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DAILY ECLOSION PATTERN OF THE SARATOGA SPITTLEBUG, *APHROPHORA SARATOGENSIS* (FITCH) (HOMOPTERA: CERCOPIDAE)

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The Saratoga spittlebug, *Aphrophora saratogensis* (Fitch), is a destructive pest of young planted pines in the Lake States. The adults injure the pines by feeding on the sap of branches. However, nymphs feed on the sap of alternate host plants, which include many herbs and woody plants on the forest floor. Our studies show that the time of eclosion and shortly thereafter is one of the most vulnerable periods in the insect's life cycle. During this period the nymphs must free themselves from the eggs that are on pine buds, vacate the pines, search out suitable host plants on the forest floor, initiate feeding, and cover themselves with masses of spittle. And they must do this before they desiccate (Ewan, 1961), starve, or are captured by predators.

As part of a survival study we wanted to observe the nymphs at eclosion because their emergence and behavior pattern at that time would certainly affect their survival. In the Lake States area eclosion occurs from early April to late May, a period when weather varies greatly from cool and wet to warm and dry. Reported is the nymphal eclosion pattern during the peak of the eclosion periods in 1969 and 1970.

METHODS AND MATERIALS

Observations were taken in two young red pine (*Pinus resinosa* Ait.) plantations in Michigan, one in Alcona County in 1969 and one in Wexford County in 1970. Sticky traps and windowpane traps were used to detect the nymphs vacating the trees following eclosion. The sticky traps were flat boards (1 ft.^{2}) mounted at their center on short stakes and covered with cardboard sprayed with tanglefoot. Ten traps were placed in each plantation under several eight-foot tall trees containing spittlebug eggs. Four windowpane traps (see Wilson, 1969 for details) were placed five to ten foot out from the trees to catch windborne specimens. The trees were examined throughout most of the day for emerging nymphs, and nymphs caught on the traps were recorded hourly. Observations were made during several periods for two or three consecutive days in each area during the peak of the eclosion period from May 5 to 14 each year.

RESULTS AND DISCUSSION

Nymphal eclosion occurred on all days of the test. Eclosion always began after 0600 hrs., peaked between 0800 and 0900 hrs., and then declined the rest of the day culminating before 1600 hrs. (Fig. 1). Nymphs never emerged between 1600 and 0600 hrs. About 33% eclosion occurred during the peak hour (0800-0900 hrs.); 85% occurred between 0700 and 1100 hrs.

Eclosion began at a different time each day depending upon morning temperature. The earliest was just after 0600 hrs. and the latest just after 0830 hrs. Cool, cloudy, or misty days prolonged the emergence period, extending it occasionally into mid-afternoon. Hot and sunny mornings abbreviated the emergence period; on such days it seldom lasted

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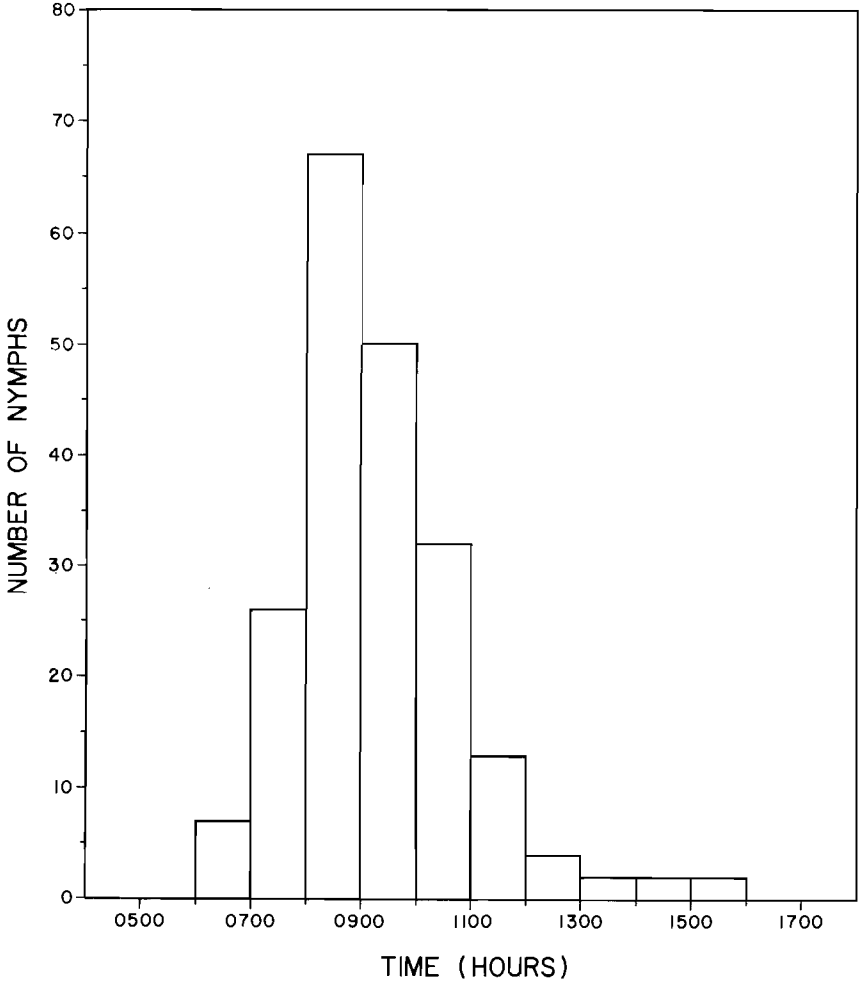

Fig. 1. Frequency of spittlebug nymphal eclosion per hour (EST).

beyond three hrs. However, on the average, about the same number of nymphs emerged on any two consecutive days that differed greatly in weather conditions.

The nymphs usually freed themselves from the egg in less than one min. They did not pause to dry out their exoskeleton, as some other insects do, but rather immediately began wandering over the surface of the bud or up and down nearby needles. They spent several minutes on the bud and needles if the humidity was high or if the sky was overcast, and less time when the day was sunny and warm. Most nymphs "dropped off" the tree, but a few were blown off by gusts of wind, as our windowpane traps attested.

Once on the ground the nymphs' immediate survival depends upon the proximity of suitable hosts and the humidity. The humidity in the morning near the ground, especially under the tree, is higher than on the tree, and the speed of their searching behavior

normally can bring them to a host within a few minutes. Ewan (1961) has shown that they can travel a long distance in a few minutes. Of course, the nymphs are also vulnerable to spiders and other predators at this time, especially if the hosts are scarce.

Morning would be a logical time for major eclosion activity for insects such as young spittlebugs that are subject to relatively quick desiccation. Temperature and moisture probably interact to bring about eclosion under the best survival conditions. A rise in temperature in the morning may trigger the hatching sequence, and this is a time of day when the humidity is normally the highest. Moisture certainly is important but it appears not to be the only factor because the R.H. often reaches 100% at night and also on rainy afternoons, periods when the insects do not normally eclose. Temperature may also squelch eclosion later in the day.

In conclusion, it appears that the time of day eclosion occurs, the subsequent nymphal behavior, and perhaps the long six to seven weeks eclosion period all aid in the survival of this insect.

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