Plant Propagation Protocol for *Arceuthobium americanum*
ESRM 412 – Native Plant Production
URL: https://courses.washington.edu/esrm412/protocols/*2023*/*ARAM.pdf*

Arceuthobium americanum on lodgepole pine. [1]

Photos of specimen from CCH2.org.[2]

TAXONOMY	
Plant Family	
Scientific Name	Viscaceae Batsch [3]
Common Name	Christmas Mistletoe family[3]
Species Scientific Name	
Scientific Name	*Arceuthobium Americanum* Nutt. Ex Engelm
Varieties	NA
Sub-species	NA
Cultivar	NA
Common Synonym(s)	*Arceuthobium americanum* Engelm.
Common Name(s)	Lodgepole pine dwarf mistletoe, American dwarf mistletoe
Species Code (as per USDA Plants database)	ARAM
GENERAL INFORMATION	
Geographical range	

	 This plant is native to western United States and southern Canada.[3]
Ecological distribution	This plant is a herbaceous parasitic plant that grows on lodgepole pine (*Pinus contorta)*—and sometimes on other *Pinus* species—growing throughout high elevation pine forest systems.[4] These forests are characterized by dry, rocky-loamy soil with spotty sunlight.[2]
Climate and elevation range	This species can be found on elevations between 1210-8135 ft in areas with annual precipitation of 16-2”-109.4”, temperatures in the coldest months ranging from 26.9-49.4 F and in the hottest months 52-73.9 F.[5]
Local habitat and abundance	*Arceuthobium americanum* grows throughout the range of its host species: lodgepole pine (*Pinus contorta).*[6] The species may also be found occasionally on Jeffrey pine, limber pine, ponderosa pine, shore pine (a sub species of lodgepole pine) and even more seldomly on Englemann spruce, blue spruce, whitebark pine and Rocky Mountain bristlecone pine. [6] These tree species exist in high elevation pine forests and are most common throughout the Rocky Mountain, Sierra Nevada, and Cascade Range in the United States.[5]
Plant strategy type / successional stage	*Arceuthobium americanum* is a parasitic plant that has specialized stems that penetrate bark of the host plant to anchor itself to the plant and access the xylem and phloem. *Arceuthobium americanum* is obligate and dependent on its host species for survival.[1]
Plant characteristics	*Arceuthobium americanum* is a parasitic plant that use haustorial tissue to penetrate the host tree, often lodgepole pine (*Pinus contorta).*[7] The plant is perennial and dioecious with sperate male and female parts.[5] It has a simplified coral-shaped form consisting of short, bushy whorls of yellow/green and leaf-less stems tipped by petal-less flowers.[1,5] The plant uses its host tree to access food from the phloem and water from the xylem, becoming embedded into the tree’s xylem tissues.[7] For *Arceuthobium americanum*, male and female flowers are produced yearly, but a female flower takes two years to mature and produce one-seeded berries.[7] In contrast, male flowers will mature, produce staminate structures, and disperse pollen on annually.[7,8] During the fruit ripening process, water builds up inside the fruit until the fruit wall bursts, creating an explosive discharge, and the seeds are shot out at high speeds up to 60 miles per hour, traveling as far as 15 to 50 feet, seeking to stick to the stem of their next host tree and await for

germination.[1] The seeds of these trees are adapted for this process with a sticky and viscous texture that helps them adhere to their host tree.[1] It can take two years after germination for the infected area of the tree to swell and for dwarf-mistletoe shoots to appear, and start the fruiting process anew.[1]

This species causes significant detriment to the timber industry by affecting the host trees in many ways: the plant reduces wood quality, increases drought stress, reduces seed production, and increases susceptibility to insects and fire.[1,6] Infested stands can be identified be swelling on the boles of the plant, abnormally tufted branches, as well as the shoots of the mistletoe on branches and main stems, which are harder to see.[6] The plants effect on trees may be exacerbated with a changing climate, further increasing this plants overall impact on forest health.[1] Species spread is aided by fires when partial burns leave infested trees in the overstory, ideally located for infection of the regenerating stand.[6]

