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SOME LIGHT AND TEMPERATURE EFFECTS ON THE BEHAVIOR OF THE ADULT PALES WEEVIL, *HYLOBIUS PALES* (COLEOPTERA: CURCULIONIDAE)

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ABSTRACT

Adult pales weevils react to light and temperature cues regarding their movements in pine plantations. They remain at the base of their host trees during the day and move onto the trees after dark. A drop in light intensity to 2 fc triggers this response. Ambient temperature below 10°C curtails their movements. Weevils placed on the ground are photophobic at temperatures below 20°C and photophobic and thermophobic above 35°C. Orientation is erratic above 40°C and heat stupor occurs in a few minutes.

In Michigan the pales weevil, *Hylobius pales* (Herbst), is sometimes a serious pest in Christmas tree plantations. It breeds in the root collar and roots of recently killed pines or freshly cut stumps. Adults feed on the bark of living pines and other conifers, degrading the shoots and making the trees less profitable at market.

In a companion study (Corneil and Wilson, 1984), we investigated the dispersion and seasonal activity of the adult weevil in several Christmas tree plantations. Dispersion and seasonal activity in part were due to temperature and light intensity. This study further examines the behavior of the adults under various temperature and light conditions found in pine plantations.

METHODS AND MATERIALS

Field observations and tests were conducted during July and August 1979, in a Scotch pine Christmas tree plantation in Tuscola County, Michigan. Observations of adult weevils were made from 2000 to 0100 hrs EST. We recorded the time when weevils moved from the litter up onto the stem and branches to feed, as well as light intensity, temperature, and precipitation during the observation hours.

A laboratory test was conducted in July 1979 to examine day and night activity. In the test, 10 male and 10 female adult weevils were placed in each of two cages (41 by 30 by 25 cm) constructed with plywood frames and nylon screens. The cages were positioned on a table near a window facing east, and a light meter was placed on the floor of one cage to measure light intensity. Scotch pine twigs were inserted into moist sand and placed in the center of the cage floor to provide the adults with food and a place to climb. Crumpled paper toweling was laid aroung the twigs to simulate needle litter and provide shelter. After indoor observations on three consecutive days, the cages were taken to an open field and the location and movements of adults were recorded hourly from afternoon until after dusk on four consecutive days. Locomotory and orientation behavior was observed in a grid in a clearing within the Tuscola County plantation. The 2.1 by 2.1-m grid, oriented north and south, was marked off on the ground with string at 0.3-m intervals. Small forbs and debris littered the ground, similar to conditions that normally exist between and under trees, except that there was less shade. Several Scotch pine Christmas trees were about

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1.5 m to the east of the grid and a mature stand of bigtooth aspen, *Populus grandidentata* Michx., was about 60 m to the west. No trees were north or south of the grid for at least 200 m.

Locomotory and orientation trials were made on sunny afternoons during the first two weeks of July 1979. Twelve insect trials were run when soil surface temperatures were between 12 and 25°C; 17 insect trials were run at temperatures between 35° and 52°C. Weevils were brought to the grid in jars kept in a cooler with ice. Each jar was allowed to warm to ambient condition in the shade for at least 1 h before using the weevils. Ground surface temperatures and incident light intensity were monitored in the grid during each trial, using a thermister thermometer and a light meter in 1°C and 1-fc intervals, respectively. Weevils were tracked and their trails were traced on a chart similar to the grid on the ground. They were observed up to 4 h or until they found shelter, left the grid, or died.

One part of the trial was run with a grid constructed on bare compact clay. Except for a few pebbles, the soil was free from obstructions. This situation was one a weevil would seldom encounter, but it permitted us to measure the top speed a weevil could travel at a set of given temperatures over unobstructed terrain. Fourteen insect trials were run on sunny afternoons at temperatures between 30° and 36°C.

RESULTS

During daylight, pales weevils were found on the soil beneath the litter or on the bark of the root collar of the trees. At dusk, the weevils began moving up the tree stems when the light intensity, measured at the tree surface of the foliage, dropped to 2 fc. This occurred around 2000 hrs on most clear nights and somewhat earlier on cloudy nights. On one evening that was particularly overcast, the weevils began climbing approximately 45 min earlier than on the previous evening when the sky was clear. All weevils remained near the bases of the trees when the temperature was below 10°C regardless of light intensity.

