The Great Lakes Entomologist

Volume 7
Number 3 -- Fall 1974 *Number 3 -- Fall 1974*

Article 4

September 1974

Within-Tree Distribution of the Jack Pine Tip Beetle, Conophthorus Banksianae McPherson, on Jack Pine

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WITHIN-TREE DISTRIBUTION OF THE JACK PINE TIP BEETLE, *CONOPHTHORUS BANKSIANAE* MCPHERSON, ON JACK PINE[1]

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The jack pine tip beetle (*Conophthorus banksianae* McPherson) attacks the shoot tips of jack pine (*Pinus banksiana* Lamb.) and other pines, killing the apical one inch of the shoot and thus causing crooks and forks in the branches and main stem. Several recent studies on this insect have presented the bionomics, host relations, and mortality (McPherson, Wilson, and Stehr, 1970; McPherson, Stehr, and Wilson, 1970; Hall and Wilson, 1974), as part of a project to learn its importance to the forest resource and to seek potential control methods. In the part of the study reported here we wanted to know the vertical distribution of attacked tips on the host in order to more readily understand the insects' injury to a stand of pine. Casual observation indicated that the attacked tips appeared to be aggregated in the tops of the crowns and were especially abundant on taller trees. Therefore we examined vertical distribution of attacks in relation to tree height, degree of exposure of the attack site to the sky (celestial hemisphere), and shoot tip size.

METHODS AND RESULTS

Nine jack pines were sampled four times each in a young plantation in Wexford County, Michigan, in 1971. Data taken were: (1) tree height, (2) number of attacked tips, (3) vertical distance of attack from the top of the tree, (4) diameter of attacked tip and nearest neighboring tip (measured 3/8 in. below the base of bud), and (5) percent of the celestial hemisphere to which attacked tip was exposed (estimated visually). Data were collected on July 2, July 9, July 27, and August 10 in 1971, which covered the major attack and oviposition period.

During the first two weeks of the attack period, the top five inches of the crown received the most attacks even though it contained far fewer tips than the lower crown sections (Fig. 1). Later on, the next lower five inches surpassed the top five. The rate of attack slowed after July 27 and ceased by August 10.

The percent of attacks is high in the upper levels and decreases through the lower levels. Nearly 50% of the attacks are in the top ten inches of the crown and over 95% in the top three feet, even on trees that are over 11 feet tall (Table 1).

Incidence of attack was directly related to tree height at the 80% level of significance ($n = 9$, $r^2 = 0.32$). This trend is not surprising as taller trees have proportionately more susceptible shoot tips to attack. The jack pines are even-aged, plantation trees and differ only about three feet in height. A higher correlation would likely occur if a wider range of tree sizes was available.

The distribution of attacked tips is clearly shifted to the higher exposure classes. Tips well exposed to the sky are most likely to be attacked (Fig. 2). T-test showed curves differed significantly at 0.001 level. A few tips 60% exposed or less were attacked, indicating that the adult is not limited to highly exposed tips, but avoids them below 40% exposure. Also there were many unattacked tips in the classes above 70% indicating

