Greenhouse Germination Trials of Pelletized Western Redcedar and Red Alder Seeds

Nabil Khadduri

Nabil Khadduri is Natural Resources Scientist, Webster Forest Nursery, Washington Department of Natural Resources, Olympia, WA 98504; Tel: 360.664.0139; E-mail: nabil.khadduri@wadnr.gov.

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Abstract: Pelletized western redcedar (*Thuja plicata* Donn ex D. Don) and red alder (*Alnus rubra* Bong.) seeds exhibited lower total germination and delayed germination speed (G50 or days to 50% germination) when compared to non-pelletized "raw" seeds in greenhouse trials. Averaged across two lots of western redcedar, pelletizing decreased total germination from 81% to 76% and delayed germination by 2 days. Averaged across four lots of red alder, pelletizing decreased germination from 78% to 68% and delayed germination by 7 days. It is logistically difficult to both stratify and pelletize seeds. Western redcedar often receives a stratification treatment in practice, even though none is recommended in standard protocols. Lab tests conducted on four lots of 21-day stratified versus non-stratified seeds showed no change in total germination and only a 2.5-day delay in germination speed, suggesting a lack of dormancy in western redcedar. Given the efficiencies gained in mechanical sowing and subsequent thinning operations, pelletizing is a cost effective decision for the light, irregular-shaped seeds of these species.

Keywords: pelletized seeds, *Thuja plicata, Alnus rubra*

Introduction

Why Pelletize?

Western redcedar (*Thuja plicata* Donn ex D. Don) and red alder (*Alnus rubra* Bong.) (ITIS 2006) are increasingly used for reforestation in the Pacific Northwest, but their light, irregular-shaped seeds make efficient sowing a challenge in container production. Seeds are difficult to singulate, causing mechanical sowing lines to run slowly because they are hindered by inconsistent seed placement and an increased need for manual checking. In order to keep production moving, a choice must often be made between empty cells and excessive seeds per cell. Empty cells waste greenhouse space, whereas multiple seeds per cell lead to extra time spent thinning to one seedling per cavity.

Seed pelletization (fig. 1) refers to a process where difficult-to-sow seeds are bulked up with inert fillers and binders to become comparatively rounder, smoother, heavier, and more uniform in shape (Brandt 1996). Quality pelletizing results in one seed per pellet, with a very low rate of empties or multiples. The seeds are easy to manipulate, and mechanical sowing is optimized.

While pelletization of western redcedar and red alder is the norm in British Columbia (Kolotelo 2006), this practice is less common among U.S. growers of these species.

Stratification Needed for Western Redcedar?

Due to the logistical difficulties of coordinating pelletization and stratification treatments, seeds that are pelletized are generally sown without stratification (cold, moist chilling). Alder is known to lack a stratification requirement (Radwan and DeBell 1981), especially when optimal temperatures are used in greenhouse production. However, for western redcedar, an informal survey of several growers in Washington and Oregon revealed that many feel that stratification is necessary for

Figure 1—Pelletized and raw seeds of western redcedar and red alder, respectively.

best germination results. As pelletization of western redcedar seeds in British Columbia became operational in the 1990s, some growers at the time also questioned the lack of stratification associated with this treatment. In response, the Tree Seed Centre of the BC Ministry of Forests ran a comparison of 22 lots of 21-day stratified versus non-stratified seeds. They found that, on average, total germination was unchanged with only a slight delay in germination (Kolotelo 1996).

To confirm a lack of dormancy in western redcedar, we first conducted lab germination tests comparing stratified versus non-stratified western redcedar from four lots representing each of the main seed transfer zones in western Washington. We then carried out a greenhouse trial, without any stratification treatment, to compare pelletized versus non-pelletized, or "raw," seeds for two lots of western redcedar and four lots of red alder.

Methods

Stratification Requirement Trial for Western Redcedar

Tests comparing stratified and non-stratified seeds were conducted on four lots of western redcedar representing the four main seed transfer zones in western Washington for this species.

1. **Stratification treatment**. Four replicates of 100 seeds for each lot were separated into individual mesh bags and placed under a running water soak for 24 hours. After 24 hours, seeds were surface dried at 21 °C (70 °F). Seeds were then placed on Petri dishes on #4 Whatcom blotting paper, pre-moistened with distilled water, and arranged so that no contact occurred between seeds. Petri dishes were inserted into plastic bags and placed in a stratification room at 2 °C (36 °F), where they remained for 21 days.

