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Thermal Requirements for Development of the Rednecked Peanutworm, *Stegasta Bosqueella.*[1]

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ABSTRACT

Thermal requirements for development of life stages in the rednecked peanutworm, *Stegasta bosqueella* (Chambers), were determined. Embryonic, larval, and pupal threshold temperatures were 11.7°C (53°F), 11.0°C (52°F), and 12.2°C (54°F), respectively. Mean C° day accumulations required for completion of life stages were: 66.5 - egg, 156.0 - larva (to prepupa), 25.1 - prepupa, and 94.2 - pupa.

Key Words: Rednecked peanutworm, *Stegasta bosqueella*, Threshold Temperature.

The rednecked peanutworm, *Stegasta bosqueella* (Chambers), is a perennial pest of peanuts in Oklahoma. Larvae feed within the terminal buds of plants and cause considerable defoliation and stunting of growth when population densities are high (3). We have learned in life table studies (Wall and Berberet, unpublished) that dramatic population increases often occur during July and August in Oklahoma with heavy damage to peanuts resulting. We have conducted the present study on temperature requirements for development of *S. bosqueella* to enhance our capability for predicting occurrence of population increases and possible timing of chemical control measures.

Knowledge of temperature thresholds and development rates for life stages is essential for determination of lengths of successive generations and an aid for predicting population fluctuations. The rate of insect development is determined by time and temperature above a threshold (1). A good estimator of developmental time which takes into account both time and temperature is based on accumulated degree days, which we have calculated for *S. bosqueella* in this study.

Materials and Methods

Development of eggs, larvae, and pupae of *S. bosqueella* was monitored in constant temperature cabinets (Sherer® Model CEL 4-4) to determine thresholds and degree day accumulations necessary for completion of life stages. Ten replications were utilized for each life stage with at least 12 individuals held at each of 4 temperatures (12.8±1, 18.3±1, 23.9±1, and 29.4±1°C) for each replication. Developmental times were thus determined from a minimum of 120 individuals of each stage per temperature setting. Humidity was maintained at 65±5% with a 12 h photoperiod for all studies.

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Eggs were obtained by confining 3 pairs of newly emerged moths in clear plastic dishes (ca. 40 X 100 mm) covered with paper toweling which served as a substrate for egg deposition. Humidity was maintained by placement of a damp sponge covered with filter paper in each dish and adults were fed Gatoraid® Eggs were counted on the paper toweling at the end of each 12 h period using a stereomicroscope and replications were started in all 4 temperatures when at least 48 eggs were available at the same time period. Virtually all eggs were laid during scotophase. Consequently, all egg replications were started as photophase commenced. Egg development was observed at 12 h intervals and numbers hatching recorded.

To simulate field conditions as closely as possible, plant terminals were used in studies on larval development. Newly hatched larvae were placed in cut terminals which had been inserted into small containers of Hoagland's solution (2). Parafilm® was utilized to seal stems in containers and prevent evaporation. Each container was then placed in a petri dish with a ring of Tanglefoot® applied around the edge to prevent escape of larvae when they left the terminals to pupate. Shortly before pupation *S. bosqueella* larvae discontinue feeding and become very active, descending the plant in search of an appropriate pupation site, which in the field is the upper 1-5 mm of soil around plants. Departure of larvae from terminals delineated the end of larval development. Developmental time was recorded for larvae at 12 h intervals. Developmental times for individual larval instars were not recorded because of the difficulty in observing larvae without injuring them once they have begun feeding within plant terminals.

The prepupal period was defined as beginning when the larva discontinued feeding and descended the plant and ending when the molt to the pupal instar was completed. Prepupae were obtained from larval studies. They were held in vials plugged with cotton at 23.9±1°C and checked at 6 h intervals to determine the degree day accumulation necessary for completion of the prepupal period. The threshold temperature calculated for larval development was utilized in these computations.

In order to obtain sufficient numbers of pupae of uniform age for developmental studies, large larvae were collected from plant terminals in the field and reared to pupation on artificial diet. When sufficient numbers of larvae (at least 48) pupated within a 12 h period, they were used to establish replicates to determine requirements for pupal development. Pupae were incubated in 30 ml cups with cardboard lids and checked at 12 h intervals to observe adult emergence.

In order to record adult longevity and oviposition rates, 25 groups, each consisting of 3 pairs of newly emerged moths, were reared at 23.9±1°C in chambers described previously in this paper. Adults utilized in these studies emerged from field collected pupae. Eggs deposited on paper toweling were counted at 48 h intervals until all females had died.

Results and Discussion

The relationship between rate of development (%/12 h) and temperature is plotted in Figure 1 according to the regression equation computed for each life stage. The theoretical developmental threshold (°C) is shown by the X-intercept of the regression line for each stage. Degree days required for development equals experimental temperature

minus the threshold X the number of days at each constant temperature (Table 1). No significant differences (P = 0.05) were found between degree day accumulations required for completion of life stages at 18.3, 23.9 and 29.4°C.

