Quick Tree Decline: A New Problem of Macadamia in Hawaii

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Abstract. A new problem of macadamia trees (Macadamia integrifolia Maiden and Betche) in Hawaii is characterized by slight leaf chlorosis, followed by rapid leaf browning, and tree death. Ambrosia beetle [Xyleborus affinis Eichhoff and X. perforans Wollastan (Coleoptera: Scolytidae)] infestations and fungal fruiting bodies were present on trees that subsequently exhibited the decline pattern. ‘Ikaika’ was the most susceptible cultivar, and tree death occurred 8.3 ± 2.6 months after beetle infestations were detected.

Macadamia nut production in Hawaii is a $45.5 million industry and ranks only behind sugarcane and pineapple in value (Rowley, 1988). Although disease and arthropod pests are associated with macadamia culture in Hawaii, the industry has not encountered problems that pose a serious economic threat (Mau and Tsuda, 1982; Nishijima, 1983). However in 1986, many dead and rapidly declining 14- to 36-year-old macadamia trees were observed in an orchard in Keaau, Hawaii, and this may represent an emerging threat to the industry. Subsequently, similar observations have been reported from other orchards located on the east side of Hawaii Island (Hirae, 1989). This report describes new problem of M. integrifolia in Hawaii. We report the rate of tree decline, cultivars affected, and the association of ambrosia beetle infestations with declining trees.

Tree foliage of declining trees initially becomes slightly chlorotic, followed by rapid leaf browning and tree death. Although some defoliation precedes tree death, trees typically retain most of their dead leaves. This decline pattern, which has been designated as “macadamia quick decline” (Hirae, 1989), is new to macadamia in Hawaii and has not been reported in other countries or regions growing macadamia.

Ambrosia beetles appear to be associated with the declining and dead trees. These beetles typically bore into the trunks at 0.5 to 1.5 meters above ground, resulting in entry holes evidenced by cylindrical dust posts (≤ 1 mm in diameter) or mounds of wood dust (2 to 5 mm in diameter). Before this decline problem, ambrosia beetle trunk infestations were not normally seen on healthy macadamia trees. Other wood-boring insects have also been recovered; however, their presence is not as consistent, nor are they as abundant as X. affinis or X. perforans. Cross sections of trunks of declining trees revealed the presence of dead phloem and discolored xylem tissue in the area of ambrosia beetle infestations.

Table 1. Ambrosia beetle infestation of macadamia trees of various cultivars.1

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Table 1. Ambrosia beetle infestation of macadamia trees of various cultivars.

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Total trees</th>
<th>Percent ± SD</th>
<th>Total trees</th>
<th>Percent ± SD</th>
<th>Dead Total trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ikaika</td>
<td>319</td>
<td>74.9 ± 2.8</td>
<td>131</td>
<td>40.1 ± 4.6</td>
<td>31</td>
</tr>
<tr>
<td>Kau</td>
<td>25</td>
<td>5.9 ± 1.1</td>
<td>2</td>
<td>8.3 ± 9.6</td>
<td>0</td>
</tr>
<tr>
<td>Kakea</td>
<td>63</td>
<td>14.8 ± 4.3</td>
<td>1</td>
<td>1.3 ± 2.6</td>
<td>0</td>
</tr>
<tr>
<td>Keaau</td>
<td>19</td>
<td>4.5 ± 5.0</td>
<td>4</td>
<td>16.7 ± 14.4</td>
<td>0</td>
</tr>
</tbody>
</table>

1Total trees are from four, discontinuous 0.6-ha blocks within the same orchard.

2Percentages are means of four, discontinuous 0.6-ha blocks within the same orchard.
predisposed to infestation. An association of ambrosia beetles with trees weakened by pathogens or nutritional stress has been reported in peach (Kovach and Gorsuch, 1985) and coconut (Ferreira and Morin, 1985). Other possible predisposing factors, such as a particular susceptible rootstock or graft incompatibility, does not seem likely because infested trees from other orchards had several rootstock and were of different ages. Nematode levels were also low and no parasitic species were recovered.

6.0 SD new trees infested per month (Fig. 1). Peak periods of new infestations were not correlated with rainfall, temperature, or other possible stress factors, such as other pests, herbicides, and fertilization. Fruiting bodies of *Nectria rugulosa* Pat. and *Shizopora paradox* (Fr.) Donk or *Kretzschmania clavus* (Fr.) Sacc. were evident on 75% and 7% of the newly infested trees, respectively. All 31 trees that died during the study were ‘Ikaika’. All trees were infested with ambrosia beetles before death and had *N. rugulosa* fruiting bodies in the area of beetle infestations. Tree death occurred $8.3 \pm 2.6$ SD months after initial beetle infestation was observed. Trees that were not infested with beetles or did not have *N. rugulosa* fruiting bodies did not exhibit the quick decline pattern.

These observations suggest that ‘Ikaika’ macadamia trees are more susceptible to quick decline than other cultivars. Also, the occurrence of ambrosia beetle infestations on the trunks of healthy-appearing macadamia trees provides a means for detecting trees that may be susceptible to quick decline. Since ambrosia beetles usually attack unhealthy or recently fallen trees (Beaver, 1976; Kovach and Gorsuch, 1985; Norris, 1979), their presence in the trees does not necessarily implicate them as the primary cause of the decline, but suggests that the trees were predisposed to infestation. An association of ambrosia beetles with trees weakened by pathogens or nutritional stress has been reported in peach (Kovach and Gorsuch, 1985) and coconut (Ferreira and Morin, 1985). Other possible predisposing factors, such as a particular susceptible rootstock or graft incompatibility, does not seem likely because infested trees from other orchards had several rootstock and were of different ages. Nematode levels were also low and no parasitic species were recovered.

### Literature Cited


