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QUANTITATIVE ANALYSIS OF TEMPERATURE AND RELATIVE HUMIDITY ON GROWTH AND DEVELOPMENT OF *LASIODERMA SERRICORNE* FABRICIUS IN FENNEL SEED

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ABSTRACT: Laboratory experiments were conducted during 2007-08 and 2008-09 with fennel (*Foeniculum vulgare*) to determine the effect of temperature and relative humidity on growth and development of cigarette beetle, *Lasioderma serricorne* Fabricius. The longest developmental period was found to be 69.0 days under a combination of 20°C and 90 per cent relative humidity (RH), while shortest development period was for 42.2 days at 30°C and 70 per cent relative humidity. A combination of 30°C and 70 per cent RH resulted in maximum adult emergence (92.90%), whereas it was minimum (40.10%) at 35°C under 90 per cent RH., The adult longevity of male and female was found to be highest (21.8 and 22.8 days, respectively) at 20°C and lowest (13.0 and 14.0 days, respectively) at 30°C. The length of survival period of both sexes was maximum (23.6 and 24.2 days) at 20°C and 90 per cent RH, while minimum (10.9 and 11.9 days) at 30°C and 70 per cent RH The duration of oviposition period also depended on the temperature and relative humidity, it was the longest (16.70 days) at 20°C and 60 per cent RH while, shortest (10.30) at 30°C and 90 per cent RH The longest oviposition period (16.70 days) was recorded at 20°C and 60 per cent RH, while the started period (10.30 days) at 30°C and 90 per cent RH The higher grain damage (67.20 %) and loss in weight (17.72%) were observed at 30°C and 70 per cent RH while lower (37.70 % & 8.85%) at 20°C and 60 per cent RH The growth index was maximum (2.20) at 30°C and 70 per cent RH, whereas, it was minimum (0.60) at 20°C and 60 per cent RH

KEY WORDS: Cigarette beetle, *Lasioderma serricorne*, fennel, temperature, humidity

INTRODUCTION

Among the various stored grain insect pests, cigarette beetle (*Lasioderma serricorne* Fabricius) is the serious pest of several stored commodities. Beside its main host tobacco and cigarette, it has also been recorded on turmeric, ginger, castor beans, wheat, coconut meal, pepper, cardamom, mustard, chilli, fennel, cumin and opium leaves (Ayyar, 1934; Chatterjii, 1963; Hussain & Khan, 1966; Gahukar, 1975; Samuel *et al.*, 1984 and Sharma, 2007). It is well known fact that food constituents play a vital role in the survival and reproduction potential of the insects. In order to develop economic and effective control measures for this pest, detailed and accurate knowledge of its bio-ecology is essential under variable macro-ecological conditions which lead to the possible prediction of population levels and study of various mortality factors regulating pest abundance. Abiotic factors such as temperature, relative humidity and moisture percentage of stored products vis-à-vis pest interaction. Rao and Babu (2004) studied the influence of certain ecological factors on biology of *L. serricorne* and reported that the optimum constant conditions for growth and development of the host were 30°C and 75 per cent RH. The temperature <10°C and >40°C and the RH <45 and >90 per cent proved fatal to all the development stages. The adult longevity in both sexes of *L. serricorne* when feed on artificial diet (wheat flour + dried yeast at 2:1 ratio) was observed to be maximum under ambient conditions.

MATERIAL AND METHODS

Developmental studies of *L. serricorne* were undertaken in the laboratory at four different temperatures and humidity levels on fennel seeds in order to observe their effects on developmental period, adult emergence, longevity adult, oviposition period, incubation period, grain damage, weight

loss of grain and growth index. The temperature levels of 20 ± 1°, 25 ± 1°, 30 ± 1° and 35 ± 10°C were maintained using digital environmental chamber.

Freshly laid eggs were obtained from adults reared at of 30 ± 2°C temperature and 70 ± 5 per cent relative humidity. Newly hatched larvae were transferred to specimen tubes containing 20g fennel seeds. Prior to the addition of larvae, the grains were conditioned at least for a week in an incubator maintained at 30 ± 2°C and 70 ± 5 per cent relative humidity to raise their initial moisture content. The specimen jars were covered with pieces of muslin cloth and kept in digital environmental chamber at each combination of temperature and relative humidity. There were three replications in each case. The observations on developmental period (egg to adult stage) including, incubation, larval and pupal periods of test insects were recorded. The per cent adult emerged was worked out on the basis of number of larvae placed in the jar and number of adult emerged. The longevity of male and female adults were determined by recording the dates of their emergence and the dates of natural death.

