

# **Verbenone Use Guidelines**

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## **1. Introduction**

Verbenone (trimethyl-bicyclo-heptenone) is a semiochemical. In relation to mountain pine beetle (MPB), verbenone acts as an anti-aggregation pheromone.

MPBs aggregate in large numbers when colonizing host pine trees. The types and rates of pheromones released by beetles during this phase of attack influences the level of attack on a given tree. At the beginning of an attack, chemicals produced by infested trees and by the beetles attract additional beetles of the same species. As the number of MPB approaches the maximum that the tree can support, the beetles in the tree release verbenone to repel newly arriving beetles.

Verbenone is also synthetically produced and commercially available. It can be deployed in small plastic pouches to help protect pine trees from MPB attack. Verbenone has been most effectively used to protect hi-valued trees over a relatively small area when beetle population pressure is low to moderate. Areas of use may include: backyards, resorts, campgrounds, woodlots, ornamental plantings, genetic sites, species at risk, forest stands of high ecological or social value etc.

The purpose of this guide is to provide information for landowners, municipalities and forest managers on the operational use and limitations of using verbenone for MPB protection.

## **2. Effectiveness**

While verbenone has been shown to be effective at low to moderate beetle population pressure, it is not very effective when the pressure is high. Even under low and moderate beetle pressure, complete protection may not be achieved.

Millar et al. (1995) demonstrated that interruptions in the attraction of MPB to aggregation pheromone-baited funnel traps was significantly verbenone dose dependant; with the highest dose having the greatest effect. Experimental rates ranged from 0.01-54.02 mg released per day.

Verbenone is released from a point source (the pouch) and diffuses outward in a three dimensional space. Verbenone concentrations decrease with increasing distance from the

point source. Further variation within/between stands may result from changes in crown closure and penetration by sunlight, as verbenone is photoisomerized by ultraviolet radiation into a chemical that has no known behavioural effect on MPB (Kostyk et al., 1993).

In 2003, verbenone trials were undertaken in a number of forest stands in BC. The results showed that when beetle pressure was low, and there is little in-flight, verbenone was relatively effective (up to 26% decrease in MPB attack in verbenone treatment area compared to control sites) (Maclauchlan et al., 2003). In stands with considerable MPB in-flight, there was no difference in the amount of MPB attack in treated and untreated blocks.

Maclauchlan's 2003 findings are supported by Bentz et al., in that verbenone did not prevent beetles from dispersing through the treated stands, but the overall number of attacked trees was on average significantly reduced compared to non-treated stands (2005). Results from the study also showed that some verbenone-protected stands had more attacked trees than non-treated stands. This suggests there is likely a beetle pressure threshold above which verbenone becomes ineffective. Although more data are required to accurately determine this threshold, results suggest that when there are >140 attacked trees within and surrounding the treatment area verbenone protection is not attainable (Bentz et al., 2005).

A USDA Forest Service position paper suggests that if more than 15% of the stand is currently infested, and those trees cannot be controlled prior to beetle flight, do not use verbenone (2009). In such a situation the results may not be worth the cost of treatment.

A recent study in the rural community of Lac le Jeune, BC, Borden et al. (2007) looked at the operational success of verbenone against the MPB in 4 subdivisions. In 3 of the subdivisions, where previously infested trees had been removed, the mass-attack from MPB was reduced to an average of 3.6% of 3857 trees where verbenone was applied. In the 4th subdivision where infested trees were not removed, verbenone protection was less effective, and 19.6% of 634 trees were mass attacked. The number of verbenone pouches dispensed in these 4 communities averaged 53.6/hectare. Borden et al. concludes that verbenone is a useful tool to prevent attack when used as part of a multi-year integrated pest management program that includes disposal of all infested trees (2007).

