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Red Alder: Guidelines for Seed Collection, Handling, and Storage

David E. Hibbs
Alan A. Ager

FOREST RESEARCH LAB

College of Forestry Oregon State University

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Introduction

The increasing demand for red alder (*Alnus rubra* Bong.) stumpage in the Pacific Northwest has stimulated interest both in more intensive management of existing stands and in the establishment of managed plantations. However, silviculture of the species is hampered by limited information, which is particularly scarce in the area pertaining to the propagation of red alder from seed. Little has been published on seed and seedling biology that is useful to organizations planning seedling production for managed stands.

This paper gives information pertaining to the collection, extraction, and storage of red alder seed, the important first steps in the establishment of managed stands. The information was compiled during a 1-day workshop at Oregon State University attended by people actively collecting red alder seed in the Northwest, and it represents their collective experience.

Given the present state of knowledge of red alder genetics and seed biology, the recommendations in this guide should be regarded as provisional. However, we believe they accurately summarize current knowledge of the species. One clear conclusion of the workshop that generated this guide was that further research is needed on all topics covered here.

The guide is divided into five parts. The first two address some genetic considerations, suggesting provisional rules for seed-transfer and the selection of trees for seed collection. The third section describes a method of assessing the seed crop and suggests ways to improve the quantity and regularity of crops. The fourth covers cone collection—its timing and methods. Last is a description of procedures for the handling of seed, from cone collection to seed storage.

Seed Zones and Transfer Rules

Red alder appears to have geographic patterns of genetic variation that are similar to those of sympatric conifer species indigenous to the Pacific Northwest (Ager 1987). Red alder also shows population differentiation on a fine scale (Ager 1987), apparently in response to climate-related selection pressures. Therefore, it appears that seed transfer may generally be guided by principles developed for Pacific Northwest conifers. We recommend that the seed zones established by the Western Forest Tree Seed Council for conifers in Oregon and Washington and the biogeoclimatic zones in British Columbia (Rowe 1972) be used as a guide for seed transfer (Figure 1). However, two specific transfers within the zones should be avoided: 1) those between the north and south slopes of the major east-west river drainages of the Cascade and Olympic Mountains, and 2) those between the river bottoms and the side slopes of a given drainage.

The guidelines given here are conservative and so preclude obtaining performance gains by planting nonlocal materials having faster inherent growth rates than local materials. Although data indicate that some seed sources markedly outperform others (Ager 1987; Lester and DeBell 1989), long-term testing is needed to better quantify the risks associated with seed transfer. Future work will delimit seed zones specific to red alder. Until then, use of the conifer seed-zone maps and the biogeoclimatic map will minimize regeneration problems. In the interim, we offer the following provisional guidelines:

- Seed should be collected within the same seed zone as the intended plantation site.
- Within a given seed zone, seed should be collected from stands having the same physiography as the plantation site. In particular, significant differences in elevation and aspect should be avoided. A significant difference in elevation is one that exceeds 700 feet (215 m). A significant difference in aspect is that between north and south aspects on a slope of 20 percent or more.
- Seed lots should be identified by stand location so that they may be properly allocated within a new seed-zone system when it is available.