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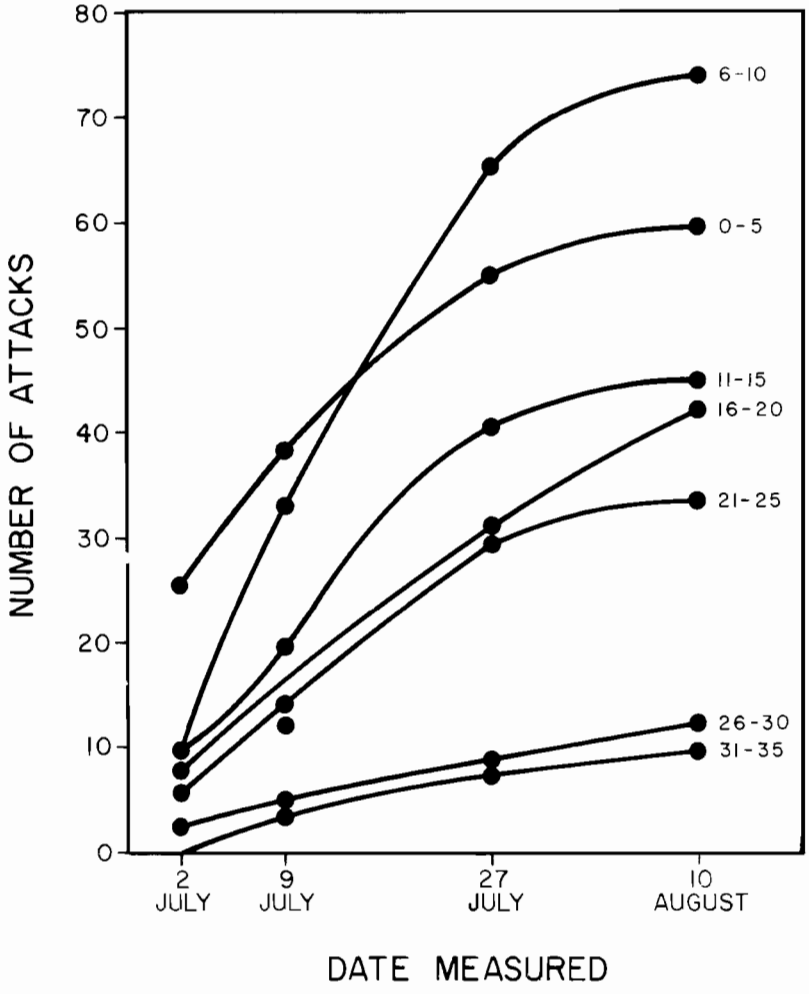

Fig. 1. The vertical distribution of *Conophthorus* attacks accumulated through the oviposition period. Numbers assigned to curves refer to the distance (inches) interval from the top of the tree. (The 16 to 20 inch class interval above was drawn disregarding the datum point for July 9.)

that the adults were not driven to the shaded tips due to lack of exposed tips. On the last measurement date, more than half of the unattacked tips were exposed to 61% sky or more.

Large diameter tips appeared to be preferred for attack (Fig. 3). T-test showed curves differed significantly at 0.001. There were only ten attacked tips with diameters less than 3.0 mm, while there were well over 100 available unattacked. Also, there were very few tips in the two largest diameter classes left unattacked.

Table 1. Vertical distribution of jack pine tip beetle attacks on nine jack pine trees in a plantation (autumn 1971).

Attack location (inches below top of tree)	Attacks		
	Number	Percent	Accumulated percent
0 - 5	59	21	21
6 - 10	76	26	47
11 - 15	44	15	62
16 - 20	42	15	76
21 - 25	33	12	88
26 - 30	12	4	93
31 - 35	9	3	96
36+	12	4	100
TOTAL	287	100	

