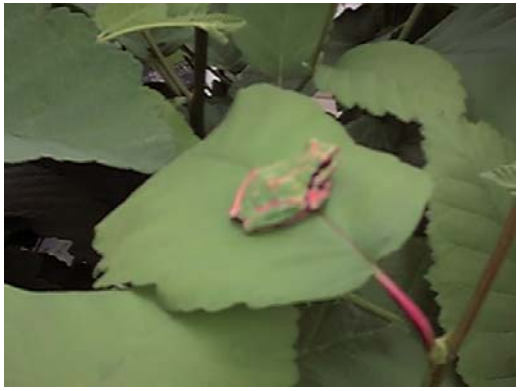
Alder Planting Stock

2015 WA Hardwood Commission
June 9th Mt Vernon
Barri Herman
Randi Peterson



Red Alder Regeneration Options

- What is a superior seedling and why do you want it?
  - Seeds and seedlings
  - Bareroot and container grown
- Selected material
  - Selected versus seed
  - Alder selection system
  - Rooting and Transplanting rooted cuttings
- Characteristics for which we selected
  - Growth and form
  - Wood properties
  - Disease tolerance
  - Cold tolerance
- Frankia
- Alder Breeding Program
- Ealasid – WSU - Weyerhaeuser

Why you want superior seedlings

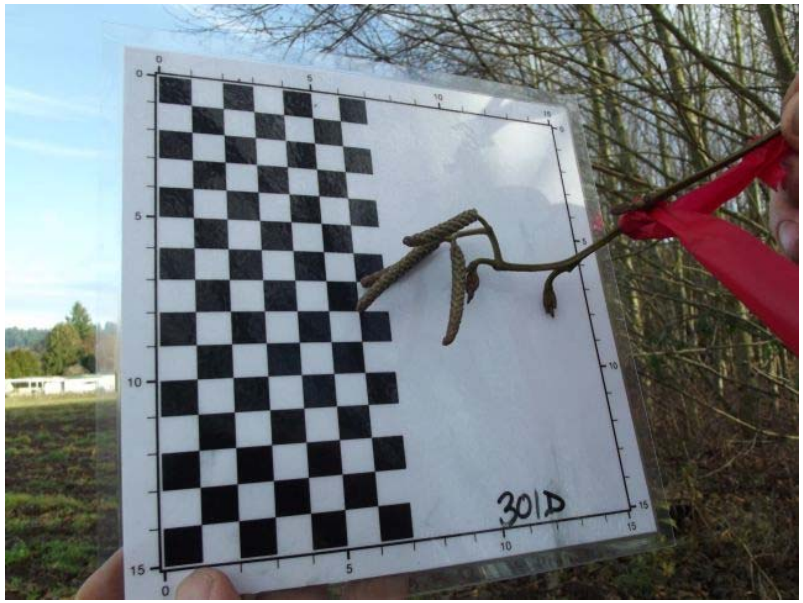
- Better establishment
  - Better quality seedlings with root systems primed to go will give better and faster stand establishment
- Faster initial growth to out grow weeds
  - Because alder seedlings have frankia which fixes nitrogen they have to be able to escape the weed competition which becomes pretty fierce with all of the N they produce
- Faster canopy closure
  - Same as above, the faster you can get canopy closure the faster you can shade out the competing weeds

What is a better seedling

- 20 to 36 inches in height – 45 container and bare root
  - I know the bigger ones look better but in all of our trials they tend to grow slower over time or die back in the 2nd year
  - Need a defined root to shoot ratio often with bare root the roots are cut very short for the size of the shoot
  - Same problem with container grown where plants are not shut down fast enough and outgrow the plug size
- 3-5mm caliper
  - Caliper is a major driver in survival, you are better off with shorter plants than a smaller caliper, the more marginal the site the bigger the caliper the better
- Good Root system
  - In general alder does not seem to be susceptible to root problems however you need to see white root tips and make sure that bareroot stock is not cut too short
- Frankia nodules
  - The roots go an orange color when frankia inoculation has occurred and before the nodules are evident. Depending on site the frankia inoculation is critical to survival.

Seed selection

- General collection of seed
  - Some growers use a home source of seeds collected from a specific area that they wish to replant
  - Some growers use a variety of sources collected from field trees and then planted onto broader areas, these sort of seedlings are mainly planted by conservancy districts or groups that wish to maintain a specific ecological group in one area.
- Select collection of seed
  - Most of the commercially grown seedlings are grown from stock collected from trees that were selected for form and growth in a particular area, they are sold by region
- Improved seed
  - At this point there is no improved seed available commercially but we are currently setting up selected orchards of our best clones and will be producing improved seed.



