HATCHING OF THE EGGS OF THE EASTERN TENT CATERPILLAR, *MALACOSOMA AMERICANA* (F.) (LEPIDOPTERA : LASIOCAMPIDAE)

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The eastern tent caterpillar has a single annual generation wherever it occurs on rosaceous trees in North America. It is one of the first insects to exhibit activity in the spring of the year. Eggs hatch when foliage of the host trees provides a minimum of food for the young larvae, and egg masses within a geographical locality hatch within about 48 hours of each other. As the spring season progresses, larval development is completed, cocooning and pupation occur, and adults emerge to mate and produce the masses of eggs on host twigs. These eggs remain dormant throughout the summer, autumn, and following winter. In Florida, the single annual generation has been completed and eggs have been laid for the following year before egg hatching has occurred in many Lakes States and New England locations. The applications of Hopkins (1919) "Bioclimatic Law" are apparent.

Since 1949, the activity of the eastern tent caterpillar has been observed on host trees (wild cherry, *Prunus serotina* Ehrh., and wild plum, *Prunus angustifolia* Marsh.) at Gainesville, Florida. Hatching dates of egg masses have been recorded each year. At Gainesville, the date of hatching varies from late January to late February in different years; the average for the 13 years of observation being during the first week of February. The variation of hatching dates suggested the need of a study of climatological data for these years.

Flemion and Hartzell (1936) have reported on studies of the effect of low temperatures in shortening the hibernation period of insects in the overwintering egg stage. Part of their work involved observations of the eggs of eastern tent caterpillar in a single season in New York State. Egg masses were treated for 8 to 12 weeks at temperatures of 1°, 5°, 10°C. It was found that time to hatching decreased (on exposure to room temperatures) as the period of low temperature treatment was increased.

Hodson and Weinman (1945) have reported on studies of the closely related forest tent caterpillar, *Malacosoma disstria* Hbn., in Minnesota. Their studies indicate that embryonic development within the eggs is completed within two to three weeeks after the eggs have been laid in July. Diapause then lasts until the following spring when temperatures and plant development are favorable for the young caterpillars. The eggs tolerate a wide variety of weather conditions, must be exposed to freezing temperatures and hatching is stimulated by temperatures in the range of 50° to 77°F.

U. S. Weather Bureau records for Gainesville for the years 1948 through 1961 were examined. First temperatures in the near-freezing range in autumn seemed to be a logical starting point for temperature calculations. The date of such temperatures varied from November 1 in 1955 to December 26 in 1949. The average date for the first frost at Gainesville is December 4th. Oddly enough, the average date for the last frost is February 22nd at Gainesville; usually occurring after egg hatch in any year. Yet reduction

in numbers of eastern tent caterpillar larvae by low temperatures has not been observed locally.

Calculations of daily means from the date of first near-freezing temperatures were made but proved cumbersome. Since such temperatures were not experienced until after the winter solstice in 1949, it was decided to begin computations of daily means for all years with the winter solstice. Furthermore, plant development is controlled by photoperiodism as well as temperature; egg masses of eastern tent caterpillar do not hatch until a minimum of new foliage on the trees is available as food. A mean of 50°F was arbitrarily selected as the point of critical insect development. Table 1 compares the calculations for the different years.

TABLE 1.—ACCUMULATED DAYS AND MEAN TEMPERATURES* BETWEEN WINTER SOLSTICE AND HATCHING OF EGGS OF EASTERN TENT CATERPILLAR AT GAINESVILLE, FLORIDA.

Year and hatch date	Total days	Days Mean above 50°	Accumulated Mean degrees	Accumulated Mean Degrees above 50	Average Daily Accumulation
1949, Feb. 5	46	42	2899.0	624.5	69.2°
1950, Jan. 28	38	37	2535.5	637.5	69.6°
1951, Feb. 11	52	41	2932.0	406.5	61.3°
1952, Feb. 10	51	43	3080.0	556.5	63.8°
1953, Jan. 30	40	32	2329.5	358.0	63.6°
1954, Jan. 27	37	30	2196.0	362.5	63.2°
1955, Feb. 6	47	35	2619.0	382.5	62.5°
1956, Feb. 5	46	33	2515.5	278.0	60.6°
1957, Jan. 31	41	35	2485.0	472.0	67.2°
1958, Feb. 24	65	27	3238.0	231.5	56.8°
1959, Feb. 4	45	35	2529.0	351.5	63.3°
1960, Feb. 8	49	39	2799.0	422.5	62.6°
1961, Feb. 15	56	37	2944.0	249.0	62.4°
Average	47.15	35.85	2700.1	410.2	63.6°

* Recorded in degrees Fahrenheit.

