

# Mountain Hemlock Is Occasional Host for Hemlock Dwarf Mistletoe in Alaska

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## ABSTRACT

Shaw, C. G., III. 1982. Mountain hemlock is occasional host for hemlock dwarf mistletoe in Alaska. *Plant Disease* 66:852-854.

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) was found on mountain hemlock (*Tsuga mertensiana*) near Homeshore, AK. This is the first and only confirmed occurrence on this host in Alaska since a single, uncertain collection in 1913. *A. tsugense* infects this host less commonly in Alaska than in the western contiguous United States, where *T. mertensiana* is a principal host for *A. tsugense*. The relative infrequency of infection, unusually large swellings at the point of infection, and sparse shoot development suggest some degree of host-parasite incompatibility.

Hemlock dwarf mistletoe (*Arceuthobium tsugense* (Rosendahl) G. N. Jones) is common on western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) in southeast Alaska (8), occurring from Portland Canal to slightly north of Haines. Mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.) mixes with western hemlock throughout the range of the latter species in southeast Alaska, particularly at higher elevations and on noncommercial forest land fringing muskies (5).

At certain locations in California, mountain hemlock trees are severely infected by *A. tsugense* and may be killed by the parasite (2). In contrast, *A. tsugense* is considered uncommon on mountain hemlock in British Columbia, although certain instances of extensive infection have been noted (4).

Hawksworth and Wiens (6) considered both western and mountain hemlock to

be principal hosts for *A. tsugense*. They defined a principal host as one in which more than 90% of the trees of that species growing within 6.1 m of a severely infected host tree were infected. Secondary, occasional, and rare hosts were defined, respectively, as having from 50 to 90%, 5 to 50%, and from greater than 0 but less than 5% of the trees within a 6.1 m radius of a severely infected tree bearing mistletoe infections (6).

The only previous record of *A. tsugense* on *T. mertensiana* in Alaska is one specimen collected in 1913 from "near Sitka" and identified by J. R. Weir (6,8). Interestingly, Weir did not mention that specimen in 1915 when he reported the occurrence of *A. tsugense* in Alaska (12). With only a single host needle present in that collection, it is difficult to confirm that the host was mountain hemlock and not a mislabeled western hemlock.

Laurent, who first reported Sitka spruce (*Picea sitchensis*) as a host for *A. tsugense* (7), has not seen *A. tsugense* on mountain hemlock in 25 yr of observations throughout Alaskan forests (T. Laurent, *personal communication*). Drummond and Hawksworth (3) found no mountain hemlock infected with *A. tsugense* near Kake, AK, even though the several trees they examined were intermingled with

infected western hemlock. It was thus apparent that mountain hemlock growing in Alaska was not a principal host for *A. tsugense*, and questionable whether it was a host at all.

In May 1981, three putative infections of *A. tsugense* were collected from two mountain hemlock trees growing among several severely infected sapling and pole-sized western hemlock trees on a muskeg fringe near Homeshore, AK (58° 19' 30" N., 135° 21' 0" W.). The infections were putative because no mistletoe shoots or basal cups of previous plants were present. Externally, the small lateral branches exhibited unusually large fusiform swellings. The specimens were sent to the USDA Forest Service Forest Pathology herbarium at Fort Collins, CO, for cross-sectional microscopic analysis to detect the endophytic "sinkers" of dwarf mistletoe. This examination confirmed that all three specimens were dwarf mistletoe (F. G. Hawksworth, *personal communication*). Because *A. tsugense* is the only dwarf mistletoe occurring in Alaska (6) and the mountain hemlock trees were growing among severely infected western hemlock, the specimens were undoubtedly *A. tsugense*.

