EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 3 Number 4 (April-2015) pp. 373-380

www.ijcrar.com

Variation in biological parameters of *Corcyra cephalonica* Stainton (Lepidoptera:Pyralidae) with quality of rearing media

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KEYWORDS

Food grains,
dextrose,
yeast,
larva,
pupa,
adult,
Corcyra cephalonica

A B S T R A C T

Variation in biological parameters of *Corcyra cephalonica* Stainton (Lepidoptera:Pyralidae) with quality rearing media was studied against four (4) different types of locally available grains namely maize, wheat, Italian millet and scented rice as solo and fortified with 3% dextrose and yeast. The insect had significantly shortest larval-pupal period when the food grains were fortified with dextrose followed by yeast and the period was longest in solo grains. The insect complete its life cycle within 51.28 days during August-October as compared to 54.67 days in May-August. The period was longest in scented rice (64.71 days) and shortest in maize-dextrose (45.00 days). Adult emergence was the maximum during August-October (71.33%) and in wheat (solo as well as fortified). The sex ratio showed female dominance. Fortification of 3% dextrose and yeast increased female per cent and thereby fecundity in Italian millet. Hence, Italian millet alone or fortified with dextrose and yeast can be used as alternative food as rearing media for *Corcyra*.

Introduction

The rice moth *Corcyra cephalonica* Stainton is an important insect-pest of different stored products in tropics. It is the major pest of rice, wheat, sorghum, corn (maize), cocoa, peanuts, almonds, dates, groundnut, cotton seeds, coffee, spices and cocoa beans, cashews, raisins and millet (Cox *et al*., 1981; Trematerra, 1983; Allotey and Kumar, 1985; Mbata, 1989; Allotey, 1991a; Johnson et al., 1992; Locatelli and Limnota, 1998; Harita et al., 2000). It is one of the most factitious hosts for *Trichogramma* production in several countries of the world (Parra, 1997). Besides, some entomopahothegic nematodes

such as *Steinernema feltiae* are also reared on the larvae of *Corcyra cephalonica* (Kumar and Murthy, 2000). In India, it is being utilized in various bio-control research developmental and extension units for mass production of number of natural enemies (Jalali and Singh, 1992). The rearing host diet is potentially of importance to the nutritional quality of host eggs and the survival of *Trichogramma* and other egg parasitoids released into the environment as biological control agent (Hunter, 2003).

Therefore, an attempt has been made to study the variation in biological parameters of *Corcyra cephalonica* in different food grains locally available fortified with dextrose and yeast to evaluate the quality of rearing media.

Materials and Methods

The experiment was carried out at the laboratory, Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar from August to October, 2011-12.

Climate during the period of experiment

During the period of experiment the maximum temperature was ranged from 33.10 to 35.19 ^{O}c and the minimum being from 21.20 to 28.04^{O}c. The maximum relative humidity was 79.53 to 93.00% and the minimum relative humidity was 66.37 to 88.07%.

Rearing media

To study the life fecundity table of *Corcyra cephalonica* four (4) different types of foods namely maize, wheat, Italian millet and scented rice as solo and fortified with 3% dextrose and yeast were used as rearing media. The food grains were roughly ground for the experiment purpose. The different combinations of foods taken for the experiments are listed in table 2.

Table.1 Average of different meteorological data during the period of experiment pooled mean of 2011-12

Month	Temperature (^{o}C)		Relative humidity (%)	
	Max.	Min.	Max.	Min.
April	33.1	22.4	79.53	66.37
May	34.71	25.06	80.84	72.35
June	34.43	26.63	93	87.33
July	33.62	27.62	92.12	85.73
August	35.19	28.04	88	81.00
September	33.5	26.9	91.18	88.07
October	33.1	21.2	86.26	75.72

