BIOLOGY OF THE SPINY BOLLWORM

EARIAS INSULANA BOIS.

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The sudden outbreak of the spiny bollworm in the year 1966 in the cotton growing areas of GORGAN & GONBAD revealed apparently the necessity of the study of the life history of this insect in these areas. The study, therefore, was carried out both in the field and in the laboratory under wide ranges of temperature and humidity.

CHARACTERISTICS AND BIOLOGY

EGG: spherical, less than 0.5 mm diam., light blue-green when laid, with approximately 30 longitudinal ridges, half of which alternately project upwards to form a crown (Fig. 4).

The female lays more eggs at the temperatures of 25–29 C° . The fertility of the eggs are also higher at these temperatures. Most of the eggs did not hatch at the average temperature less than 19° .

Table 1: is presenting incubation period of the eggs at different temperatures

Average temperature (C° .)	Incubation period (days)
15–16	14.2(10–16)
17–18	10 (9–12)
19–20	5.7(5–6)
20–21	5.2(4–6.5)
22–12	5 (4–6)
25–26	3.5(4–2)
28–29	3 (2.5–3.5)
29–30	2.6(3–2)

LARVA : The full grown larva is about 15–10 mm. long, somewhat stout and spindle-shaped, bearing a number of long hairs or setae on each segment, on the last two thoracic, and all the abdominal segments, two pairs of fleshy tubercles, one of which is dorsal and the other lateral (Fig. 2).

The larvae start to feed from the buds, bolls and terminal shoots soon after hatching. The attacked young bolls and buds usually would fall down, but this may also be due to other reasons, such as, soil salinity, hot winds, fertilizers, irrigations or so forth. The observations indicated that the percentages of the shedding due to the spiny bollworm attack were only 45.5, 53.5, 63.6 and 43.9 during September, October, November and December respectively.

Usually one larava will enter the boll, but during the "outbreak" 2-3 lavrae may be seen in a boll. The attacked bolls may also be affecetd by the sooty fungi.

Table 2: Shows the duration of the larva at different temperatures in the laboratory

Temperatures C°.	Relative humidity%	Larval development (days)
19—20	55—60	23(20—31)
22—23	« «	17.4(12—22)
25—26	« «	11(8—15)
27—28	« «	8(6—12)

Table 3: Shows the duration of the larvae at different temperatures in the field

Relative humidity%	Average temperatures C°.	Larval development (days)
18	60—70	29(22—36)
21	« — «	19(17—27)
26	« — «	10 5(7—14)
27	« — «	10.1(7—14)
30	« — «	6.3(5— 9)

PUPA: Chocolate brown, head and tip of the abdomen bluntly rounded, enclosed in a cocoon shaped boat. The color of the cocoon is dirty-white or pale-brown.

Table 4: Shows the duration of the pupal development at different temperatures in the laboratory.

Mean temperature C°.	Mean R.H. %	Pupal development (days)
19—20	55—50	20(18—21)
22—23	« «	18.7(14 - 20)
23—24	« «	14.2(14—15)
26—27	« «	10.3(9—12)
27—28	« «	10.4(10—12)
28—29	« «	10.5(9—11)
29—30	« «	8.4(7—10)
30—31	« «	7.1(5— 8)
31—32	« «	7.5(5— 8)

Table 5: Shows the duration of the pupae at different temperatures in the field

Duration of pupal development (days)	R. H.	Average temperature C°.
54 (52–57)	69	15
49 (47–54)	68	16
34.6(30–39)	68.5	17
27.5(23–31)	71	18
15.6(– –)	71	21
15 (14–16)	71	23
10.8(10–12)	65	24
10.2(9–12)	65	25
9.6(8–11)	65	26
10.5(9–12)	61.5	27

MOTH: The abdomen and hindwings are a uniform silvery or creamy–white, while the head, thorax and forewings vary from green to straw–yellow(Fig 11).

Table 6: Shows the preoviposition period and the longevity of the moth at different temperatures.

Longevity		Oviposition period	
Average temp.	Longevity (days)	Average temp.	Pre-oviposition (days)
15–16	31(26–47)	15–16	5.5(4–9)
17–18	19(12–37)	17–18	4.9(3.8–8.5)
20–21	12(8–16)	19–20	3(2–4)
21–23	9(6–13)	20–21	3(2 5–4)
25–26	7(5– 8)	25–26	2.4(1.5–2.8)
		27–28	2 2(1.5–2.6)
		29–30	2(1–2.2)

The above table shows that the suitable temperatures for oviposition was between 25–29 C°. At these temperature the oviposition usually starts about two days after the moth emerged from the pupa. The moth usually feeds on nectars of flowers particularly before oviposition. The longevity of the moth in the optimal temperature 21–26 C°. is 7–10 days and duration of oviposition is 4-7 days. The oviposition is usually observed soon after sun set and continued during the night. The moth usually

lays its eggs separately on the terminal part of the host. The number of eggs varies between 12–80 during each oviposition. However the maximum of total of 281 eggs was observed in one female. During December the egg laying of the moth was observed at the average temperature of 12–17 C° . During the day at this period the minimum temperature was recorded as low as 4 C° . Under these conditions, the longevity of the moth was 27–40 days.

