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2000-2001 REDFISH LAKE VERBENONE TRIAL
Progress Report

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Populations of mountain pine beetle (MPB) *Dendroctonus ponderosae* Hopkins have been building at the Sawtooth National Recreation Area (SNRA) in south-central Idaho. Tree losses associated with outbreaks of MPB have been described as devastating (Safranyik 1988), with changes in density, stand age and species composition occurring within several years. Outbreaks of MPB are usually targeted toward the oldest and largest trees (> 8 inches in diameter) in a stand. Mass attack by many beetles on individual trees in a brief period (over 1 or 2 days) overwhelm tree defenses causing imminent mortality (Amman and Cole 1983). Emergence commonly occurs over a 2-3 week period (Amman and Cole 1983). Evidence of beetle infestation usually consists of pitch tubes where beetles have entered the tree and boring dust in bark crevasses and at the base of the tree (Amman and Cole 1983).

Lodgepole pine (*Pinus contorta*) is the dominant tree species at the Redfish Lake Recreation Complex. A significant percent of the lodgepole pines are over 8 inches in dbh (diameter breast height) and at risk of being attacked and killed by MPB. Lodgepole pine mortality at Redfish Lake has currently increased to levels that diminish the ambiance and esthetic integrity of the recreational complex. To protect trees that enhance the recreational value of the campgrounds, picnic areas, lodge and visitor center the insecticide carbaryl has been applied to the tree bole, deterring successful beetle attack. Trees immediately adjacent to the lake cannot be chemically treated because of the unacceptable risk of water contamination resulting from over-spray. To attempt to deter beetle attacks within this sensitive area an experimental antiaggregative compound (verbenone) was placed among lakeside trees in 2000 and in 2001.

Verbenone (4,6,6-trimethylbicyclo[3.1.1]-hept-3-en-2-one) is considered the principal antiaggregative pheromone component of MPB. Verbenone has not been registered for operational use on MPB by the U.S. Environmental Protection Agency (EPA), however the material may be used for experimental purposes on a total of less than 250 acres nationwide per year (59 FR 3681). Much of the literature has shown that verbenone reduces the incidence of successful MPB attacks on lodgepole pine (Miller et al. 1995, Amman and Ryan 1994, Amman et al. 1991, Shea et al. 1991, Amman et al. 1989, Lindgren et al. 1989, Schmitz 1988), other authors have found either inconsistent results on lodgepole (Gibson et al. 1991) or that verbenone was ineffective in preventing MPB attacks on ponderosa pine (Bentz et al, 1989, Lister et al. 1990). However, since there is no alternative method to deter beetle attacks on waterside trees at the SNRA,

we initiated a trial to assess and demonstrate the efficacy of verbenone in preventing MPB attack. This trial was initiated using a higher concentration (5g pouches) with an increased rate of release (25-35 mg per day) over previous trials. The objective of this evaluation is to demonstrate the ability of verbenone to provide protection against beetle attack in environmentally sensitive areas through the course of a multi-year outbreak. This investigation is of particular interest because there has been no prior study evaluating the efficacy of verbenone for more than a single year. The ability of the compound to preserve stand integrity throughout the course of a multi-year outbreak would be a substantial addition to MPB management techniques.

