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Influence of magnetic field and diet on growth and development of *Corcyra cephalonica*

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Abstract
The present experiment was carried out in the laboratory of Entomology, Dr. PDKV Akola, during August 2017-18 and 2018-19, to find out the Influence of magnetic field and diet on growth and development of *Corcyra cephalonica*. The nine main treatments were the exposure of *Corcyra* larvae to the magnetic field for 0 hrs, 24 hrs, 12 hrs, 6 hrs, 3 hrs, 2 hrs, 1½ hrs, 1 hrs and ½ hrs duration and four sub treatments were rearing of the larvae on diet CSH-35 (D_1), Maldandi 35-1 (D_2), Swati (D_3) and CSH-9 (D_4) variety of sorghum. Observations were recorded based on pooled data, after 8 days on weight, length and larval mortality of *Corcyra*. The result indicates that, rearing of *Corcyra* in the magnetic field for 12 hrs recorded maximum weight 1.36 mg in M_{12} and maximum length 5.08 mm in treatment M_{12} and maximum mortality of *Corcyra* larvae was observed in 24 hrs magnetic field treatment.

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

1. Introduction
Corcyra also called as "Rice moth'' or the "Flour moth" is the only recognized species of *cephalonica* order Lepidoptera, family Pyralidae, sub – family Galleriinae, Tribe Tirathabini and Genus *Corcyra*. *Corcyra* was known to the scientific word since 1866, Stainton. *Corcyra cephalonica* (Stainton) a primary and secondary stored grain pest has origin in Greece Island known as Corfu (Rogonot, 1885) [20], from where it has been migrated to Europe and elsewhere through rice trade. Today it has become one of the predominant polyphagous stored grain pests (Durant and Beveridge, 1913) [10]. It has been said that from causing heavy losses to stored grain in England. England through grain trade it was distributed throughout the world and has acquired the status of cosmopolitan pest. After causing damage in the West Africa through imported rice in 1960s it has spread to other important food commodities the West African sub region (Allotey 1986) [2]. At present it has been found to cause damage to rice, wheat, corn, sorghum, groundnut, cotton seed, coffee, spices, cocoa etc (Ayyar, 1934) [4].
Though it is a pest on stored grain but has been found to the mass cultured on artificial diet and good healthy eggs of *Corcyra* can be produced and the eggs of *Corcyra* are found to the most suitable host for many parasites and predator production and larval stages to multiply Nematodes, larval parasite and predator in laboratory for field release. The present study was framed to know the effect of magnetic field treatments, on *Corcyra* larvae when kept for different durations in a magnetic field so that if there is a positive effect then it can be introduced in *Corcyra* rearing to enhance the *Corcyra* egg production in the laboratory and negative effect it can be implemented in controlling stored grain pests.

2. Material and Methodology
The present experiment was carried out in Factorial Completely randomized design during the year 2017-18 and 2018-19 in a laboratory at Entomology Department, College of Agriculture, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was laid out in Factorial Complete Randomized Design with six replication and nine treatment and diet i.e. four sorghum varities. The effect of magnetic field on *Corcyra* larvae when reared for different time durations like 0 hrs, 24 hrs, 12 hrs, 6hrs, 3hrs, 2 hrs, 1½ hrs, 1 hrs and ½ hrs and diet different four varieties of sorghum i.e. CSH-35, Maldandi 35-1, Swati and CSH-9. Then 30 gm prepared diet was filled in each container, treatment wise. There six replications and total of 224 containers were used for the experiment. In each container 20 larvae were released. To rear the *Corcyra* larvae in the permanent magnetic field, magnetic chambers were prepared by

fixing magnets around the box. The magnets were fixed in such a way that the North pole was facing an upward direction and the South pole downward toward the diet kept in the containers. After hatching of the eggs rearing of larvae was under taken as per the schedule treatments daily till larvae pupates.

3. Statistical analysis

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

4. Result and Discussion

4.1 Effect of magnetic field on the weight of *Corcyra* larvae (Factor A)

Significantly maximum larval weight of 1.36 mg over all the treatments was recorded in treatment M_{12} and was at par with treatment M_6 recording 1.34 mg larval weight. Significantly least larval weight 1.25 mg was recorded in treatments M_2, $M_{1½}$, M_1 and $M_{½}$ hrs and was at par with the treatment M_3 recording 1.26 mg larval weight.

4.2 Effect of diet on weight of *Corcyra* larvae (Factor B)

The result indicates that diet treatment D_2 was significantly superior to diet treatment D_3 and D_4 with 1.31, 1.27 and 1.27 mg larval weight, respectively. All these treatments were at par with diet treatments D_1 recording 1.28 mg larval weight, respectively.