In the Progar (2005) 5-year operational test to deter mass-attack by MPB on lodgepole pine at the Sawtooth National Recreation Area in central Idaho, five-gram verbenone pouches were evenly distributed at 10m spacing (100/hectare). During the first 2 yr of the study, verbenone protected sites had on average 12% attack compared to 59% in the unprotected control sites. Once beetle attack in the untreated plots reached 50%, the detectable beetle response to verbenone on the treated plots dramatically declined. After 5 years there was 87% attack in the untreated plots and 67% attack in plots containing verbenone. Progar hypothesizes that the decreasing effectiveness of verbenone over time may be related to changes in population size and spatial scale, i.e., large numbers of vigorous beetles in a local area with a reduced number of preferred large-diameter trees become crowded and stressed, causing a decline in the response to verbenone (2005).

### **3. Deployment Instructions**

The following instructions for deploying verbenone pouches are based primarily on various manufacturer recommendations. Ensure all label instructions for deployment are read and followed. For further information, consult a pest management professional.

#### Timing

Verbenone pouches must be deployed before the beetles emerge from under the bark of their host tree to attack non-infested trees. The deployment should be strategically timed so that the initial high-dose release of pheromone is as close to the major beetle flights as possible.

In Alberta, mountain pine beetles can emerge from May through September, with the peak flight often occurring in mid-July. To pin point the start of the flight period in your area, infested trees must be monitored. The presence of callow and mature adult beetles under the bark indicates the flight will be soon. Exit holes in the bark indicate the flight has begun.

#### General Placement

Verbenone pouches should be attached to the north face of a tree or vertical object at maximum reach from the ground. If a second pouch is being placed on the same tree or vertical object, attach it at approximately 2.5 meters above ground on the north face.

Pouches are hung on the north side of trees or objects to protect them from the direct sunlight that reduces the efficacy of the verbenone.

#### Single tree protection

Applicable to situations such as backyards, urban parks, golf courses, heritage trees etc. A pine is considered a single when spaced more than approx 10-15 meters from another.

Attach one-two pouches on the north face of the susceptible pine tree to be protected.

For extremely high valued trees, or where beetle pressure is high, added protection may be attained by stapling additional pouches surrounding or upwind of the protected tree. Additional pouches should be placed 4-5 meters from the tree to be protected. It is not required that these additional pouches be attached to a pine tree, but should be fixed on the north side of non-host tree species or other objects of suitable height.

In communities or subdivisions with patches or stands of multiple susceptible pine scattered across property boundaries (closer than 10-15 meter tree spacing), consideration should be given to establishing a coordinated program. In these situations a multi-tree or stand level protection strategy may be more effective than working independently.

#### Multi-tree (patch) protection

Applicable to communities, landowners, urban parks, campgrounds, golf courses, genetic sites (etc.) with isolated patches of susceptible pine that are less than ½ acre in size (<20m<sup>2</sup>).

Patches of susceptible pine may be protected by attaching one-two verbenone pouches on trees or other vertical objects to form a perimeter. Spacing of verbenone along the perimeter should be 4-5 meters. For additional protection, trees in the center of the

perimeter may also be treated with one-two pouches of verbenone. The number of verbenone pouches deployed in the center of the patch may increase with the patch size and number or value of pine.

#### Stand level protection

Applicable to woodlots, communities, parks, whitebark/limber pine protection sites, genetic sites (etc.) with susceptible pine stands 1 acre or larger (>40m<sup>2</sup>).

Stand protection may be attained through an even distribution of verbenone to blanket the area in a plume of the pheromone. This is most effectively done by deploying one-two verbenone pouches/tree in grid pattern with 10-15 meter spacing (44 – 100 pouches/hectare when using one pouch/tree). The rate should depend on the beetle pressure in the area; the higher the pressure, the higher the suggested deployment rate.

It is not absolutely necessary to have each pouch on a susceptible tree, as other vertical objects and non-host trees should be used to maintain the integrity of the grid.

If it is known which direction the beetles will come from, additional verbenone pouches can be placed in a line or lines in front of the trees to be protected.

