Perspectives and Outplanting Performance with Deciduous Forest Seedlings

Alex Dobkowsi[1]

Dobkowski, A. 1996. Perspectives and Outplanting Performance with Deciduous Forest Seedlings. In: Landis, T.D.; South, D.B., tech. coords. National Proceedings, Forest and Conservation Nursery Associations. Gen. Tech. Rep. PNW-GTR-389. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 215-219. Available at: http://www.fcanet.org/proceedings/1996/dobkowski.pdf

Abstract-In 1986 Weyerhaeuser initiated a series of research studies and pilot-scale plantations to provide information pertaining to the plantation establishment of red alder (*Alnus rubra* Bong.). The establishment of operational- scale plantations began in 1990. The current target is to regenerate approximately 3,000 acres per year in western Washington to red alder. Recently, we have begun small-scale plantings to investigate the nursery culture and field performance of bigleat maple (*Acer macrophyllum* Pursh) and Oregon ash (*Fraxinus latifolia* Benth.) seedlings.

The past ten years of experimentation and operational experience by Weyerhaeuser and others has culminated in considerable progress having been made relative to understanding the requisites for red alder plantation establishment. Proper site selection, quality seedlings, thorough weed control, and outplant timing are the keys to a successful plantation. Rapid capture of the site by the planted seedlings is critical in order to capture the early fast growth of the species. Lack of attention to any one aspect of the prescription can lead to poor plantation performance.

Poor soil drainage, frost, drought, competing vegetation, and big-game activity can provide considerable hindrance to successful plantation establishment. Through the careful evaluation of site characteristics, experienced foresters can select locations for red alder production that have a high probability of regeneration success.

It is important to plant only high quality seedlings. Bare-root seedlings, grown in open nursery beds, can provide seedlings with the attributes necessary to regenerate most sites suitable for red alder production. Nursery production can be adversely impacted by the effects of disease, unusually cool summer temperatures, and fall/ winter freeze damage. Freeze damage is of particular concern because even minor top-kill can result in otherwise healthy seedlings that will develop multiple stems/poor stem quality after outplanting. Seedling performance is greatly enhanced with thorough site preparation to control weeds; herbaceous weed competition in the first-year has been shown to be very detrimental to red alder seedling performance.

The proper planting date is an important consideration. Depending upon local site conditions and expected weather trends, a planting date should be selected to balance the risks of freeze damage (planting too early) and drought stress (planting too late). Experience in western Washington places the recommended planting window between mid-March and mid-April at elevations less than 1000 feet.

These findings with red alder are expected to apply to bigleaf maple and Oregon ash as well. One difference that has already been shown is that maple and ash are more susceptible than red alder to damage from big-game browse. Maple and ash appear vulnerable to browse throughout the year. The browse can result in mortality and severely diminished vigor and growth. Browse can also predispose the seedlings to the effects of weed competition. These effects can significantly increase the amount of time necessary for the species to capture the site.

INTRODUCTION

Weyerhaeuser's experience with the planting of deciduous tree species has been with red alder (*Alnus rubra* Bong.) Red alder is one of the few quality hardwoods which can be grown to a high value commodity in a relatively short rotation (30 to 40 years). In addition to its lumber value, red alder is also a valuable pulpwood species. These facts coupled with a projected declining supply of alder and an increasing product demand gives Weyerhaeuser an optimistic view of the value of dedicating land to red alder production.

In 1986 Weyerhaeuser Company became interested in understanding the plantation culture of red alder. An operational research project was initiated to address informational needs pertaining to the following topics: planting stock production and field performance; site selection; site preparation requirements (including weed control); planting specifications (planting date, stock handling, etc.); stand culture; and managed stand growth and yield. The establishment of operational-scale plantations began in 1990. The current target is to regenerate approximately 3,000 acres per year in western Washington to red alder. Red alder will be grown to supplement the supply of naturally occurring red alder sawlogs.

The past ten years of experimentation and operational experience by Weyerhaeuser and others has culminated in considerable progress having been made relative to understanding the requisites for red alder plantation establishment. Proper site selection, quality seedlings, thorough weed control, and out plant timing are the keys to a successful plantation. Rapid capture of the site by the planted seedlings is critical in order to capture the early fast growth of the species. **Lack of attention to any one aspect of the prescription can lead to poor plantation performance.**

Recently, we have begun small-scale plantings to investigate the nursery culture and field performance of bigleaf maple (*Acer macrophyllum* Pursh) and Oregon ash (*Fraxinus latifolia* Benth.) seedlings. Many of the key learnings derived from research and operational experience with red alder are expected to apply to bigleaf maple and Oregon ash as well.

SITE SELECTION

Red alder will occupy sites with a range of soil and physiographic conditions. However, the risk of plantation failure can be very high on poorly drained, frost prone, or droughty sites. Through the careful evaluation of site characteristics, experienced foresters can select locations for red alder production that have a high probability of regeneration success.