Of these years, 1955 most nearly approaches the "average" year with eggs hatching on February 6th. Numerous departures from the "average" are apparent for the different years. Obviously, temperatures are not the only factor involved in stimulating the hatching of these eggs.

Precipitation records for these years were examined. Rainfall during the period under consideration varied from less than an inch in 1957 to more than 9 inches in 1952 and offers less correlation than temperatures.

Temperatures would probably be more reliable if we had an accurate record of them for the micro-environment of the egg masses. Temperatures of the egg masses would hardly be the same as those recorded on U. S. Weather Bureau thermometers, as is certainly obvious when one con-

siders the location of the egg masses on the twigs of the host trees. The dark-colored egg masses are exposed to direct sunlight on bright days and the temperatures within the egg mass would exceed the maxima recorded within a thermometer shelter. Likewise the egg masses would be exposed to lower nocturnal temperatures than the recorded minima. Furthermore, the U. S. Weather Bureau instrument location was on the campus of University of Florida through 1957. In 1958 the old location was abandoned and records had to be taken from the new location on the Agricultural Experiment Station Farm approximately 2 miles from the old location.

Flemion and Hartzell (1936) reported that the eggs of eastern tent caterpillar hatched out-of-doors on April 1, 1936, at Yonkers, N.Y. The U.S. Weather Bureau does not maintain a recording station at Yonkers. However, Mr. Keith Butson, Florida State Climatologist, secured daily temperature data for this period from nearby stations at Scarsdale and Mt. Vernon, N.Y. Mt. Vernon is four miles southeast of Yonkers and Scarsdale is six miles northeast of Yonkers and six miles north-northeast of Mt. Vernon. By averaging daily temperatures from these two stations beginning December 22, 1935, through the hatch date of April 1, 1936, Yonkers temperatures have been approximated.

Dr. A. T. Drooz, U.S. Forest Service Entomologist (personal communication), provided the following hatching dates for eastern tent caterpillar; Confluence, Penn. April 8, 1959, and Harrisburg, Penn. April 13, 1960. Daily U.S. Weather Bureau records were consulted for these locations. Table 2 presents information for the New York and Pennsylvania records.

TABLE 2.—ACCUMULATED DAYS AND MEAN TEMPERATURES* BETWEEN WINTER SOLSTICE AND HATCHING OF EGGS OF EASTERN TENT CATERPILLAR.

Location, year, and hatch date	Total days	Days Mean above 50°	Accumulated Mean degrees	Accumulated Mean degrees above 50	Average Daily Accumulation
Yonkers, N.Y. 1936, April 1	102	8	3141.0	26.5	30.8°
Confluence, Penn. 1959, April 8	108	6	3360.5	18.0	31.0°
Harrisburg, Penn. 1960, April 13	114	9	3946.0	59.5	34.6°

* Recorded in degrees Fahrenheit.

The difference in total days between the winter solstice and egg hatching at Gainesville, Florida, and the New York and Pennsylvania locations correlates very nicely with Hopkins "Bioclimatic Law." It is obvious that the arbitrarily selected 50°F temperature has little significance. The accumulated daily mean degrees are fairly consistent, especially when

one considers the variation in this category in different years at the Gainesville location. The average, daily temperature accumulations are also indicative of correlation. The importance of temperature, from the time of the winter solstice to the hatching of the eggs of the eastern tent caterpillar, is apparent in stimulating both the insect and the vernal development of the host plants.

Hatching dates of the eggs of the eastern tent caterpillar need to be studied over a series of years at other locations within the extensive range of this insect. Temperature calculations at these other locations could then be made and compared with calculations for the Gainesville area to obtain a fuller understanding of the operation of this factor on development.

Literature Cited

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