Bare root seedling

- Cheap - These are the cheapest to produce, but production is somewhat limited by the weather and whole crops can be lost in big frosts etc. etc.
- Big - The seedlings are generally big but this is not necessarily the best, particularly if the root to shoot ratio is not good. They are very often variable in size
- Tough root system - They have a very tough and fibrous root system which can be good for the rigors of planting but at the same time they are often trimmed to facilitate planting and have very little new root left.
- Bulk inoculation - They are inoculated with a bulk inoculum which is not targeted at any sort of site, the advantage is that just about all of the trees get inoculated – its difficult but not impossible to get a failed inoculation

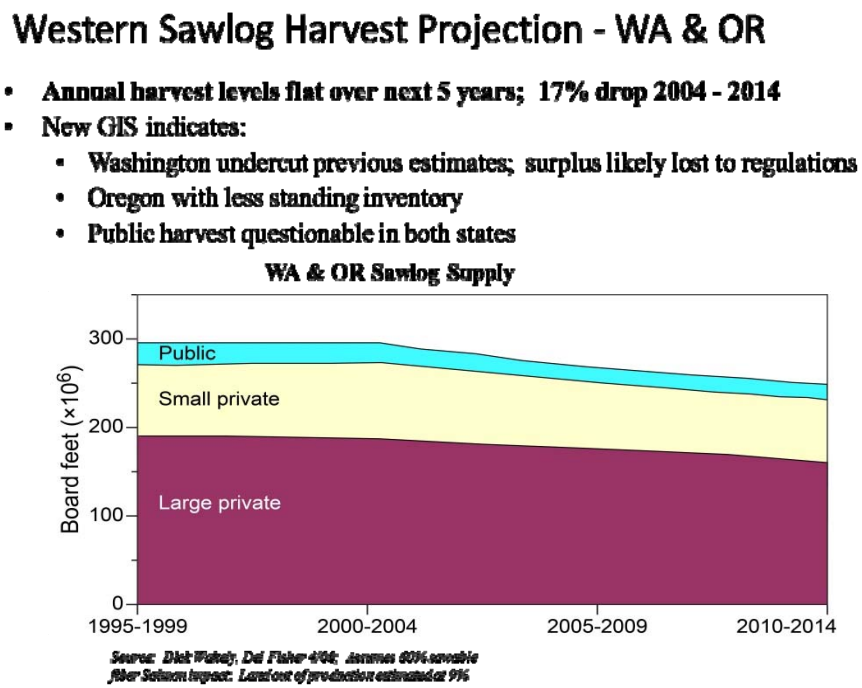
Container grown seedling

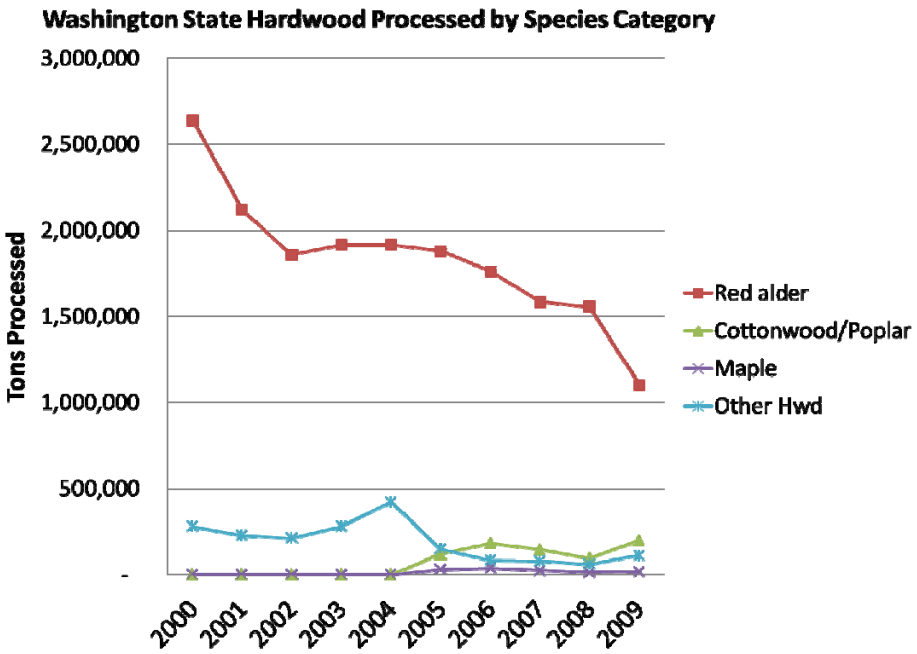
- Tap root / adventitious root system - They have a taproot system which is often air pruned at the bottom of the container
- Optimum root to shoot ratio (1:1-1.5)- Environment control means spec seedlings can be pushed into chemical dormancy. Seedlings can be primed with P and K prior to freezing or outplant
- Optimum media – seedlings are grown in a defined media so the air filled porosity and nitrogen draw down can be planned and the type of root system formed can be manipulated by the media used.
- Optimum fertilization – In a contained system the fertilizer and media can be modified to improve seedling growth and root growth.
- Bulk frankia or possibility of selected frankia - The frankia can be applied through the irrigation system (bulk frankia inoculum or selected mixes of frankia) can be applied to certain batches of seedlings with good inoculation success.

