

2

Sierra Cascade Intensive Forest Management Research Cooperative Proposal 04-02,  
Verbenone Study

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Title: Verbenone-releasing flakes protect *Pinus contorta* trees from attack by  
*Dendroctonus ponderosae* and *Dendroctonus valens*

Year Funded: 2004

**Executive Summary:**

A study was initiated in 2004 to determine if verbenone, a beetle-produced pheromone, could be effective in limiting damage to pines by *Dendroctonus* spp. bark beetles. Specifically, verbenone contained in a polymer laminate flake as the release device was to be tested against *Dendroctonus ponderosae* and *Dendroctonus valens* species in an attempt to protect *Pinus contorta* from attack by these beetles.

The study was installed on August 12, 2004 on Fruit Growers Supply lands in Siskiyou County, California about 5.6 km NE of the peak of Mt. Shasta at an elevation of 2240m. The forest is a second-growth natural stand consisting of east-side lodgepole pine with a small component of Shasta red fir (*Abies magnifica* var. *shastensis* Lemm). Forty lodgepole pine trees of similar size (DBH) and live crown ratio were selected from among all accessible trees in the stand. Trees selected for the study were a minimum of 50 meters apart. Twenty of the trees were selected at random for treatment from among the forty trees and the remainder served as controls. There was no significant differences in DBH, basal area, and live crown ratio between treated and control trees.

Application of the verbenone was made on August 12, 2004 using a modified hydroseeder seed/mulch spraying apparatus at the rate of 11.4 liters/tree carrying 15 g AI/tree. The laminated flakes carrying the verbenone were suspended in a solution of distilled water with Gelva sticker and guar gum. A solution of the formulation without flakes was used on the control trees. Flake and control formulations were sprayed onto trees in a single strip, roughly 30 cm wide, on a single side of each tree from ground level to a height of seven meters. Immediately after treatment, each tree was baited at breast height with a mountain pine beetle lure.

At two, four, six, and eight weeks following treatment, counts were made of the number of resinous *D. ponderosae* and *D. valens* attacks and *D. ponderosae* attacks producing dry frass. At eleven months following treatment, trees were inspected and ranked into one of three categories: (1) obviously dead, (2) obviously alive, or (3) uncertain status.

Treated trees had significantly fewer attacks by *Dendroctonus ponderosae* at two, four, six and eight weeks following application of the flakes. None of the treated trees were attacked by *D. valens*, whereas control trees averaged nearly

two *D. valens* attacks per tree eight weeks after treatment. The dry frass index, used to predict ultimate tree mortality, was significantly higher in control trees than in treated trees for all sampling intervals and for week eight, data analysis showed that the control trees had a significantly poorer prognosis than treated trees. Ten months following treatment, treated trees showed significantly lower mountain pine beetle mortality than control trees (figure). The dry frass index was a highly reliable indicator of ultimate tree mortality.

The investigators feel that the verbenone flake formulation has potential for application for a variety of bark beetle problems in forestry. The flake release device has the potential for aerial application as well as ground applications, and may present fewer environmental concerns than other delivery systems because the active ingredient is enclosed within the flake and may therefore be less accessible to children and wildlife.

## Frequency distribution of trees in mortality categories.



There was a significant treatment effect of mortality categories (Pearson's test  $P < 0.0001$ ).