How Important Are Bole Infections In

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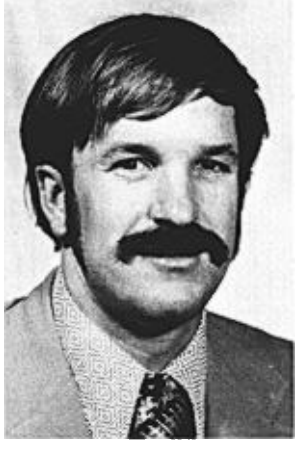
ABSTRACT—The relation between vigor of dwarf mistletoe (*Arceuthobium vaginatum* subsp. *cryptopodum*) bole infections and diameter of ponderosa pine was evaluated in several areas in Colorado. Infections which occur where the bole is over 5 inches in diameter seem to pose little threat to surrounding trees. In this study all such trees were over 7 inches d.b.h.

Dwarf mistletoe (*Arceuthobium* spp.) bole infections affect their host trees in several ways: (1) They may produce seeds that intensify infection within the tree or adjacent trees, (2) they may adversely affect bole form and wood quality, and (3) they may kill the host. For these reasons, recommendations for control of southwestern dwarf mistletoe (*Arceuthobium vaginatum* subsp. *cryptopodum* [Engelm.] Hawks. & Wiens) on ponderosa pine (*Pinus ponderosa* Laws.) typically include suggestions to remove all trees with bole infections (*1, 3, 6*). However, we have observed that many such infections, particularly on larger trees, are of low vigor and produce few seeds. Thus we studied the relationship between shoot and fruit production on dwarf mistletoe bole infections and diameter of the host tree to determine whether trees with bole infections need to be removed.



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Bole infections usually induce a fusiform swelling, weakening the wood in the affected part of the bole (*3*). The vertical spread of infections is rather slow—about 1 inch per year in each direction (*2*)—so there is little urgency in removing such trees for this reason. For ponderosa pine, tree mortality caused by bole infection seems to be confined to trees under about 2 inches d.b.h.

Infections Examined

The study was conducted in 11 areas in the Roosevelt and Pike National Forests, Colorado. A total of 611 bole infections in 387 trees was examined. The stands were uneven aged, and the trees ranged from 1 to 19 inches d.b.h. For each tree with a bole infection within about 20 feet of the ground, we recorded: d.b.h. of tree, dwarf mistletoe rating, 6-class system (*3*), height of the infection, sex of the mistletoe plant, and vigor of the infection. Vigor was rated as one of three classes:

- **Poor.** Shoot vigor poor, shoots usually less than 1 inch high. Shoots occur individually over infected area of bole.
- **Fair.** Shoot vigor intermediate, most shoots 1 to 2 inches high. Shoots scattered throughout infected area of bole.
- **Good.** Shoots vigorous, mostly over 2 inches high. Shoots abundant throughout infected area of bole.

In addition, 170 female bole infections were examined to determine the number of dwarf mistletoe seeds produced in bole infections of the three vigor classes:

Vigor	*Female dwarf mistletoe plants examined*	*Fruits per plant, mean and standard error*
	No.	No.
Poor	56	4 ± 2
Fair	78	50 ± 8
Good	36	260 ± 29

.d of Ponderosa Pine Dwarf Mistletoe?

Table 1. Relation between diameter at point of infection and vigor of 611 dwarf mistletoe bole infections.

Tree diameter	Infections examined	Mistletoe vigor		
		Poor	Fair	Good
inches	number	— — — percent — — —		
1 - 3	272	9	62	29
4 - 6	218	35	51	14
7 - 9	74	65	35	0
10 - 12	28	89	11	0
13+	19	100	0	0

Table 2. Relation between tree d.b.h. and vigor of 611 dwarf mistletoe bole infections.

D.b.h.	Infections examined	Mistletoe vigor		
		Poor	Fair	Good
inches	number	— — — percent — — —		
1 - 3	218	13	65	22
4 - 6	260	30	51	19
7 - 9	91	53	36	11
10 - 12	23	83	17	0
13+	19	100	0	0

The relation between dwarf mistletoe vigor and tree diameter was determined for the point of infection (*Table 1*) and for d.b.h. of the infected tree (*Table 2*). Data were combined for female and male infections, because the results were essentially the same.

The seed production of "poor" and "fair" bole infections is limited. Because only a very small proportion of the seeds produced actually result in new infections (*4*), seed production by these two bole infection classes can probably be ignored. For potentially serious seed production, therefore, we only need to consider bole infections in the "good" vigor class. Essentially all trees with "good" vigor bole infections were in diameter class 5 inches or less at the point of infection or had a d.b.h. of 7 inches or less. Although only bole infections within about 20 feet of the ground were examined in this study, the results are probably applicable to infections at any height.

Implication for Control

In control operations it is usually desirable to remove as many infected trees as possible, but this is often impractical because it would seriously reduce stocking. In most stands there are some larger trees with only bole infections, and some with bole infections plus prunable light branch infections. This study shows that such trees over 5 inches in diameter at the point of infection pose little threat to surrounding trees. In this study all such trees were over 7 inches d.b.h.

These results also suggest modifications in pruning guides published for dwarf mistletoe-infected branches in ponderosa pine (*5*). These guides help determine which branch infections are far enough from the bole so that the endophytic (or root) system of the branch infection has not invaded the bole. The published guides suggest that, if shoots on branches under 1.0 inch in diameter are not closer than 6 inches from the bole, the infection may be completely removed by pruning the branch flush with the bole. For each inch increase in branch diameter, the minimum safe distance is increased by 2 inches. This study indicates these pruning guides need not be used for larger trees, because infections—even if they do develop in the bole—are of little consequence in spread of the parasite. Observations of infected pruning wounds several years after removal of infected branches show that dwarf mistletoe shoots are not vigorous on larger trees.

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