2. **Control (non-stratified treatment**). On day 21 of the stratification treatment, an additional four replicates of 100 seeds for each of the four lots were plated out onto Petri dishes as described above.

Tests were carried out using a germinator with alternating day/night temperatures of 30/20 °C (86/68 °F) and a photoperiod of 16 hours light/8 hours dark. Blotter paper was moistened as necessary with a spray of distilled water. Germination counts were made on days 7, 14, and 21, with germinants removed at time of counting. Germination was defined as extension of the radicle to at least four times the length of the seed coat.

Pelletization Trial for Western Redcedar and Red Alder

Tests comparing pelletized and raw seeds were conducted on seed lots of western redcedar and red alder representing seed transfer zones in western Washington.

Seeds of western redcedar and red alder were pelletized at Harris Moran Company (Salinas, CA) using a proprietary combination of inert filler and binder materials. For a detailed description of making pellets, see Walters and Geary (1989) or Scott and others (1997). Writing in an online newsletter, Kubik (2006), seed physiologist at Harris Moran, refers to the process this way (fig. 2):

> "…seed is placed in a large rolling pan. The pan is continuously turning and tumbling the seed during this process. The pelleter sprays water until the seed surface is wet. After that, he sprinkles the pelleting powder over the wet, tumbling seed. The powder sticks to the wet seed. The pelleter then sprays adhesive until the seed and powder is again wet. Then more powder, then more adhesive, then powder, then adhesive etc. etc. etc. During the process the pellets are removed from the rolling pan several times in order to run them over a sizing screen so that smaller pellets can be built up, while any larger pellets wait outside the pan. This is done until all pellets are exactly the same standard size. Knowing when and how much adhesive to add, and when and how much powder to add is an

Figure 2—Pelletizing seeds (courtesy Harris Moran).

art that takes some time and practice to perfect. For example, if you get the seed too wet in the beginning the seed sticks to each other and you get two seeds per pellet. Not enough adhesive makes for a pellet that is too soft."

Western redcedar pellets received from Harris Moran were oval-shaped, approximately 4 by 3 mm (0.15 by 0.1 in). Red alder pellets were round, approximately 2 mm (0.08 in) in diameter. Pelletized seeds were shipped in sealed, plastic 7.6 l (2 gal) buckets. Upon recommendation, seed containers were stored at 2 °C (36 °F). Cost per lot in 2006 was U.S. $300, with a sliding scale after 1 million pelletized seeds. Seed turnaround from shipment to receipt was under 3 weeks.

In conjunction with operational sowing, seeds were sown into Styroblock™ trays. For western redcedar, a 240 cavity tray with a cavity volume of 39 cc (2.4 in^3) was used. The trial consisted of a two seed treatment (pelletized seeds versus raw seeds) by two seed lot factorial design, with four seed treatment-seed lot combinations. Four 100-seed replicates for each seed treatment-seed lot combination were randomly assigned to trays, but no combination was allowed to occur more than once in any given tray.

For red alder, a 448 cavity tray with a cavity volume of 18 cc (1.1 in^3) was used. The trial consisted of a two seed treatment (pelletized seeds versus raw seeds) by four seed lot factorial design, with eight seed treatment-seed lot combinations. Again, four 100-seed replicates for each seed treatment-seed lot combination were randomly assigned to trays, but no combination was allowed to occur more than once in any given tray.

For both western redcedar and red alder, seeds were surface sown by hand onto a soilless medium (80% peat/20% perlite). Western redcedar seeds were covered with 3 to 4 mm (0.1 to 0.15 in) forestry sand (Target Supplies, Burnaby, BC). Red alder seeds were not covered. Containers were watered operationally in a boom irrigation system with an initial 2.5 cm (1 in) drench, followed by misting passes as needed. Germination counts took place every 7 days for 28 days, with germination defined as emergence of the cotyledons above the soil surface.

Results

Stratification Requirement Trial for Western Redcedar

For the four western redcedar lots tested, germination capacity (or total germination) at day 21 was, for practical purposes, unchanged whether seeds were stratified or not stratified (fig. 3). Error bars represent standard error of the mean. Non-stratified seed germination capacity averaged 87.6% compared to an average of 86.1% for stratified seeds.