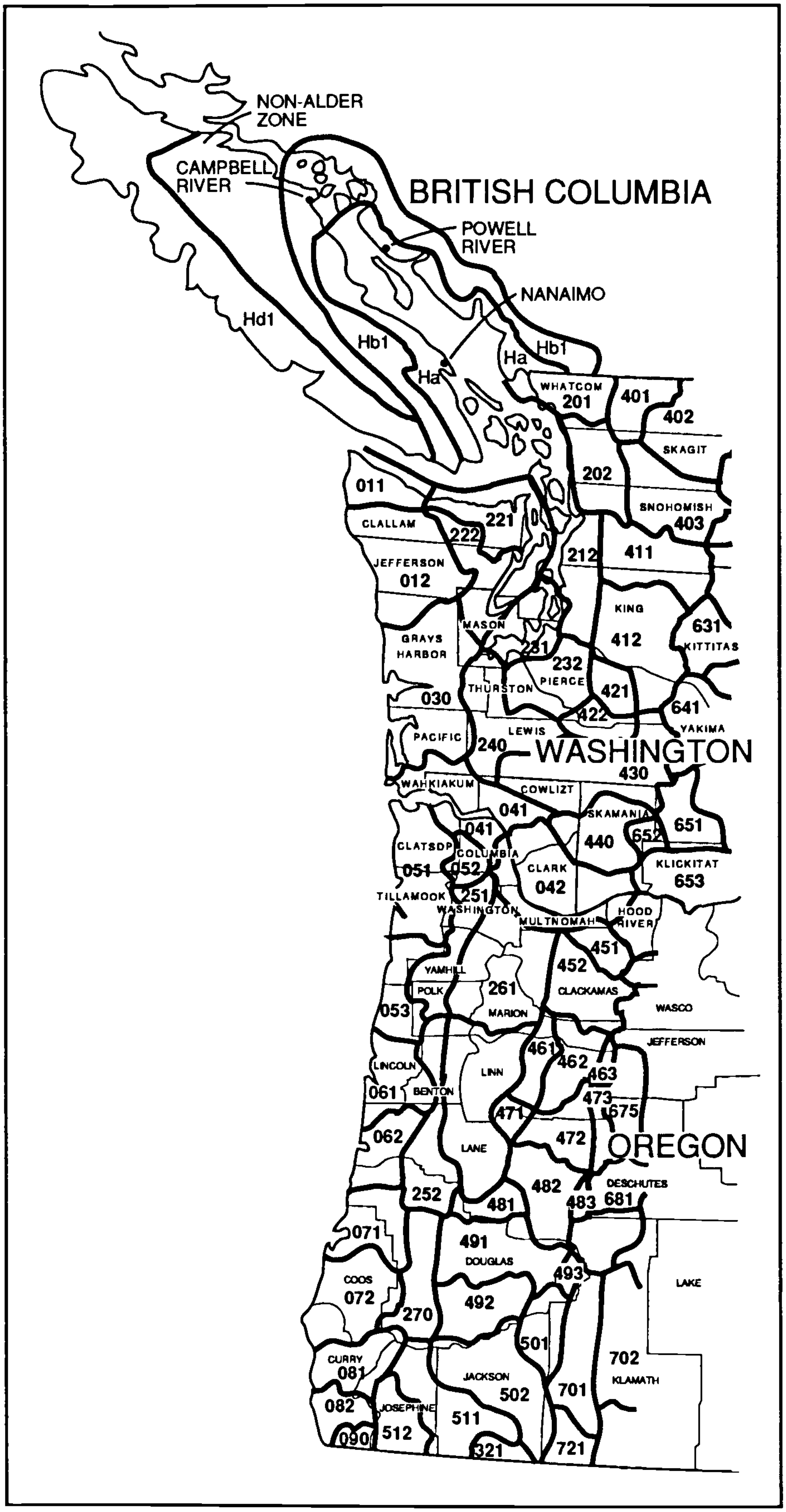

Figure 1. *Conifer seed zones for western Oregon and Washington and the biogeoclimatic zones for coastal British Columbia recommended as provisional seed zones for red alder.*

Seed-Tree Selection

Cone collections should be made from trees that have good growth and form and that are free of disease and insect problems. Collections should be concentrated on better-than-average stands of alder. Selection of superior stands and trees may result in performance gains of 5 to 10 percent, although gains from field selection of red alder have not yet been documented.

We suggest that the following steps be taken to ensure a broad genetic base in seed lots destined for reforestation.

- Collection should be avoided in stands smaller than 1 acre (0.4 ha) as they tend to have lower seed viability. If the only available stands are smaller than 10 acres (4 ha), the seed lot should be bulked from several nearby stands with similar history and site characteristics.
- Selected seed trees should be at least 100 feet (30 m) apart.
- A given seed lot should include seed from at least 10 to 20 of the larger, better formed trees in a stand.
- Seed should be stored by lot.
- At least two seed lots from a given seed zone should be combined in any reforestation effort, and a different combination of lots should be used for each project within a zone.
- As the area to be reforested increases, the number of lots in the mix should increase.

Seed-Crop Assessment

Red alder trees may produce seed as early as age 3, although the average age at the beginning of production is closer to 15 years. Seed production is greatest between 25 and 35 years, but it continues throughout the life of the tree. Each fall, a large number of catkins (male flowers) and strobiles (female flowers) for the next year's seed crop are visible. However, through a summer, many flowers abort, and many of the seeds remain unfilled. Thus, the potential for seed production is always greater than actual production. Nevertheless, each year at least a modest seed crop is produced.

The seed crop is best assessed in August by counting cones (mature strobiles) on trees and counting filled seed in cones. Binoculars aid in counting cones in the upper portions of a tree crown. Since the seed crop of individual trees within a stand may vary greatly in both quantity and quality (Brown 1986), several potential seed trees should be observed. Usually a tree will have many more cones than can be seen from the ground. A good cone crop is indicated by a count of several hundred cones on a tree 20 to 35 years old.