This plant is a host plant for butterfly and moths, such as the Thicket Hairstreak (*Callophrys spinetorum*), Johnson's Hairstreak (*Callophyrs johnsoni*), White-lined Sphinx (*Hyles lineata*), and *Dasypyga alternosquamella*. The structures formed within trees as a product of infection can be important for nesting birds and other wildlife. Considering this plant's value to insect and animal species, propagation of the species may be desired at some point. Likely, this propagation would be for conservation reasons with the goal of increasing infection of lodgepole pine in new areas.

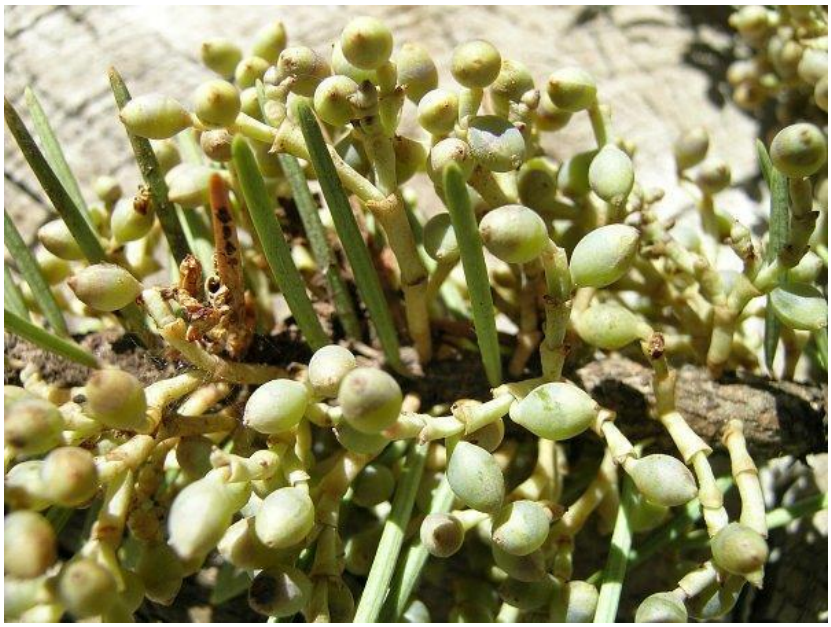
Photo: extensive infection can cause "witches brooms" which are dense, multiple branched infection centers.[9]