Laboratory studies supported our field observations. Caged weevils remained beneath the paper toweling until light intensity inside the cages fell to 2 fc; then some would climb onto the screen walls and pine twigs. During the three observation periods, about 50% of the weevils were on the cage walls or pine twigs 10–20 min after the first one arrived. When the laboratory lights were turned on, the weevils became motionless and then gradually moved to the paper toweling on the floor in 65–90 min.

When cages were placed outdoors, weevils followed the same pattern, but their behavior was affected by temperature. One evening, when the air temperature was 5°C at dusk, all weevils remained beneath the paper toweling. During three other evenings, when temperatures were 11°C or higher at dusk, weevils began appearing when light intensity dropped to 2 fc, as they did on the trees in the field. About 50% of the weevils appeared from beneath the toweling within 25–35 min of the first weevil; males and females appeared at the same time.

In the grid trials at temperatures between 12° and 25°C, the weevils moved very slowly even though in full sunlight. They did not exceed a walking speed of 8 cm/min (Fig. 1). At the start of each test, they remained motionless from 0.5 min to almost 10 min before moving about as if searching for shelter. Most stopped when they found forest debris or small plants for shelter, and most remained motionless for the rest of the test. A few, however, resumed movements later on. One insect was tracked for 115 min before it hid and ceased moving.

Above 35°C the weevils moved much faster but their speed depended less on temperature than terrain (Fig. 1). Some weevils moved more erratically and frequently stopped beneath protective debris, but more often moved again soon after. In the trials with temperatures above 40°C, the adults circled frequently as if desperately searching for shelter. When the weevils did not find shelter within a minute, their legs began moving erratically and they almost lost their balance. These adults entered permanent heat stupor in less than 2 min. One insect traversing the soil at 46°C soon climbed a grass blade and remained about 2 cm above the soil for almost 4 h, occasionally moving to test the soil surface. When the temperature dropped to 34°C, the weevil left and wandered until it found a grass clump where it stayed the rest of the day.

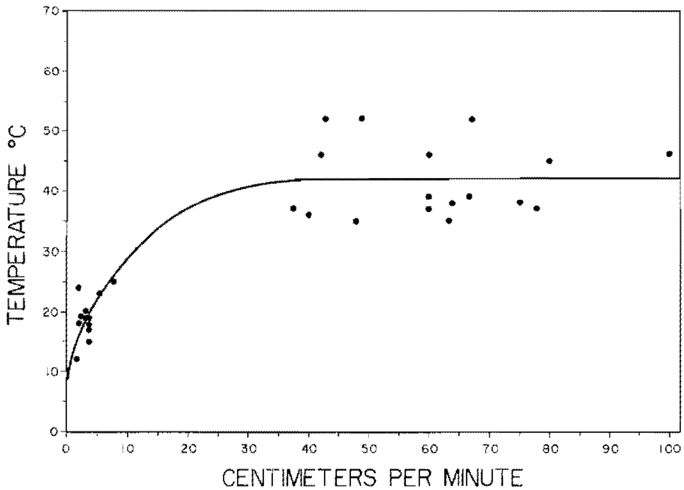

Fig. 1. Walking speeds of adult pales weevils at various soil surface temperatures in full sunlight. Several specimens at temperatures above 40°C died in less than 2 min after the trials began; all others survived the test.

Weevils tested on flat smooth clay at temperatures between 30° and 36°C moved from 198 to 482 cm/min with an average of 297 cm/min, more than three times faster than on normal terrain in a plantation. Most weevils remained immobile for 1–3 min at the start of each trial and then moved continuously until well outside the grid.

The adults in the 35 grid trials almost always moved away from the sun (Fig. 2). Seventy-one percent of the insects oriented toward, and then moved in the direction within the quadrant directly away from the sun (i.e., 45° each side of 180° from the sun) and 91% moved in the hemicircle opposite the sun's rays (i.e. 90° right and left of 180°). Three insects (9%) traveled toward the sun, one almost directly toward it (Fig. 2). The latter burrowed into the litter after traveling a few centimeters and remained there for most of the test.

DISCUSSION

In a previous study, we learned that pales weevils follow a consistent daily cycle. During the day, they remain in the litter near the base of pine trees; at night they move onto or between trees (Corneil and Wilson, 1984). This study indicates that the stimulus that initiates evening movements is a drop in light intensity to about 2 fc. Temperatures below 10°C at or after dusk curtail or halt these evening sojourns. A rise in light intensity cues the insect to return to the root collar area. It did not rain during this study, but rain probably curtails weevil movements somewhat, as it does those of the closely related pine root collar weevil, *H. radicis* Buchanan, (Wilson 1968).