Table.2 Different grains: solo and fortified

Diet groups	Composition	Components proportion (%)
Maize	Maize (M)	100
	Maize (M) +Dextrose (D)	97 + 3
	Maize (M) +Yeast (Y)	97+3
Wheat	Wheat (W)	100
	Wheat (W) +Dextrose (D)	97 + 3
	Wheat (W) +Yeast (Y)	97+3
Italian Millet	Italian Millet (IM)	100
	Italian Millet (IM) +Dextrose (D)	97 + 3
	Italian Millet (IM) +Yeast (Y)	97+3
Scented rice	Scented rice (SR)	100
	Scented rice (SR) +Dextrose (D)	97 + 3
	Scented rice (SR) +Yeast (Y)	97+3

Laboratory experiments

The culture of *C. cephalonica* was collected from National Bureau of Agriculturally Important Insects, Bangalore and the stock culture was maintained in the bio-control laboratory. Different combinations of food twelve (12) numbers @100 gms., containing maize, wheat, Italian millet and scented rice alone and fortified with 3% dextrose and yeast were taken in 10 cm diameter plastic jars. Random samples of freshly laid eggs collected from the stock culture were examined under a stereoscope to get uncollapsed eggs for the study. Hundred (100) nos. of un-collapsed eggs were carefully transferred to the plastic jars with different rearing media. It was replicated 5 times. The open mouth of each jar was covered with a muslin cloth with a rubber band for aeration and was left undisturbed until emergence of moths.

Insect Parameters

Newly emerged males and females were sexed based on labial palpi as proposed by Ayyar (1934). The developmental period (Larval-Pupal) and duration of life cycle were recorded. Emergence of moths (Total, male and female), adult longevity was recorded. The moths emerged from each of the rearing media were keep to mate and the mated pairs were then placed in oviposition cages. The number of eggs laid by each female moth were removed and counted till the death. The mean fecundity of the moths of different rearing media was determined.

Statistical analysis

The experimental design was complete randomized block design with five replications. Two factor Anova with the transformed data wherever needed and single degree of freedom contrast analysis were performed on all biological parameters in different seasons over different food grains. The calculation was made on the pooled mean data (with transformation wherever needed) of two years study. Entire Statistical Analysis was done using Statistical Analysis System SAS (Version: 9.2).

Result and Discussion

The larval-pupal period, adult life span, life cycle, adult emergence percent and

fecundity varied significantly with different food combinations, seasons and with their interaction (Table 3&4).

The developmental period (larval-pupal) in general, was shortest in the food grains fortified with dextrose (37.83 days in maize; 39.67 days in Italian millet; 45.17 days in wheat) followed by yeast (41.83 days in maize; 43.50 days in scented rice; 47.00 days in Italian millet) and longest being in solo grains (56.17 days in scented rice; 48.33 days in wheat). The fortification of 3% yeast increased the duration in wheat (47.00 days) and Italian millet (48.13 days). In relation to the rearing seasons it was shorter 43.42 days during August-October as compared to 47.08 days recorded in May-August. The duration was longest in scented rice (56.33 days and 56.00 days) in both the seasons.

Table.3 Duration of different stages of *Corcyra cephalonica* Stainton as influenced by foods over seasons (pooled mean of two years)

Food	Larva+pupa (Days)			Longevity (Days)						Life cycle (Days)		
				Male			Female					
	May-Aug	Aug-Oct	**Mean**	May-Aug	Aug -Oct	**Mean**	May-Aug	Aug -Oct	**Mean**	May-Aug	Aug - Oct	**Mean**
M	48.00	42.67	**45.34**	5.83	5.75	**5.79**	5.08	4.67	**4.88**	55.92	50.83	**53.38**
M+D	38.33	37.33	**37.83**	5.00	4.67	**4.84**	4.17	3.83	**4.00**	45.33	44.67	**45.00**
M+Y	43.33	40.33	**41.83**	4.83	4.50	**4.67**	4.00	3.67	**3.84**	50.17	47.50	**48.84**
W	52.33	44.33	**48.33**	4.67	4.33	**4.50**	3.92	3.67	**3.80**	59.08	51.50	**55.29**
W+D	48.33	42.00	**45.17**	6.00	5.67	**5.84**	5.25	5.00	**5.13**	56.42	50.50	**53.46**
W+Y	50.67	43.33	**47.00**	4.92	4.58	**4.75**	4.17	3.67	**3.92**	57.67	50.50	**54.09**
IM	45.00	39.33	**42.17**	6.33	6.00	**6.17**	5.67	5.33	**5.50**	53.50	48.17	**50.84**
IM+D	36.33	43.00	**39.67**	5.67	5.33	**5.50**	3.67	3.00	**3.34**	42.83	49.50	**46.17**
IM+Y	55.00	42.67	**48.84**	6.00	5.67	**5.84**	5.00	4.67	**4.84**	62.83	50.83	**56.83**
SR	56.33	56.00	**56.17**	6.58	6.25	**6.42**	5.42	5.33	**5.38**	64.58	64.83	**64.71**
SR +D	47.33	47.00	**47.17**	6.00	5.67	**5.84**	5.00	4.50	**4.75**	55.17	55.00	**55.09**
SR +Y	44.00	43.00	**43.50**	6.67	6.33	**6.50**	5.67	5.00	**5.34**	52.50	51.50	**52.00**
	47.08	**43.42**		**5.71**	**5.40**		**4.75**	**4.36**		**54.67**	**51.28**	

