SPATIAL AND TEMPORAL DISTRIBUTION OF OVIPOSITION BY PLUM CURCULIOS,
CONOTRACHELUS NENUPHAR

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ABSTRACT

The spatial and temporal patterns of oviposition of the plum curculio,
Conotrachelus nenuphar (Herbst), were established near Gainesville, Florida, by placing suitable host fruit at 3 and 6 ft above the ground in wild plum and oak thickets. Females consistently oviposited more in fruit at the higher level, and they readily located fruit placed in non-host trees. Oviposition occurred from 11 March to 7 October and peaked in early June. Although the plum curculio is considered a multivoltine species in the southeastern U. S., the short period when wild host fruit is available and the relatively long time it takes these insects to complete a generation means that only one major generation is produced each year in north central Florida.

Observations of oviposition by the plum curculio, Conotrachelus nenuphar (Herbst), in wild plum thickets suggested that fruit were attacked more readily in the higher portions of thickets and that fruit at lower levels often escaped damage. However, there were more fruit near the top of the trees so it was difficult to determine the reason for the pattern. Also, because wild plums generally disappear by 1 June in northern and central Florida, there was a question of whether oviposition would occur throughout the growing season if host fruit were available or whether oviposition was generally restricted to the spring months by some intrinsic factor. Observations in many thickets over a period of 2 years also revealed that most isolated plum thickets bearing fruit harbored plum curculios even though those thickets may not have produced fruit the previous year. Apparently plum curculio females were efficient in locating fruit, especially in the higher levels of thickets. We conducted this study near Gainesville, Florida, during 1974, to test the validity of these observations.

MATERIALS AND METHODS

Wild plum thickets are useful for experimenting with the behavior and population dynamics of the plum curculio because this type of community is stable and functions as an ecological island. In such habitats, population fluctuations are normally not influenced by insecticide applications or other agricultural practices.

For this study, we selected an isolated plum thicket (Prunus angustifolia Marsh.) with a moderately high rate of oviposition by plum curculios. We also selected a young oak thicket (Quercus sp.) of similar configuration. The thickets were located ca. 100 m apart and separated by thick woods.

1Coleoptera: Curculionidae.
In each thicket we suspended 10 green apples (ca. 2.5 cm diam, the type used in rearing plum curculios in the laboratory), in trees at each of 3 and 6 ft heights (ca. 1 and 2 m). Each site of fruit suspension represented a replication—i.e., each of 4 treatments was replicated 10 times. Initially, apples were also placed directly on the ground; however, they were removed by scavenging animals so these treatments were discontinued. The exposed apples were replaced with fresh apples every 3.5 days.

As each apple was removed, it was placed into an individual 8-oz ventilated plastic container and labeled. The containers were taken to an insectary where they were held at temperature and light conditions approximating those of the shady thickets. Larvae usually began emerging from the fruit after ca. 17 days, and the apples were observed for emerging larvae for an additional 15 days. The numbers of emerging larvae were estimates of the amount of oviposition occurring in the field. Although the values were probably low because of egg or larval mortality, the mortality was assumed to be equal between treatments. The study extended from 11 March to 31 December 1974. Data were analyzed by analysis of variance. Orthogonal comparisons were used to compare specific treatments independent of the rest of the data (Steel and Torrie 1960).

**RESULTS AND DISCUSSION**

Oviposition occurred in fruit during the first 3.5 days of the study and was continuous until early October. During the period from 11 March to 30 September significantly more oviposition occurred at the 6 ft level in both thickets (Table 1). When native fruit were not present, as in the plum thicket after fruit drop and in the oak thicket, equal numbers of oviposition sites were available for oviposition at both levels. Therefore, the observed

### TABLE 1. NUMBER OF LARVAE AND FREQUENCY OF OVIPosition IN APPLES PLACEd AT 3 AND 6 FT IN HOST AND NON-HOST THICKETS, 11 MARCH-7 OCTOBER 1974.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Larvae/site (mean ± SE)</th>
<th>Frequency of oviposition† (mean ± SE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Host area—6 ft</td>
<td>93.5 (±12.2)</td>
<td>49.7 (±4.0)</td>
</tr>
<tr>
<td>B. Host area—3 ft</td>
<td>54.5 (±4.8)</td>
<td>29.5 (±1.7)</td>
</tr>
<tr>
<td>C. Non-host area—6 ft</td>
<td>37.6 (±4.8)</td>
<td>22.9 (±2.4)</td>
</tr>
<tr>
<td>D. Non-host area—3 ft</td>
<td>17.5 (±3.3)</td>
<td>17.5 (±2.0)</td>
</tr>
</tbody>
</table>

Orthogonal comparisons‡

- A vs. B **
- C vs. D **
- A, B vs. CD **

†Number of periods per site when oviposition occurred, expressed as percent of total periods (n = 58).
‡*Significant at the 5% level of confidence; ** significant at the 1% level of confidence.
difference in oviposition apparently resulted from a tendency of the females to frequent the higher level. This behavior would tend to increase the probability of finding oviposition sites because most of the natural fruit in wild plum thickets occur on the higher branches.