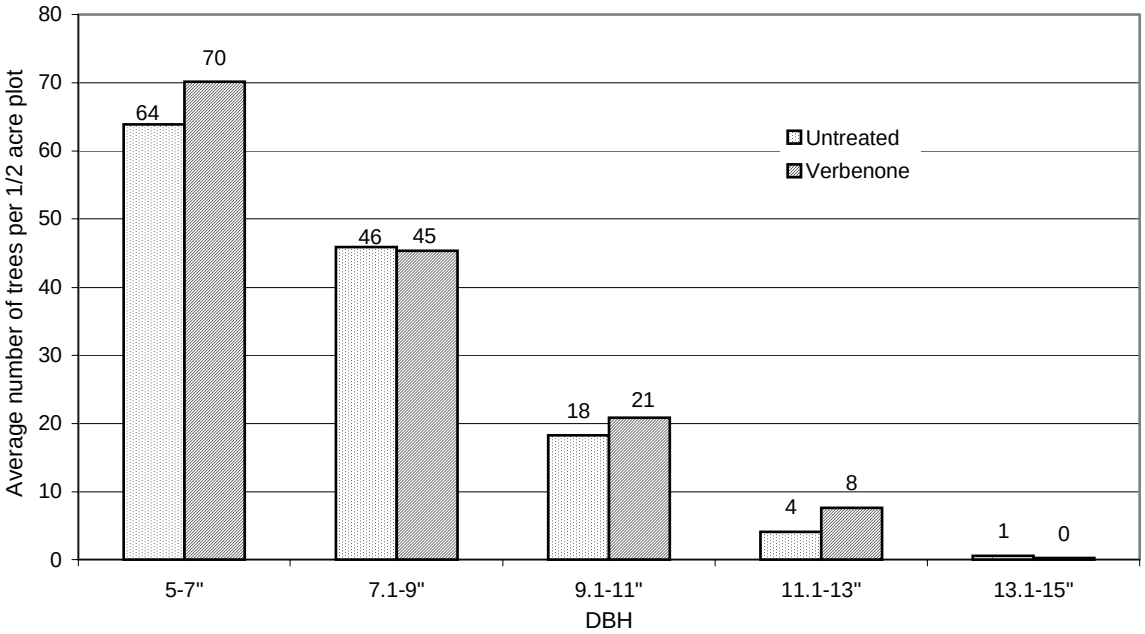
Methods

On June 8, 2000, sixteen one-half acre plots were located in campgrounds and outside visitor facilities in lodgepole stands along the shoreline of Little Redfish and Redfish lakes. The species, dbh (diameter breast height), year of attack (old MPB attack prior to 1999 vs. new attack in 1999 containing brood) were measured and tabulated for each tree on the plots. Plots were randomized and eight were selected for treatment with verbenone pouches. The eight remaining untreated plots were used as comparison plots. On July 5, 2000 and on June 14, 2001, twenty pouches were placed on the north facing side of the tree 12 ft. above the ground at a spacing of one pouch per 1000 sq ft. in each treated plot. We also erected attractant-pheromone baited funnel traps at three locations within the Stanley Basin to monitor beetle emergence. The plots were revisited in October 2000 and September 2001 when current-year beetle attacks were tabulated for evaluation.

Results and Discussion

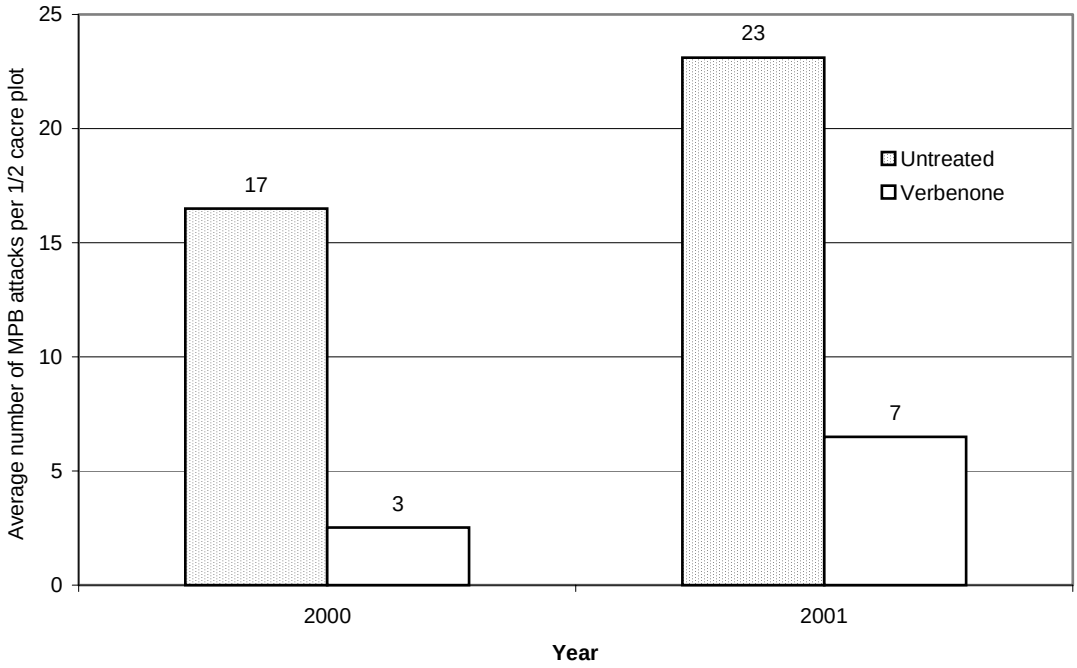
Analysis of host tree dbh showed no significant difference within size class among plots receiving verbenone and those in the untreated check (Fig. 1).

