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 engelmannii* 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 °C 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 bee-
tles caught in traps on MCH-treated plots
was 546 ± 293 and the average caught in
traps on controls was 473 ± 245. As ex-
pected, there were no significant differ-
ences 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 sig-
ificantly 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 demon-
strated 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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