Why the move to clones

Weyco started the move to clones because there was a depression in the availability of alder trees for sale and by moving to clones we felt we could shorten the rotation age and “fill the hole” faster than just using seedlings.

Because of the depression in 2008 to current and the reclassification of some sites to allow more alder felling has helped but the drop in alder log availability is pushing the price higher and the demand nationally and from Asia is increasing!





Current Growth Standards

Weyco Internal Standard

- Based on young plantations or natural regen sites only managed from 11 years of age
- Older sites from natural regen over time
- Of the 38 natural stands, 13 were pure alder at 20-30 years
  - Of the 13, 6 made over 50 cunits at 25-30 years on SI DF 140 - 130
  - Only 1 site on DF 120
- Average number of trees per acre is fairly high

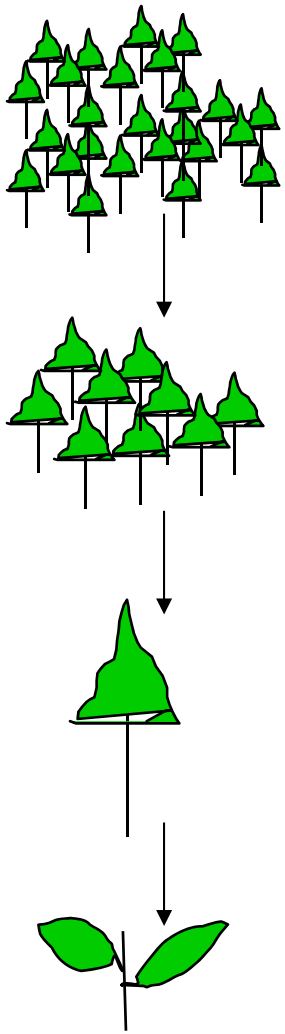
– Study by Bill Scott and Rick Leon

USFS Trials

- Oldest available plantation trial, planted with container grown non selected seedlings
- Planted on DF Site II lands at 1,000 ft altitude
- Trial was a spacing trial ranging from 4'X4' to 8'X8' both square and rectangular spacing by Dean de Bell
- At 20 years, all trials are over 42 cunits and all will exceed 50 cunits before 25 years
- Spacing effects are noticeable on diameter with rectangular spacing consistently better
- Average tpa is fairly high

Concept Validation
Selection & Current Production System

- **Selection is following standards used worldwide for eucalyptus, pine and acacia**



Select a group of the best 100 trees out of an acre of selected seedlings for growth and form 100:680

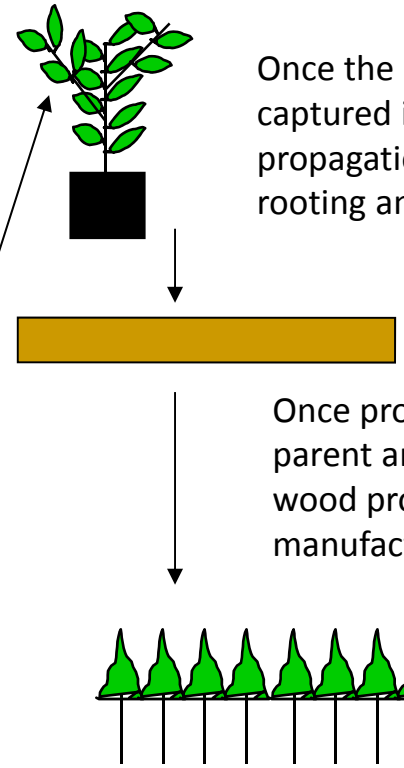
From that group of trees select the best 10 trees on form and growth that meets or exceeds selection criteria

10:100

Take the best tree from those 10 and then repeat 10 times on each of 5 sites to get the best 50 trees

1:10

Take material from each of the trees and try to propagate cuttings



Once the material is captured it has to meet propagation criteria of 80% rooting and 80% survival

42:50

Once propagated fell the parent and check that the wood properties. Meet the manufacturing criteria

