

Guidelines for Whitebark Pine Planting Prescriptions

Glenda L. Scott, Reforestation Specialist, USDA Forest Service, Northern Region, Missoula, MT;

Ward W. McCaughey, Research Forester, retired; **Kay Izlar**, Ecologist, USDA Forest Service, Pacific Northwest Research Station, Anchorage Forestry Sciences Lab

Abstract—Whitebark pine (*Pinus albicaulis*) is a keystone species in high-elevation ecosystems of the western United States. Unfortunately many fragile subalpine ecosystems are losing whitebark pine as a functional community component due to the combined effects of an introduced disease, insects and succession. Planting whitebark pine is one part of a multifaceted restoration strategy (Keane and Arno 2001). Once seedlings are established, they have the potential to be a long term seed source where existing trees have been lost. The practice of growing and planting whitebark pine is relatively new compared to traditional conifers, and with the high cost of cone collection and seedling production, survival is particularly important. This paper describes the planting guides created by Scott and McCaughey (2006) and further refined by McCaughey and others (2009). The planting guidelines should help increase survival making wise use of limited funds, and further the restoration of whitebark pine.

Ecological Environment

Whitebark pine is adapted to a wide range of ecological conditions however it has a specialized niche with a distinct competitive advantage on windswept ridge tops, shallow soils, and high elevation sites. It is typically a pioneer species in the more mesic portions of its range, and it is successional to shade tolerant species such as subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*). In the drier portions it maintains itself in a self-perpetuating climax species. In the Northern Rockies, it is present on a variety of habitat types defined by Pfister and others (1977) although it is most common as a long lived seral on the *Abies lasiocarpa*-*Pinus albicaulis*/*vaccinium scoparium* and *Abies lasiocarpa*/*Luzula hitchcockii* types (Arno and Hoff 1989).

Whitebark pine is most successful in establishing where there is a gap in the forest canopy (Arno and Weaver 1990, Larson and Kipfmüller 2010). It appears to be relatively shade intolerant, with less tolerance than subalpine fir and spruce and more tolerance than lodgepole pine (*Pinus contorta*) (Arno and Hoff 1989). Larson and Kipfmüller (2010) found seedlings, but few saplings, under a subalpine overstory but there were established saplings in canopy breaks. Izlar (2007) found fewer whitebark pine where it was outcompeted by faster growing lodgepole pine, spruce and Douglas-fir. When whitebark pine and lodgepole pine coexisted, Moody (2006) found whitebark pine to be below the dominant lodgepole pine canopy layer.

The presence of ground vegetation has a strong effect on the ability for whitebark pine to establish. Seedlings planted in the presence of grouse whortleberry (*Vaccinium scoparium*) had higher survival and growth than if planted in bare ground or other vegetation (Perkins 2004). Grouse whortleberry likely produces positive effects from reduced evapotranspiration, but the greater benefits may be from mycorrhizal relationships or other beneficial below ground interactions. Seedlings did not survive well when planted with sedges or similar ground vegetation and were especially outcompeted by species such as beargrass (*Xerophyllum tenax*) which has a tough fibrous root system.

Whitebark pine grows in cold, windy, snowy climatic zones (Arno and Hoff 1989). On these relatively harsh sites, planted seedlings survive best when they are protected by microsites which reduce the light intensity and stem heating (Izlar 2007) and also moderate cold conditions. Young seedlings, while drought resistant, are not frost resistant (McCaughey 1994) further emphasizing the benefits of microsites. Planted seedlings that were protected from moving snow and soil also survived better (Izlar 2007). In areas where soil movement was occurring, planted seedlings were protected by large stable material uphill from the planted seedling; the material caused moving snow and soil to be redirected away from the seedling. Material below the seedling however caused soil to “pool” around the seedlings, partially covering it.

Guidelines for Planting Prescriptions

The following planting guides presented by McCaughey and others (2009) incorporate the ecological and adaptive properties of whitebark pine into tree planting prescriptions to optimize survival and establishment and develop stands for long term restoration.

