**Use of Hericon Verbenone Flakes to Prevent Engraver Bark Beetle (*Ips* spp.)Colonization of Ponderosa Pine Slash**

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## Introduction

Pine engraver beetles (*Ips pini*, Say.), a widely distributed, common and important bark beetle in North America (Furniss and Carolin 1977), preferentially colonize weakened or recently killed small diameter (5-20 cm) trees and, under appropriate conditions, can damage healthy host trees (Kegley et al. 1997). Slash piles, like those currently being produced by restoration and fuels reduction treatments in the Southwest, provide excellent host material for the reproduction of these insects and can become an important pest management concern (Parker 1991, Six et al. 2002).

The use of verbenone as an anti-aggregation pheromone has been studied for several *Dendroctonus* and *Ips* bark beetles in North America, but not for the engraver beetles that attack ponderosa pine in Arizona. A combination of ipsenol and verbenone has been found to effectively minimize increases in population levels of pine engravers, due to the availability of excessive slash material (Miller et al. 1994). Technical problems with the release devises exist, however. High initial efficacy followed by substantial reductions in efficacy, due to rapid decline of release rates within the first 2 weeks (Devlin 1992), was found when using polyethylene and polypropylene beads, for verbenone and ipsenol, respectively. Ipsenol and vebenone, in sets of bubblecaps (release rates of 0.3 and 10 mg/day at 24°C, respectively), were found to be effective in

protecting downed lodgepole pine in south-central British Columbia, even when challenged using the aggregation pheromone ipsenol (Borden et al. 1992).

In this study, we tested the efficacy of variable treatment rates of Hericon verbenone flakes in preventing pine engraver attack and subsequent beetle reproduction in ponderosa pine slash piles. We tested three research hypotheses: 1) verbenone flakes affects male log selection behavior, 2) verbenone flakes disrupt pheromone communication (i.e. male attraction of female pine engravers) and 3) population growth can be reduced as a result of verbenone flake treatment of slash piles.

**Methods**

This field experiment took place at Camp Navajo Army Depot, approximately ten miles west of Flagstaff, Arizona, in an area with known high pine engraver population levels. Vegetation at the study site was dominated by a ponderosa pine/Gambel oak overstory. The study site was approximately 15 ha.

Six inch and under diameter at breast height (dbh) ponderosa pine trees were cut 27-29 June, 2006. Enough trees were cut to make 50, 2 m high, by 1.5 m diameter slash piles. Boles were limbed and cut into two meter lengths, and placed on top of slash piles. Slash piles were created on a 50 m grid, and randomly assigned a treatment. Treatments consisted of 100, 200, 400 and 800 g of Hericon flakes verbenone per pile, plus a control that had no Hericon flakes. Hericon flakes were applied with a hand held garden fertilizer spreader. Two two-meter bolts, approximately 15 cm in diameter were randomly selected at each pile and tagged. At the end of an eight week period (23 August, 2006), when beetles had exited the bolts, 30 cm lengths were cut from the center of tagged bolts, and brought back to the laboratory for dissection.

*Statistical Analysis*

For the purpose of analysis, the sample unit was a slash pile. Response variables nuptual chamber density, exit-hole density, and egg galleries per nuptual chamber were recorded on 30 cm bolts. Wood borer damage was also estimated to the nearest 5% for each bolt. Bolts with greater than 50% wood borer damage were removed from the analysis. Response variables were then averaged by pile. A one-way analysis of variance (ANOVA) was then conducted on the response variables with SigmaStat software (Systat Software Inc. 2004).

**Results and Discussion**

Pine engraver beetles attacked and reproduced in logs in all of our treatments. There was no statistically significant difference in nuptual chambers per 1,000 $cm^2$ ($n = 10$, $F = 0.41$, $P = 0.80$), egg galleries per nuptual chamber ($n = 10$, $F = 1.89$, $P = 0.13$), or exit-holes/1,000 $cm^2$ ($n = 10$, $F = 1.22$, $P = 0.32$) between treatments (see Fig.1).