For the study of oviposition period, five pairs of freshly emerged beetles were released in glass vials for egg laying. The total numbers of eggs laid by the female were counted daily and oviposition periods were recorded. Growth index was calculated by dividing percentage of adult emergence by total developmental period in days.

The damaged seeds and weight loss were recorded after 90 days of the released of larvae. For this purpose, the sample of seeds was spread upon a white sheet and damaged seeds were counted. The percentage of damaged seeds was calculated. The loss in weight was obtained after removing all insects' stages and frass. It was worked out by subtracting the final weight from the initial weight and then converted into percentages.

RESULTS AND DISCUSSION

In present investigations, the developmental period was affected by temperature and humidity. The complete development was found to be maximum (65.95 days) at 20°C, while minimum (46.55 days) at 30°C (Table 1). The data obtained on the effect of relative humidity revealed that the insect took minimum time (53.33 days) under 70 per cent relative humidity for completing its development. The minimum duration (42.2 days) was recorded at 30°C and 70 per cent relative humidity, while maximum (69.0 days) at 20°C and 90 per cent relative humidity. These findings are in agreement with the results obtained by Allotey and Unanaowo (1993); Jha and Yadav (1996); Zhang and Wang (1996) and Rao and Babu (2004) who reported that the optimum temperature and relative humidity for optimum growth and development of *L. serricorne* were 30°C and 70-75 per cent, respectively.

The maximum adult emergence (83.07%) was recorded when insects were reared at 30°C followed by 78.65, 51.40 and 47.40 per cent at

Table 1. Influence of temperature and humidity levels and their interactions on developmental period of *L. serricorne*

Relative humidity (%)	Developmental period (days)*				Mean
	Temperature (°C)				
	20	25	30	35	
60	68.2	67.2	45.3	49.8	57.63
70	62.7	59.7	42.2	48.7	53.33
80	63.9	63.0	48.4	52.0	56.83
90	69.0	68.3	50.3	58.7	61.58
Mean	65.9	64.5	46.5	52.3	
		SEm±	CD at 5%	CV%	
Temperature		0.46	1.32		
Relative humidity		0.46	1.32	2.77	
Temperature x Relative humidity		0.22	2.64		

* Mean of three replications

25°C, 20°C and 35°C, respectively (Table 2). The most favourable humidity level for adult emergence was found 70 per cent, at which maximum adult emergence (75.54%) occurred. The results on interaction of temperature and humidity revealed that the combination of 30°C and 70 per cent relative humidity resulted in maximum adult emergence, whereas, it was minimum at 35°C and 90 per cent relative humidity. Powell (1931) stated that a constant temperature of 40°C is fatal to *L. serricorne* in every stage and that the optimum temperature and humidity for development were 32°C and 75 per cent, respectively which support the present findings. Similarly, Schwartz and Burkholder (1991) reported that the development of *Sitophilus granarius* Linnaeus was the slowest at 15°C and fastest at 30°C.

The longevity of both sexes depends entirely upon temperature and humidity if adequate food is available. The survival period of male and female beetle was the longest at 20°C and 90 per cent relative humidity and shortest at 30°C and 70 per cent relative humidity (Table 3-4). No work on the effect of temperature and relative humidity on longevity of *L. serricorne* adults is available, however, Rao and Babu (2004) reported that the adult longevity in both sexes of *L. serricorne* was found to be maximum (23.7 days for male and 29.3 days for female) at 20°C. Similarly, Simwat and Chahal (1981); Nawrot (1981) and Chander (2003) reported that the adult life span of *Tribolium castaneum* Herbst, *Cadra cautella* Walker and *Rhizopertha dominica* (Fabricius), respectively, decreased consistently with the rise in temperature.

