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OBSERVATIONS OF THE HABITS OF *CORTHYLUS PUNCTATISSIMUS* (COLEOPTERA: SCOLYTIDAE) INFESTING MAPLE SAPLINGS IN CENTRAL MICHIGAN

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ABSTRACT

Corthylus punctatissimus, the pitted ambrosia beetle, infested and killed maple saplings that were 3–12 years of age with a basal diameter of 4–14 mm. The habits of the parental pair of adults are described. The beetles construct a spiral gallery system with about five egg niches per host. Half the brood reaches adult stage during the summer with a sex ratio of 1:1. No relationship was found between the number of niches, length of gallery system, or diameter of stem.

The pitted ambrosia beetle, *Corthylus punctatissimus* Zimmerman, infests a wide variety of deciduous woody saplings and shrubs in eastern North America (Finnegan 1967, Wood 1982, Roeper et al. 1987). Finnegan (1967) provided a seasonal life history of the beetle from observations of the beetle infesting sapling sugar maples (*Acer saccharum* Marshall) in Ontario and Quebec. Finnegan found the beetles constructed a spiral gallery which was initiated at the soil level of maple stems. Within this gallery the beetles bored egg niches in which oviposition occurred. Finnegan (1963) also found the male beetle possessed the fungal transmitting structure, the mycangia, which disseminated the beetle's symbiotic fungi to inoculate the main gallery and egg niches. Two larval instars were recorded, and the larvae were observed feeding on the fungi lining their niches (Finnegan 1967). He recorded only a single generation per year for *C. puntatissimus*. The purpose of this study was to provide further understanding of the habits of *C. punctatissimus* through a detailed description of the nature of the infested host, the gallery, and the activity of the beetle.

METHODS

Corthylus punctatissimus was collected at two locations in Gratiot County, Michigan. One location was in Pine River Park, City of Alma (Arcada Township Sec. 4, T1N, R3W) with a dominant, mature sugar maple canopy and sapling understory. The second study area was a red pine (*Pinus resinosa* Aiton) plantation with an understory of red maple (*Acer rubrum* L.) located in the Gratiot-Saginaw State Game Area (Hamilton Township Sec. 14, T10N, R1W). Collections were made between 1981–1986 with intensive, systematic weekly collections made during 1982 and 1983.

Infested maple saplings were recognized by their wilted condition. Host saplings were excavated, returned to laboratory, and stored at 4°C until examined. The infested saplings were characterized by determining the age based on the number of apical bud scars, by measuring the height of the aerial portion, and by measuring the diameter of the stem at

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its base where the beetle enters. The infested portions of the stems were then carefully opened by paring tangential thin-sections. The number of entrance holes, length of the stem infested with the spiral main tunnel, number of egg niches constructed, and number of beetles found within were recorded. The sex of the adult beetles was distinguished by the flattened or slightly concave front of the female's head, covered with short dense hairs (Finnegan 1967). No statistical differences could be found between the red maple and the sugar maple collections for any characteristic, so these data were combined.

OBSERVATIONS AND DISCUSSION

Characteristics of Host Saplings. The mean age of the infested maple saplings was 5.8 years (S.E. = 0.93, n = 378, range 3–12). Infested hosts with an age above nine years accounted for only 1.6% (n = 6) of those recorded. The aerial portions of the saplings were found to have a mean height of 730.0 mm (S.E. = 8.3, n = 404, range 279–1360 mm). The range of diameter of the basal stem where the beetle enters, was 4–14 mm and averaged 6.9 mm (S.E. = 0.62, n = 404). Saplings below the age of three years or with a basal diameter less than 4.0 mm lack the physical volume of woody tissue that appears to be needed by the beetle to construct its gallery system. No evidence of attacks on host saplings older than 12 years or with a basal diameter greater than 14.0 mm was found even after intensive searching, although older saplings were present at both study locations.

Beetle Attack and Gallery Characteristics. Maple saplings infested by *C. punctatissimus* were easily detected by their wilted condition. The beetle's construction of its spiral main gallery cuts off the xylem water transport system of the infested host. The leaves of an infested host loose turgidity and bend downwards at the point of petiole attachment to the stem, wilting so quickly that leaf abscission does not occur. The earliest record of infestations of saplings in the study areas was 29 June. An initial period of infestation was observed from late June through mid-July, followed by later attacks on different saplings until early August. These later attacks could be easily distinguished from the earlier infestations by the greener appearance of wilted leaves of the hosts.