	Larva+pupa (Days)			Adult male (Days)			Adult female (Days)			Life cycle (Days)		
Interaction	F	S	FXS	F	S	FXS	F	S	FXS	F	S	FXS
S.Em(±)	0.242	0.592	0.838	0.137	0.336	0.475	0.155	0.379	0.563	0.413	1.013	1.432
CD@5%	0.487	1.939	2.743	0.276	0.676	NS	0.312	0.763	1.079	0.832	2.038	2.883

The males lived longer than their female counterpart. The adult longevity was longer during May-August (5.71 days and 4.75 days for male and female respectively). Fortification of 3% dextrose and yeast shorten the life span of adults (both male and female) in maize and Italian millet over the solo grains. The trend was reverse in case of wheat. Among the foods the longevity was ranged from 4.50-6.50 days for male and 3.80-5.50 days for female. The life span of male was shortest in wheat (4.50

days) followed by maize-yeast (4.67 days) and wheat-yeast (4.75 days). The female lived for significantly shortest time in Italian millet-dextrose (3.34 days) followed by wheat (3.80 days), maize-yeast (3.84 days) and wheat-yeast (3.92 days) media. The duration was longest in scented rice, scented rice-yeast and Italian millet media (6.42 days, 6.50 days and 6.17 days for male and 5.38 days, 5.34 days and 5.50 days for male respectively).

The duration of life cycle followed the same trend as that of larval-pupal period. The insect completed its life cycle faster during August-October (51.28 days) than May-August (54.67 days). The period was shortest on maize-dextrose and Italian millet-dextrose (45.00 days and 46.17 days) and the duration was found maximum on scented rice (64.71 days) followed by Italian millet-yeast (56.83 days) and wheat (55.29 days).

Table.4 Adult emergence and fecundity of *Corcyra cephalonica* Stainton as influenced by foods over seasons (pooled mean of two years)

Food	Adult emergence%			Male%			Female%			Fecundity		
M	84.23	72.45	**78.34**	47.89	46.85	**47.37**	52.16	53.00	**52.58**	504.00	538.20	**521.10**
M+D	62.32	74.25	**68.29**	47.12	46.00	**46.56**	52.96	53.95	**53.46**	457.00	477.50	**467.25**
M+Y	54.25	70.23	**62.24**	47.23	49.15	**48.19**	53.26	51.00	**52.13**	398.75	422.50	**410.63**
W	77.89	86.69	**82.29**	49.45	47.26	**48.36**	50.89	52.96	**51.93**	525.50	568.67	**547.09**
W+D	80.12	88.00	**84.06**	44.95	47.89	**46.42**	54.97	52.45	**53.71**	412.20	442.12	**427.16**
W+Y	91.78	80.23	**86.01**	43.35	47.98	**45.67**	57.16	53.44	**55.30**	357.50	381.00	**369.25**
IM	64.23	85.98	**75.11**	47.15	47.65	**47.40**	53.24	53.86	**53.55**	489.50	512.00	**500.75**
IM+D	63.89	58.15	**61.02**	47.26	34.26	**40.76**	53.48	65.98	**59.73**	525.50	545.00	**535.25**
IM+Y	64.25	80.25	**72.25**	44.56	42.45	**43.51**	55.95	57.92	**56.94**	554.75	604.75	**579.75**
SR	60.56	40.36	**50.46**	40.23	40.34	**40.29**	60.00	59.89	**59.95**	385.75	410.00	**397.88**
SR +D	54.23	49.89	**52.06**	47.98	39.98	**43.98**	52.45	60.23	**56.34**	450.50	476.00	**463.25**
SR +Y	62.45	72.45	**67.45**	47.88	47.16	**47.52**	52.23	53.00	**52.62**	385.50	397.00	**391.25**
	68.35	**71.58**		**46.25**	**44.75**		**54.06**	**55.64**		**453.87**	**481.23**	