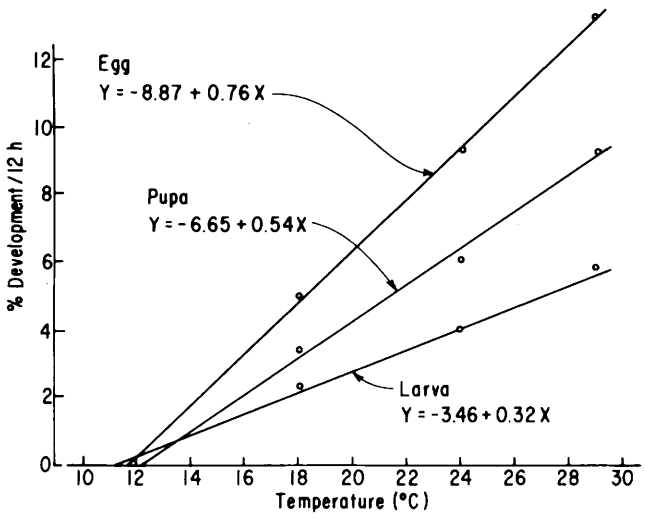

Fig. 1. Developmental rate of immature stages of *Stegasta bosqueella*. Percent development/12 hr. = [1/(H/12)] X 100; where H = hours required to complete development. (r = 0. 99 for each regression).

Table 1. Thermal requirements for development of immature stages of *Stegasta bosqueella*.

Temperature (°C)	Eggs		Larvae		Pupae	
	days	degree-days	days	degree-days	days	degree-days
12.8	-	-	-	-	-	-
18.3	10.2	67.6	21.5	154.9	15.2	92.7
23.9	5.3	65.2	14.1	156.0	8.3	97.3
29.4	3.8	66.7	8.6	157.0	5.4	92.5
Mean		66.5		156.0		94.2

Although the theoretical threshold for embryogenesis in *S. bosqueella* was 11.7°C (Fig. 1), no hatching occurred in eggs incubated in 12.8°C. Color changes associated with normal embryonic development could be detected at this temperature, however. Degree day requirements for hatching of eggs incubated at other experimental temperatures were quite similar and the mean was 66.5C° days (Table 1).

The threshold temperature for larval development was 11.0°C. Although newly hatched larvae remained alive for 3-4 weeks at 12.8°C, little development of these individuals was observed. Apparently this temperature was too near the threshold to allow larval development to proceed efficiently. Thermal requirements for development at other temperatures varied from 154.9 to 157.0 with a mean of 156.0C° days (Table 1). The prepupal period required an average of 25.1C° days. A mean of 94.2C° days was needed for the pupal stadium.

S. bosqueella laid an average of 16 eggs under laboratory conditions. Egg deposition progressed at a constant rate for 12-14 days after adult emergence (Figure 2). The mean number of eggs/female for 25 groups of 3 moths was produced during the initial 8 days of the adult stadium. Because a threshold for egg deposition was not determined, we have utilized the figure for egg development (11.7°C) in calculating degree day accumulation for the ovipositional period. The total for the 8 days at 23.9°C required for mean egg production was 97.6C° days.

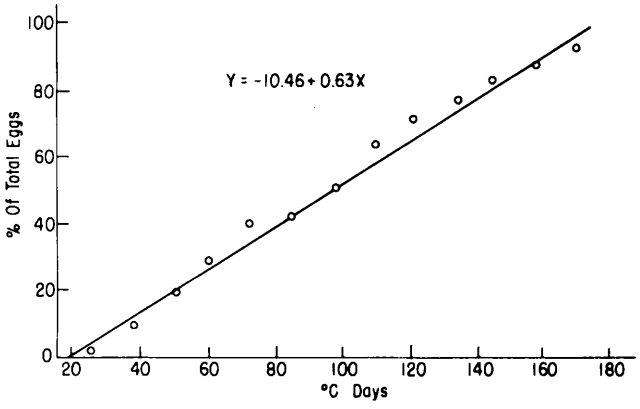

Fig. 2. Egg deposition by laboratory reared *Stegasta bosqueella*. (r = 0.99).

We have computed a total generation time for *S. bosqueella* of approximately 440 C° days. We are utilizing this information to assist in segregation of generations for life table studies. In Oklahoma, temperature conditions during the peanut growning season permit completion of ca. 3 generations of *S. bosqueella*.

During late July and early August, when peanuts are most sensitive to defoliation (3), larval population densities may increase quite rapidly. During this period, up to 20C° days are accumulated/calendar day, and the life cycle of *S. bosqueella* may be completed in as little as 23 days.

Literature Cited

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