Despite previous studies implying that verbenone could be used as an anti-aggregation treatment for pine engraver beetles, we found no evidence that this treatment will work for defending ponderosa pine slash piles in the Southwest. One reason for the lack of treatment effect may be the high levels of volatile chemical emissions, which serve as a pine engraver attractant, being given off by fresh slash piles. The effect of these attractants may be hard to overcome. Taken together with difficulties in designing a release devise that releases verbenone at high rates for long periods of time, creating an effective verbenone treatment for ponderosa pine slash piles may prove impractical. Verbenone may have other potential uses in the Southwest, however. Recent research has shown that verbenone treatments can reduce mountain pine beetle attacks on

individual trees and stands of lodgepole pine (Progar 2005; Gillette et al. 2006; and Bentz et al. 2005). Similar treatments could provide enough of a deterrent to prevent attacks by pine engraver and other pine bark beetle attacks on old growth ponderosa pine stands, thereby avoiding unwanted mortality in ecologically valuable areas.

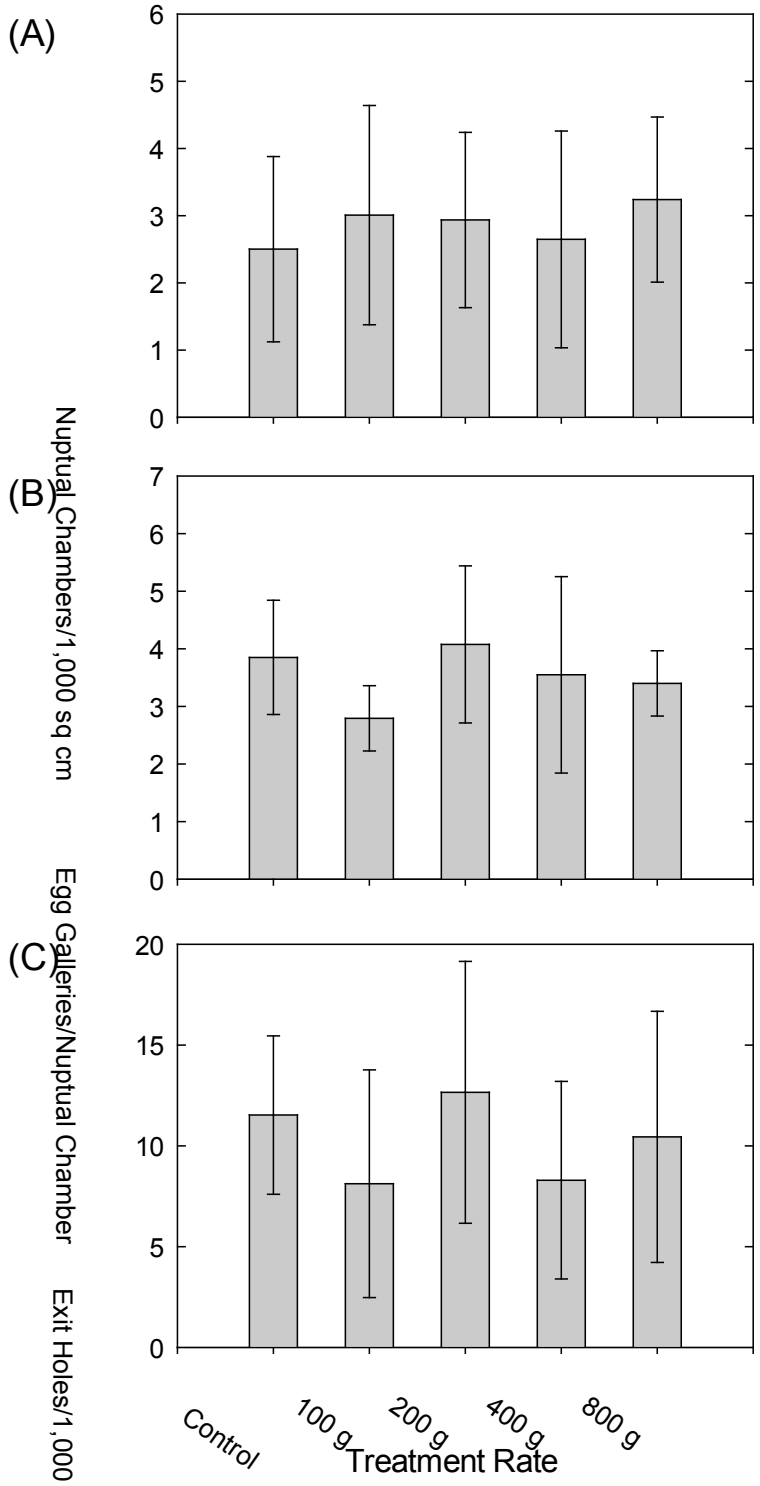


**Fig. 1** Comparisons of treatment effects on (A) density of successful male *Ips* attacks, (B) females galleries constructed per successful male attack, and (C) density of second generation emergence from test bolts at Camp Navajo Army Depot in 2006. Bars represent mean ± one standard deviation.

**Literature Cited**

**Bentz, B.J., S. Kegley, K. Gibson, and R. Their. 2005.** A test of high-dose verbenone for stand-level protection of ledgepole and whitebark pine from mountain pine beetle (Coleoptera: Curculionidae: Scolytinae) attacks. *J Econ. Entomol*. 95(5): 1614-1621.

**Borden, J.H., Devlin, D.R., and D.R. Miller. 1992.** Synomones of two sympatric species deter attack by the pine engraver, Ips pini (Coleoptera: Scolytidae). *Canadian Journal of Forest Research* 22:381-387.