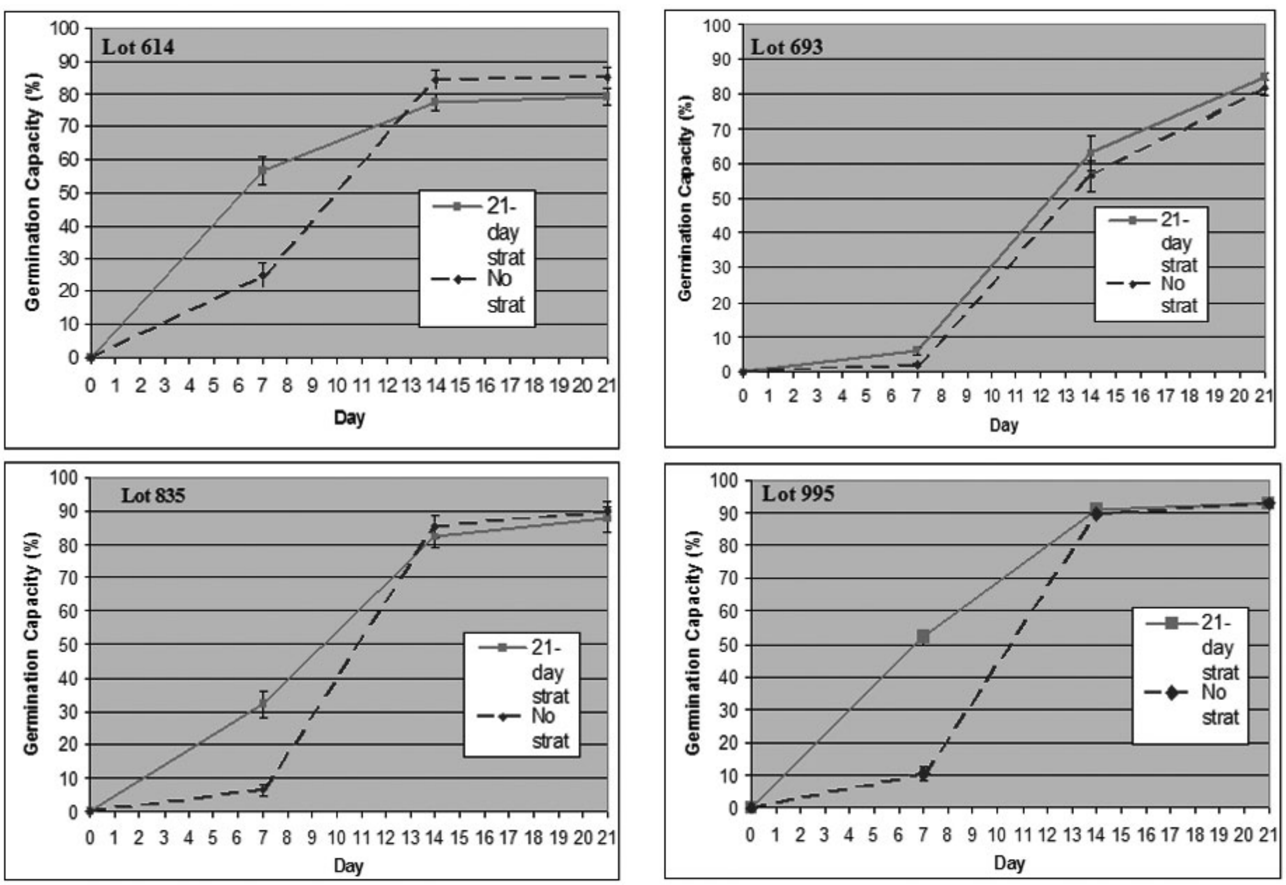

Figure 3—Stratification (21-day) versus no stratification lab germination for 4 lots of western redcedar. Error bars represent standard error of the mean.

Germination speed can be defined as days to 50% germination (G50). Averaged across the four lots, stratifying seeds increased germination speed an average of 2.5 days.