There was significantly more oviposition in the host thicket than in the non-host thicket, which would be expected because the plum thicket was probably the point of origin of the ovipositing plum curculios. There were fifty-eight 3.5-day periods during the course of the study when oviposition occurred. To assure that a few instances of high oviposition rates were not responsible for differences between total numbers of eggs laid among the various treatments, the mean number of periods when oviposition occurred in each treatment was compared orthogonally (Table 1, where the data are expressed as percentages). Those treatments producing the greater numbers of larvae were also those that had higher consistent frequencies of oviposition throughout the season (Table 1). Lower frequencies of oviposition in the non-host area were most pronounced in late summer.

Gravid females located fruit in the non-host thicket during the first 3.5-day period. It was not possible for the beetles to fly directly from the plum thicket to the oak thicket because of an impeding wall of dense, tall vegetation. Apparently, they were either able to detect the odor of the fruit and move to it, or they were already present in the surrounding vegetation.

The oviposition observed at the beginning of the study (11 March) was by females that had emerged from hibernation because there had not been sufficient time for the 1st generation (progeny of overwintered adults) to have completed development in the fruit. The subsequent peak emergence of adults of the 1st generation was expected to result in a large increase in the number of eggs. This indeed happened. During the early part of the study, from 15 March to 29 April an average of 1.33 larvae per apple per week eventually emerged. Then from 30 April to 6 June an average of 1.68 larvae eventually emerged. Fruit had disappeared from the plum thicket by the 2nd week in May, and there was a small increase in oviposition in the artificially provided fruit at that time (Fig. 1). The period of peak oviposition in the apples occurred 7–18 June; there was an average of 9.22 larvae/site per week. This large increase had probably resulted from the peak emergence and maturation of the 1st generation of plum curculio adults. Scott and Quaintance (1910) reported that in central Georgia the appearance of the new generation was marked by a sudden increase in numbers of adults on and after 7 June. The period of peak oviposition occurred at the non-host site at the same time as in the host site even though no beetles had emerged there, and all ovipositing beetles had to migrate either from the plum thicket or elsewhere.

Extrapolating backward from the period of peak oviposition, we can identify the previous period of peak oviposition that created this population surge. The time spent by the egg and larval stages in the fruit in this study ranged from 17 to 22 days; the pupation in the soil lasted 21 to 28 days, and there was about an 8-day previposition period after the adults emerged. Therefore, the oviposition that created this new generation probably occurred 46 to 58 days earlier, about the first 2 weeks in April.

From late June to early August, the rate of oviposition declined rapidly and then stabilized. This rapid decline in oviposition may represent a dispersal of gravid females from the area of emergence. Also beginning with
Fig. 1. Seasonal ovipositional patterns of plum curculios in artificial hosts in host (plum thicket) and non-host (oak thicket) areas near Gainesville, Florida. Numbers on the ordinate are larvae eventually emerging from 40 apples exposed for 3.5 days. Wild fruit suitable for oviposition was present in the host area from early March to late April. Mature fruit, unsuitable for oviposition, persisted until the 2nd week in May.

the 1st week of August, there was a rather steady decline in oviposition until it ceased by 7 October. The study was continued until 31 December, but no further oviposition occurred. Apparently after early October, the beetles were preparing to hibernate. Scott and quaintance (1910) reported that they were unable to collect adult plum curculios after 11 October in central Georgia, and speculated that the beetles had entered hibernation.

As noted, the plum fruit had disappeared from the thicket by the middle of May. Therefore, adults emerging from the soil after that date normally would not have access to fruit for oviposition. Nevertheless, the fact that oviposition in the apples persisted throughout the summer indicates that females will lay eggs if suitable hosts are available. In the absence of fruit, that is, throughout the summer, the beetles feed on host vegetation before they enter hibernation in the fall (Quaintance and Jenne 1912). We have ascertained that adults of both sexes can live at least 4 months on a diet of only plum leaves, become sexually mature, and mate without exposure to fruit. When fruit were provided, the leaf-fed beetles oviposited almost immediately.

From our data, overwintered adult plum curculios are responsible for most of the oviposition in wild plums. The fruit generally disappears before 1st-generation adults emerge. A partial 2nd generation may occur if beetles emerge while some immature fruit is still available. This generation should have no great impact on the total number of beetles surviving through the summer. The newly emerged females, not having fruit available in the immediate area, probably disperse in search of oviposition sites. However, suitable alternate wild host fruit—e.g. Crataegus spp., Chaeno-
meles lagenaria Koidz., and Cydonia oblonga Mill. (Quaintance and Jenne, 1912)—are scarce in northern and central Florida woodlands. Those females that do not find such fruit probably subsist on host vegetation throughout the summer.

Although the plum curculio is considered multivoltine in the southeastern United States (Chapman 1938, Dozier et al. 1932, Quaintance and Jenne 1912, Smith 1957, Smith and Fiori 1959), the opportunity for more than one substantial generation per year to occur on wild hosts in northern and central Florida is probably remote. However, the new generation will oviposit if fruit is available so the beetles remain a threat to late maturing cultivated host fruit.

Literature Cited

Scott, W. M., and A. L. Quaintance. 1910. Control of the brown rot and plum curculio on peaches. USDA Bur. Ent. Cir. 120.

BOOK NOTICE

A new photography book that should be of special interest to entomologists and naturalists is now available: Field Photography—Beginning and Advanced Techniques, by Alfred A. Blaker. 1976. W. H. Freeman and Company, San Francisco, 451 pages, plus a 41-page Field-use Data booklet. There will be a Univ. of Fla. seminar using this book as a text and it will be reviewed in the December 1976 Florida Entomologist.