6SW i.e. 0.89 mg. Result indicates that diet and 2 hrs magnetic field treatment had positive effect (Table 1).

This result of rearing of *Corcyra* larvae in magnetic field for longer duration i.e. 4 hrs, 8 hrs are in consistent with the finding of Gandhi *et al.* [2] and Dangat *et al.* [1], who reared *Corcyra* larvae for 0 hrs, 24 hrs, 12 hrs and 6 hrs in magnetic field, respectively and recorded negative effect on the weight of larvae indicating that there is negative effect on larvae when reared in magnetic field.

Regarding diet Dangat *et al.* [1] reported sorghum alone as the most suitable diet which is also observed in the present study indicating that sorghum alone is the best diet. The study indicates mixing other cereals in diet with sorghum does not have any positive effect on weight of *Corcyra* larvae after 8 days.

Table 1: Effect of magnetic field and diet on weight of *Corcyra* larvae after 8 days (mg)

Magnetic treatment	Diet				Mean Factor A
	Sole Sorghum (SS)	Sorghum + Bajra (SB)	Sorghum + Maize (SM)	Sorghum + Wheat (SW)	
	Mean Interaction A X B				
0 hrs	1.86	1.65	1.57	1.00	1.52
2 hrs	2.00	1.64	1.29	1.14	1.52
4 hrs	1.86	0.96	1.07	1.00	1.22
6 hrs	1.29	1.07	0.91	0.89	1.04
Mean Factor B	1.75	1.33	1.21	1.01	

	Factor A	Factor B	Interaction A X B
"F" test	Sig.	Sig.	Sig.
SE (m) ±	0.06	0.06	0.13
CD at 5%	0.18	0.18	0.36

4.2.4. Cumulative effect of magnetic field & diet on length of *Corcyra* larvae (Factor A x B)

In the cumulative effect of magnetic field and diet on length of larvae it was observed that when *Corcyra* larvae was reared in non magnetic field on diet sorghum + wheat recorded significantly least larval length 3.93 mm and was at par with treatments M_6SW, M_0SM, M_6SB recording 4.00, 4.07 and 4.14 mm larval length, respectively.

Significantly maximum larval length over all the treatments was observed in the treatment M_4SS recording 4.71 mm of larval length and was found at par with M_2SS, M_0SB, M_4SB, M_6SM, M_0SS, M_6SS, M_2SM, M_4SM recording 4.57, 4.57, 4.57, 4.57, 4.50, 4.43, 4.43, 4.43 mm larval length, respectively (Table 2).

Regarding effect of magnetic field on length of *Corcyra* larvae though [2] and [1] reported that all the treatments recorded least larval length (0.41 cm) and (4.06 mm) than control this was due to exposure of *Corcyra* larvae to magnetic field for longer duration. But similar observations were not observed in present study as the larvae were exposed to magnetic field for short duration.

The results regarding diets are in consistence with Dangat *et al.* [1] who also recorded good larval length in Sorghum diet followed by Bajra, Maize and Wheat. Pathak *et al*. [10] found maximum of 37.02% moth emergence when reared on sorghum only and Mehendale *et al*., [7] reported that maximum of 52% moth emergence occurred when reared on sorghum, groundnut and powdered yeast. Kumar and Kumar [6] reported 37.04% moth emergence from sorghum (2 kg) with 4000 *C. cephalonica* eggs and 31.99% in pearl millet.

Table 2: Effect of magnetic field and diet on length (mm) of *Corcyra* larvae after 8 days

Magnetic treatment	Diet				Mean Factor A
	Sole Sorghum (SS)	Sorghum + Bajra (SB)	Sorghum + Maize (SM)	Sorghum + Wheat (SW)	
	Mean Interaction A X B				
0 hrs	4.50	4.57	4.07	3.93	4.27
2 hrs	4.57	4.21	4.43	4.29	4.38
4 hrs	4.71	4.57	4.43	4.29	4.50
6 hrs	4.43	4.14	4.57	4.00	4.29
Mean Factor B	4.55	4.38	4.38	4.13	

	Factor A	Factor B	Interaction A × B
"F" test	Sig.	Sig.	Sig.
SE (m) ±	0.05	0.05	0.10
CD at 5%	0.15	0.15	0.29

5. Conclusion

From the present study, it can be concluded that, Rearing of *Corcyra* for more than four hours had negative impact on growth and development of *Corcyra*. Keeping of *Corcyra* larvae in magnetic field for two hours had positive impact on larval weight. However, there was reduction in larval weight and length after 8 days from egg hatching. Amongst different diets tested the best diet for the growth and development of *Corcyra* was observed to be sorghum followed by sorghum + bajra. To see the positive effect of magnetic field on *Corcyra*, magnetic field treatment time schedule should be reduced below two hours to get the information about positive effect of biology of *Corcyra*.

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