30:42

Set out clonal trials for selection of best clones in 3 - 5 years

Selections are shown in red 10:30

Simple overall selection 1:3400

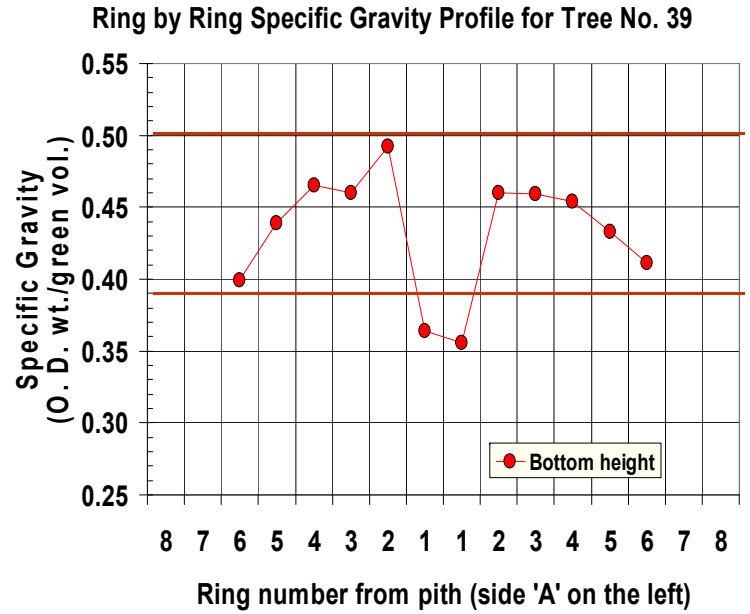
Sawmill trial

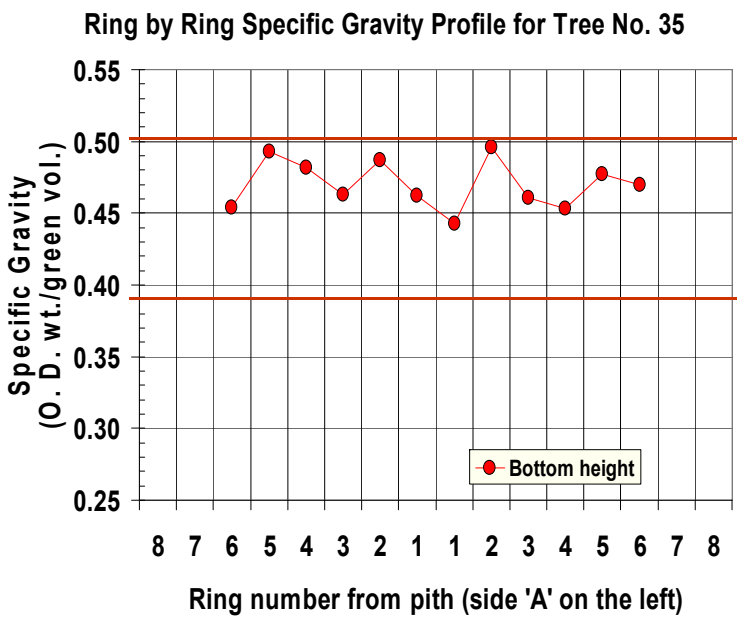
- We have run saw trials of several categories of wood to assess the recoveries and values and have looked at MOE and MOR to improve lumber drying recovery

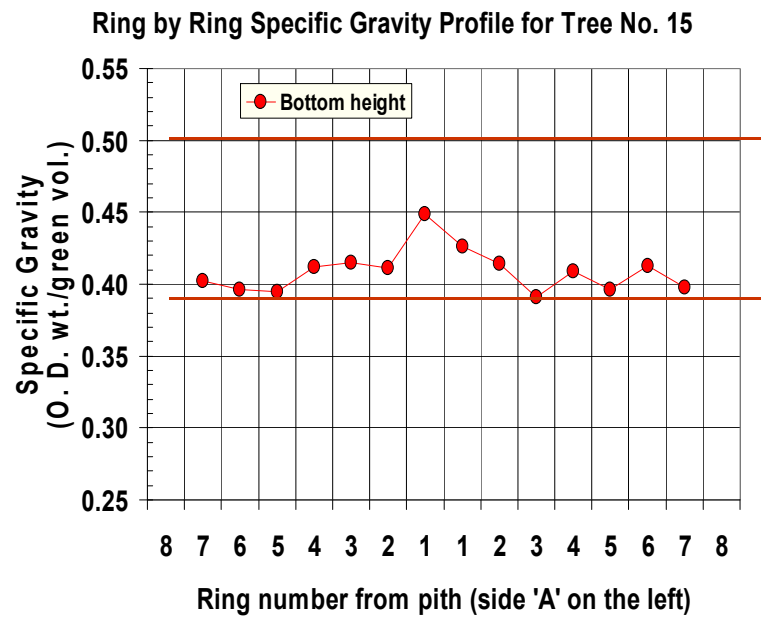
Sample of Wood Tree Density Properties

Wood Properties Criteria

- Density is a critical property to improve recovery and lumber uniformity and can be selected for in a clone program
- Density to be between the limits and fluctuate less than 30 points between rings and 50 points across either radius
- We also have anatomical data for cell wall thickness (3um) and lumen diameter (18um) and fibers per gram (30-32 million)