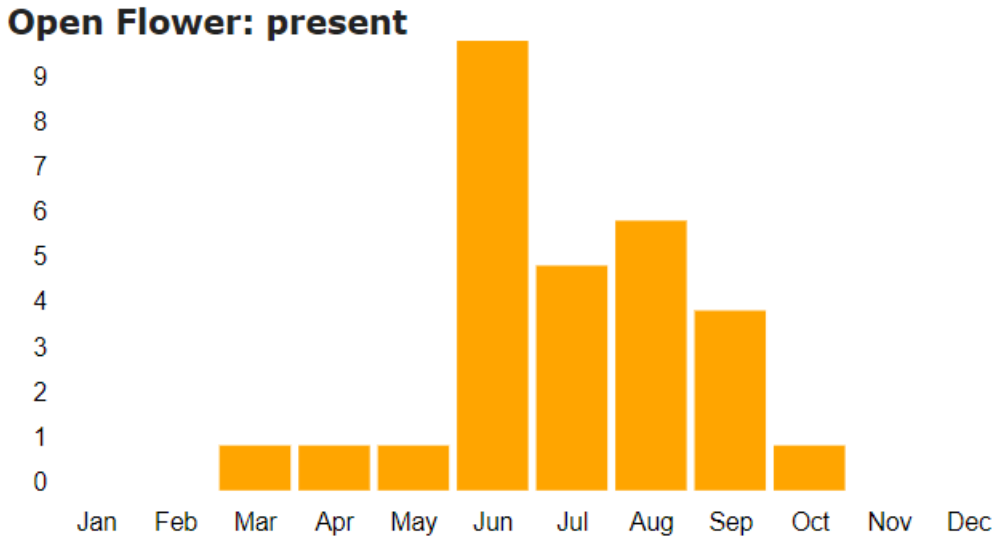
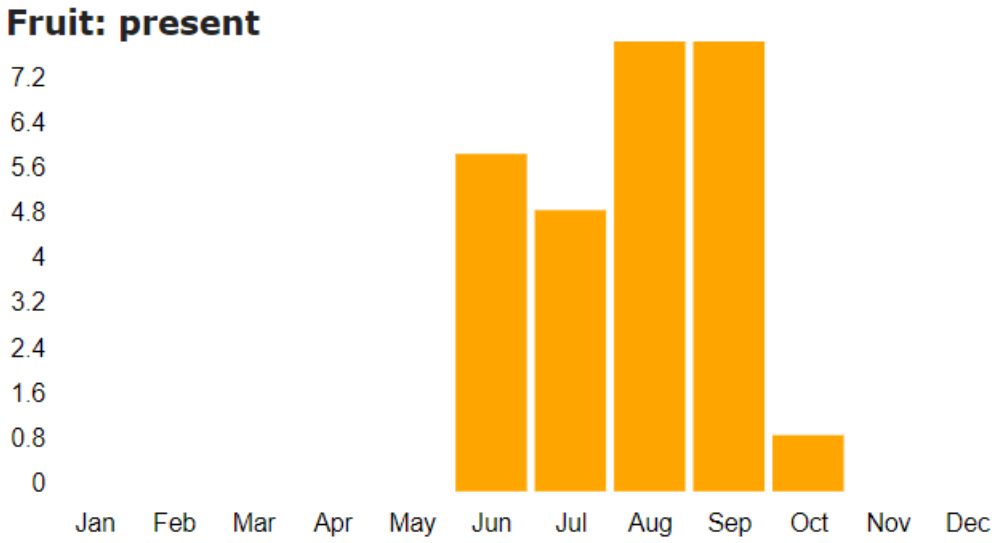
	 Photo: example of swelling on infected branch.[10]