The number of filled seed in a cone is determined by splitting a cone longitudinally along its central axis and counting the number of filled seed on one cut face (Figure 2). The number may vary from zero to twenty or more. Counts of

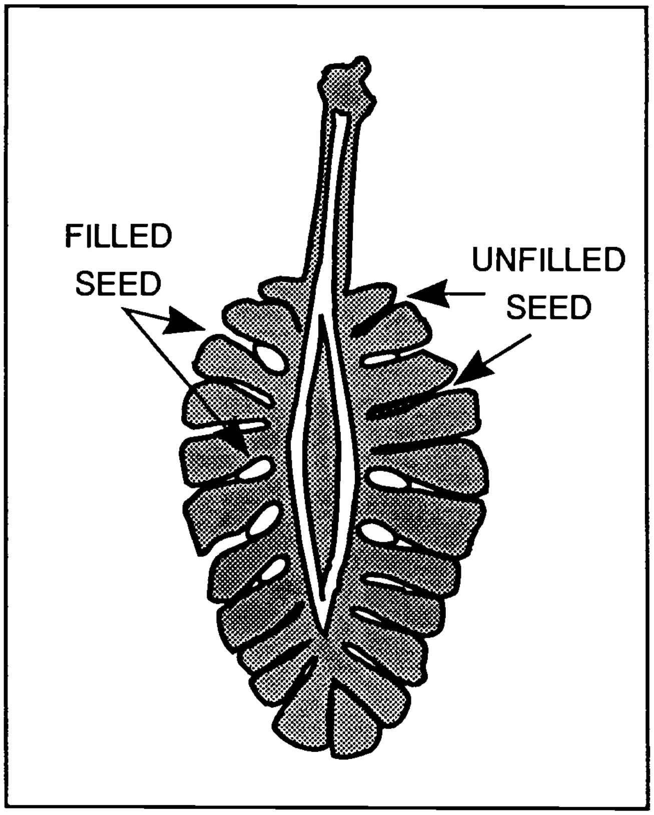

Figure 2. *A split alder cone. The light-colored seeds are located between the cone scales and near their base. A good seed crop is indicated by a count of five or more per face.*

less than four filled seed per face show that cone collection will yield little seed. From ten to twenty cones from several trees should be examined.

Large-crowned trees and trees under little environmental stress produce larger and more regular seed crops, which leads to the conclusion that management (thinning, weed control, phosphorus fertilization) may enhance seed production.

Seed yields vary widely. The following ranges are derived from *Seeds of Woody Plants in the United States* (Schopmeyer 1974) and the experience of the workshop participants.

Cones per tree	0.1 to 0.5 bushels
Cones per pound	0.14 to 0.2 bushels
Seed per 100 pounds of cones	1.4 to 15 pounds
Seed per bushel of cones	0.1 to 1.1 pounds
No. of seeds per pound of seed	383,000 to 1,087,000

Cone Collection

Depending on the location, seed ripens between early September and mid-October. Cone crops in stands in areas with long growing seasons, such as low-elevation coastal regions, usually mature later than their counterparts in inland stands at higher elevations. The time differential between seed maturation in the coastal and higher inland sites can exceed 1 month. However, pronounced variation in maturity among stands within an area may obscure area-to-area differences.

Maturity can be evaluated by twisting a cone along the long axis (Figure 3). If it twists easily and the scales part slightly, the seed is sufficiently mature for collection. Color is also a good indicator of maturity. Immature cones are green, while mature cones are mottled shades of yellow-green, yellow-brown, and gray-brown. Dark brown cones on a tree that also has green cones are probably cones from the previous year. Current-year aborted cones are abundant in drought years and also are brown.

The most efficient technique for cone collecting is to fell a seed tree onto a roadway, trail, or other open space. When repeated collections from the same tree are required, trees can be climbed by means of ladders or spurs and individual limbs removed. Cones may be stripped from branches with a cone rake, and the leaf litter may be blown out later with a fan. Cones from the upper third of the crown tend to contain the most viable seed (Brown 1986).

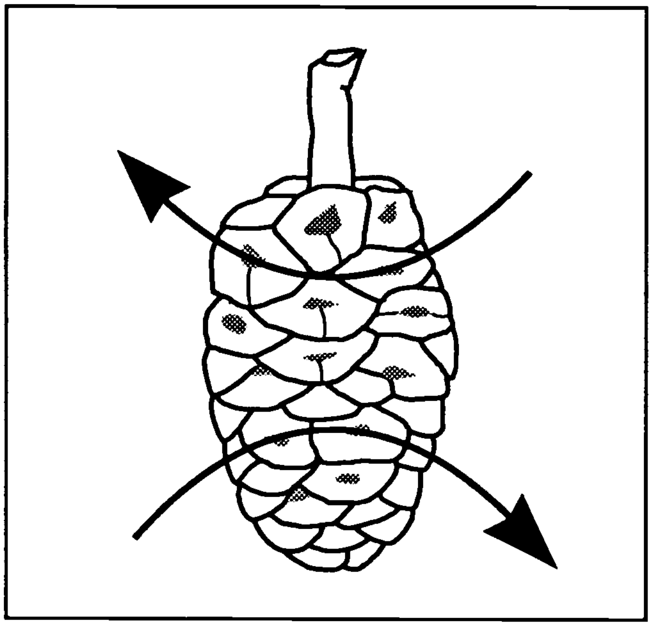

Figure 3. *When cones begin to change color from green to yellow, maturity can be tested by twisting the top and bottom of the cone in opposite directions. Cone scales will separate easily when the cone is ripe.*

Seed Handling and Storage

The seed of red alder can be dried, extracted, and stored with procedures similar to those used for Pacific Northwest conifers.