#### Push-pull Strategy

When using verbenone to protect susceptible pines in a currently infested stand, aggregation pheromone lures may be used to pull the beetles away from the treated stand at the same time that the verbenone is pushing them out. This is known as a push-pull strategy.

In theory this strategy should work relatively well, although such projects can be fairly difficult to design. Some operational uses have shown promise, but additional studies are needed.

Note that the improper use of aggregation pheromone lures can lead to an increase in the MPB population in an area. For more information on the push-pull strategy contact a pest management professional.

### **4. Additional Management Tips**

- Verbenone has a limited life span. Once a pouch is installed it is activated by the ambient temperature and verbenone is slowly released. To prevent verbenone from being released, keep it stored at or below 0 degrees Celsius.
- During unusually warm summers, when verbenone pouches are depleted more rapidly and the beetle flight period is expanded, 2 applications per season may be considered.
- When determining verbenone deployment rates (i.e. one or two pouches/tree, and/or pouch spacing), one must weigh the cost of the verbenone against the potential benefit of protection. In addition, one must consider the beetle pressure in the area and/or the proximity to known infestations.
- Verbenone is not the ‘silver bullet’ to prevent mortality caused by MPB; it is most effectively used as part of an integrated strategy that includes beetle control measures and risk reduction.

## 5. Regulations for use on public land in Alberta

Forest Management Branch Directive No. 2004-03 ([Pesticide, Bark Beetle Pheromone and Biological Control Use Guidelines for Forest Pest Management](#)) regulates the use of verbenone for the purpose of forest pest management on public land managed by Sustainable Resource Development.

The Directive provides information on the application and approval process for companies/individuals proposing the use of bark beetle pheromones on crown land.

## 6. SRD Standards for Deployment

The application of verbenone is an approved activity for both the FRIAA and Municipal MPB grant programs. Although, within the grant program documentation/guidelines there are no specified limits, which address the rate of deployment, that will be approved. The following rates are the maximum that will be approved for grant related compensation for the specific deployment strategies:

- Single tree protection – one verbenone pouch/tree
- Multi-tree (patch) protection – up to 5 pouches/20m<sup>2</sup> patch (or one pouch/4m of perimeter where patch is <20m<sup>2</sup>)
- Stand level protection – 60 pouches/ha (13m grid spacing @ one pouch/grid point)

## 7. References

- Borden, J.H., Sparrow, G.R., and Gervan, N.L., 2007. Operational success of verbenone against mountain pine beetle in a rural community. *Arboriculture & Urban Forestry* 2007, 33(5):318-324.
- Kostyk, B.C., Borden, J.H., and Gries, G. 1993. Photoisomerization of antiaggregation pheromone verbenone: biological and practical implications with respect to the mountain pine beetle, *Dendroctonus ponderosae* Hopkins. *J. Chem. Ecol.* 19: 1749-1759.
- Maclauchlan, L.E. , and Brooks, J.E. 2003. Determining susceptibility of young pine stands to the mountain pine beetle, *Dendroctonus ponderosae*, and manipulating future stands to mitigate losses. FIA FSP Project Y072003.
- Millar, D.R., Borden, J.H. and Lindgren, B.S. 1995. Verbenone: dose-dependent interruption of pheromone-based attraction of three sympatric species of pine bark beetles (Coleoptera: Scolytidae). *Journal of Environmental entomology*, Vol. 24, No. 3, pp. 692-696 (1 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*). *Journal of Environmental Entomology*, vol. 34, no6, pp. 1402-1407.

USDA Forest Service, FHP, Missoula, MT, Ken Gibson. Using verbenone to protect host trees from mountain pine beetle attack. January 2009.  
[http://www.extension.colostate.edu/gilpin/docs/gibson\\_verbenone\\_use\\_position\\_paper\\_2009.doc](http://www.extension.colostate.edu/gilpin/docs/gibson_verbenone_use_position_paper_2009.doc)