Indian Journal of Applied Entomology **25**(1) : 39–42 (2011)

EFFECT OF TEMPERATURE AND RELATIVE HUMIDITY ON BIO–ECOLOGY OF *SITOPHILUS ORYZAE* (LINN.) IN STORED MAIZE*

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ABSTRACT

The effect of different temperatures and humidity levels was studied on bio–ecology of *Sitophilus oryzae* (Linn.) in stored maize 26°C, 28°C, 30°C and 32 ±1°C with variable humidity levels *i.e.*, 65, 70, 75 and 80±5 per cent under laboratory condition in different BOD incubators in the Department of Entomology, Rajasthan College of Agriculture, Udaipur during 2007 and 2008. The longest ovipositional period (42.55 days), maximum fecundity (155.73 eggs/female) and shortest developmental period from egg to adult (28.58 days) of *S. oryzae* was recorded at 30°C temperature. The combination of 30°C temperature and 75 per cent relative humidity was preferred by *S. oryzae* where longest ovipositional period (48.80 days), maximum fecundity (170.70 eggs/female), minimum duration of larval and pupal period (23.70 days) and shortest developmental period from egg to adult (27.40 days) was recorded. At 26°C temperature and 65 per cent humidity growth and development of *S. oryzae* was retarded as evinced by ovipositional period (25.00 days), longest incubation period (7.00 days), maximum larval and pupal period (38.60 days) and longest developmental period from egg to adult (45.60 days).

Key words: *Sitophilus oryzae*, maize, bio–ecology, temperature, relative humidity

Maize is infested by a number of insect pests in storage in different parts of the world. Among them, the rice weevil, *Sitophilus oryzae* (Linn.) has been reported as one of the most important insect pest causing considerable loss (Pathak and Jha, 2003). It is cosmopolitan noxious pest of stored cereals causing about 50 per cent loss in weight in storage (Koura and El–Halfway, 1967). The use of high yielding crop husbandry resulting into increased production and food storage for longer periods have posed many problems in storage and increased the importance of prevention of loss to stored commodities.

In order to develop economical and effective control measures for *S. oryzae*, detailed and accurate knowledge of its bio–ecology is essential along with possible prediction of population levels and study of the various mortality factors regulating the pest. Therefore, the present investigation was carried out on bio–ecology of *S. oryzae* in the laboratory at different temperature and humidity levels.

MATERIALS AND METHODS

The experiment on bio–ecology of rice weevil, *Sitophilus oryzae* (Linn.) conducted as a factorial CRD with five replications was carried out at different temperatures and humidity levels in the laboratory, Department of Entomology, Rajasthan College of Agriculture, Udaipur (Rajasthan) during 2007–08. Maize grains were sterilized at 55°C for 4 hours to remove any hidden infestation. These grains were conditioned for 24 hours at 30 ± 1°C temperature and 75 ± 5 per cent relative humidity before use in the study of bio–ecology of *S. oryzae*. A single gravid mated female of *S. oryzae* was released on conditioned maize grains for multiplication. Subsequently, for maintaining the insect culture 25 pairs of one day old adult insects of 1st generation were released in wide mouthed cylindrical glass jars containing 100 g grains for oviposition for a period of seven days. These jars were covered with muslin cloth, tightened with rubber bands and kept in a B.O.D. incubator fixed at 30 ± 1°C temperature and 75 ± 5 per cent relative humidity. After seven days, the adults were removed from the jars. Freshly emerged adults were collected in small glass vials (80 × 55 mm) for further experimentation.

For present investigation 50g conditioned maize grains were taken in five plastic containers (230 × 75 mm). Freshly emerged, single pair of *S. oryzae* was released in

* Part of Ph.D. thesis submitted to Maharana Pratap University of Agriculture and Technology, Udaipur.

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each of the five containers. These containers were kept in different B.O.D. incubators, which were adjusted at fixed temperatures of 26°C, 28°C and 32±1°C with variable humidity levels *i.e.*, 65, 70, 75 and 80±5 per cent. Every day grains were checked for egg laying and kept in separate glass tubes tightened with cotton plug. This process was continued till egg laying was completed to record ovipositional period. Observations were undertaken on fecundity, incubation period, larval + pupal period, developmental period (egg to adult) and longevity of male and female adults. Effect of temperature at variable levels of relative humidity and effect of relative humidity at different levels of temperature on bio–ecology of *S. oryzae* were recorded and presented.

