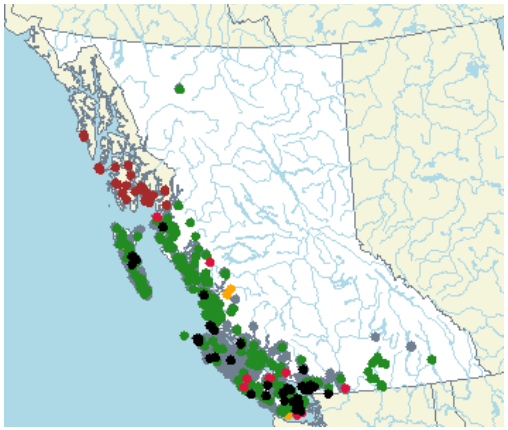
Enhancing Early Douglas-fir Growth on Dry, Salal-dominated Sites

CSC 2010 Winter Meeting
February 25, 2010
Nanaimo, BC

Salal: a coastal species



Old-growth stand near Port Alberni. Salal is long lived and grows under low light levels

Salal cover enhanced beneath thinned Douglas-fir stand

Salal: on drier sites

‘ .. in the Coastal Western Hemlock (CWH) dm, mm1, and xm subzones, salal gains its greatest site domination on moderately to slightly dry site..’.

Salal cover commonly increases after timber harvest

Extensive root system

Salal expands vegetatively through

- layering,
- sprouting of rhizomes,
- root suckering, and
- sprouting from the stem base

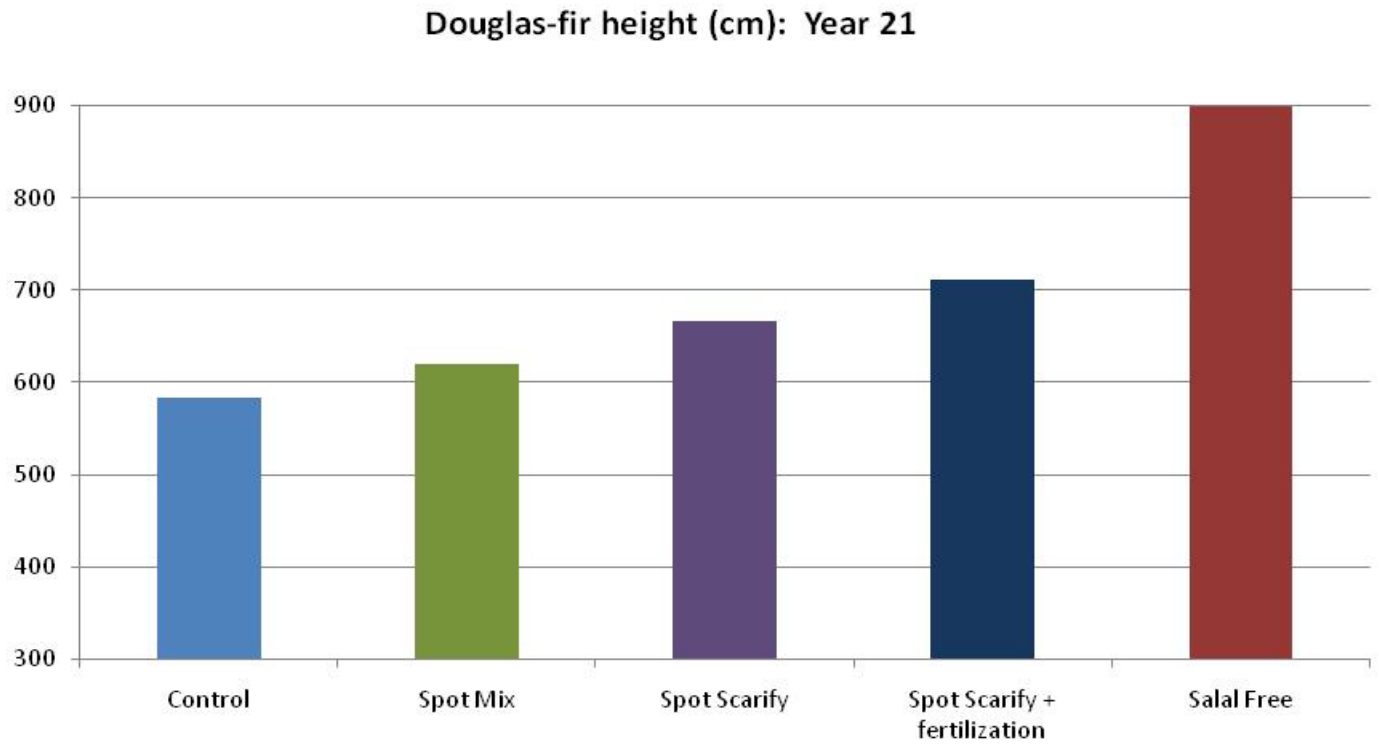
Salal: Competition to Douglas-fir growth ?

