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EFFECTS OF TEMPERATURE ON THE BIOLOGY OF *SPODOPTERA LITURA* FAB.[1]

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ABSTRACT

Laboratory studies were carried out to determine the effect of temperature on the biology of *Spodoptera litura* Fab. The highest and lowest number and fertility of eggs were observed at an average temperature of 19.55 and 34.9°C, respectively, while the shortest duration of life cycle (26.6 days) was also recorded at 34.9°C. Correlation and regression equations provided a good estimate of effects of termperature on different biological parameters of *S. litura*.

Key words: *Spodoptera litura*, biology, tobacco cutworm, life cycle *Medicago sativa*

INTRODUCTION

Tobacco cutworm, *Spodoptera litura* is one of the economically important polyphagous noctuid insect pests of cosmopolitan distribution. It causes severe damage to many field and nursery crops (Alam, 1969; Bishara, 1934; Beeson, 1941; Talhouk, 1969; Ozer, 1971; Dennis, 1975), and has been reported to attack 112 different species of cultivated crop plants throughout the world (Moussa *et al* 1960).

In Pakistan, *S. litura* has been reported attacking many crops such as *Gossypium hirsutum* L., *Spinacia oleracea* L., *Brassica oleracea* L., *Trifolium alexandrinum* L., *Medicago sativa* L., *Arachis hypogaea* L., *Phaseolus aureus* Roxb., *Phaseolus vulgaris* L. and *Nicotina tabacum* L., during different seasons throughout the year (Younis, 1973; Baloch and Abbasi, 1977; Khuhro *et al* 1986). In Southern Pakistan (South Sind) where vegetable growing season starts earlier than other parts of the country this pest causes heavy losses to *Brassica* and other vegetables and continues its activities till summer months. With the on-set of hotter days the pest suddenly disappears from the field and very little population could be found attacking crops. One of the factors of low population density of pest in the field is high temperatures which affect the biology of this pest in various ways. Therefore, these studies were undertaken with specific purpose of investigating the effects of temperature on the biology of this insect.

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MATERIALS AND METHODS

Insect culture was initiated from field collected larvae of *S. litura.* Larvae were reared in Petri dishes (10 and 15 cm dia) lined with blotting paper. They were provided fresh food of lucerne *(Medicago sativa)* leaves daily. When full-grown, larvae were kept in individual plastic jars measuring 7x5 cm with sterilized moist soil for pupation. After adult emergence, moths were released in pairs in ventilated oviposition cage measuring 22.5 x 22.5 x 30 cm with frame and bottom made of wood, two sides and top of iron mesh and remaining two sides having glass pans, one with sliding door to facilitate changing of oviposition medium and food.

Moths were fed a 10% (w/v) glucose solution impregnated on to cotton wool placed in small Petri dish covered with wire gauze. A small twig of *M. sativa* and seasonal flowers with their stalks dipped in water contained in small vials were placed inside cage as oviposition sites. Observations were taken on the copulation time, pre-oviposition, oviposition and post-oviposition period. A pen light torch with red colour tissue paper on the lens was used to observe mating during night time. Eggs when laid, were removed by a fine hair brush and kept in Petri dishes Observations were taken daily to record the fecundity and fertility of eggs.

To study effect of temperature on the biology of *S. litura*, laboratory minimum/maximum temperatures were recorded daily and average calculated on monthly basis. The regression equation $y = a + bx$, was used to express the effect of temperature on different biological values of *S. litura.*

RESULTS AND DISCUSSION

Mating took place just after sun set. The time taken for completing copulation, pre-oviposition, oviposition and post-oviposition periods decreased with increase in temperature. Oviposition took place during the night hours. The maxium number of eggs laid and the highest fertility of eggs was found during December, while the minimum number of eggs and the lowest fertility during June when the temperature was the highest (Table 1). The results of present studies for oviposition period are in agreement with Basu (1945) and Baloch and Abbasi (1977) who reported 2—4 and 1—3 days, respectively. While oviposition period reported by Talbouk (1969) was 2 days in summer which extended up to 2 weeks in winter. Fecundity of females showed clear variation during different months of the year. In the present study maximum number of eggs were laid during December, while Miyahara (1973) reported maximum number of eggs laid in September which could be due to the difference in climatic conditions of both areas.

Eggs were laid in double rows generally in irregular batches on the lower surface of leaves, firmly glued and covered with brownish to yellowish tuft of anal hairs. The incubation, larval and pupal periods and duration of life-cycle of *S. litura* was longer during winter months (Table 3). The emer-

Table 1. **Copulation time, pre-oviposition, oviposition and post-oviposition period, fecundity and fertility of *S. litura* from February to December 1982.**