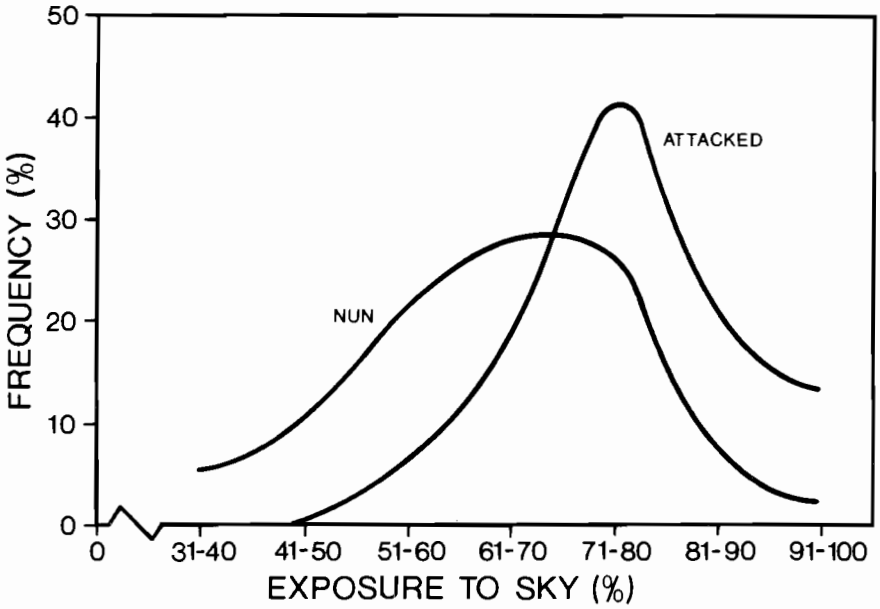

Fig. 2. Frequency distribution of attacked and unattacked shoot tips relative to percent exposure to the sky (percent of celestial hemisphere). Curves are significantly different at the 0.001 level (t-test).

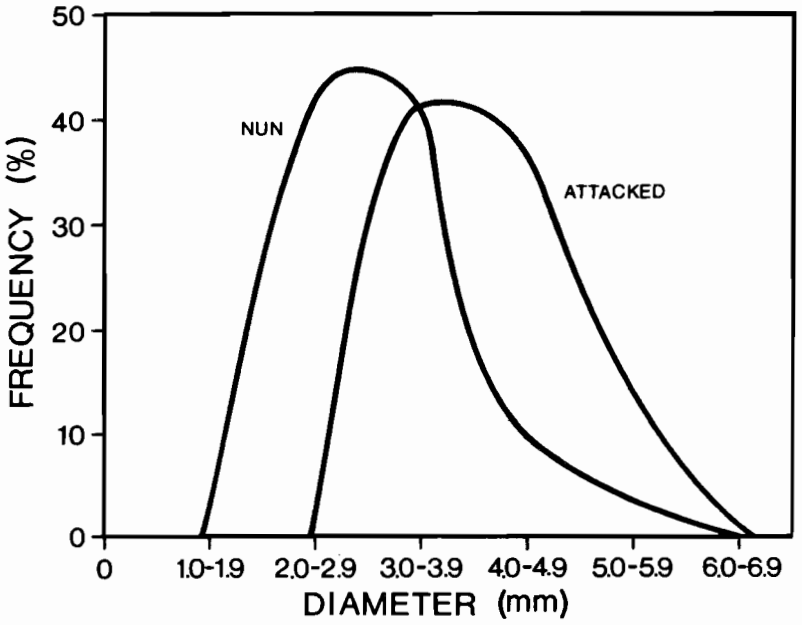

Fig. 3. Frequency distribution of the diameters of attacked and adjacent unattacked shoot tips. Curves are significantly different at the 0.001 level (t-test).

DISCUSSION

Tree height, degree of exposure of the shoot tip to the celestial hemisphere, and shoot tip size all appear to effect the vertical distribution of the jack pine tip beetle attacks on jack pine. More attacks might be expected on larger trees because larger trees have more shoots than smaller trees of the same age. Exposed shoots are attacked more readily than shaded shoots regardless of their location in the tree. The beetles discriminate by showing a preference for the largest shoots, thus attacks are more prevalent on the top of the tree because most of the larger exposed shoots occur there. Early in the attack period the first five inches of treetop is the preferred attack site. Later on, the zone six to ten inches from the treetop becomes more heavily attacked, presumably because the upper five inches becomes saturated with attacks. On the rest of the tree the attacks are related inversely to distance from the top, but rarely occur below three feet from the top, at least on the closed-crown trees in the sample. Some attacks may occur lower on the crown of open-grown trees. Shoots 3.0 to 4.0 mm in diameter are preferred to attack and most shoots smaller than 3.0 mm are rejected by the adults regardless of their exposure.

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