Figure 1. Average per plot density of susceptible lodgepole pine between treatments by dbh.



In 2000, treatment comparison of MPB attacks by ANOVA indicated significantly ($P \leq 0.05$) more lodgepole pines were attacked on the untreated plots than on plots containing the verbenone pouches ($F = 6.9$; $df = 1, 14$; $P = 0.02$). The mean number of successfully attacked lodgepole pine per plot was 16.5 (SE=5.28) for untreated plots and 2.37 (SE=1.03) in plots containing verbenone pouches Fig. 2). In 2001, beetle attacks increased by 35% to an average of 23 trees per untreated plot and by 133% to an average of 7 attacked trees in the verbenone treated plots. The increase in the incidence of successful attack on treated plots may indicate a threshold intensity of beetle pressure for verbenone. Although more trees were attacked by MPB in verbenone treated plots in 2001 than in 2000, there were significantly ($F = 13.1$; $df = 1, 14$; $P = 0.003$) fewer successful attacks in the plots containing verbenone than in untreated plots (Fig. 2).

Figure 2. Average number of successful MPB attacks per plot during 2000 and 2001.



Examination of treatment differences within size class (Figs. 3 & 4) showed significantly ($P \leq 0.05$) greater numbers of attacks in the untreated check on smaller size class trees (<11" dbh) during both years. However, in either 2000 or 2001, trees greater than 11" dbh did not show significant differences in the number of MPB attacks between treatments. In 2000, an average of 3.5 (SE = 1.4) trees greater than 11" dbh were successfully attacked on the untreated plots whereas 0.87 (SE = 0.4) were attacked on plots containing verbenone pouches (Trees < 11": dbh: $F = 8.05$; $df = 1, 14$; $P = 0.01$; Trees > 11": $F = 3.09$; $df = 1, 14$; $P = 0.10$)). In 2001, there was an average of 4 trees (SE = 1.8) (>11" dbh) per plot successfully attacked on the untreated plots and 3.87 (SE = 1.6) trees on the verbenone treated plots (Trees < 11"dbh: $F = 25.63$; $df = 1, 14$; $P = 0.0002$; Trees > 11" dbh: = .$F = 0.002$; $df = 1, 14$; $P = 0.95$). Lack of significant differences between treatments among trees with greater dbh may indicated that verbenone may lose it effectiveness on larger trees under conditions of increasing beetle pressure. Future studies should include a sufficient number of trees with a dbh greater than 11" to adequately evaluate the relationship of

verbenone and MPB in larger size-classed trees.

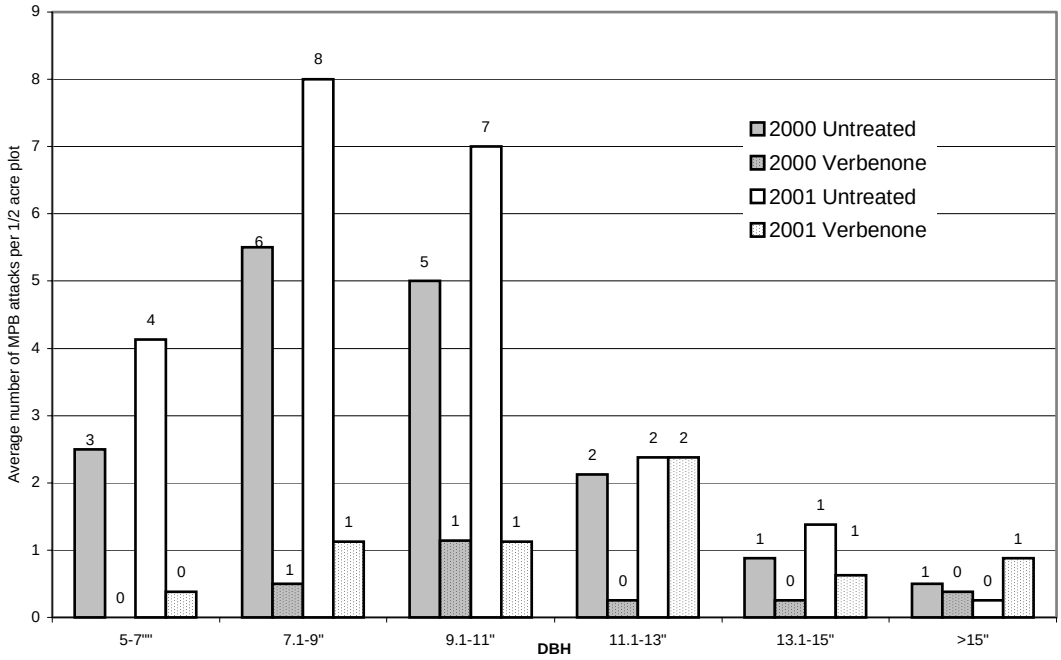


Figure 3. Comparison of trees by dbh size class between untreated plots and plots treated with verbenone during 2000 and 2001.

