Introduction to Dwarf Mistletoes

Parasitic vascular plants with conifer hosts

Pathogens—Dwarf mistletoes (*Arceuthobium* spp.) are parasitic plants of conifers that obtain almost all of their needs, including water, mineral, and carbon nutrients, from their hosts. Fulfilling these resource requirements stresses infected trees, causing reductions in growth, cone, and seed production and, with high infection levels, mortality. Dwarf mistletoes are some of the most common and easily identified disease agents where they occur in the coniferous forests of the Rocky Mountain Region.

Hosts—Five species of dwarf mistletoes occur in this Region, each with a specific set of susceptible hosts (table 1).

Figure 1. Aerial shoots of American dwarf mistletoe plant on lodgepole pine. Note the swelling in the branch associated with the aerial shoots. *Photo: Brian Howell, USDA Forest Service.*

Signs and Symptoms—Dwarf mistletoes produce aerial shoots on branches or stems of infected trees (fig. 1). Shoots are nearly leafless and vary in color; yellow, brown, purple, or green shoots are common. Plants size also varies within and among species. Douglas-fir dwarf mistletoe shoots are often shorter than the host's leaves, while southwestern dwarf mistletoe shoots are typically 3-6 inches (7-15 cm) long. When shoots are shed, characteristic basal cups remain (fig. 2). Infection with dwarf mistletoe also causes characteristic deformities in the host. Witches' brooms are areas of profuse, dense branching often induced by dwarf mistletoe infection (fig. 3). Branch swellings are often found in the immediate vicinity of local infections (fig. 1). Cankers (areas of dead cambium) are often associated with older infections. Dieback of the host's foliage from the top-down and eventual mortality is often observed in trees that have been infected for many years (fig. 4), depending on the species of dwarf mistletoe and host, the level of infection, and site factors. These symptoms on the hosts are often associated with mistletoe infection but may also be caused by other agents. Plants or basal cups should be present for positive identification of dwarf mistletoe infection.

Table 1. Dwarf mistletoes and their hosts in the Rocky Mountain Region.

Dwarf mistletoe (DM)	Primary host[a]	Other hosts[a]
Lodgepole pine DM *Arceuthobium americanum*	Lodgepole pine	Secondary: ponderosa pine Occasional: whitebark and limber pines
bristlecone pine		Rare: Engelmann and blue spruce,
Limber pine DM *A. cyanocarpum*	Limber pine, Whitebark pine, Bristlecone pine	Rare: ponderosa pine, lodgepole pine
Pinyon DM *A. divaricatum*	Pinyon pine	None
Douglas-fir DM *A. douglasii*	Douglas-fir	Rare: subalpine fir, Englemann and blue spruce
Southwestern DM *A. vaginatum* subsp. *cryptopodium*	Ponderosa pine	Occasional: bristlecone pine, lodgepole pine Rare: limber and southwestern white pine, blue spruce

[a] Hosts are in the following categories:
Primary: more than 90% infection when close to heavily infected trees.
Secondary: frequently infected (50-90% infection) when close to heavily infected principal hosts.
Occasional: occasionally infected (5-50% infection) when close to heavily infected principal hosts.
Rare: rarely infected (≤5% infection), even when close to heavily infected principal hosts.

Disease Cycle—Dwarf mistletoes have separate male and female plants (figs. 5-6). Seeds are produced annually on mature female plants. These are explosively released and typically fly less than 33 ft (10 m). Upon germination, the dwarf mistletoe plant produces a specialized root-like structure that contacts the phloem and xylem of the host, from which the parasite obtains

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Figure 2. After aerial shoots are shed and basal cups remain as signs of dwarf mistletoe infection. *Photo: Kelly Burns, USDA Forest Service.*

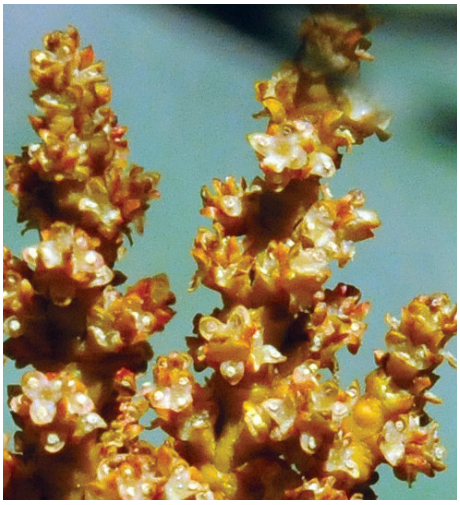

Figure 5. Male flowers on shoots of southwestern dwarf mistletoe. *Photo: Brian Howell, USDA Forest Service.*