	Larva+pupa (Days)			Adult male (Days)			Adult female (Days)			Life cycle (Days)		
Interaction	F	S	FXS	F	S	FXS	F	S	FXS	F	S	FXS
S.Em(±)	0.834	2.042	2.888	0.978	2.396	3.389	0.897	2.197	3.107	4.304	10.543	14.912
CD@5%	1.678	4.111	5.814	NS	4.823	6.824	1.805	4.422	6.253	8.664	21.223	NS

The adult emergence was the maximum during August-October (71.33%) as compared to 68.17% in May-August. The sex ratio showed female dominance. The female emergence was more during August-October (55.50%) and the male counter part during May-August (46.08%).

In respect to different foods adult emergence was significantly the maximum on wheat and its fortification with 3% dextrose and yeast (82%, 84% and 86% respectively), followed by Italian millet (75%, 61% and 72% respectively) and maize (78%, 68% and 62% respectively). The minimum

number of adult was emerged from scented rice (50%, 52%, and 67% respectively). The fortification of 3% dextrose and yeast increased the female per cent in wheat (53.50% and 55%) and Italian millet (59.50% and 57%) and maize (53.50% and 52%) and decreased in case of scented rice (56% and 52.50%). In case of male the trend was reversed.

The fecundity was found significantly higher during August-October (481.23) than May-August (453.87). It was decreased with the fortification in case of maize (467.25 and 410.63 with dextrose and yeast respectively) and wheat (427.16 and 369.25 with dextrose and yeast respectively) while that increased with fortification in Italian millet (535.25 and 579.75 with dextrose and yeast respectively) and scented rice (463.25 and 397.88 with dextrose and yeast respectively) as compared to the solo grains (521.10, 547.09, 500.75 and 391.25 on maize, wheat, Italian millet and scented rice respectively).

Table

Table.5 Contrast Analysis of different biological parameters on different groups of food grains (pooled mean of two seasons)

Contrast (A with B)		Larva+ Pupa (Days)	Adult Female (Days)	Adult Male (Days)	Life cycle (Days)	Adult %	Male %	Female %	Fecundity
A	**B**	*Pr > F*	*Pr > F*	*Pr > F*	*Pr > F*	*Pr > F*	*Pr > F*	*Pr > F*	*Pr > F*
IM, IM+D, IM+Y	M, M+D, M+Y	<.0001	0.0042	0.0062	<.0001	<.0001	0.0029	0.0004	<.0001
	W, W+D, W+Y	<.0001	0.0465	0.0013	<.0001	<.0001	0.0067	<.0001	0.0028
	SR, SR+D, SR+Y	<.0001	0.0689	0.0873	<.0001	0.0027	0.2931	<.0001	<.0001
W, W+D, W+Y	M, M+D, M+Y	<.0001	<.0001	0.0011	<.0001	<.0001	0.2897	0.0063	<.0001
	SR, SR+D, SR+Y	0.0157	0.0180	0.0019	0.0024	<.0001	0.0005	0.0033	0.0009
M, M+D, M+Y	SR, SR+D, SR+Y	<.0001	0.0117	0.0006	<.0001	<.0001	0.0002	0.0004	<.0001
M, W, IM, SR	IM+D, W+D, M+D, SR+D	<.0001	0.0349	0.1249	<.0001	0.0134	0.0160	0.0493	<.0001
	IM+Y, W+Y, M+Y, SR+Y	<.0001	<.0001	0.0085	<.0001	<.0001	0.0105	0.0070	<.0001
IM+D, W+D, M+D, SR+D	IM+Y, W+Y, M+Y, SR+Y	<.0001	<.0001	0.0137	<.0001	<.0001	0.0100	0.0375	<.0001