Disease and Cold Tolerance

Rank	Family	Mean Visual Rating
1	13	1.62500
2	14	2.25000
3	11	2.33333
4	15	2.33333
5	32	2.58333
6	10	2.66667
7	23	2.79167
8	29	2.87500
9	3	2.91667
10	30	2.95833
11	16	3.08333
12	5	3.20833
13	18	3.20833
14	1	3.33333
15	6	3.37500
16	20	3.37500
17	24	3.37500
18	2	3.41667
19	27	3.41667
20	31	3.41667
21	19	3.45833
22	28	3.45833
23	8	3.50000
24	4	3.54167
25	7	3.54167
26	12	3.54167
27	21	3.54167
28	17	3.79167
29	22	3.83333
30	9	3.91667
31	26	3.95833
32	26	4.00000

Rank	Family	Stump Production
1	13	2.4104
2	15	2.4521
3	18	2.4772
4	14	2.8545
5	10	3.0424
6	9	3.3483
7	5	3.5877
8	12	3.9891
9	11	4.0185
10	2	4.0316
11	29	4.0740
12	32	4.1390
13	28	4.2339
14	16	4.4182
15	1	4.4198
16	20	5.1064
17	30	5.4154
18	31	5.8534
19	4	5.7581
20	6	5.7727
21	23	6.0289
22	19	6.3374
23	22	6.9033
24	3	7.5057
25	27	7.6124
26	8	8.9856
27	17	8.8389
28	7	9.2531
29	24	9.2673
30	21	9.3691
31	26	13.0066
32	25	13.1089

We are doing cold tolerance testing and we constantly monitor the clonal field trials for cold damage. We screen the WSU lab cold tolerance results against field tests in Eastern OR. These have moved to eastern WA in the Pullman trials

The Clonal Production System

Clonal Production System 2

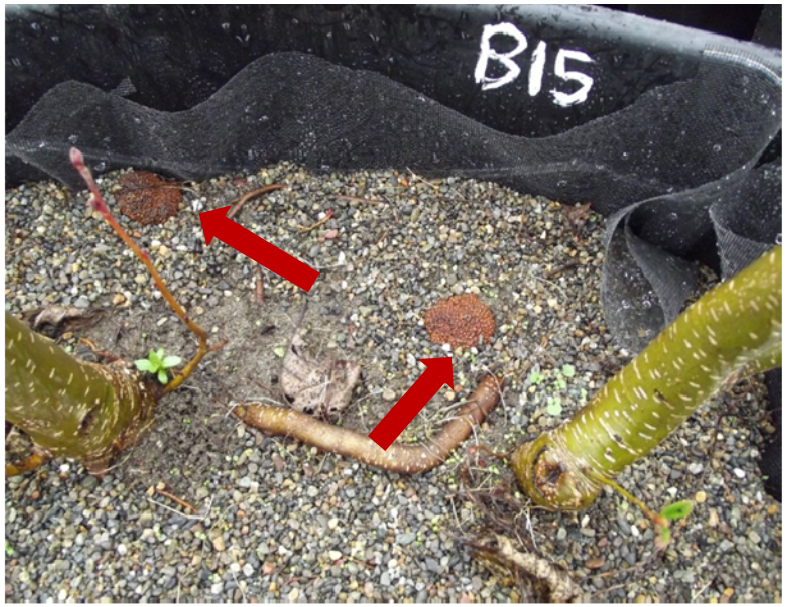
Rooting and Transplanting

After approx 4 to 6 weeks in the rooting tray the plug is transplanted to the growing tray – a 45 or 48 styro. The growing media is a high 13% AFP media with minimal N drawdown. Transplant shock is minimized with misting and transplant recovery is over 90%

Rooting is done in earthpot trays using media I developed with the producers. The media is formulated to give very good drainage under heavy misting so maintaining a good AFP for this sort of application. With the best clones rooting is consistently over 90%
In a production trial at Greenwood they achieved an average 95% and the second run was an unprecedented 98% across clones.

Frankia Selections

- We have developed clones for both Douglas-fir type sites and less traditional more marginal sites
- We have trials from good Douglas-fir land types right through to marginal coastal land in the hemlock zone and even riparian flood zones in the Vancouver and Mt Vernon areas
- We have a total of 67 frankia selections and 37 that have been tested on some of the most marginal sites – these are used to give the alder a better chance of survival on these marginal sites – a boost from day one



Rooted cutting as a bareroot crop – NOT a Success for Bareroot but possibly for hot planting on good sites with irrigation

In the 12 weeks after planting as rooted cutting plugs the best clones grew to around 8ft tall and an inch in diameter at the base – far too big to pull and pack