Month	Average temp. oC	Time in hours and minutes (mean± SD)					
		Copulation	: Pre-oviposition	: Oviposition	: Post-oviposition	: Eggs: Means ± SD	Fertility
February	18.78	2.26 ± 0.45	30.8 ± 3.70	32.8 ± 7.08	161.4 ± 5.70	813.0 ± 115.46	100.0
March	24.33	2.00 ± 0.86	28.8 ± 3.11	28.2 ± 7.15	113.0 ± 16.84	555.0 ± 103.36	92.3
April	33.31	1.58 ± 0.83	24.8 ± 1.30	27.0 ± 4.52	106.0 ± 8.73	605.0 ± 181.02	72.7
May	33.69	2.07 ± 0.40	24.6 ± 2.96	23.0 ± 2.12	100.2 ± 10.37	489.0 ± 183.94	63.1
June	34.9	1.45 ± 0.59	25.5 ± 3.78	25.0 ± 3.96	92.0 ± 17.92	387.4 ± 157.19	45.2
July	34.76	1.42 ± 0.53	25.5 ± 4.43	26.0 ± 3.39	94.8 ± 20.36	421.6 ± 172.21	49.5
August	30.24	1.48 ± 0.54	30.6 ± 5.59	27.0 ± 2.91	111.0 ± 20.65	686.6 ± 125.45	60.7
September	29.53	1.51 ± 0.93	34.8 ± 6.30	31.6 ± 5.22	130.8 ± 11.00	816.4 ± 197.59	85.3
October	27.86	2.39 ± 1.00	51.6 ± 14.57	30.8 ± 1.78	138.6 ± 11.28	940.0 ± 155.77	94.0
November	23.55	2.13 ± 0.58	42.0 ± 13.20	35.0 ± 3.08	160.0 ± 25.35	958.0 ± 168.75	98.7
December	19.55	2.54 ± 0.76	50.6 ± 12.62	40.0 ± 5.24	191.6 ± 47.54	1034.0 ± 193.43	100.0

Table 2. **Regression equations for the effects of temperature on biological parameters *S. litura*.**

Parameter	Range of temp. (C)	Regression equation a/	r	r2
Copulation time (hrs)	18.78—34.9	0.4656 + 0.0508x	—0.691	0.477
Oviposition (hrs)	17.78—34.9	9.3078 + 0.7244x	—0.850	0.722
Postoviposition (hrs)	17.78—34.9	— 12.65 + 4.9874x	—0.893	0.797
No. Eggs (x)	17.78—34.9	— 155.617 +30.527x	—0.781	0.610
% Fertility	17.78—34.9	— 12.417 + 3.236x	—0.899	0.808

a/ Regression equation is Y = a + bx, where Y is time in hours and x is the temperature in °C.

gence of moths from pupation predominantly took place during night hours. The maximum emergence percentage was 94.5 in October and the minimum 77.4 in June.

The incubation and pupal periods observed in the present studies were also reported by Bishara, (1934); Alam, (1969); Talhouk, (1969); and Baloch and Abbasi, (1977). The results on larval period were in partial agreement with the findings of Baloch and Abbasi (1977) who reported that larval duration was 24- 26 days in winter and 18—25 days in summer months. The variation could be due to difference in larval food and climatic conditions. Duration of life-cycle reported by Ayyar (1963) and Nayar *et al* (1979) was 30—40 days which is different from the results of present investigation. This could also be due to variation in climatic conditions.

The over all effect of temperature on the biology of *S. litura* was reduction in the duration of life-cycle as temperature increased coupled with decrease in fecundity and fertility of eggs which was not affected seriously up to 30°C (Hashmat and Khan 1977; Nakamura, 1973) but beyond this, temperature adversely affects both fecundity and fertility of the insect and at 36 °C eggs are completely sterile (Hashmat and Khan, 1977). The low fecundity and fertility of the pest in the laboratory very clearly coincided with field observations where the pest almost completely disappeared during these months which is probably due to lower fecundity and fertility coupled with migration to cold areas in the north country. During this season the maximum temperatures sometimes shoot up to 44°C in the southern part of Pakistan.

Table 3. Duration of different life stages of *S. litura* influenced by temperature.

Month	Avg.	Developmental stage : Mean ± SD (Days)				
	oc	Egg	Larval	Pupal	Adult	Duration of life-cycle.
February	18.78	9.8 ± 1.1	30.6 ± 2.9	14.1 ± 2.0	10.2 ± 1.3	64.7
March	24.33	2.6 ± 0.5	18.1 ± 0.9	10.4 ± 1.6	8.0 ± 1.2	39.1
April	31.31	2.0 ± 0.0	15.9 ± 1.6	9.0 ± 0.9	7.6 ± 0.9	34.5
May	33.69	2.0 ± 0.0	14.0 ± 1.5	8.3 ± 0.6	6.4 ± 1.5	30.7
June	34.9	2.0 ± 0.0	11.8 ± 1.5	7.0 ± 0.9	5.8 ± 0.8	26.6
July	34.76	2.0 ± 0.0	13.0 ± 1.4	7.2 ± 0.7	5.6 ± 0.9	27.8
August	30.24	2.6 ± 0.5	15.2 ± 1.7	8.1 ± 0.9	8.0 ± 1.0	33.7
September	29.53	2.5 ± 0.4	16.5 ± 2.2	9.3 ± 0.7	8.4 ± 0.9	49.3
October	27.86	4.8 ± 0.8	23.7 ± 3.4	11.8 ± 1.1	9.0 ± 1.0	49.3
November	23.55	5.8 ± 0.8	24.4 ± 2.1	16.3 ± 3.2	10.4 ± 1.8	56.9
December	19.55	9.2 ± 1.1	29.4 ± 3.2	24.6 ± 5.5	11.8 ± 2.5	75.0

Table 4. Regression equations for the rate of development of life stage of *S. litura* in relation to temperature.

Stage	Range of temp. (oC)	Regression equation a/	r	r2
Egg	17.78 – 34.9	– 8.5777 + 0.4532x	– 0.894	0.799
Larval	"	– 10.645 + 0690x	– 0.937	0.878
Pupal	"	– 9.3176 + 0.7410x	– 0.819	0.671
Adults	"	– 0.4276 + 0.3109x	– 0.916	0.839
Duration of life-cycle	"	– 26.373 + 2.5215x	– 0.910	0.828

a/ Regression equation is Y = a + bx, where Y is the number of days and x is the in °C.

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