The contrast analysis on biological parameters (pooled mean of two seasons) of *Corcyra cephalonica* against four different groups of foods namely maize, wheat, Italian millet and scented rice (as solo and fortified with 3% dextrose and yeast) is presented in table.5. It is observed that all the parameters varied significantly among all the groups. The adult longevity had non-significant variation in response only to Italian millet and scented rice. The male longevity of solo and dextrose fortified groups are at par. The emergence percent of male was non-significant among Italian millet and scented rice as well as wheat and maize groups.

From the result it was found that the insect complete its life cycle significantly fastest on maize and Italian millet when fortified with dextrose (45.00 days and 46.17 days). Bernardi *et al*., (2000) found that the diets with wheat germ and yeast proved to be the most adequate for rearing the moth as this reduced the total (egg-adult) cycle (62.70±10.29 days). In the present study the duration was 54.09 days, shorter than the earlier case. They further added that on diet consisting of rice bran and yeast the duration was 70.16 ± 5.34 days but in present study the period was only 52.00 days. The duration of larval pupal period was recorded maximum on scented rice (56.17 days),

followed by wheat (48.33 days) and maize (45.34 days) which is in close agreement with the studies made by Ayyar (1934) who recorded total larval period of 53 days on paddy, 38 days on maize, 42 days on wheat. While Tauthong (1989) recorded only 42.53 days of larval-pupal period in rice, which is shorter than the present result as well as the findings of earlier works. Shailaja *et al*., (2009) recorded the average duration of egg; larva and pupa of 4.84, 33.67 and 12.34 days respectively on proso millet. The total developmental period occupied, 41 to 59 days with an average of 41.95±2.68 days on foxtail millet as reported by Jagdish et al., (2009). In the present study the duration was 42.17 days in Italian millet confirms the findings of earlier works. Combination with maize based diet didn't express any positive performance in respect of accelerating the growth factor of *Corcyra cephalonica* as opined by Tirthakar *et al*. (2006) corroborate the present study. According to Allotey and Azalekor (2000) the mean developmental period was ranged from 33.2±0.2 to 45.3±1.8 days confirmed the findings of the present investigation where the period ranged from 37.83-56.17 days in different rearing media.

Nathan *et al*. (2006) reported that the rearing of *C. cephalonica* larvae on a high-quality nutritional source resulted in high-quality eggs. They found that the performance and the adult emergence percentage were higher when the food was millet followed by wheat and rice is at par with the findings of the present study. Uberoi (1961) also reported that flour of pearl millet and broken grain of wheat proved the best media for the growth of this insect. A predominance of female over male was observed in the present study corroborates Shailaja *et al*., (2009). In the present study it was observed that there were significant differences in the adult longevities of *C. cephalonica* emerged from the different rearing media supports Allotey and Azalekor (2000). They recorded that the adult longevity ranged from 1.5±0.5 to 11.9±1.3 days for males and 1.5±0.5 to 16.5±1.2 days for females in different pulses. In the present work the longevity of adults ranged from 4.50-6.50 days for male and 3.80-5.50 days for female in different cereals and millet. The difference is mainly due to the food used as rearing media. Report on female longevity of 4.78 days on rice by Tauthong (1989) corroborates the findings of the present investigation.

Therefore, it can be concluded that though the primary food media for mass production of *Corcyra* was wheat and maize but in this region Italian millet alone or fortified with dextrose and yeast performed at par or better than wheat and maize in respect of all the biological parameters and finally on the fecundity *i.e* egg production. So, Italian millet alone or fortified with dextrose and yeast can be used as alternative food for rearing of *Corcyra*.

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