1. Plant large, hardy seedlings with good root development. Good tree vigor and fibrous roots systems give the seedlings the best advantage on harsh sites.
2. Reduce overstory competition to increase light and day length to improve the effective growing season.
 - a. Whitebark pine is relatively shade intolerant requiring open conditions to establish and grow well.
 - b. In early seral stages, whitebark pine does not tend to dominate and create wide crowned individuals because

- of competition and crowding from faster growing species.
3. Emphasize planting in areas where whitebark pine is growing or is known to have grown in the past.
 - a. Avoid planting in areas where other species are establishing because they tend to outcompete whitebark pine seedlings. For example, burned lodgepole pine stands typically regenerate quickly with high seedling density that will rapidly outcompete whitebark pine seedlings.
 - b. Do not plant in 'mixed plantings' with other conifers. Whitebark pine can be easily outcompeted by faster growing tree species such as lodgepole pine, Douglas-fir and Engelmann spruce. Whitebark pine is slow growing and terminal growth will slow when shaded.
 4. Reduce most understory vegetation especially grasses and sedges to reduce competition for available soil moisture.
 - a. Do not aggressively remove grouse whortleberry during site preparation. If grouse whortleberry is not present, a planting spot with bare mineral soil is the best alternative.
 - b. Avoid areas of highly competitive vegetation. For example avoid beargrass areas as it is an extremely hardy, competitive plant, and has a very tough and fibrous root system making it difficult for planting any type of tree.
 5. Consider ridge tops or exposed slopes which are generally the most suitable for planting. Avoid planting in swales or frost pockets considering the topographic position as well as the actual planting spot. Gopher activity increases where soils are deeper thus increasing mortality of planted trees. Young whitebark seedlings do not appear to be frost hardy during certain times of the growing season.
 6. Provide microsites for newly planted trees to improve water utilization, reduce light intensity and stem heating, and protect the seedlings from wildlife trampling. A favorable microsite is one of the most critical conditions for survival. Stumps, rocks, and large logs are favorable microsites. Large material uphill from the planted seedling protects it from moving snow and soil, but microsites that are down-slope of seedlings can cause soil to pool and partially bury seedlings. Microsites should be stable and not able to roll over or onto seedlings.
 7. Avoid planting seedlings next to tall snags. Dead trees will, in time, fall. There are several reports of seedlings being uprooted in the root ball of falling trees. Downed trees or broken off snags are better microsite choices.
 8. Do not overcrowd planted trees to avoid long-term inter-tree competition. Open grown trees produce the largest crowns and the most cones; tree form is not important. Adjust spacing guides based on expected survival. For example if the prescription is for 100 live seedlings per acre (247 per hectare) and typical survival is 50 percent, then the planting density should be 200 trees per acre (494 trees per hectare) with spacing averaging 15 ft x 15 ft (4.5 m x 4.5 m).
 9. Plant when there is adequate soil moisture. Summer and fall planting may avoid the need for long expensive snow plows and delayed entry due to heavy spring snow loads, however recent dry summers may be limiting the summer plant window.

Additional observations

The best chance for success in restoring and maintaining whitebark pine is from planting seedlings with blister rust resistance. Cones should be collected from trees expressing resistance using criteria established by Mahalovich and Dickerson (2004) as a first but critical step towards improving rust resistance. The Forest Service has an aggressive blister rust resistance breeding program, and are establishing seed orchards. We hope the orchards will be producing rust resistant seed for many seed zones in Montana and Idaho in the next five to six years (Mahalovich 2010).

Nursery managers in the western U.S. have been producing increasingly better quality whitebark pine seedlings. Seedlings are generally grown in a large container for two growing seasons; a 10 in³ container is most common. These larger containers allow for extensive root development which whitebark pine needs, while two growing seasons allow seedlings to develop height and larger caliper. Managers should continue testing various containers and cultural practices to grow target seedlings prescribed for varying site conditions. There is promising research on the benefits of inoculating seedlings with beneficial mycorrhizae, and practices are being developed for seed scarification which will enhance germination success and reduce handling and contamination. As an alternative to planting, seeding trials are in progress to more easily artificially reforest whitebark pine in hard to access areas.