Identification. Each seed lot should be identified by source, and the identification should be carried with the lot through processing and storage. Seed certification is a convenient method for doing this and can help ensure future identification of a seed source. Information that should be recorded on seed-certification tags is species, date, collector, seed zone (or equivalent), elevation, aspect, slope position (e.g., bottom, slope, ridge), stand size, number of trees used, and exact location. The location can be recorded by its legal site description, the UTM military grid system, or any reproducible method.

In the United States, the certifying agencies listed below provide application forms and information on the certification process.

Washington State Crop
Improvement Association, Inc.
512 North Front Street
Yakima, WA 98901
Phone: (509) 248-3240

Seed Certification Service
31 Crop Science Building
Oregon State University
Corvallis, OR 97331
Phone: (503) 737-4513

British Columbia only certifies seed for export.

Drying. Freshly picked cones should be transferred promptly to a drying facility. Air circulation is important for minimizing mold. Cones can be dried in fine mesh bags or on screens (Figure 4). Cones are dried at temperatures in the range of 60° to 80°F (16° to 27°C) until the scales begin to flair and the seed is loose. Drying time varies from 2 to 7 days, depending on temperature, humidity, and ventilation.

Extraction. Seed are extracted by tumbling. Extraction is sometimes aided by partially crushing the cones, although this increases both the amount of cleaning required and the likelihood of damage to the seed.

Cleaning. Seed are cleaned first by passing them through a screen to remove large trash and then by processing them with an air column to remove small material.

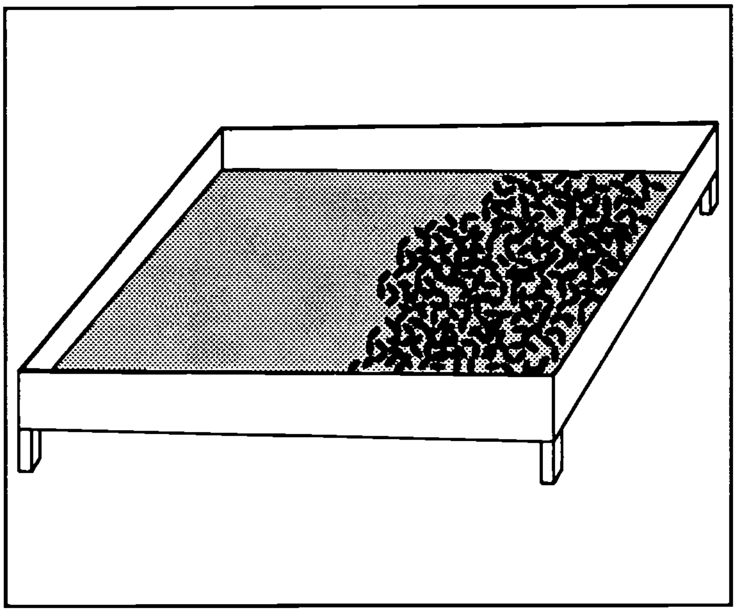

Figure 4. *A typical cone-drying rack consisting of a wire screen held within a wooden frame. The screen mesh size is small enough to retain alder seed. The frame is elevated to ensure good air circulation.*

Viability. Viability (percentage of germination) of cleaned seed may be as high as 85 percent. Variation in viability is pronounced both among trees within a stand and among stands (Ager unpublished data). Low viability is usually attributable to empty seed; therefore, a rough indication of the viability of freshly collected seed can be obtained by determining the percentage of filled seed under a dissecting microscope. A more accurate estimate can be obtained by germinating a 30- to 100-seed sample on moist paper in a petri dish at 70°F (21°C) for 2 weeks. Red alder seed does not need stratification.

Storage. Refrigeration is adequate for short-term seed storage, but for long-term storage, seed should be dried to less than 10-percent moisture content and stored at 8° to 10°F (–12° to –13°C) in moisture-proof containers. Storage for as long as 5 years has not resulted in large losses of seed viability.

Each seed lot should be kept in a separate container and should be identified with the source information recorded at collection and the handling history since collection. This information should be securely attached to the storage container. A duplicate tag inside the container will add security.

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