THE NUMBER OF GENERATIONS OF THE SPINY BOLLWORM IN GORGAN IN 1966

The appearance of the moth and the numbers of generation in a year depend on the environmental conditions.

The following table shows the percentage of emergence of the moth in March and April 1966.

Table 7: Emergence of the moth of *Earias insulana*

	March			April		
	1—10th	11—20th	21—30th	1—10th	11—20th	21—30th
Moth emergence %	7	18	46	18	2	3
Average temperature	11 8	11	14.1	9.1	13.2	19.9

The above table indicates that the first generation of the insect has appeared during March and early April. The development period of the insect continued until June due to the low temperature (Average temperature 18 C°.). During this period the spiny bollworm completed its life cycle on wild hosts and probably on the remainders of cotton stalks which were still alive due to the presence of mild winter.

The following generations of the insect in 1966 continued on the cotton plants as well as on the wild hosts. The Table 9 shows that at this year four generations of the insects were observed from June to September. Towards the end of the September and during October there has been another generation as well a small number of the larvae which were under better conditions pupated during December and January, but the rest of the larvae died due to the low temperature. If the winter of 1967 was as mild as it was in 1966 the larvae of this generation could probably overwinter, but due to the low winter temperature of the year 1967 (sometimes reached minus 4.5 C° .) the host plant and the cotton stalks as well as the larvae died. The continuation of the generation of the insect however could be followed only by the pupae, which overwinter and had suffered a high mortality. It should be mentioned here that the appearance of the moth in 1967 was retarded due to the low temperature of the winter and early spring.

Table 8: Shows the length of the life cycle of each generation of the insect at various temperature (in the laboratory and in the field).

Average temperature	R.H.	Pre-ovipo-sition (days)	incubation (days)	Larval development (days)	Pupal development (days)	Longevity of the moth	Length of the life cycle of one generation
15—14	70—60	—	—	—	54(57—52)	31(47—26)	—
16—15	«	5.5(4—9)	14 2(16—10)	—	49(54—47)	21(26—18)	
17—16	«	—	—	—	34.6(39—30)	—	
18—17	«	4.9(3.8—8 5)	10(9—12)	29(36—22)	27.5(31—23)	19(27—12)	68
19—20	«	3(2—4)	5.7(5— 6)	23(31—20)	20(10—18)	12(8— 6)	52
21—20	«	3(2.5—4)	5 2(4—6.5)	19.5(27—17)	19.2(20—12)	12(7—18)	46.9
22—21	«	2.6(4—6.5)	5(4— 6)	—	—	—	—
23—22	«	« « «	« «	17.2(24—12)	18.7(20—14)	9(6—13)	43
24—23	«	—	—	—	12.5(10—15)	—	—
25—24	«	—	—	—	10.2(9—12)	—	—
26—25	«	2.4(1.5—2.8)	3.5(3— 4)	11(15— 8)	9.6(8—11)	—	26
27—26	«	« « «	« «	10.1(7—14)	10.3(9—12)	7(8— 5)	26
28—27	«	2.2(1.5—2.6)	« «	8(6—12)	10.1(9—12)	—	24
29—28	«	« « «	3(2.5—3.5)	—	10.5(9—11)	—	—
30—29	«	2(1.5—2 2)	2.6(3— 2)	6.3(9— 5)	8.4(7—10)	—	20
31—30	«	—	—	—	7.1(8— 5)	—	—
32—31	«	—	—	—	7.5(8— 5)	—	—

Table 9: Shows the average monthly temperatures (C° .) in 1966 in Gorgan and Gonbad.

January	February	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
11 8	11.8	12 3	12.7	20.5	25.3	27.3	27.3	26	21.6	14 9	12.7

CONCLUSION

1. The studies carried out indicated that the length of development of the spiny bollworm are nearly the same in the field and Laboratory at equal temperatures.

2. The effect of the average temperature on the length of the life cycle of insect could be devided in three following categories:

a) Optimal temperature 25—29 C° . , at this temperature the length of one generation was very short (about 22—23) days; the mortality decreased to minimum at different stages. The data also shows that with the optimal temperatures no considerable differences were observed as far as longevity of each generation was concerned.

b) At temperatures between 18-24 C° . the development takes place normally, but with a small change of temperatures the development period was varied greatly. For example this variation at the average temperature of 18 , 20 and 21 C° . were 68, 52 and 47 days respectively (Diag. 1).

c) At the average temeratures below 16 C° . the length of the total development period of the insect was very long. The mortality was very high, particularly during th egg and larval stages. Sometimes the length of the pupal stage was even up to four months.

3. The geographical distribution of the spiny bollworm may be indicated through the average temperatures and the length of the optimal prevailing temperatures in the cotton growing areas, but the outbreak of this insect depends on cotton growing period, the wild host plants, the activities of predators and parasites and the climatical factors.

4. The spiny bollworm has 6–8 generations in a year in Gorgan and Caspian Sea area.