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

In the interaction study of magnetic field and diet significantly maximum larval weight after 8 days over all the treatments was observed in $M_{12}D_2$ recording 1.39 mg larval weight and were at par with treatment $M_{12}D_1$, $M_{12}D_3$, M_6D_2, $M_{12}D_4$, M_6D_4, M_6D_3, $M_{½}D_2$, M_0D_2, M_6D_1, and M_3D_2 recording 1.37, 1.35, 1.35, 1.34, 1.34, 1.33, 1.33, 1.32, 1.32 and 1.32 mg larval weight, respectively. Significantly least larval weight over all the treatments was observed in M_2D_3 and M_3D_4 recording 1.17 mg larval weight and were at par with treatments $M_{½}D_3$, $M_{1½}D_1$, $M_{½}D_4$ and M_1D_2 recording 1.19, 1.20, 1.21 and 1.24 mg larval weight, respectively. (Table 1)

4.4 Effect of magnetic field on length of *Corcyra* larvae (Factor A)

Significantly maximum larval length over all the treatments was recorded in the treatment M_{12} (keeping *Corcyra* larvae in a magnetic field for 12 hrs) recording 5.08 mm larval length. The significantly least larval length over all the treatments 4.08 mm was observed in treatment $M_{½}$ hrs and was at par with treatment M_2 with 4.30 mm larval length.

4.5 Effect of diet on length of *Corcyra* larvae (Factor B)

In the study with diet significantly maximum larval length over all the treatment was observed in diet D_2 recording 4.64 mm larval length. Significantly least larval length was observed in diet D_3 recorded 4.36 mm and was at par with D_1 recording 4.41 mm larval length.

4.6 Cumulative effect of magnetic field and diet on length of *Corcyra* larvae (Factor A x B)

In the interaction study of the magnetic field and diet significantly maximum larval length after 8 days over all the treatments was observed in treatment $M_{12}D_2$ recording 5.50 mm larval length and was at par with the treatments $M_{12}D_3$ and $M_{12}D_1$ recording 5.10 and 5.09 mm larval length, respectively. Significantly least larval length over all the treatment 3.75 mm was observed in the treatment $M_{½}D_1$ and was at par with treatments $M_{½}D_3$, M_2D_3, M_3D_1, $M_{1½}D4$, $M_{1½}D_3$, M_1D_1 and $M_{½}D_4$ recording 3.92, 3.94, 4.03, 4.10, 4.10, 4.11 and 4.22 mm larval length, respectively. (Table 2)

4.7 Effect of magnetic field on mortality of *Corcyra* (Factor A)

Significantly maximum mortality over all the treatments was recorded in the treatment M_{24} (keeping *Corcyra* in a magnetic field for 24 hrs) with 24.37 per cent mortality and was at par with treatment $M_{½}$, M_1 and M_3 recording 23.54, 22.60 and 22.39 per cent mortality, respectively. Significantly least mortality over all the treatments was observed in treatment M_0 recording 18.12 per cent mortality and was at par with treatment $M_{1½}$ recording 18.85 per cent, mortality.

4.8 Effect of diet on mortality of *Corcyra* (Factor B)

In the study with diet maximum mortality over all the treatment was observed in diet D_4 recording 22.22 per cent and was at par with diet D_3 and D_1 recording 22.08 and 21.43 per cent mortality, respectively. Significantly least mortality over all the treatments was observed in diet D_2 recording 19.81 per cent mortality.

4.9 Cumulative effect of magnetic field and diet on mortality of *Corcyra* (Factor A x B)

In the interaction study of magnetic field and diet significantly maximum mortality over all the treatments was observed in treatment $M_{24}D_4$ recording 27.91 per cent mortality and was at par with the treatments M_2D_3, $M_{24}D_3$, $M_{½}D_4$, $M_{24}D_1$, $M_{½}D_1$, M_1D_3 and M_3D_4 recording 25.41, 24.58, 24.58, 24.16, 23.75, 23.75 and 23.75 per cent mortality, respectively. Significantly least mortality over all the treatment 17.08 per cent was observed in the treatment M_0D_1 and was at par with the treatment M_2D_4, M_0D_2, M_0D_3, $M_{1½}D_2$, M_6D_2, M_2D_2, $M_{12}D_1$, $M_{1½}D_4$, $M_{1½}D_1$, $M_{1½}D_3$, M_0D_4, M_3D_3, M_6D_3, $M_{12}D_2$, and $M_{24}D_2$ recording 17.50, 17.50, 17.50, 17.50, 17.50, 17.50, 18.75, 18.75, 19.16, 20.00, 20.41, 20.41, 20.41, 20.41 and 20.83 per cent mortality, respectively. (Table 3)

Regarding the effect of magnetic field on weight, length and mortality of *Corcyra* larvae Gandhi (2014) [11] and Dangat (2016) [7] reported that all over the treatments was observed maximum 1.27 mg and 1.23 mg larval weight, 0.42 cm and 4.32 mm larval length and larval mortality was observed 60.83 and 46.40 per cent. But similar observations were not observed in the present study of *Corcyra* larvae were exposed to a magnetic field. The finding is quite consistent with the present finding and minor differences in weight and length of larvae may be due to the difference in diet provided to the larvae during the study.

