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STUDIES ON EFFECT OF TEMPERATURE AND RELATIVE HUMIDITY ON BIOLOGY OF RICE MOTH *Corcyra cephalonica* (STAINTON) UNDER LABORATORY CONDITION

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ABSTRACT

Some biological parameters of *Corcyra cephalonica* Stainton were studied in the laboratory at the temperature levels of 20 ± 1, 25 ± 1, 30 ± 1 and 35 ± 1 p C and humidity levels of 60, 75 and 85 per cent on broken conditioned sorghum grains. The most favorable combination of temperature and relative humidity for fecundity and weight of full grown larva were 30p C and 75% relative humidity at which maximum egg laying of 135.66 eggs per female and weight of full grown larva (0.070 g) were recorded. The larval and pupal periods were observed highest to the tune of 49.55 and 14.66 days at 20 and 35p C, respectively. The effect of humidity on larval and pupal periods showed that the highest periods of 39.75 and 13.41 days respectively were, recorded at 60% relative humidity. The larva completed its development in 25.00 days at 35p C and 85% relative humidity and the shortest pupal period of 9.00 days was observed at 35p C and 85% relative humidity. The most favorable combination for the development of *C. cephalonica* was 35p C and 85% relative humidity at which it took least period of 31.33 days.

KEY WORDS
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INTRODUCTION

Corcyra cephalonica (Stainton), popularly known as the "Rice meal moth" or the "Flour moth", belongs to family Pyralidae of order Lepidoptera. The earlier reference of this insect was made by Stainton (1866), who provisionally named it *Melissoblaptes cephalonica* giving a brief description. Later a new genus, *Corcyra* was erected by Rogonot (1885) to accommodate this insect, the name being derived from the ancient name of "Corfu", where it was presumed to have been imported into England.According to Chittenden (1919), though *Corcyra* is known to occur in many parts of Europe, Asia and America, it is not a true cosmopolitan insect. This view cannot be readily accepted, since none of the so called cosmopolitan insects, as it was found ever in all parts of the world mainly because of lack of suitable environmental condition for a continued existence. According to Durant and Beveridge (1913), *Corcyra* is apparently of eastern origin and has been introduced into Europe and elsewhere by the rice trade.

Mass rearing of bioagents is a prerequisite of biocontrol programme; this needs a regular and sufficient production of easily culturable factitious insect hosts for mass culturing of any bioagent. In India, rice moth, *C. cephalonica* (Pyralidae: Lepidoptera) popularly known as the flour moth or rice meal moth, is a major stored grain pest of many cereals and oilseeds. In India, rice meal moth is being utilized in various biocontrol research, developmental and extension units for mass production of number of natural enemies (Jalali and Singh, 1992). It ranks first in the mass culturing of entomophagous insects due to its amenability to mass production, adaptability to varied rearing conditions and its positive influence on the progeny of the natural enemies (Pathak *et al*., 2010).

During the rearing of *C. cephalonica*, temperature and humidity are important components that affect rate of metabolism, growth, development, reproduction, general behaviour and distribution of insect. Temperature mediated physiological actions regulate population dynamics. The effect of humidity on the development of host insect is almost intimately associated with that of temperature and operates indirectly through the moisture content of grains. These parameters ultimately shows their effect on the feeding ability and 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 (Bhushan *et al*., 2012 and Fand *et al*., 2013). Thus, the present study were undertaken to find out the role of different temperature and the relative humidity levels and their combined effect on some biological parameters of *C. cephalonica*.

MATERIALS AND METHODS

The present experiment was carried out on mainly two parameters *i.e.,* temperature

and relative humidity under laboratory conditions for their influence on biology of *C. cephalonica* at Biocontrol Research Laboratory, JAU, Junagadh during 2012-13.Biological studies of *C. cephalonica* were undertaken at four different temperatures and humidity levels by the mass culturing of *C. cephalonica*. The temperature levels of 20 ± 1, 25 ± 1, 30 ± 1 and 35 ± 1ºC and humidity levels of 60, 75 and 90 per cent were maintained in humidity control oven. There were three replications for each combination of temperature and humidity. Twenty five newly hatched larvae (within 24 hrs) obtained from the laboratory culture were carefully introduced into glass jar containing 100 g sorghum grains + 0.1 g streptomycin + 2 g yeast, with the help of a camel hair brush and covered with muslin cloth. There were three replicates for each combination of temperature and relative humidity.

The biological observations were recorded every day till the completion of the experiment. The larval period was worked out by recording period between the date of hatching and date of formation of silken web in the food. For determining the pupal period, the period between web formation and adult emergence was considered as pupal period.Two days old pupae were separated from pupal cases with the help of forceps and brush, and were weighed on an electronic balance for recording the weight of full grown larvae. The fecundity was recorded as adults emerged from pupae developed at different combination of temperature and relative humidity levels were kept for egg laying in separate jars and the number of eggs/ female were counted. The period between egg hatches till the first day of moth emergence was considered for developmental period.