Growth Across Sites

Clone	dbh gain	ht gain
clone 1	1.42	1.48
clone 2	1.34	1.16
clone 3	1.33	1.41
clone 4	1.33	1.18
clone 5	1.30	1.2
clone 6	1.29	1.19
clone 7	1.25	1.14
clone 8	1.24	1.39
clone 9	1.23	1.14
clone 10	1.23	1.14
clone 11	1.21	0.98
clone 12	1.19	1.16
clone 13	1.16	1
clone 14	1.16	1.36
clone 15	1.16	1.17
clone 16	1.13	1.21
clone 17	1.13	1.26
clone 18	1.12	1.2
clone 19	1.05	1.23
clone 20	1.04	1.33

top 10 clones	
dbh gain	ht gain
1.296	1.243

This means a 29.6% increase in DBH and a 24.3% increase in Height

top 20 clones	
dbh gain	ht gain
1.2155	1.2165

- The growth analysis was kindly carried out by A. Dobkowski of Weyerhaeuser and approved by D. Marshall.
- These clones are being compared to the average seedling on DF 130 and 140 sites
- The best clones on agricultural sites are outperforming these growth rates
- The best clone on WSU farm 5 has grown at 1 inch per year diameter for the last 9 years

On Farm fields in good soils!

This is part of a clonal trial on WSU Farm 5. The trees are on a good soil just off Bowman Hilton road on the Puyallup river and were planted in 2002. The clones are planted in replicated rows and 6 of the 14 clones in the trial were significantly better than the seedling control. In 2012 the trial was damaged by the big ice storm.

The best clones in the trial at that point measured around 9.5 inches in diameter. Almost an inch a year growth and still at full stocking – they had not been thinned yet only pruned. Modelling the growth would suggest if we had thinned to 280 to 300 trees per acre at 6 or 7 years of age we would have pulled a 5 - 6 inch commercial thinning and run to 12 inch diameter at the lower stocking within 13 – 15 years.

Left at full stocking suggests the best clones would have hit 12 inches at 15 years but the poorer clones around them would have been highly suppressed.

Fall Planting – something to think about

We have 4 fall planting trials established on Weyerhaeuser property and 1 as a bioenergy crop planting on WSU property.

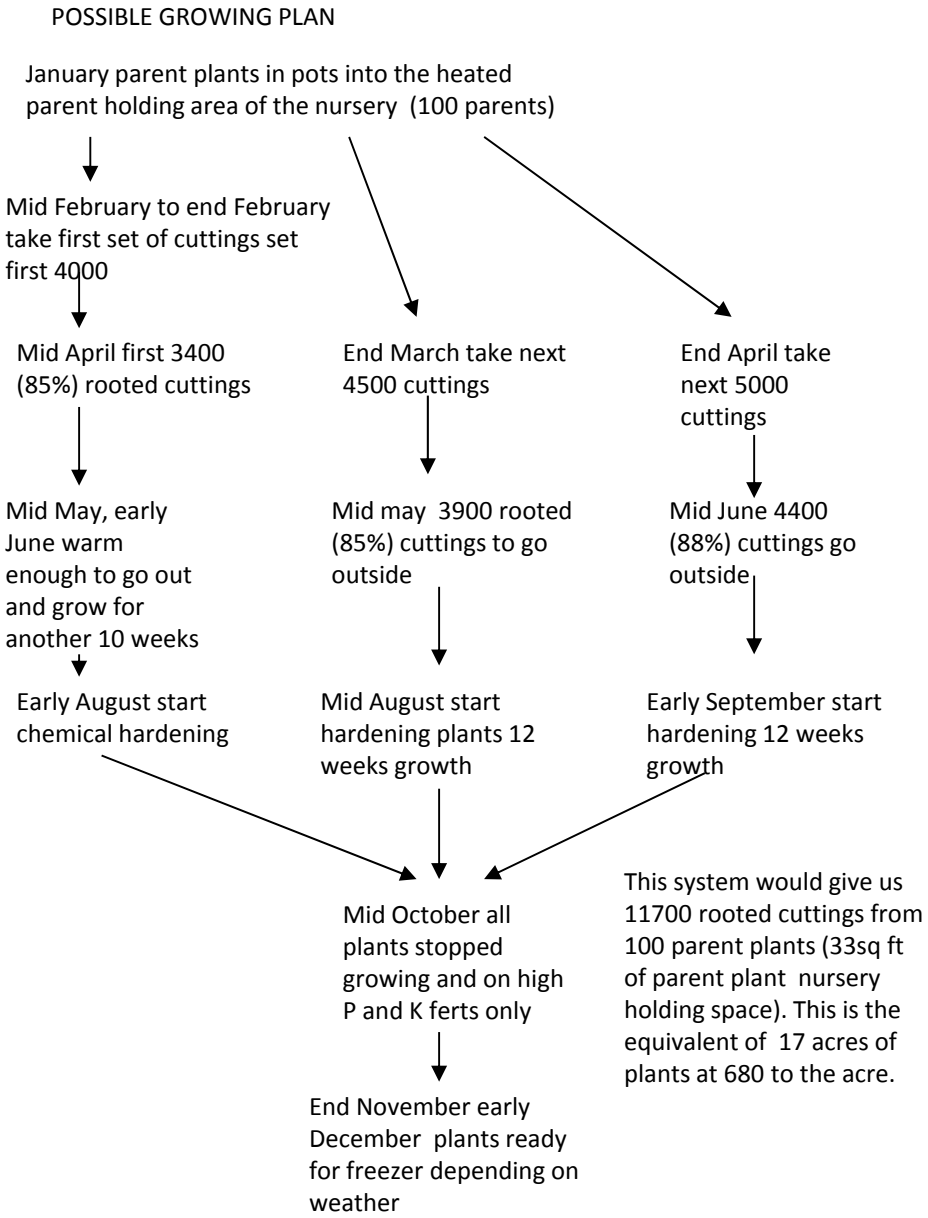
All of the trials were planted towards the end of August after a few good rains and all of the seedlings were actively growing with the media fully loaded with P and K from alternating 4:25:35 and 20:20:20 at about 800us above incoming water.