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

Magnetic treatment (hrs)	Pooled				
	CSH-35 (D1)	Maldandi-35-1 D2	Swati D3	CSH-9 D4	Factor A
Mean Interaction A X B					
Control	1.31	1.32	1.30	1.30	1.31
24	1.29	1.30	1.30	1.30	1.30
12	1.37	1.39	1.35	1.34	1.36
6	1.32	1.35	1.33	1.34	1.34
3	1.30	1.32	1.26	1.17	1.26
2	1.27	1.29	1.17	1.27	1.25
1½	1.20	1.30	1.25	1.25	1.25
1	1.25	1.24	1.25	1.25	1.25
½	1.25	1.33	1.19	1.21	1.25
Factor B	1.28	1.31	1.27	1.27	

	A Fact	B Fact	A × B Fact
'F' test	Sig.	Sig.	Sig.
S.E.(m)±	0.01	0.01	0.02
C.D. at 5 %	0.03	0.03	0.07

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

Magnetic treatment (hrs)	Pooled				
	CSH-35 (D1)	Maldandi-35-1 D2	Swati D3	CSH-9 D4	Factor A
Mean Interaction A X B					
Control	4.33	4.41	4.50	4.35	4.40
24	4.41	4.62	4.41	4.66	4.53
12	5.09	5.50	5.10	4.64	5.08
6	4.50	4.75	4.75	4.85	4.71
3	4.03	4.66	4.26	4.44	4.35
2	4.53	4.35	3.94	4.37	4.30
1½	4.94	4.54	4.10	4.10	4.42
1	4.11	4.51	4.25	4.55	4.35
½	3.75	4.43	3.92	4.22	4.08
Factor B	4.41	4.64	4.36	4.46	

	A Fact	B Fact	A × B Fact
'F' test	Sig.	Sig.	Sig.
S.E.(m)±	0.08	0.05	0.17
C.D. at 5 %	0.23	0.15	0.47

Table 3: Effect of magnetic field and diet on per cent larval mortality of *Corcyra* (pooled result)

Magnetic treatment (hrs)	Pooled				
	CSH-35 (D1)	Maldandi-35-1-D2	Swati D3	CSH-9 D4	Factor A
Mean Interaction A X B					
Control	17.08 (24.33)	17.50 (24.60)	17.50 (24.65)	20.41 (26.78)	18.12 (25.09)
24	24.16 (29.42)	20.83 (27.12)	24.58 (29.66)	27.91 (31.85)	24.37 (29.51)
12	18.75 (25.45)	20.41 (26.82)	23.33 (28.78)	22.08 (27.93)	21.14 (27.24)
6	21.25 (27.38)	17.50 (24.66)	20.41 (26.80)	22.91 (28.56)	20.52 (26.85)
3	22.91 (28.53)	22.50 (28.21)	20.41 (26.80)	23.75 (29.09)	22.39 (28.16)
2	23.33 (28.85)	17.50 (24.68)	25.41 (30.22)	17.50 (24.52)	20.93 (27.07)
1½	19.16 (25.92)	17.50 (24.65)	20.00 (26.52)	18.75 (25.57)	18.85 (25.67)
1	22.50 (28.27)	22.08 (27.81)	23.75 (29.10)	22.08 (27.99)	22.60 (28.29)
½	23.75 (29.12)	22.50 (28.26)	23.33 (28.79)	24.58 (29.66	23.54 (28.96)
Factor B	21.43 (27.48)	19.81 (26.31)	22.08 (27.92)	22.22 (27.99)	

	A Fact	B Fact	A × B Fact
'F' test	Sig.	Sig.	Sig.
S.E.(m)±	0.50	0.33	1.00
C.D. at 5 %	1.40	0.93	2.80

5. Conclusion

From the present study, concluded that exposure of *Corcyra cephalonica* to magnetic field for 12 hrs had a positive impact on larval weight and length also there was an increase in pupal weight, adult emergence and fecundity. However there was a reduction in egg hatching percentage and mortality. Hence found fit for commercial rearing of *Corcyra* larvae and ½ hrs, 1 hrs and 24 hrs period had a negative impact on growth and development of larvae and hence can be used in *Corcyra* management in store grains. Amongst different diets tested the best diet for the growth and development of *Corcyra* was observed to be sorghum variety Maldandi-35-1 (D_2). So this variety can be recommended for the commercial rearing of *Corcyra*.

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