RESULTS AND DISCUSSION

Larval period

The insect prefer fairly high and low temperature conditions for its development. The result obtained indicates that larval period decreased with the increase in temperature (Table1). The mean larval period was found to be maximum (49.55 days) at 20ºC and minimum (24.44 days) at 35ºC. The larval period decreased with increase in temperature. The results obtained on the effect of relative humidity revealed that the larva took maximum mean larval period (39.24 days) at 60% relative humidity. Minimum larval period of 34.39 days was required at 85% relative humidity for completing the development of *C. cephalonica*.

The combined effect (interaction) of temperature and relative humidity on larval period revealed that maximum larval period (50.66 days) was recorded at 20º C temperature and 60% relative humidity which was found to be at par with 20ºC temperature and 85% relative humidity (49.66 days) whereas, test insect took minimum larval period (25.00 days) at 35º C temperature and 85% relative humidity. Meena and Bhargava (2010) reported that highest larval period (55.00 days) at 20ºC and lowest (23.86 days) at 35º C. They also reported effect of relative humidity on larval period and found that highest larval period (41.79 days) at 60% relative humidity and lowest (28.03 days) at 90% relative humidity. The same results support the present findings.

Pupal period

Table 1: Influence of temperature and relative humidity on larval period, pupal period and weight of full grown larvae of *C. cephalonica*

Relative Humidity (%)	Larval period (days) at				Pupal period (days) at				Weight of full grown larvae (g) at				
	20°C	25°C	30°C	35°C	Mean	20°C	25°C	30°C	35°C	Mean	20°C	25°C	30°C	35°C	Mean
60	45.38*	39.22	31.52	33.83	37.61	23.31*	21.41	21.13	19.96	21.45	1.20*	1.45	1.5	1.19	1.33
	-50.66	-40	-27.33	-31	-39.24	-15.66	-13.33	-13	-11.66	-13.41	-0.044	-0.064	-0.067	-0.044	-0.056
75	44.04	39.03	38.25	29.55	37.86	22.51	20.84	18.43	18.1	19.97	1.36	1.49	1.52	1.21	1.39
	-48.33	-39.66	-38.33	-24.33	-37.66	-14.66	-12.66	-10	-9.66	-11.75	-0.056	-0.068	-0.07	-0.045	-0.06
85	44.8	36.47	37.26	25.1	35.9	21.69	20.55	19.66	17.44	19.84	1.38	1.43	1.48	1.16	1.37
	-49.66	-35.33	-36.66	-18	-34.39	-13.66	-12.33	-11.33	-9	-11.58	-0.058	-0.063	-0.067	-0.042	-0.057
Mean	44.74	38.24	35.73	29.63		22.5	20.93	19.74	18.5		1.31	1.46	1.5	1.19	
	-49.55	-38.33	-34.1	-24.44		-14.66	-12.77	-11.44	-10.11		-0.053	-0.065	-0.069	-0.043	
	S.Em. ±	C.D.at 5%		C.V%		S.Em. ±	C.D.at 5%		C.V%		S.Em. ±	C.D.at 5%		C.V%	
T	0.33	0.97				0.17	0.5				0.0092	0.0269			
R.H	0.28	0.84	2.6			0.15	0.43	2.55			0.008	0.0234		2.02	
T X R.H	0.57	1.68				0.3	0.87				0.0159	0.0464			

*Arcsine transformed value. Figures in the parentheses are retransformed values T- Temperature, R.H- Relative Humidity

Table 2 : Influence of temperature and relative humidity on fecundity and developmental periodof *C. cephalonica*

Relative Humidity	Fecundity (per female) at					Developmental period(days) at				
(%)	20°C	25°C	30° C	35°C	Mean	20°C	25°C	30° C	35°C	Mean
60	9.32**	10.23	10.37	8.79	9.32	55.75*	48.25	39.62	40.96	46.09
	-87	-104.66	-107.66	-77.33	-87	-68.33	-55.66	-40.66	-43	-51.91
75	9.57	11.04	11.64	9.12	9.57	52.93	46.72	44.04	36.27	44.99
	-91.66	-122	-135.66	-83.33	-91.66	-63.66	-53	-48.33	-35	-49.99
85	9.83	11.28	11.44	9.38	9.83	51.75	44.62	43.27	32.79	43.18
	-96.66	-127.33	-131	-88	-96.66	-61.66	-49.33	-47	-29.33	-46.83
Mean	9.57	10.85	11.15	9.1	9.57	53.46	46.52	42.32	36.73	
	-91.77	-118	-124.77	-82.88	-91.77	-64.55	-52.66	-45.33	-35.77	
	S.Em. ±	C.D.at 5%		C.V%		S.Em. ±	C.D.at 5%		C.V%	
T	0.04	0.13				0.42	1.23			
R.H	0.03	0.11	1.32			0.36	1.07		2.95	
T X R.H	0.07	0.22				0.73	2.14			

