SCIENTIFIC NOTE

Evaluation of the antiaggregation pheromone, 3-methylcyclohex-2-en-1-one (MCH), to protect live spruce from spruce beetle (Coleoptera: Scolytidae) infestation in southern Utah

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The spruce beetle, *Dendroctonus rufipennis* (Kirby), produces the antiaggregation pheromone 3-methylcyclohex-2-en-1-one (MCH) (Rudinsky *et al.* 1974). MCH has reduced the numbers of spruce beetles attracted to infested logs and synthetic semiochemical lures or reduced colonization rates throughout the beetles range (Kline *et al.* 1974, Rudinsky *et al.* 1974, Furniss *et al.* 1976, Dyer and Hall 1977, Lindgren *et al.* 1989). MCH has not prevented the infestation of live trees (Werner and Holsten 1995), with one exception. MCH in a novel formulation incorporating a microinfusion pump prevented the infestation of live spruce in Alaska in an area with a low spruce beetle population (Holsten *et al*. 2003). The objective of this study was to test MCH using commercially available diffusion releasers for protecting live trees from spruce beetle infestation in an area with a high spruce beetle population in southern Utah.

Study plots were located about 20 km east of Cedar City, Utah (lat. 37°38' N, long. 112°49' W) at elevations of 3,000 to 3,200 m, in a spruce beetle outbreak area. Circular, 1-ha plots were located in mixed stands of mature Engelmann spruce, *Picea engelmanii* Parry ex Engelm, and subalpine fir, *Abies lasiocarpa* Nutt. Two treatments (MCH application and untreated control) were replicated four times in paired plots. Pairs were about 100 m apart and replicates were 100-2,000 m apart. Plots were established on 24 and 25 June 1998 prior to spruce beetle flight. MCH-treated plots had 180 releasers stapled to the north side of trees and snags around the plot perimeter at a height of 2 m. Because of availability limitations, two different types of releasers were interspersed evenly with one another on each plot, 110 of the releasers were from IPM Technologies, Inc., Portland, Oregon, (release rate, 9 mg/day at 22 °C) and the other 70 releasers were from Phero Tech, Inc., Delta, British Columbia, Canada, (release rate, 7 mg/day at 25 °C). A multiple-funnel trap baited with a lure containing frontalin and α-pinene in polyvinyl chloride formulations each releasing 0.8 mg/day at 25 ºC was placed at the center of each plot to monitor beetle activity. Traps were emptied on 2 and 7 July 1998, and were removed when successful beetle colonization on trees within the plots was first observed. The basal area of all trees ≥20 cm diameter at breast height (dbh) was measured at 30 m from the plot center in the four cardinal directions and recorded by species. Percent spruce basal area was calculated. Plots were surveyed on 17 September 1998 after beetle flight had ended to determine the dbh and infestation status of all spruce ≥20 cm dbh. Trees were classified as mass-attacked or unattacked based on the presence or absence of large amounts of boring dust on the lower third of the bole. Percentage of spruce trees ≥20 cm dbh that were mass-attacked was calculated for each plot.

Paired *t*-tests were used to test for treatment differences in the total numbers

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of spruce beetles caught in the traps and in the tree and stand data. Percentages of spruce trees mass-attacked were arcsin square root transformed. Nontransformed means are reported.

There was no significant difference in spruce beetle catches between MCH-treated and untreated plots (P = 0.7430). The average (± SE) number of spruce beetles caught in traps on MCH-treated plots was 546 ± 293 and the average caught in traps on controls was 473 ± 245. As expected, there were no significant differences between treatments for basal area (P = 0.2113), percent of total basal area (P = 0.9409), tree density (P = 0.6715), or dbh (P = 0.4592), since plots were selected to be similar with respect to stand structure and composition. Furthermore, the percent of spruce ≥20 cm dbh that were mass-attacked by the spruce beetle was not significantly different on MCH-treated (52.7 ± 20.3%) and untreated plots (68.3 ± 15.3%) (P = 0.4262). The majority, if not all, of the colonized trees were heavily infested.

The application rate of MCH used in this study was more than twice the current recommended dose for the Douglas-fir beetle (Ross *et al*. 2001). Despite the high application rate, MCH was not effective in preventing host-tree infestation by the high-density spruce beetle population. The lack of a significant effect of MCH might have been related to release rates of the compound under field conditions or to the lack of a behavioral response of the species to the compound. A recent study demonstrated that spruce beetle host selection behavior changes with population density (Wallin and Raffa 2004) and this could explain the different responses to MCH that have been observed in field studies. Further study will be needed to determine the conditions under which MCH might be operationally feasible for protecting live spruce.

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