The maximum oviposition period (15.10 days) was observed when the insects were reared at 20°C. The most favourable humidity level for oviposition period was found 80 per cent. Regarding the combined effect of temperature and relative humidity on the oviposition period, the longest duration (16.70 days) was recorded at 20°C and 60 per cent relative humidity, while the minimum duration (10.30 days) at 30°C and 90 per cent relative humidity. Rao and Babu (2004) reported that the oviposition period was maximum at 20°C followed by 300C and 60 per cent relative humidity which support the present findings. Similarly, Simwat and Chahal (1970) and Chander (2003) found that the oviposition period of *T. castaneum* and *R. dominica*, respectively was influenced by temperature.

The incubation period was found to be maximum (7.37 days) at 20°C and minimum (5.46 days) at 30°C (Table 6). The most favourable humidity level for incubation period was 70 per cent. Regarding the combined effect of different temperature and relative humidity levels on the incubation period, the longest duration (8.02 days) was recorded at 20°C and 60 per cent relative humidity, while minimum (4.77 days) at 35°C and 70 per cent relative humidity. Allotey and Unanaowo (1993)

Table 2. Influence of temperature and humidity levels and their interactions on adult emergence of *L. serricorne*

Relative humidity (%)	Per cent adult emergence*				Mean
	Temperature (°C)				
	20	25	30	35	
60	41.00 (39.81)**	63.00 (52.54)	70.00 (56.79)	44.10 (41.61)	54.52 (47.69)
70	63.30 (52.72)	87.40 (69.23)	92.90 (74.63)	58.50 (49.90)	75.54 (61.62)
80	58.10 (49.66)	84.30 (66.67)	91.20 (72.77)	46.90 (42.71)	70.11 (57.95)
90	43.20 (41.09)	79.90 (63.38)	78.20 (62.18)	40.10 (39.29)	60.37 (51.48)
Mean	51.40 (45.82)	78.65 (62.95)	83.07 (66.59)	47.40 (43.38)	
		SEm±	CD at 5%	CV%	
Temperature		0.31	0.88		
Relative humidity		0.31	0.88	1.94	
Temperature x Relative humidity		0.61	1.76		

*Mean of three replications
**Percentages transformed to angles

Table 3. Influence of temperature and humidity levels and their interactions on longevity of adult male of *L. serricorne*

Relative humidity (%)	Longevity of adult male (days)*				Mean
	Temperature (°C)				
	20	25	30	35	
60	22.0	18.9	13.7	14.8	17.35
70	20.1	17.2	10.9	13.7	15.48
80	21.7	18.0	12.4	15.7	16.95
90	23.6	21.3	15.0	20.0	19.98
Mean	21.85	18.85	13.00	16.05	
		SEm±	CD at 5%	CV%	
Temperature		0.40	1.14		
Relative humidity		0.40	1.14	7.87	
Temperature x Relative humidity		0.79	2.28		

*Mean of three replications

Table 4. Influence of temperature and humidity levels and their interactions on longevity of adult female of *L. serricorne*

Relative humidity (%)	Longevity of adult female (days)*				Mean
	Temperature (°C)				
	20	25	30	35	
60	23.1	19.0	14.1	15.8	18.00
70	21.1	18.5	11.9	14.3	16.45
80	22.8	19.3	13.7	16.0	17.95
90	24.2	22.2	16.3	21.2	20.97
Mean	22.80	19.75	14.00	16.82	
		SEm±	CD at 5%	CV%	
Temperature		0.43	1.24		
Relative humidity		0.43	1.24	8.16	
Temperature x Relative humidity		0.86	2.49		

*Mean of three replications

reported that 80.3 per cent egg hatchability was found at 28-32°C and 72.5-80.5 per cent relative humidity within an incubation period of 5 to 8 days. Rao and Babu (2004) also observed that incubation period of *L. serricorne* was maximum at 20°C and minimum at 30°C.

More loss in weight and higher grain infestation occurred when the grains were incubated at the temperature and humidity optimum for the insect. During the present study, the grain infestation and loss in weight increased with the increase in temperature and relative humidity from 20 to 30°C and 60 to 70 per cent relative humidity, respectively, but thereafter, it decreased at 35°C and 90 per cent relative humidity (Table 7-8). The higher grain damage (67.2%) and loss in weight (20.0%) were observed at 30°C and 70 per cent relative humidity, while lower at 20°C and 60 per cent relative humidity. The work on the effect of temperature and relative humidity on grain damage and weight loss is not available, however, the same type of work on other insect pests have been discussed. Khokhar and Gupta (1974) reported maximum grain infestation due to *R. dominica* at optimum temperature. Similarly, Haque *et al.* (1996) reported that 30°C and room temperature with high moisture level were conducive to rice weevil damage.