Poorly drained soils have the effect of inducing seedling mortality where saturated soils persist into the growing season. It also severely restricts root growth on seedlings that survive periodic soil saturation. This can be particularly true if the periods of saturation coincide with periods of maximum root growth. The diminished root system can predispose newly planted seedlings to summer drought stress. Given the heavy herbaceous weed communities that can develop on these sites and limited site preparation options, drought stress effects can be compounded resulting in considerable seedling mortality.

Areas of severe frost hazard should not be regenerated to red alder. Sites associated with topographic features that have a high probability of cold air drainage from higher elevations in the spring and fall seasons should be avoided. Both late spring and early fall frosts can be disastrous to a first year alder plantation. On plantations located in severe frost pockets stemkill to ground level was observed on trees which were 3 to 5 feet in height. Re-sprouting from root systems may provide acceptable survival. However, the accumulation of effects from frost events can result in a stand with very poor log quality.

STOCK QUALITY

As with any reforestation program, quality planting stock is essential to red alder plantation establishment. The following seedling propagation technologies are available to produce operational quantities of planting stock:

> **Plug-seedlings:** (green-house grown in plastic-foam blocks [82 or 131 cm^3] or in single plastic cells [164 cm^3]);
>
> **Bare-root bed-house seedlings:** (seed sown in the nursery bed and grown under a transparent, tent like covering to facilitate germination and provide shading);
>
> **Bare-root open-bed seedlings:** (seed sown in the nursery bed and grown without protective cover); and
>
> **Plug-transplant:** (a small plug (33 cm^3) grown in the greenhouse from March until transplanted in June into a nursery bed where it remains for the rest of the growing season).

Inoculation of growing medium with *Frankia* (an actinomycete bacteria which colonizes red alder root systems and functions to fix atmospheric nitrogen) increases seedling vigor and crop yield with all of the above technologies.

Although these technologies differ in production cost, all yield seedlings of suitable quality for outplanting in one growing season. All stock types have been used to successfully establish red alder plantations. The bare-root (open-bed) and plug/transplant nursery cultures produce seedlings that perform on average, across all site conditions, better than seedlings produced by the other technologies.

Greenhouse- and nursery-grown red alder seedlings are vulnerable to certain diseases. Considerable fall-down in crop yield has been attributed to *Septoria alnifolia* (a leaf-spot fungus that can develop stem cankers) and *Botrytis* sp. (a gray mold that results in leaf mortality and causes top-kill). An aggressive disease detection and treatment program is very necessary.

Nursery freeze damage in the late-fall/early winter and winter can also decrease nursery yields. Freeze damage is of particular concern because even minor top-kill can result in otherwise healthy seedlings that will develop multiple stems/poor stem quality after outplanting. It is essential to have the capacity to frost protect red alder nursery beds. The potential down-side of frost protection, some stem breakage and delayed leaf abscission, are minor when compared the severe effects of nursery freeze damage.

The seedling grading process needs to include an assessment of root systems, stem and root breakage, top-kill and overall seedling health. Seedlings with ascertainable top-damage (from freeze, disease, or mechanical damage) and damage to roots that are greater than 2 mm in diameter should be excluded from pack. Seedlings that loose apical dominance will develop multiple stems after outplanting. Given the heliotropic nature of red alder, these multiple-stems will persist at normal planting densities and cause a degrade in log quality.

Field trials have shown that seedlings with a height of 12 to 36 inches, basal caliper a minimum 0.16 inches (measure I inch above the root collar), and a full root system will give good performance. Field performance is more a function of caliper and roots system that it Is height. Forester preference is for a seedling that is 18 to 24 inches in height and greater than 0.20 to 0.25 inches in caliper. The height provides a seedling that is short enough for easy handling and tall enough to be seen by planters. Top-pruning is not a desirable method to control seedling height in nursery beds - after outplanting seedlings can develop into trees with multiple stems/poor stem quality. The larger caliper gives better resistance to the effects of sun-scald and seems to be correlated with a vigorous root system.

The selection of proper stock is dependent upon the regeneration risks associated with a particular site weighted against site preparation and stock cost. All stock types are vulnerable to a degree to the effects of herbaceous weed competition. Taking into consideration stock cost and field performance, bare-root seedlings produced with open-bed nursery technology are the preferred stock type for reforesting most alder sites.

SITE PREPARATION

Red alder can be very sensitive to weed competition, particularly herbaceous weeds in the first growing season after planting. Weed competition in the extreme case can preclude seedling establishment. However, even without approaching the survival threshold, weed competition can affect growth and may retard the rate of stand development. Since there are currently few broadcast herbicides available for the release of red alder from weed competition, the use of pre-plant herbicides to promote rapid site occupancy by the red alder crop is an important consideration.