Survival and growth has been excellent on all sites. The WSU bioenergy planting at 2 x 2 spacing is at 1 year between 9 and 12 ft (2.9 – 3.8m) in height and (2 – 2.2cm) 13/16th to 7/8th of an inch

Current production

The current condition of the parent plants for fall 2016 or spring 2017 planting.
The parent plants are cut back and are currently growing new shoots under high fertilizer regimes. These will be cut back once more and then allowed to form shoots and before these extend over 4 inches the parents will be pushed into chemical dormancy and allowed to rest. Parents will then be moved into the greenhouse in November/December and started up again so the first cuttings can be taken in January – February.

Production schedule

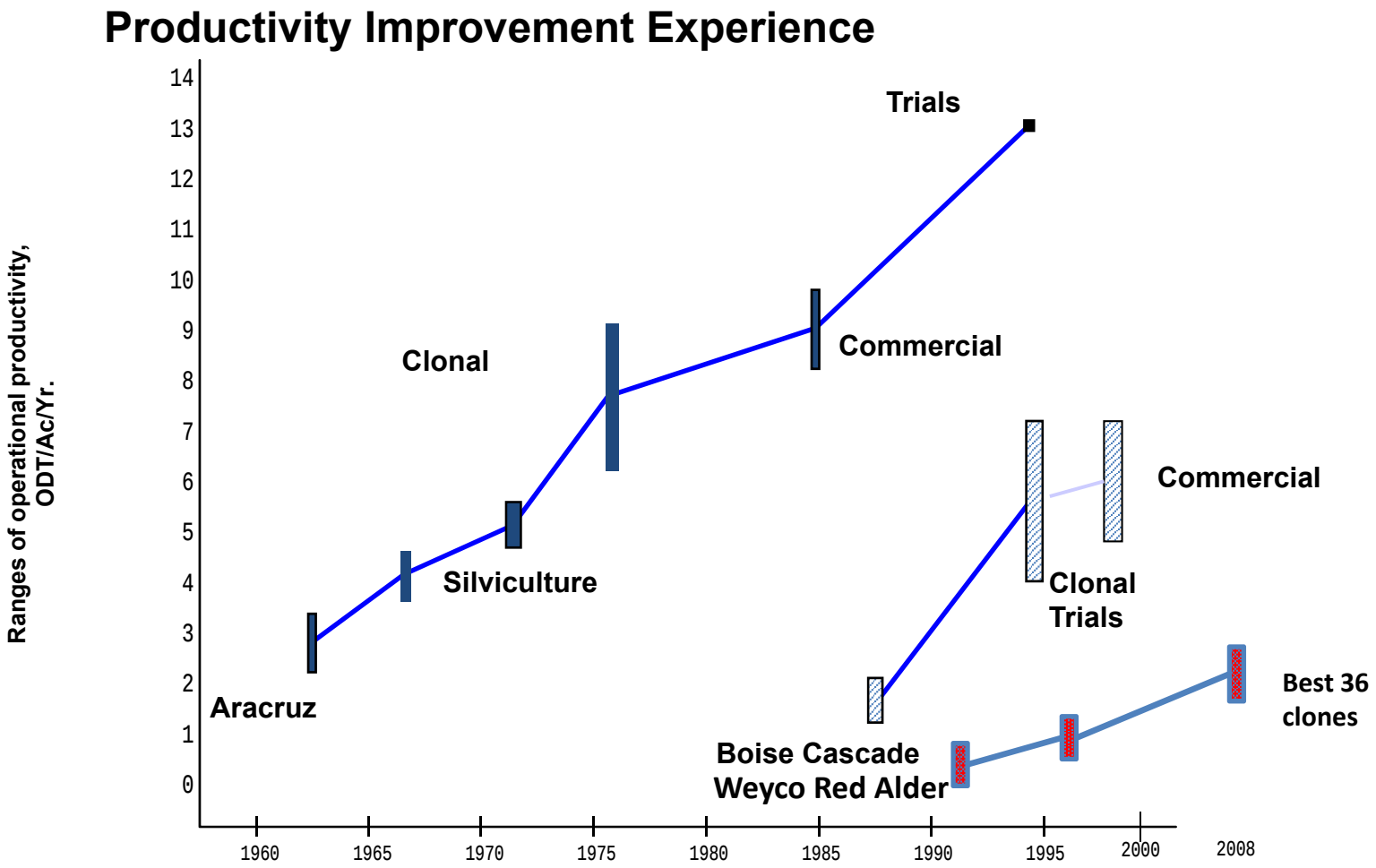


Our current plan – pending funding – Is to produce approx. 50K red alder clones. Some of these will be ready for a Fall Planting in 2016 and the remainder in 2017 Spring. If the funding continues we will be able to produce approx. 250K for fall 2017 into spring of 2018 and 400K for Fall 2018 into spring 2019.

After 2019 we will be able to produce upwards of 1 Million plants a year provided we get the funding required or by then we should have been able to teach enough Nurseries how to produce rooted cuttings to allow for external production. Our seed/breeding orchards should come online around 2018/9

Clonal Improvement

Eucalyptus and Poplar (cottonwood) Alder is added in red



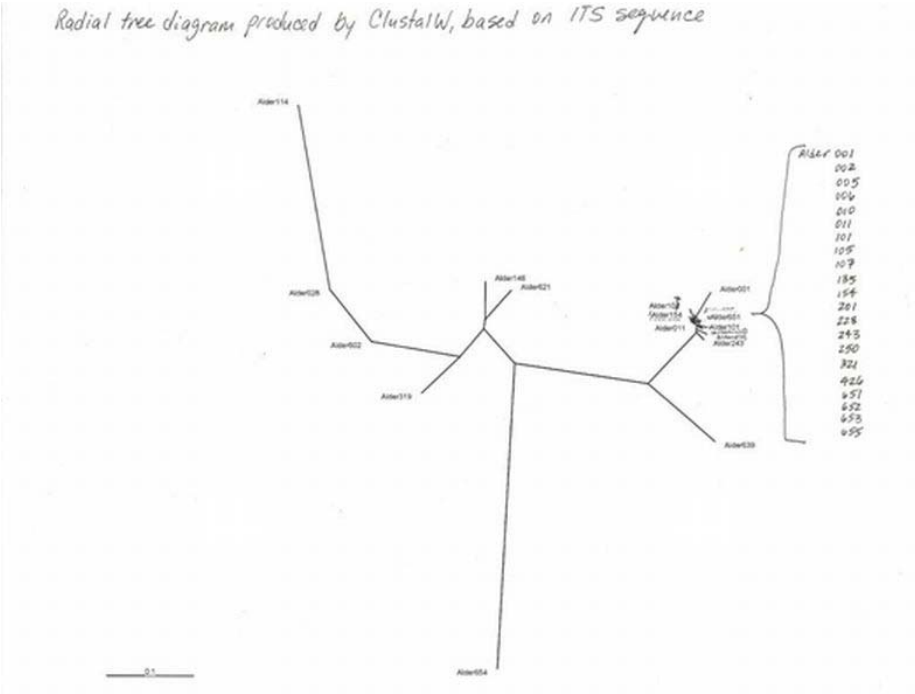
Source: Jaako Poyry 1998

What you can get to!