A male beetle initiated the gallery construction. The number of entrance holes in the stem varied among individual saplings. A single entrance hole was recorded on 76.6% (n = 310) of the host stems collected. Multiple entrance holes were found on 94 host saplings; 18.6% of the total (n = 75) had two entrance holes, 3.2% (n = 13) were recorded with three entrance holes, and 1.5% (n = 6) had four distinct entrance holes. Generally only one of the entrance holes led to a fully constructed gallery system with egg niches. Infested hosts collected from late June to 15 July, early in the attack period, had a higher proportion (42.3%, n = 22 of 52) of multiple entrance holes, as compared to 23.4% incidence of multiple entrance holes for all the infested host stems analyzed. In hosts with multiple entrance holes detected in the early attack period, the tunnel system originating from separate entrance holes merged to form a common gallery system in nine cases. In the other 13 samples the tunnel systems consisted of either short and aborted tunnels without niches (n = 6) or short tunnels with only one or two egg niches (n = 7) per tunnel. An individual male or female beetle was collected from each of the non-merged tunnel systems in multiple-entrance-holed stems, but never was a mating pair of beetles found.

As Finnegan (1967) observed, it appears the male normally constructs the main tunnel spirally downwards in the stem. In only 14.2% of the infested stems were tunnels constructed upwards. Exact measurement of the spiral main tunnel constructed by the male was difficult. Portions of host stem which the main tunnel transversed had a mean length of 26.1 mm (S.E. = 0.62, n = 404, range 6.0–51.0 mm). Egg niches approximately 5 mm long and 1.5 mm dia. were also constructed by males along the main tunnel. The niches were oriented vertically into the stem axis. Of a total of 1166 niches recorded, 64.2% were constructed downward from the main spiral tunnel with the remainder oriented upward on the stem axis. The average number of egg niches per infested host was 4.64 (S.E. = 0.16, range 1–12 niches per host). Three to seven were most common, with 73% of the total number of niches found within this more limited range. Only 13 full-length tunnel systems were found to lack niches. Analysis of these characteristics found no statistical relationship between number of niches and the length of the stem with gallery or with the diameter of the infested stem, or between length of stem with gallery and diameter. Often the whole cross-section of the stem, except for the bark, was excavated with the spiral main tunnel and niches.

As the male constructed the gallery system, the female beetle was attracted to and joined in the boring activity. Usually a mating pair of beetles was found in galleries inspected during the active stage construction. Additional females were found occasionally where multiple-entrance-holed gallery systems merged together. Males appeared to leave earlier than females in well-developed gallery systems. The sex ratio of boring adult beetles was found to be 1.3 females to 1 male.

Prior to oviposition the male had propagated the symbiotic ambrosia fungi from its mycangia. The fungi grew as a whitish layer lining both the main tunnel and the niches. The female beetle oviposited into the rich fungal growth about half-way down the niche. The entrance of each niche into the main tunnel was covered with a mixture of fungal cells and wood-borings by the adults. As the larvae hatched they fed exclusively on the symbiotic fungi. Larvae developed within the niches for approximately two weeks followed by a short pupal stage which lasted about a week.

The parental adults appeared to leave the brood tunnel following oviposition; only a few parental adults were found in developed gallery systems from late July to October. The fate of the parental adults was unknown, yet we suggest they may exit and attack another host sapling, starting a second brood. This assumption is based on our observations that new infestations found in late July and early August tended to occur in saplings that were adjacent to an already infested sapling.

From 161 infested hosts with fully developed galleries collected from late August to October, 740 niches were counted containing 406 progeny adults. Thus 54.9% of the niches constructed resulted successfully in progeny adults. Lack of oviposition in niches, poor growth of ambrosia fungi, growth of non-ambrosia fungi, and predation by other invertebrates such as mites, nematodes, and other insects, were all observed occasionally and could be reasons why a particular niche lacked a progeny adult. Finnegan (1967) suggested progeny adults might exit their niches and overwinter in the duff outside the host, but we found no evidence for this behavior.

The sex ratio of progeny adults was 1:1 with 204 males to 202 females observed within their niches from late August through October. This contrasts with Finnegan's (1967) observation of only 35% of a brood's progeny being males. The progeny adults overwintered within their niches and emerged to attack new host saplings the next summer. The gallery wall during this overwintering period appeared a dark charcoal color due to fungal pigments. Only small patches of whitish fungal growth were observed; this growth probably responded to excreta of the progeny adults.

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