Pelletization Trial for Western Redcedar

For the 2 western redcedar lots tested, germination capacity averaged 80.9% and 75.7% for raw seeds and pelletized seeds, respectively (fig. 4). Error bars represent standard error of the mean. Compared to raw seeds, pelletizing seeds delayed germination speed by just over 2 days.

Pelletization Trial for Red Alder

Across four lots of red alder, germination capacity averaged 78.1% and 68.2% for raw seeds and pelletized seeds, respectively (fig. 5). Error bars represent standard error of the mean. Compared to raw seeds, pelletizing seeds delayed germination speed by 6.8 days.

Discussion

A lack of stratification requirement for western redcedar parallels results reported earlier in British Columbia. Even so, it is worthwhile to know the germination behavior of each seed lot before pelletizing. Where a seed lot responds particularly well to stratification, either in terms of gain in germination capacity or speed, an alternative to pelletizing should be considered.

Falldowns due to pelletizing seeds again fell in line with results from British Columbia, where 10 years of data on pelletized western redcedar showed an average 5% reduction in germination capacity compared to raw seeds (Kolotelo 2004). While pelletizing reduced germination capacity and speed for both western redcedar and red alder, these negatives were outweighed by gains in efficiency. In operational sowing, we calculated a net reduction in sowing and thinning costs, as well as improved seed use efficiency. These improvements can be attributed to more effective use of mechanical sowing. In the case of red alder, pelletized seeds sowed more than 5 times as fast as raw seeds, and, due to more accurate sowing, took roughly half the time to thin. Though not as dramatic, similar efficiencies were noted for western redcedar. In both cases, the reduction in labor and seed use costs more than offset the cost of pelletizing.

Certainly, a sufficient quantity of seeds must be utilized in order to defray the cost of pelletizing. While pelletized seeds may be stored for up to 2 years, this practice is not recommended. After storage of several months, pelletized seeds should be thoroughly tested before sowing.

With experience, growers develop skill in germinating pelletized seeds, particularly through manipulation of irrigation regimes. Some growers report germination of pelletized seeds nearly equal to that of raw seeds. Along with grower experience, advances in pelletizing technology should lead to continued improvements in germination and subsequent increases in cost efficiency.

Summary

Pelletizing seeds of western redcedar slightly inhibits greenhouse germination, with a more pronounced reduction in red alder. There is also an up-front cost for seed treatment. Nevertheless, pelletizing these species is recommended when some or all of the following situations exist: (1) large-quantity seed lots are sown; (2) labor costs are high; and (3) seeds are scarce and/or expensive. For the first time, the accuracy gained with pelletizing these species allows us to consider single sowing of small cells for transplant. In this situation, mechanical sowing lines move quickly, valuable seeds are used efficiently, and thinning costs are virtually eliminated.