The highest growth index (1.79) was observed

Table 5. Influence of temperature and humidity levels and their interactions on oviposition period of *L. serricorne*

Relative humidity (%)	Oviposition period (days)*				Mean
	Temperature (°C)				
	20	25	30	35	
60	16.70	15.20	14.01	13.50	14.85
70	16.00	14.30	11.60	12.30	13.55
80	11.50	13.10	12.30	13.63	12.63
90	16.20	16.00	10.30	14.70	14.30
Mean	15.10	14.65	12.05	13.53	
		SEm±	CD at 5%	CV%	
Temperature		0.40	1.16		
Relative humidity		0.40	1.16	10.07	
Temperature x Relative humidity		0.80	2.32		

*Mean of three replications

Table 6. Influence of temperature and humidity levels and their interactions on incubation period of *L. serricorne*

Relative humidity (%)	Incubation period (days)*				Mean
	Temperature (°C)				
	20	25	30	35	
60	8.02	7.63	6.02	7.45	7.28
70	6.82	4.99	4.94	4.77	5.38
80	7.00	5.79	5.03	5.78	5.90
90	7.64	6.99	5.85	6.60	6.77
Mean	7.37	6.35	5.46	6.15	
		SEm±	CD at 5%	CV%	
Temperature		0.30	0.86		
Relative humidity		0.30	0.86	16.42	
Temperature x Relative humidity		0.60	1.73		

*Mean of three replications

at 30°C followed by 1.23, 0.91 and 0.79 at 25, 35 and 20°C temperature, respectively (Table 9). On the other hand, maximum growth index was observed at 70 per cent relative humidity. The combined effect of both the factors showed that the growth index was maximum at 30°C and 70 per cent relative humidity and minimum at 20°C and 60 per cent relative humidity. On the basis of these results it may be said that temperature and humidity had a significant effect on the growth and development of the test insect.

References

Allotey J and Unanaowo I E 1993. Aspects of the biology of *Lasioderma serricorne* on selected food media under ambient tropical condition. *Insect Science and its Application* **14**: 595-601.

Ayyar T V R 1934. *Handbook of Economic Entomology for South India*. Govt. Press, Madras, 383.

Chander R 2003. *Host preference and bio-control studies of Rhizopertha dominica (Fab.) on barley and its management*. Ph.D. (Thesis) submitted to Rajasthan Agricultural University, Bikaner, 224 p.

Chatterjii S 1963. *Lasioderma serricorne* Fab. as a pest of mustard seeds in storage. *Indian Oil Seeds Journal* **4**: 287-91.

Gahukar R T 1975. Occurance of *Lasioderma serricorne* Fab. on coconut meal. *Indian Journal of Entomology* **37**: 308-09.

Haque N M M, Karim A N M R, Alam M Z, Hossain T and Choudhary D A M 1996. Effect of grain moisture

Table 7. Influence of temperature and humidity levels and their interactions on grain damage by *L. serricorne*

Relative humidity (%)	Per cent grain damage*				Mean
	Temperature (°C)				
	20	25	30	35	
60	37.70(37.29)**	50.50 (45.29)	58.70 (50.01)	41.30 (39.99)	46.80(43.14)
70	41.20(39.93)	65.00(53.73)	67.20 (55.06)	49.00 (44.43)	55.60(48.29)
80	40.10 (39.29)	63.90(53.07)	66.00(54.33)	44.20(41.67)	53.55(47.09)
90	39.20 (38.76)	55.00(47.91)	62.10(52.00)	42.70(40.80)	49.75(44.87)
Mean	39.30(38.82)	58.60(50.00)	63.50(52.85)	44.30(41.72)	
		SEm±	CD at 5%	CV%	
Temperature		0.48	1.37		
Relative humidity		0.48	1.37	3.60	
Temperature x Relative humidity		0.95	2.75		

*Mean of three replications
**Percentages transformed to angles

Table 8. Influence of temperature and humidity levels and their interactions on weight loss by *L. serricorne*