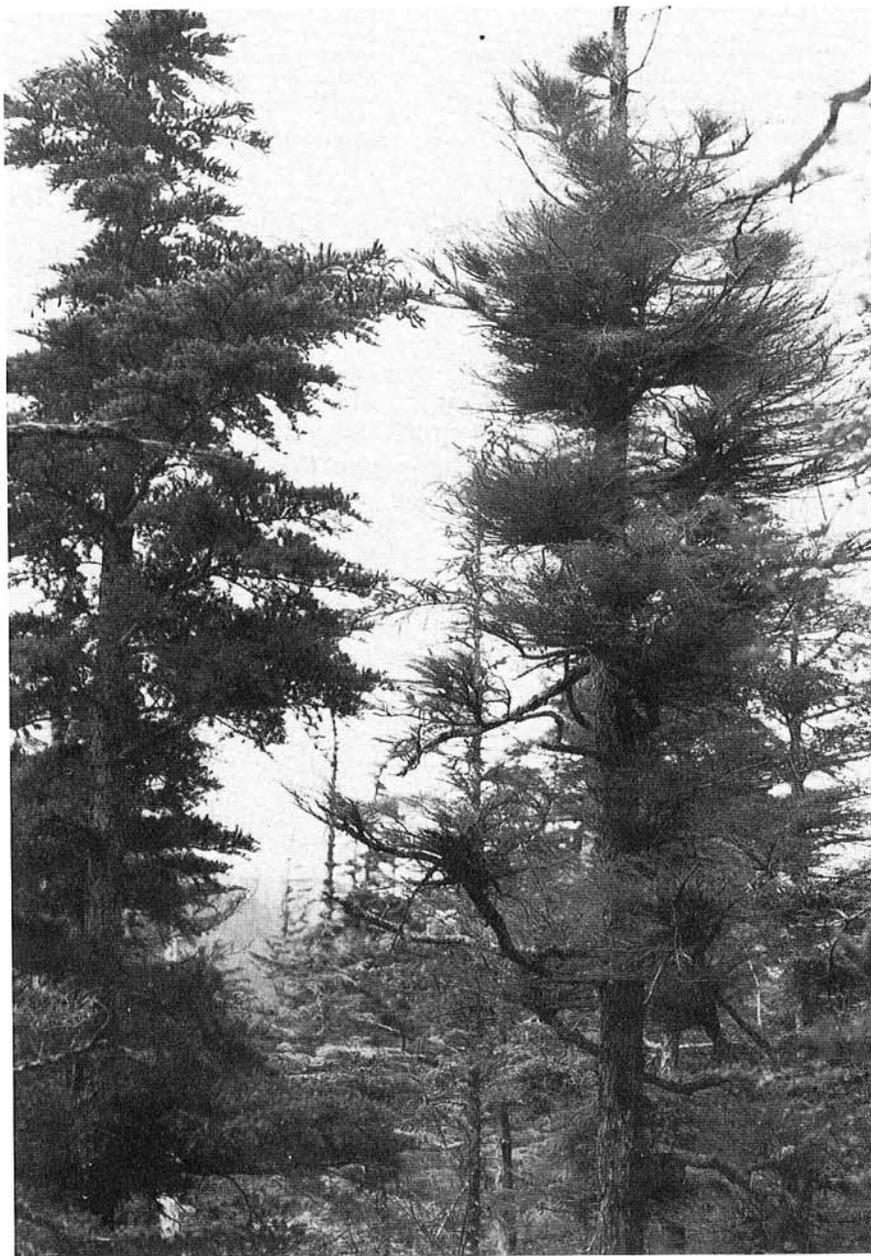
In July 1981, the collection site was revisited, and numerous mountain hemlock growing near western hemlock severely infected with *A. tsugense* were carefully examined for dwarf mistletoe infection. Twenty-five infections were gathered from four trees. Most trees examined had no infections, even where the mountain hemlock crown intermingled with that of a severely infected western hemlock (Fig. 1). The two trees in Figure 1 are more than 170 yr old, providing ample time for infection of the mountain hemlock.

Of the 25 infections, 21 were on live

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**Fig. 1.** Mountain hemlock (left) growing adjacent to a western hemlock (right) that is severely infected with *A. tsugense*. The numerous large witch's brooms on the western hemlock, which is still living, are individual dwarf mistletoe infections. Numerous smaller infections are also present. No mistletoe infections were found on the mountain hemlock. One abnormal swelling on a small lateral branch in the lower crown was collected, but cause for the swelling could not be determined because the branch was dead and extensively deteriorated. The trees are both more than 170 yr old.

branches, 3 were currently bearing mistletoe shoots, and 9 had basal cups, indicating previous shoot production. The three infections with mature shoots confirmed the identification as *A. tsugense*. As with the previous infections, these specimens typically had unusually large (in comparison to infections on similar-sized western hemlock branches) fusiform branch swellings. The overall sparsity of infection, relatively infrequent shoot production, and large swelling at infection sites suggest some degree of host-parasite incompatibility (6).

The 21 infections on live branches were sectioned transversely and microscopically examined to determine infection age and

age of host tissue at time of infection (9). This technique worked well with western hemlock branches infected with *A. tsugense* (11). The swollen annual ring that marks the year of infection, however, was not as readily apparent in infections on mountain hemlock as in those I have observed from western hemlock (10). Accurate age determinations could be made on 13 infections. In these, the age of infection ranged from 13 to 35 yr, indicating little recent infection. The age of host tissue at the time of infection ranged from 4 to 11 yr, with only two infections having been initiated on host tissue less than 5 yr old. The latter was surprising because dwarf mistletoes

generally infect host tissues less than 5 yr old (1,6). All infected branches were slow growing, averaging 0.025 cm per annual ring.

Attempts were made to establish several plots at Homeshore to determine the percentage of mountain hemlock trees that were infected with *A. tsugense* and growing within 6.1 m of a severely infected western hemlock. Only two of these plots had more than five mountain hemlock trees, the minimum number needed to calculate a percentage of infected trees. On these two plots, 1 of 6 (17%) and 4 of 14 (29%) mountain hemlock trees were infected. Each infected mountain hemlock had only one infection.

By definition (6), these infection percentages categorize mountain hemlock as an occasional host. These percentages likely approach maximum infection levels for the host in Alaska because the plots were located within the only area known to contain *A. tsugense* on mountain hemlock. Had Drummond and Hawksworth (3) established similar plots in the stand they examined near Kake, the percentage of infected mountain hemlock would have been zero. My general observations, and those of T. Laurent (*personal communication*, 8), suggest that mountain hemlock is at most only an occasional host for *A. tsugense* in Alaska.

Reasons for the low level of infection in mountain hemlock in Alaska are unknown, but may result from ecotypic variation in the host, parasite, or both, or from environmental factors. The latter seems unlikely, considering the similar environment for the two trees in Figure 1. Even though infection of mountain hemlock by *A. tsugense* is uncommon in Alaska, it still appears to be more common than is infection in Sitka spruce, which is appropriately classified as a rare host (6).

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