Figure 6. Immature female berries on shoots of southwestern dwarf mistletoe. *Photo: Brian Howell, USDA Forest Service.*

Figure 3. Large witches' brooms formed on a ponderosa pine that is heavily infected with southwestern dwarf mistletoe. The top of the tree is dying back. *Photo: Bob Cain, USDA Forest Service.*

Figure 4. Lodgepole pine killed as a result of lodgepole pine mistletoe infection. Note the typical witches' brooms. *Photo: Jim Worrall, USDA Forest Service.*

nutrients and water. Aerial shoots appear 3-5 or more years after infection; the time period before shoots are visible is known as the latent period (fig. 7).

Dwarf mistletoes spread both within and between tree crowns. As a result of the explosive seed-dispersal mechanism, infections tend to build up initially in the lower portion of the crown and spread gradually upward. Lateral spread of dwarf mistletoe through single-storied stands averages about 1.5 ft (0.5 m) per year. Spread is most rapid from infected overstory to adjacent regeneration. Long-distance seed dispersal by birds is not common but can introduce dwarf mistletoe to new areas.

Impact—As parasites, dwarf mistletoes cause significant changes in physiological processes and structural characteristics of infected trees, resulting in changes in the structure and function of forest communities. Tree growth and vigor usually decline when more than half of the crown is parasitized. Most trees survive infection for decades, but small trees tend to decline and die more quickly than large ones. Tree mortality in areas with extensive infection is often three to four times higher than in uninfected areas. Bark beetles frequently attack heavily infected trees, especially during drought.

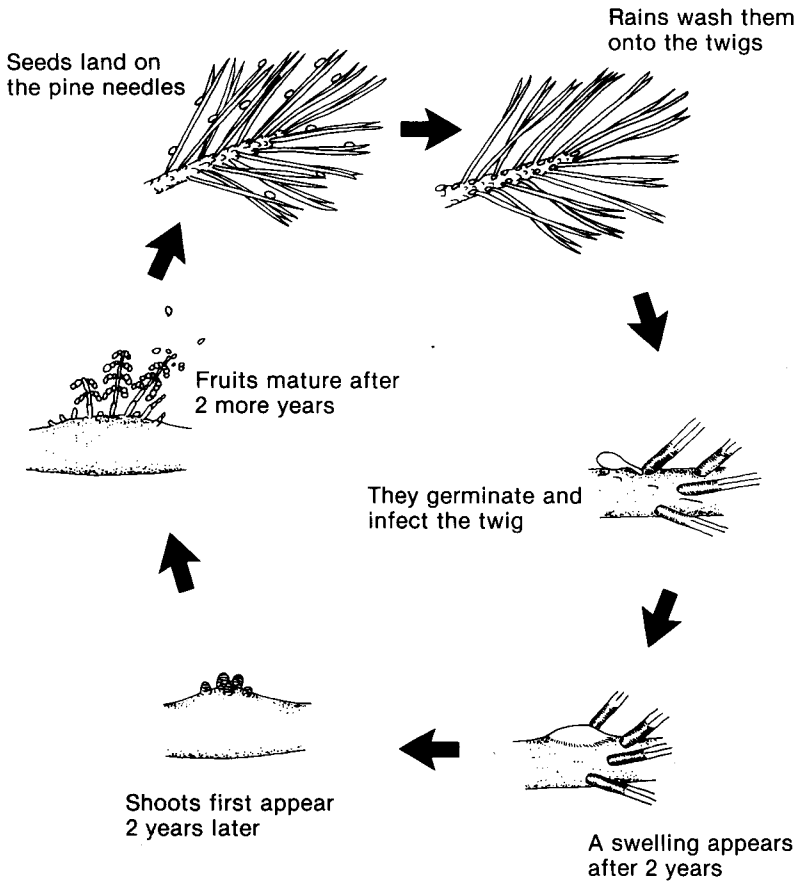

Figure 7. Generalized life cycle of dwarf mistletoes, as exemplified by lodgepole pine dwarf mistletoe on lodgepole pine (from Hawksworth and Dooling 1984).