Heavy first and second-year herbaceous weed competition has been shown to be detrimental to red alder survival and growth. On sites with the expectation of greater than 90 to 100% weed coverage, particularly with seedling over-topping, pre-plant herbicides that reduce herbaceous weed competition can be beneficial. Effective herbaceous weed control can often be the difference between plantation success and failure. Sites with an expectation of low to moderate weed competition in the first three to four years can be adequately regenerated with minimal to no site preparation. Particularly if plug/transplant stock is used. An example of low vegetation competition potential is a dense stand of western hemlock (*Tsuga heterophylla*) with little to no vegetation surviving in the understory. After harvest, the reduced weed seed bank would result in a low probability of weed re-invasion and subsequent competition

It is important to assess the risk of weed competition, then apply the appropriate level of site preparation matching stock type and planting density accordingly. The current recommendation for site preparation is to: 1) limit physical site preparation (scarification and burning): 2) use site preparation herbicides in the late Summer/early Fall to control established weeds; and 3) apply pre-plant herbicides as needed in the Spring.

PLANTING DATE

The proper planting date is an important consideration. Depending upon local site conditions and expected weather trends, a planting date should be selected to balance the risks of freeze damage (planting too early) and drought stress (planting too late).

Seedlings planted late-November through January are susceptible to winter freeze and desiccation damage. Seedlings planted in mid-February can de-harden and break bud quickly while the risk of frost is still high. Seedlings planted in May might not develop an adequate root system before the onset of summer drought. Experimentation and experience in western

Washington, at elevations less than 1000 feet, places the recommended planting window between mid-March and mid-April.

CONCLUSION

Weyerhaeuser has made considerable progress relative to understanding seedling propagation and plantation establishment requirements for red alder. By applying the knowledge gained, successful plantation establishment is predictable. Much of what we have learned has been shared with other organizations; principally through participation in the Hardwood Silviculture Cooperative at Oregon State University College of Forestry. The major information gap that exists is the lack of managed stand, growth, yield, and wood quality data. Weyerhaeuser is working along with other organizations to develop the data base necessary to address those questions.

Many of the key learnings derived from research and operational experience with red alder are expected to apply to bigleaf maple and Oregon ash as well. One difference that has already been shown is that maple and ash are more susceptible than red alder to damage from big-game browse. Maple and ash appear vulnerable to browse throughout the year. The browse can result in mortality and severely diminished vigor and growth.

ACKNOWLEDGMENT

Much of the information presented in this paper is the result of work by a team of Weyerhaeuser scientists, nursery managers, and foresters. The author would like to recognize Thomas S. Stevens, Jerry Barnes, Mark E. Triebwasser, Paul Figueroa, Willis Littke, Yasu Tanaka, Heinz J. Hohendorf, and John Keatley for their contributions.

---

[1]*Weyerhaeuser Western Forestry Research, PO Box 188, Longview, WA 98632; Tel: 360/425-2150.*

REFERENCES

Ahres, G.R., A. Dobkowski, and D.E. Hibbs. 1992. Red alder: guidelines for successful regeneration. Forest Research Laboratory, Oregon State University, Corvallis, Oregon. Special Pub. No. 24

Ahrens, G.R. 1994. Seedling quality and nursery practices for red alder. In: The Biology and Management of Red Alder. Edited by D. E. Hibbs, D. S. DeBell, and R. F. Tarrant. Oregon State University Press, Corvallis, Oregon.

Dobkowski, A. , P.F. Figueroa, and Y. Tanaka. 1994. Red alder plantation establishment. In: The Biology and Management of Red Alder. Edited by D. E. Hibbs, D. S. DeBell, and R. F. Tarrant. Oregon State University Press, Corvallis, Oregon.

Figueroa, P.F. 1988. First-year results of a herbicide screening trial in a newly established red alder plantation with 1 +0 bare-root and plug seedling stock. Proceedings of 1988 Western Society of Weed Sci. Mtg. Weed Sci. 41:108-124.

Harrington, C. A. 1986. A method of site quality evaluation for red alder. U.S. For. Serv. Gen. Tech. Rep. PNW- 192.

Harrington, C.A. and P.J. Courtin. 1994. Evaluation of site quality for red alder. In: The Biology and Management of Red Alder. Edited by D. E. Hibbs, D. S. DeBell, and R. F. Tarrant. Oregon State University Press, Corvallis, Oregon.

Kenady, R. M. 1978. Regeneration of red alder. In: Utilization and management of alder. Compiled by David G. Briggs, Dean S. Debell, and William A. Atkinson. US For. Ser. Gen. Tech. Rep. PNW-70: 183-192.

Peeler, K.C. and D.S. DeBell. 1987. Variation in damage from growing season frosts among open-pollinated families of red alder. U.S. For. Res. Note PNW-RN-464.

Pezeshki, S.R. and T. M. Hinckley. 1988. Water relations characteristics of Alnus rubra and Populus trichocarpa: response to field drought. Can. J. For. Res. 18:11591166.

Radwan, M.A., Y. Tanaka, A. Dobkowski, and W. Fangen. 1992. Production and assessment of red alder planting stock. USDA For. Ser. Res. Pap. PNW-RP-450.

Stroempl, G. 1990. Deeper planting of seedlings and transplant increase plantation survival. Tree Planters' Notes 41(4):17-2 1.

Worthington, N.P., R. H. Ruth, and E.E. Matson. 1962. Red alder: Its management and utilization. USDA For. Ser. Misc. Pub. 881.