RESULTS AND DISCUSSION

Effect of temperature: The data recorded on bio–ecology of *S. oryzae* at different temperatures and humidity levels have been presented in Tables 1 to 3. The longest

Table 1. Effect of different temperature levels of the bio–ecology of *S. oryzae*

Temperature (°C)	Mean growth and developmental parameters at different relative humidity levels						
	Ovipositional period (days)	Fecundity (No. of eggs/female)	Incubation period (days)	Larval+ Pupal period (days)	Develop–mental period (days)	Adult longevity (days)	
						Male	Female
26	28.80	138.13 (11.77)+	6.03	33.45	39.48	89.15	92.20
28	39.18	153.55 (12.41)	4.70	26.68	31.68	57.20	61.00
30	42.55	155.73 (12.50)	3.85	24.73	28.58	45.70	50.35
32	30.75	102.98 (10.17)	3.38	28.18	31.70	35.45	39.25
S.Em. ±	0.38	0.06	0.05	0.15	0.16	0.61	0.64
C.D. at 5%	1.09	0.16	0.13	0.44	0.46	1.76	1.84
C.V. (%)	4.79	2.11	4.56	2.39	2.19	4.79	4.69

+ Data in parentheses are square root (X + 0.5) transformed values.

Table 2. Effect of different humidity levels of the bio–ecology of *S. oryzae*

Temperature (°C)	Mean growth and developmental parameters at different relative humidity levels						
	Ovipositional period (days)	Fecundity (No. of eggs/female)	Incubation period (days)	Larval+ Pupal period (days)	Develop–mental period (days)	Adult longevity (days)	
						Male	Female
65	30.58	118.00 (10.89)+	5.15	31.38	36.53	55.70	59.40
70	35.78	134.65 (11.63)	4.65	27.03	33.68	59.85	63.75
75	40.58	146.53 (12.13)	4.28	27.08	31.35	59.00	62.55
80	34.35	151.20 (12.32)	3.88	26.00	29.88	52.95	57.10
S.Em. ±	0.38	0.06	0.05	0.15	0.16	0.61	0.64
C.D. at 5%	1.09	0.16	0.13	0.44	0.46	1.76	1.84
C.V. (%)	4.79	2.11	4.56	2.39	2.19	4.79	4.69

+ Data in parentheses are square root (X + 0.5) transformed values.

Table 3. Combined effect of different levels of temperature and relative humidity on the bio–ecology of *S. oryzae*

Temp. (°C)	RH (%)	Ovipositional period (days)	Fecundity (No. of eggs/female)	Incubation period (days)	Larval+ Pupal period (days)	Develop–mental period (days)	Adult longevity (days)	
							Male	Female
	65	25.00	117.60 (10.87)+	7.00	38.60	45.60	87.60	90.20
	70	28.40	137.20 (11.73)	6.20	34.00	40.20	97.20	99.80
26	75	31.80	142.40 (11.95)	5.70	32.00	37.70	92.60	95.40
	80	30.00	155.30 (12.48)	5.20	29.20	34.40	79.20	83.40
	65	33.00	130.60 (11.45)	5.50	30.60	36.10	67.40	70.60
	70	40.80	148.40 (12.20)	5.00	27.50	32.50	60.40	65.40
28	75	46.50	165.20 (12.87)	4.50	25.60	30.10	55.40	58.80
	80	36.40	170.00 (13.06)	3.80	24.20	28.00	45.60	49.20
	65	37.50	133.50 (11.58)	4.20	25.80	30.00	38.60	43.40
	70	42.30	150.40 (12.28)	4.00	25.00	29.00	48.40	52.20
30	75	48.80	170.70 (13.08)	3.70	23.70	27.40	51.60	55.60
	80	41.60	168.30 (12.99)	3.50	24.40	27.90	44.20	50.20
	65	26.80	90.30 (9.53)	3.90	30.50	34.40	29.20	33.40
	70	31.60	102.60 (10.15)	3.40	29.60	33.00	33.40	37.60
32	75	35.20	107.80 (10.41)	3.20	27.00	30.20	36.40	40.40
	80	29.40	111.20 (10.57)	3.00	26.20	29.20	42.80	45.60
S.Em±		0.76	0.11	0.09	0.30	0.32	1.22	1.27
C.D. at 5%		2.19	0.32	0.26	0.88	0.93	3.52	3.68
C.V. (%)		4.79	2.11	4.56	2.39	2.19	4.79	4.69