Figure 8. Evidence of squirrel or porcupine feeding on sugar-rich phloem found near southwestern dwarf mistletoe infections. *Photo: Brian Howell, USDA Forest Service.*

Extensive dwarf mistletoe infection greatly reduces forest productivity. However, infection has some benefits for wildlife. Large witches' brooms provide nesting and seclusion habitat for birds and small mammals. Snags created by dwarf mistletoe infection offer habitat for cavity-nesting birds. A few species are known to feed on shoots of dwarf mistletoes and the sugar-rich phloem found in and around infection sites (fig. 8).

Management—The first step when making management decisions in stands infected with dwarf mistletoe is to quantify the incidence and severity of infection. Although many systems have been used to rate levels of infection by dwarf mistletoe, one is now used almost universally: Hawksworth's 6-class dwarf mistletoe rating (DMR) system (fig. 9). Many disease parameters and management recommendations are provided in terms of DMR because this system has been used for many years. A tree's DMR ranges from 0 (uninfected) to 6 (over half the branches infected throughout the crown). Rate each third of the crown on a scale from 0 to 2, then sum the thirds for the tree rating (fig. 9). Binoculars should be used to enhance detection.

Silvicultural control of dwarf mistletoes can be effective and should be considered for use in a variety of stand conditions and dwarf mistletoe infection levels. Because dwarf mistletoes require a living susceptible host, silvicultural options include pruning, harvesting, and favoring non-host species. Due to the explosive seed dispersal mechanism, implementing buffer strips around infection centers or around sanitized patches can also be effective. A thorough discussion of management options based on stand conditions and objectives is outside the scope of this manual but can be found on the Region 2 Forest Health Management website at: http://www.fs.fed.us/r2/fhm/bugcrud/DM_MgmtGuide_R2.pdf.

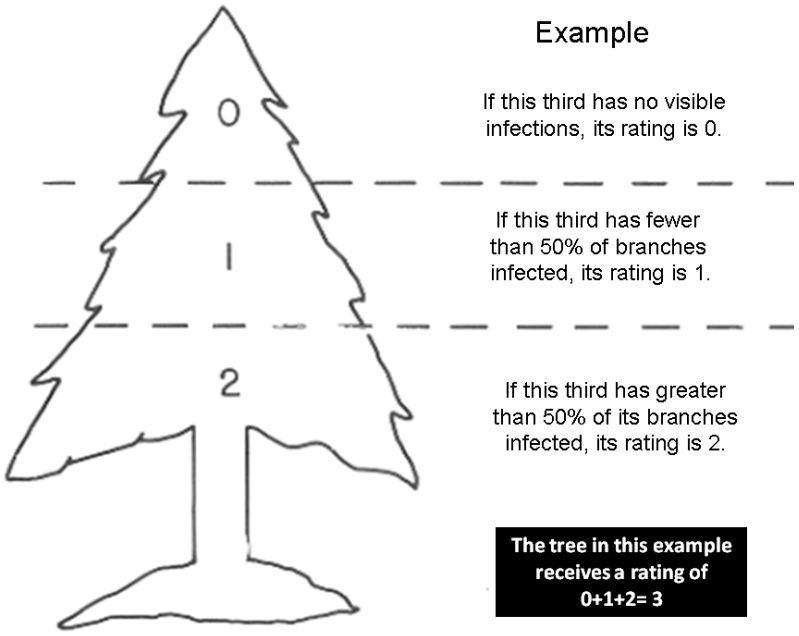

Figure 9. The 6-class Hawksworth dwarf mistletoe rating system (from Hawksworth and Wiens 1996).

1. Hawksworth, F.G. 1977. The 6-class dwarf mistletoe rating system. Gen. Tech. Rep. RM-48. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 7 p.

2. Hawksworth, F.G.; Wiens, D. 1996. Dwarf mistletoes: biology, pathology and systematics. Agricultural Handbook 709. Washington, DC: U.S. Department of Agriculture, Forest Service. 410 p.

3. Sinclair, W.A.; Lyon, H.H. 2005. Diseases of trees and shrubs. 2nd ed. Ithaca, NY: Cornell University Press. 659 p.