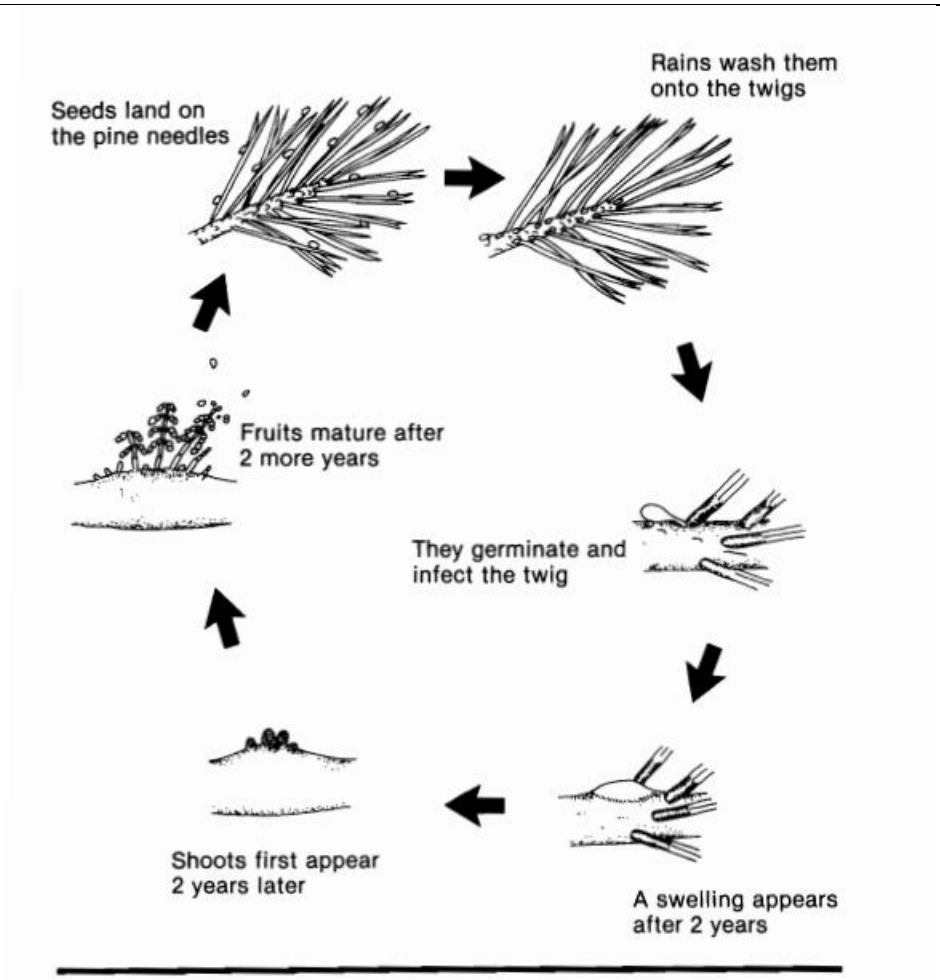
PROPAGATION DETAILS

No information was found for propagation of this species. Most reference material explained options for controlling or removing this species. The following table is conjecture only, based on the plant characteristics, for how to spread this plant to new forest areas that are not currently infected.

Ecotype	NA
Propagation Goal	Seed
Propagation Method	Seed
Product Type	Unknown
Stock Type	Unknown
Time to Grow	Plants will likely take two to five years to propagate in new forest areas. If ripe seeds can be collected, they can be placed onto a host tree (*Pinus contorta*) in a new area and allowed to germinate, infect the plant, and put out shoots. From point of contact with the new host tree to germination, it takes two to five years.[6] If this stage is sufficient for purposes (e.g. wanting to successfully spread the plant into new area) then the infection process will likely take that two to five year timeframe. If one is interested in harvesting seeds, the fruit maturation process will take another two years after shoots are present on the new host tree.[6]
Target Specifications	This write-up is intended to aid someone who is intending to spread the parasitic plant by seed in order for the plant to colonize a new forested area.
Propagule Collection Instructions	The tables below highlight typical flowering and fruiting times for the species. Seed collectors should scout and identify flowering plants June through August looking for ideal specimen. Plant collectors need to be able to identify female versus male flowers. Male flowers normally have three sepals and no petals.[8]

	Female flowers have "two perianth parts, are bilaterally flattened and symmetrical and have a heart-shaped dorsiventral face."[8] At this point, seed collection bags can be placed over the plant so as to catch the explosive seeds when they pop. These bags tend to be small gauze-like bags with a drawstring so seeds can be caught throughout the ripening phase. Specimen with bags drawn over the plant should be flagged and georeferenced so they can be located again at regular intervals.  Photo: female specimen of another type of mistletoe, Douglas-fir mistletoe (*Arceuthobium spp*.) in the same genus.[11]  Photo: male specimen of another type of mistletoe, Douglas-fir mistletoe (*Arceuthobium spp*.) in the same genus.[11]

	  Graphs sourced from CCH2.org[2]
Propagule Processing/Propagule Characteristics	Unknown
Pre-Planting Propagule Treatments	Unknown. Likely, collection bags should be monitored regularly so that seeds can be placed on new host trees as soon as possible. It's unclear how long the adhesive qualities of the seeds will last after fruit eruption.
Growing Area Preparation / Annual Practices for Perennial Crops	Thought should be given to access and convenience of host trees. If trying to produce additional seeds at scale, one might want to preemptively plant a lodgepole pine stand near the operation facility to have host plants readily accessible.
Establishment Phase Details	It takes two years for seeds to ripen once the first plant shoots appear on the host species.[6]