+ Data in parentheses are square root (X + 0.5) transformed values.

ovipositional period (42.55 days), maximum fecundity (155.73 eggs/female), minimum larval and pupal period (24.73 days) and shortest developmental period (28.58 days) of *S. oryzae* was recorded at 30°C temperature, while minimum incubation period (3.38 days) as well as minimum longevity of adult male (35.45 days) and adult female (39.25 days) was observed at 32°C (Table 1). Lower temperature inhibited the growth and development of test insect as shown by shortest ovipositional period (28.80 days), minimum fecundity (138.13 eggs/female), longest hatching period (6.03 days), maximum duration of larval and pupal period (33.45 days), maximum developmental period (39.48 days) and maximum longevity of adult male (89.15 days) and female (92.20 days).

The data on effect of humidity on bio–ecology of *S. oryzae* (Table 2) showed that 80 per cent relative humidity resulted into maximum fecundity (151.20 eggs/female), shortest hatching period (3.88 days), minimum duration of larval and pupal period (26.00 days) as well as minimum developmental period from egg to adult (29.88 days) and minimum adult longevity of male (52.95 days) and female (57.10 days). Decrease in the humidity level retarded the growth and development of *S. oryzae* by reducing ovipositional period to 30.58 days and fecundity to 118.00 eggs/female, increase in hatching period (5.15 days), larval and pupal duration (31.38 days), developmental period from egg to adult (36.53 days) and longevity of adult male (55.70 days) and female (59.40 days).

Combined effect of temperature and humidity: Combined effect of temperature and humidity (Table 3) revealed that the combination of 30°C temperature and 75 per cent relative humidity was most optimum for the pest, wherein longest ovipositional period (48.80 days), maximum fecundity (170.70 eggs/female), minimum duration of larval and pupal period (23.70 days) and shortest developmental period from egg to adult (27.40 days) was recorded. The incubation period was minimum (3.00 days) at 32°C temperature and 80 per cent humidity, while longest longevity of adult male (97.20 days) and female (99.80 days) was recorded at 26°C temperature and 70 per cent humidity. The interaction of temperature and humidity at 26°C and 65 per cent retarded the growth and development of *S. oryzae* as evinced by minimum ovipositional period (25.00 days), longest hatching period (7.00 days), maximum larval and pupal periods (38.60 days) and longest developmental period from egg to adult (45.60 days); whereas, minimum fecundity (90.30 eggs/female) and maximum longevity of adult male (29.20 days) and female (33.40 days) was observed at the interaction of 32°C temperature and 65 per cent relative humidity.

The results of present investigation conform to that of reported optimum oviposition and growth and development at 75 per cent humidity. Mun and Ki–Jong (1988) studied the temperature dependent developmental rate of *S. oryzae* on rice and reported that at 35°C temperature, the eggs could not develop into larvae and after 50 days, most of the eggs were dead. The larval period decreased as temperature increased up to 28°C and remained similar until 30°C, it ranged from 34.3 days at 20°C to 17.4 days at 28°C. Total developmental period from egg to adult ranged from 55.3 days at 20°C to 28.8 days at 28°C temperature. Bhuiyah *et al.* (1990) studied the biology of *S. oryzae* on maize at 23–35°C temperature and 79–87 per cent humidity and reported that egg, larval and pupal periods were 5 to 6, 16 to 20 and 8 to 9 days, respectively and the longevity of adult males and females was 114–115 and 119–120 days, respectively.

ACKNOWLEDGEMENT

Senior author is thankful to Head, Department of Entomology and Dean, Rajasthan College of Agriculture, Udaipur for providing necessary facilities during the present investigations.

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