This is TAG 5 a clonal selection of pure Eucalyptus grandis planted in Zululand by yours truly. These trees are 3.5 years old are 32m +/_1.2m high and have a DBH of 34cm +/_ 1.4cm yielding 260 tonnes per hectare. They were selected to pulp at a 1.5% charge at a Kappa of 18 to provide 32 million fibres per gram with a cell wall thickness of 2 - 4um and lumen of 18 - 20um for making fine paper.

Alder Breeding Program

- Part of the agreement between WSU and Weyerhaeuser included starting an Alder breeding program and we will be producing some superior alder seed and increasing the size of our seed orchard



WSU Agreement to Commercialize

When Weyerhaeuser became a REIT and sold Weyerhaeuser Hardwoods they “donated” the research work to WSU under some specific contractual obligations.

Part of the agreement between Weyerhaeuser and WSU was to commercialize the Weyerhaeuser clonal technology and make it available for sale

- The 2013 planting year crop was purchased by a startup company, Ealasid, which will use all of the clones we produced in 2012 as parent plants for a production system
- We planted 1 Fall planting trial site in 2013 and that is a bio energy planting not a commercial saw timber planting
- Once production starts Ealasid will be selling clones commercially (with agreements) and they are also starting to look at commercializing improved seed from a seed orchard on the west side

Contacts

- For any technical questions or assistance with forestry questions please feel free to contact me or Randi at

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- For seedling sales please contact Norman Lewis CEO Ealasid

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