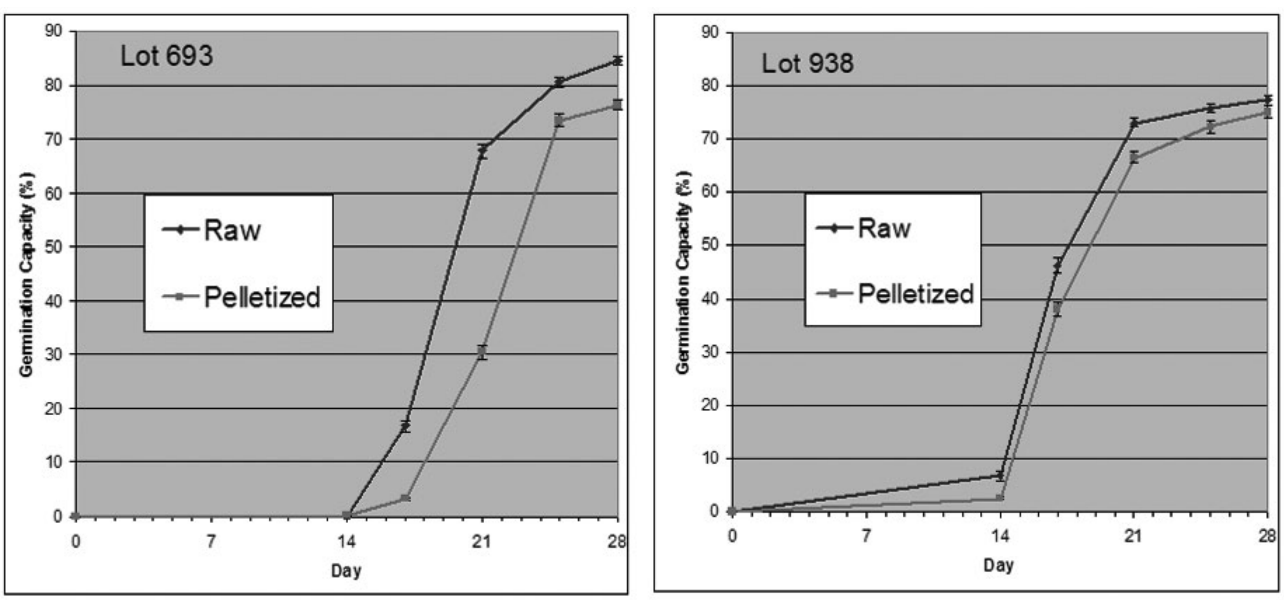

Figure 4—Raw versus pelletized greenhouse germination of western redcedar. Error bars represent standard error of the mean.

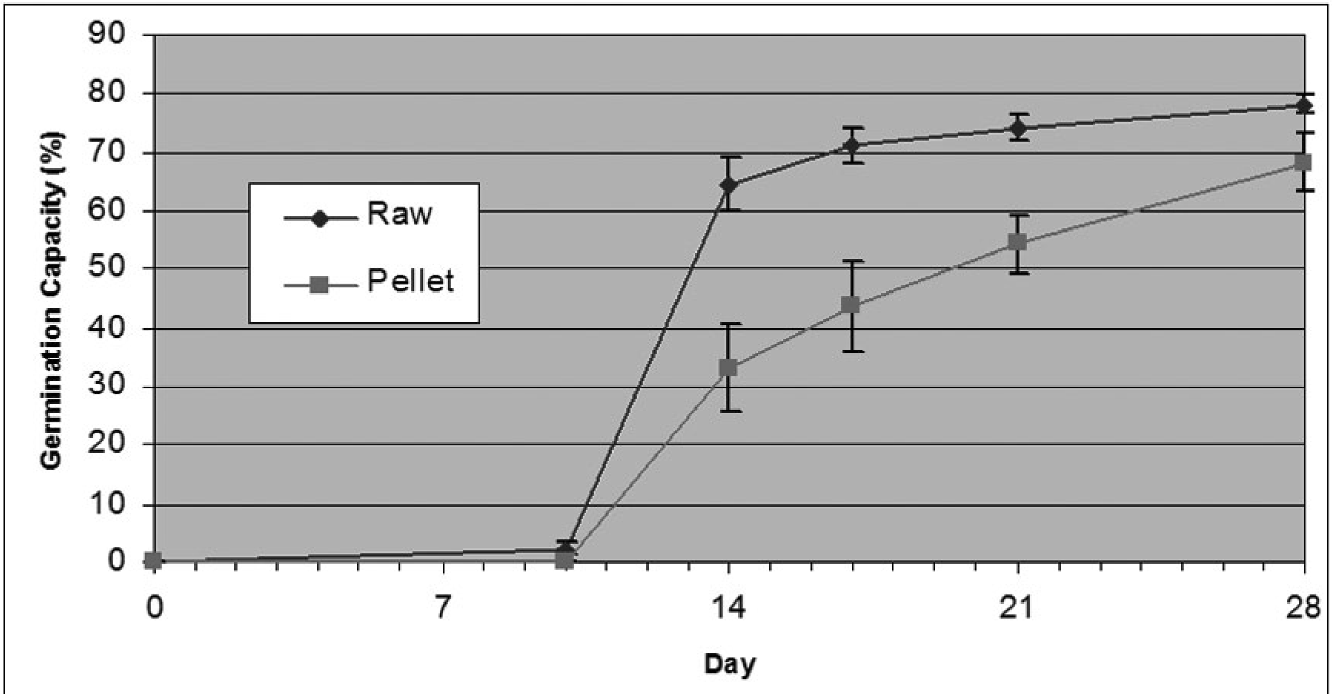

Figure 5—Raw versus pelletized greenhouse germination of red alder, averaged across 4 lots. Error bars represent standard error of the mean.

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