**Devlin, D.R. 1992.** Antiaggregants for the pine engraver. Burnaby. British Columbia: Simon Fraser University; 56 p. M.P.M. Dissertation.

**Devlin D. R. and J. H. Borden. 1994**. Efficacy of antiaggregants for the pine engraver, *Ips pini* (Coleoptera: Scolytidae), *Can. J. For. Res*. 24: 2469-2476.

**Furniss, R.L., and V.M. Carolin. 1977**. Western forest insects. USDA For. Ser. Publ. No. 1339, Washington, DC.

**Gillette, N.E., J.D. Stein, D.R. Owen, J.N. Webster, G.O. Fiddler, S.R. Mori, D.L. Wood. 2001.** Verbenone-releasing flakes protect individual *Pinus contorta* trees from attack by *Dendroctonus ponderosae* and *Dendroctonus valen* (Coleoptero: Curculiondae, Scolytinae) *Agricultural and Forest Entomology.* 8: 243-251.

**Kegley, J.K., R.L. Livingston, and K.E. Gibson. 1997**. Pine engraver, *Ips pini* (Say), in the western United States. USDA For. Serv. For. Insect Dis. Leaflet 122, Washington, D.C.

**Miller, D.R., Devlin, D.R., and J.H. Borden. 1994.** The use of antiaggregation semio-chemicals in controlling pine engravers in stands of lodgepole pine. USDA For. Service Gen. Tech. Rep., PSW-150. Washington D.C.; 6 p.

**Progar, R.A. 2005**. Five-year operational trial of verbenone to deter mountain pine beetle (*Dendroctonus ponderosae*; Coleoptera: Scolytidae) attack of lodgepole pine (*Pinus contorta*). *Environ. Entomol*. 34(6): 1402-1407.

**Parker, D.L. 1991**. Integrated pest management guide: Arizona five-spined ips, *Ips lecontei* Swaine, and pine engraver, *Ips pini*, (Say), in ponderosa pine. U.S. Dep. Agric. For. Ser. Southwest Region, R-3 91-9. Albuquerque, NM.

**Six D.L., M. Vander Meer, T.H. DeLuca and P. Kolb. 2002**. Pine engraver (*Ips pini*) colonization of logging residues created using alternative slash management systems in western Montana. *W. J. Appl. For.* 17: 96-100.

**Systat Software, Inc. 2004.** SigmaStat 3.1 user's manual. Systat Software, Inc., Point