Relative humidity (%)	Per cent weight loss*				Mean
	Temperature (°C)				
	20	25	30	35	
60	8.85(17.25)**	11.20(19.54)	14.00(21.96)	9.31(17.75)	10.84(19.12)
70	9.95(18.38)	17.75(24.91)	20.00(26.56)	10.10(18.51)	14.45(22.09)
80	9.25(17.98)	17.00(24.34)	18.98(25.82)	9.89(18.31)	13.78(21.54)
90	8.99(17.44)	16.85(24.22)	17.90(25.01)	9.66(18.07)	13.35(21.19)
Mean	9.26(17.69)	15.70(23.25)	17.72(24.84)	9.74(18.16)	
		SEm±	CD at 5%	CV%	
Temperature		0.32	0.93		
Relative humidity		0.32	0.93	5.33	
Temperature x Relative humidity		0.65	1.86		

*Mean of three replications
**Percentages transformed to angles

Table 9. Influence of temperature and humidity levels and their interactions on growth index of *L. serricorne**

Relative humidity (%)	Growth index **				Mean
	Temperature (°C)				
	20	25	,30	35	
60	0.60	0.94	1.55	0.88	0.99
70	1.01	1.46	2.20	1.20	1.47
80	0.91	1.34	1.88	0.88	1.25
90	0.63	1.17	1.55	0.68	1.01
Mean	0.79	1.23	1.79	0.91	

*Mean of three replications
**The growth index was calculated by dividing the average percentage of adult emergence by total development period

and temperature on infestation of rice weevil, *Sitophilus oryzae* (Linn.) on unhusked unparboiled rice. *Annals of Bangladesh Agriculture* **6**: 125-31

Hussain M and Khan K M 1966. Record of *Lasioderma serricorne* Fab. Anobiidae: Coleoptera on stored caster beans. *Science and Culture* **32**: 212.

Jha A N and Yadav T D 1996. Host suitability of spice mixture to *Lasioderma serricorne* Fab. and *Stegobium paniceum* (Linn.). *Indian Journal of Entomology* **56**: 332-36

Khokhar D S and Gupta D S 1974. Relative resistance of some varieties of wheat to *Sitophilus oryzae* (L.) and *Rhyzopertha dominica* (F.) at different temperatures. *Bulletin of Grain Technology* **12**: 117-23.

Nawrot J 1981. Effect of temperature and relative humidity on population parameters for almond moth *Cadra cautella* Wlk. *Prace Neukowe Instytute Ochromy Roslin* **21**: 41-52.

Powell T E Jr 1931. An economic study of the cigarette beetle, *Lasioderma serricorne* with special reference to its life history and control. *Ecological Monographs* **1**: 33-93

Rao C V N and Babu T R 2004. Influence of certain ecological factors on biology of cigarette beetle, *Lasioderma serricorne* Fab. *Indian Journal of Plant Protection* **32**: 59-62

Samuel R, Prabhu V K K and Narayana C S 1984. Influenced of spice essential oil on the life history of *Lasioderma serricorne*. *Entomon* 209-215.

Schwartz B E and Burkholder W E 1991. Development of the granary weevil (Coleoptera: Curculionidae) on barley, corn, oats, rice and wheat. *Journal of Economic Entomology* **84**: 1047-52.

Sharma S R 2007. Host preference and management of cigarette beetle, *Lasioderma serricorne* Fab. on cumin. M.Sc. (Ag.) Thesis Submitted to Rajasthan Agricultural University, Bikaner 69p.

Simwat G S and Chahal B S 1970. Effect of temperature and relative humidity on the longevity of adults of *Tribolium castaneum* Hbst. (Tenebrionidae : Coleoptera). *Bulletin of Grain Technology* **8**: 107-11

Simwat G S and Chahal B S 1981. Effect of storage period and inter specific competition among *Sitophilus oryzae* L., *Trogoderma granarium* Everts and *Tribolium castaneum* Hbst. on their population build-up and the resultant loss of wheat. *Indian Journal of Ecology* **8**: 74-81

Zhang X X and Wang M J 1996. An ecological study on the laboratory population of cigarette beetle, *Lasioderma serricorne* (F.) (Coleoptera : Anobiidae). *Acta Entomologica Sinica* **39**: 383-92.

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