Verbenone showed no selective ability in protecting individual trees. Trees containing treatment pouches within the verbenone plots exhibited the same evidence of beetle attack as trees that did not contain pouches although significantly fewer attacks occurred on verbenone treated plots.

In 2000 and 2001, there were no significant differences (yr. 2000 - F = 1; df = 1,14; P = 0.33; yr. 2001 – F = 0.07; df = 1, 14; P = 0.788) between treatments in the number of trees that pitched-out beetles. There were significantly higher numbers of strip attacks in the untreated plots in 2000 (0 = 5.62) than in the plots containing verbenone (0 = 1) (F = 5.81; df = 1, 14; P = 0.03). Also in 2001, there were higher numbers of strip attacks in the untreated plots (0 = 3.75) than in the verbenone treated plots (0 = 2.37), however the difference was not significant (F = 2.55; df = 1, 14; P = 0.13).

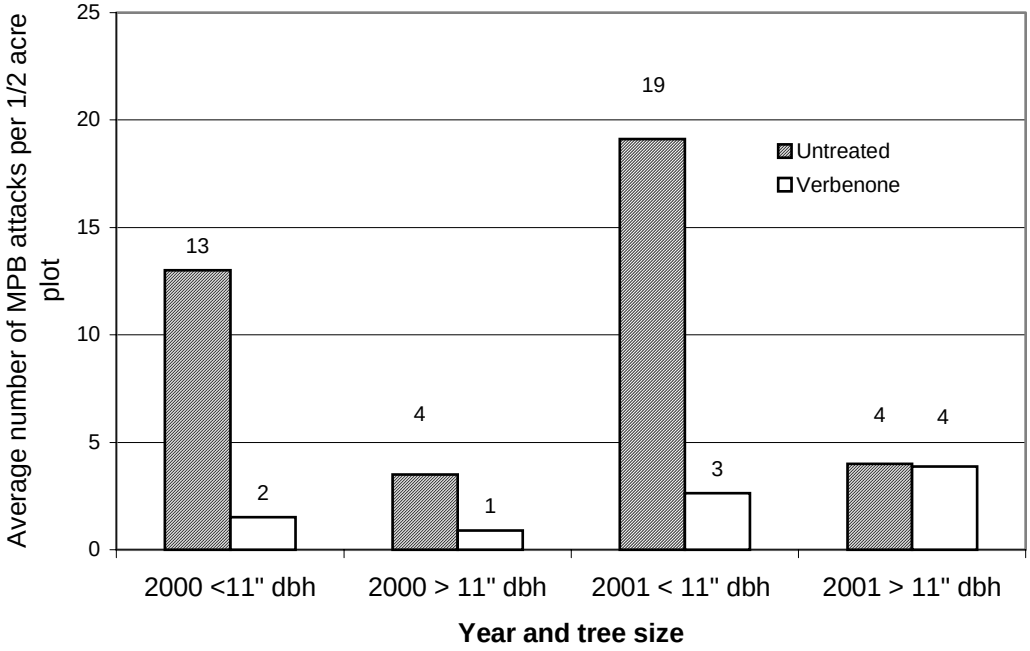


Figure 4. Comparison of MPB attacks on lodgepole pine with a dbh less than and greater than 11".

Mountain pine beetle populations are continuing to build at the Redfish Lake Recreational Complex (Their, 3420 letter, dated February 6, 2001 to Forest Supervisor Sawtooth NF). In 2002-2004 we plan to continue the current study to assess the ability of verbenone to deter MPB attack of susceptible lodgepole pine stands under increasing MPB pressures. As the outbreak expands through the recreational area, fewer unattacked trees will be available increasing pressure on unattacked trees. Future trials will assess the long-term ability of verbenone to deter beetle attack under conditions of increasing beetle severity.

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