*Arcsine transformed value. **Square root transformed value. Figures in the parentheses are retransformed values T- Temperature, R.H- Relative Humidity

The highest mean pupal period (14.66 days) was observed at 20ºC and the least mean pupal period (10.11 days) at 35ºC. The pupal period decreased with an increase in temperature but relative humidity alone had little effect on pupal period. The data obtained on the effect of relative humidity on pupal period showed that maximum mean pupal period (13.41 days) at 60% relative humidity and minimum (11.75 days) at 75% relative humidity(Table1).

The combined effect of temperature and relative humidity revealed that the shortest pupal period (9.00 days) was observed at 35º C and 85% relative humidity whereas, longest pupal period was observed at 20º C and 60% relative humidity (15.66 days) which was at par with at 20ºC and 75% relative humidity (14.66 days).Earlier, Yadav and Bhargava (2005) found that pupal period of *C. cephalonica*was 7.67 days on sorghum at room temperature.Thus, the present findingsare in partial alliancewith resultsof the above workers.

Weight of full grown larva

The mean weight of full grown larva of test insect ranged from 0.043 to 0.069 g and 0.056 to 0.060 g at different levels of temperature and humidity, respectively. The data obtained on the effect of different levels of temperature revealed that the highest larval weight (0.069 g) was found at 30º C and lowest larval weight (0.043 g) was observed at 35º C. The result obtained on the effect of relative humidity showed that the larval weight was significantly highest (0.060 g) at 75% relative humidity followed by 0.057 and 0.056 g at 85 and 60 % relative humidity, respectively (Table1).

The interaction of temperature and relative humidity showed that most suitable combination for weight of full grown larva was 30º C and 75 per cent relative humidity on which maximum weight (0.070 g) of full grown larva was observed which was at par with 30º C and 85% relative humidity (0.067 g), 25º C and 75% relative humidity (0.068 g).The results found are in complete conformity with the results ofYadav and Bhargava (2005) who reported that weight of full grown larva was 0.62 g at room temperature *i.e.* 28 ± 2ºC and 75 ± 5% relative humidity.

Fecundity

The effect of different levels of temperature and humidity on the fecundity of *C. cephalonica* revealed that the fecundity of female increased with the increase in temperature (Table 2).The result showed that fecundity of *C. cephalonica* was highly significant (124.77 eggs per female) at 30º C followed by at 25º C (118.00 eggs per female) and lowest fecundity was found to be at 35º C (82.88 eggs per female) followed by at 20º C (91.77 eggs/female) which showed that further increase in temperature resulted in the drastically reduction of the fecundity. The effect of different levels of relative humidity revealed that most favorable relative humidity required for maximum egg laying was at 85% (110.75 eggs per female).

The combined effects (interaction) of temperature and relative humidity revealed that the temperature range of 25-30p C and relative humidity in the range of 70-80 per cent were found most favourable for the activity of *C. cephalonica*. Within this range, the combinationof 30º C and 75% relative humidity was found most favourable for fecundity (135.66 eggs per female). The present findings reflect the results of Meena and Bhargava (2010) who found that *C. cephalonica* laid maximum (164.34 eggs per female) at 30º C and 70% relative humidity and also showed that fecundity of female increase with increasing temperature.

Developmental period

The result obtained on the effect of different levels of temperature and relative humidity showed that the developmental period of test insect varied with the temperature (Table 2). The developmental period was found to be maximum at 20º C (64.55 days) and minimum at 35º C (35.77 days). This result showing that the developmental period is decreased with increase in temperature of test insect. The data obtained on the effect of relative humidity revealed that the test insect took maximum period of about 51.91 days at 60% relative humidity and minimum at 85% relative humidity (46.83 days).

The present studies on effect of both factors revealed that test insects completed their development in 29.33 days at 35º C and 85% relative humidity. The result showed that combination of 35º C and 85% relative humidity was the most favourable for the development of *C. cephalonica* whereas,maximum period (68.33 days) required for the development of test insect was at 20º C and 60% relative humidity. These results are in agreement with that of Hugar and Rao (1990) and Hugar and Jairao (1991) who found that

optimum temperature range for developmental of *C. cephalonica* was between 25 and 30º C and humidity level was between 75 and 90 per cent. The present findings are also more or less similar with the findings of Yadav and Pathak (2010) who stated that the *C. cephalonica* should be reared or its culture should be maintained at 26.0 ± 2ºC and 66.0 ± 13 per cent relative humidity for its better development.

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