	 **Figure 9**—*Diagram of the typical lodgepole pine dwarf mistletoe life cycle from seed dispersal to mature plants.* Diagram taken from Hawksworth and Dooling.[6]
Length of Establishment Phase	See above diagram. Total process from shoot appearance to fruit maturation is two years, with some sources saying up to five years for this process.[6,7]
Active Growth Phase	Unknown
Length of Active Growth Phase	Unknown
Hardening Phase	Unknown
Length of Hardening Phase	Unknown
Harvesting, Storage and Shipping	Harvesting of plants in newly infected trees should follow natural bloom patterns. Bagging plants should occur during peak bloom (June) with seed collection throughout June to October.
Length of Storage	Unknown.
Guidelines for Outplanting /	Seeds should be transferred to host trees as quickly as possible to make use of natural adhesive coating on the seed and mimic natural processes as best as possible.

Performance on Typical Sites	
Other Comments	Propagation of this species should only be done with explicit direction from natural resource managers. Spread of this species can have detrimental impacts on an economically important timber production. Knowledge of propagation of this species, however, may be important for future conservation efforts.
INFORMATION SOURCES	
References	1. Fertig, W. Lodgepole Pine Dwarf Mistletoe. *USDA USFS Plant of the Week* https://www.fs.usda.gov/wildflowers/plant-of-the-week/arceuthobium_americanum.shtml. 2. Frequency of Open Flower and Fruit - present, by month, for 29 herbarium specimens of Arceuthobium americanum Nutt. ex Engelm. from the CCH2 Portal. (2023). 3. USDA Plants Database. *Arceuthobium americanum* https://plants.usda.gov/home/plantProfile?symbol=ARAM. 4. Jepson eFlora: Arceuthobium americanum. *The Jepson Herbarium* https://ucjeps.berkeley.edu/eflora/eflora_display.php?tid=13877 (2023). 5. Calscape: Lodgepole-pine Dwarf Mistletoe, Arceuthobium americanum. https://calscape.org/Arceuthobium-americanum-(Lodgepole-pine-Dwarf-Mistletoe)?srchcr=sc581004d46f331. 6. Hawksworth, F. & Dooling, D. Lodgepole Pine Dwarf Mistletoe. *USDA For. Serv. For. Insect Dis.* (1984). 7. Hampel, L. D., Cheeptham, N., Flood, N. J. & Friedman, C. R. Plants, fungi, and freeloaders: examining temporal changes in the "taxonomic richness" of endophytic fungi in the dwarf mistletoe Arceuthobium americanum over its growing season. *Botany* **95**, 323–335 (2017). 8. Munro, K. C., Jackson, J. R. M., Hartling, I., Sumner, M. J. & Friedman, C. M. R. Anther and pollen development in the lodgepole pine dwarf mistletoe (Arceuthobium americanum) staminate flower. *Botany* **92**, 203–215 (2014). 9. Koski, R. D. Mistletoes in Colorado Conifers - 2.925. *Colorado State University Extension* https://extension.colostate.edu/topic-areas/yard-garden/mistletoes-in-colorado-conifers-2-925/ (2013). 10. Government of Canada, N. R. C. Lodgepole pine dwarf mistletoe. https://tidcf.nrcan.gc.ca/en/diseases/factsheet/1000088 (2013). 11. Dwarf Mistletoes - Field Guide to Insects and Diseases of AZ and NM Forests. *USFS* https://www.fs.usda.gov/r3/resources/health/field-guide/mistletoes/dwarf.shtml.
Other Sources Consulted	The Native Plant Network (https://npn.rngr.net/) was consulted for any *Arceuthobium* species but no information was available.
Protocol Author	Stacey Dixon
Date Protocol Created or Updated	5/21/2023