If weevils come into the open after daylight, as in the grid tests, they will respond photo-negatively and attempt to reach shelter. When soil surface temperatures are below 25°C, the weevils move slowly and react mostly to light. If they find shelter, they either stay put until conditions either improve or worsen, or they seek new hiding places. Of course, dark hiding places, like the root collar area, are seldom available in the open. Adults reaching the shade of trees usually stay put until nightfall. At 30–35°C weevils move much more rapidly, their speed depending somewhat on the roughness of the terrain and their searching behavior. They are still cued almost entirely by light, although tem-

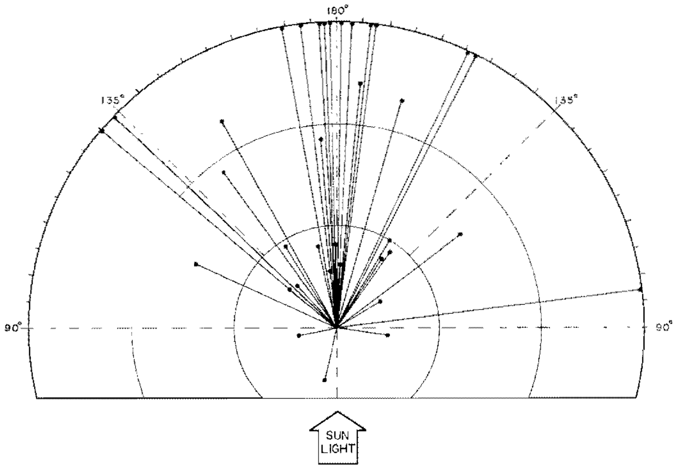

Fig. 2. Angles of locomotion relative to the sun and distances traveled by 35 adult pales weevils placed in a grid in full sunlight in July. Distance is shown as a straight line drawn from starting point to end point. Lines drawn to outer circle indicate weevil left grid. Time, not shown, ranges from less than 1 min to 115 min per weevil.

perature may be partly involved. Their direction of travel is close to 180° away from the sun and generally as straight as the terrain permits. In full sun at temperatures over 35°C, the weevils respond to both light and temperature cues by becoming highly photophobic and thermophobic. And above 40°C movements are aimed at survival. The weevils must find shelter or climb above the surface or they will die within 2–3 min. Although the weevils can fly, they never do so, even under conditions that can kill them.

The effects of temperature and light on behavior and survival may explain why pales weevil adults gather beneath host pine trees as do pine root collar weevil adults (Wilson 1968). Most pales weevil adults are found at the base of host pines during the day in the summer and fall. In the spring, however, most weevils are located around stumps produced from the previous harvest. This behavioral trait may be an olfactory response to the volatile resins and oils released by fresh stumps in the spring. Volatile attractants in stumps diminish by June, which coincides with an increased occurrence of adults around the living trees (Corneil and Wilson, 1984).

Although the survival behavior of the pales weevil adults closely resembles that of the closely related pine root collar weevil, silvicultural treatments such as low pruning (the removal of the lower branches and the litter at the base of the trees) would probably not sufficiently deter this insect as it does the pine root collar weevil (Wilson 1967). Because the pales weevil breeds in stumps and normally not living pines, it still could oviposit on stumps without difficulty. Low pruning with litter scraping (pulling back the litter 0.5 m away from the tree base) would probably force the weevils away from the root collar to the piled litter where they would hide during the day. This treatment, however, would not prevent them from ascending the trees at night to feed on and injure the shoots.

LITERATURE CITED

Corneil, J. A. and L. F. Wilson. 1984. Dispersion and seasonal activity of the pales weevil, *Hylobius pales* (Coleoptera:Curculionidae), in Michigan Christmas tree plantations. Canadian Entomol. 116:711–717.

Wilson, L. F. 1967. Effects of pruning and ground treatments on populations of the pine root collar weevil. J. Econ. Entomol. 60:823–827.

———. 1968. Diel periodicity and survival behavior of pine root collar weevil adults under various light and temperature conditions. Ann. Entomol. Soc. Amer. 60:1490–1495.

DOI: 10.22543/0090-0222.1525