Conclusion

Silviculturists are planting whitebark pine as one tool for whitebark pine restoration. Planting prescriptions for whitebark pine are similar to those for other species on harsh sites; however, whitebark pine grows in ecosystems typically avoided for planting with other conifers. Incorporating these planting guides should help enhance survival and establishment success. With proper attention to planting prescriptions, improved genetic rust resistance, and healthy tree stock, we can augment blister rust resistance and survival of planted trees where natural seed sources are limited. These planting guides should continually be updated based on research and monitoring of planted whitebark pine.

References

- Arno, Stephen F.; Weaver, Tad. 1990. Whitebark pine community types and their patterns on the landscape. In: Schmidt, Wyman C. (proj. ldr.). Proceedings—Symposium on Whitebark pine ecosystems: Ecology and management of a high-mountain resource. 1989; Bozeman, MT. Gen Tech. Rep. INT-270.

- Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station: 97-105.
- Arno, Stephen F.; Hoff, Raymond J. 1989. Silvics of whitebark pine (*Pinus albicaulis*). Gen. Tech. Rep. INT-253. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 11 p.
- Izlar, Deborah Kay. 2007. Assessment of whitebark pine seedling survival for Rocky Mountain plantings. Missoula, MT: University of Montana, MT. 76 p. Thesis.
- Keane, R. E.; Arno, S. F. 2001. Restoration concepts and techniques. In: Tomback, D. F.; Arno, S. F.; Keane, R. E., tech. eds. Whitebark pine communities: Ecology and restoration. Island Press, Washington, DC: 367-400.
- Larson, Evan R.; Kipfmüller, Kurt F. 2010. Patterns in whitebark pine regeneration and their relationship to biophysical site characteristics in southwest Montana, central Idaho, and Oregon, USA. Canadian Journal of Forestry Research. 40: 476-487.
- Mahalovich, M. F.; Dickerson, G. A. 2004. Whitebark pine genetic restoration program for the Intermountain West (USA). In: Sniezko, R. A.; Samman, S.; Schlarbaum, S. E.; Kriebel, H. B. (eds). Proceedings—Breeding and genetic resources of five-needle pine: growth, adaptability and pest resistance; 2001. Medford, OR. Proc. RMRS-P-32. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 181-187.
- Mahalovich, Mary Frances. 2010. [Personal communication]. April 26. Moscow, ID: U.S. Department of Agriculture, Forest Service, Northern Region.
- McCaughey, Ward. 1994. Silvicultural treatments and whitebark pine plantation and regeneration trial results. In: Kendall, K. C.; Coen, B.; Keane, B.; Donner, B.; Brewer, K., tech coords. Proceedings—Research and management in whitebark pine ecosystems 1994. West Glacier, MT: 35-40.
- McCaughey, Ward; Scott, Glenda L.; Izlar, Kay L. 2009. Whitebark pine planting guidelines. Western Journal of Applied Forestry. 24(3): 163-166.
- Moody, Randall John. 2006. Post-fire regeneration and survival of whitebark pine (*Pinus albicaulis* Engelm.). Vancouver, British Columbia. 108 p. Thesis.
- Perkins, Judy L. 2004. *Pinus albicaulis* seedling regeneration after fire. Missoula, MT: University of Montana. 144 p. Thesis.
- Pfister, R. D.; Kovalchik, B. L.; Arno S. F.; Presby, R. C. 1977. Forest habitat types of Montana. Gen. Tech. Rep. INT-GTR-34. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 174 p.
- Scott, Glenda L., McCaughey, Ward W. 2006. Whitebark pine guidelines for planting prescriptions. In: Riley, L. E.; Dumroese, R. K.; Landis, T. D., tech coords. National Proceedings: Forest and Conservation Nursery Associations—2005; Park City, UT. Proc. RMRS-P-43. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 84-90.

The content of this paper reflects the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.