- Salal: a less obvious competitor due to its low stature.

- Salal competes for both moisture and nutrients with extensive root system.

Past Research: growth benefits to early salal management.

Reducing salal abundance and fertilization enhances long-term Douglas-fir growth on dry nutrient poor sites by. *(Salal competition typically does not reduce Douglas-fir survival).*

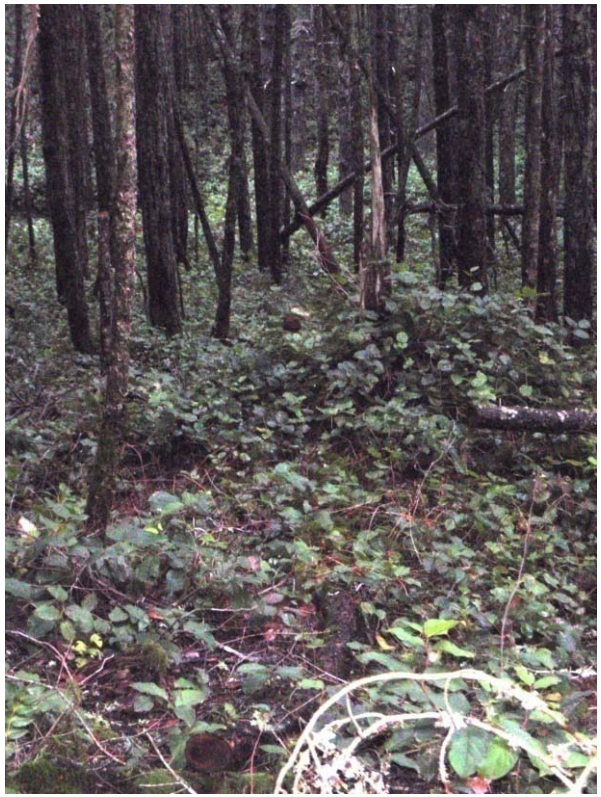


Cameron River site: CWHmm

Proposal: Research methods in the Malaspina woodlot (0020) to improve early Douglas-fir growth on dry, nutrient poor site with salal a dominant species

Paul Lucas and David Smith identified block harvested In 1997 with suitable attribute: dry, nutrient poor with salal the dominant vegetation species.

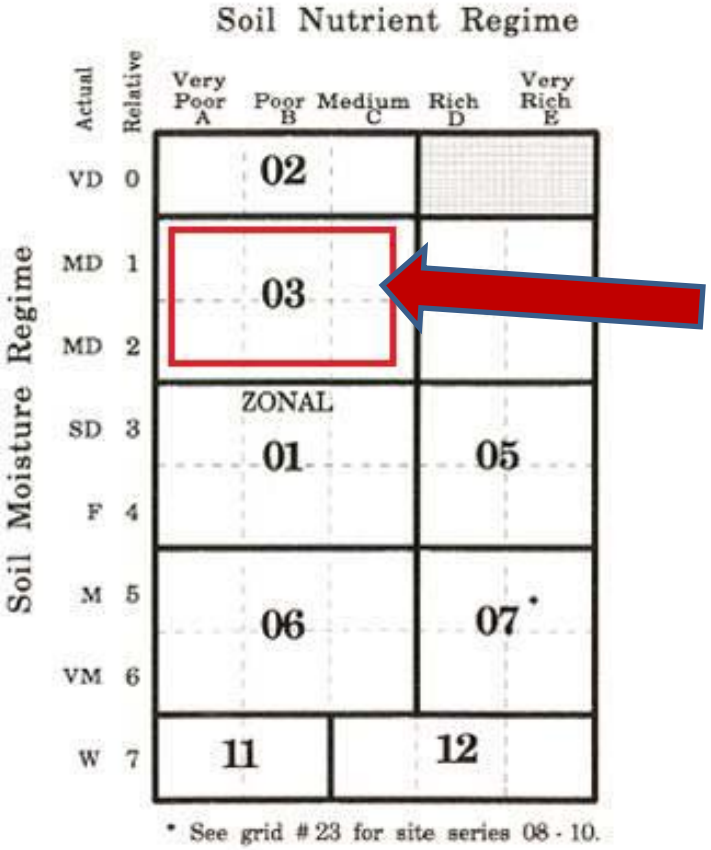
Stand conditions



'Clearcut with reserves': 8 to 12 tph.

Site Description: CWHxm (very dry maritime)

- Site Series: 03
- Humus form: Mor
- Soil texture: Loamy sand



Treatments: Selection Rationale

- Fertilize seedlings at planting to supplement low soil nutrient levels.
- **Disc trenching**: Reduce salal competition and perhaps increase availability of soil moisture and nutrients.

1. Fertilization At Planting (FAP).

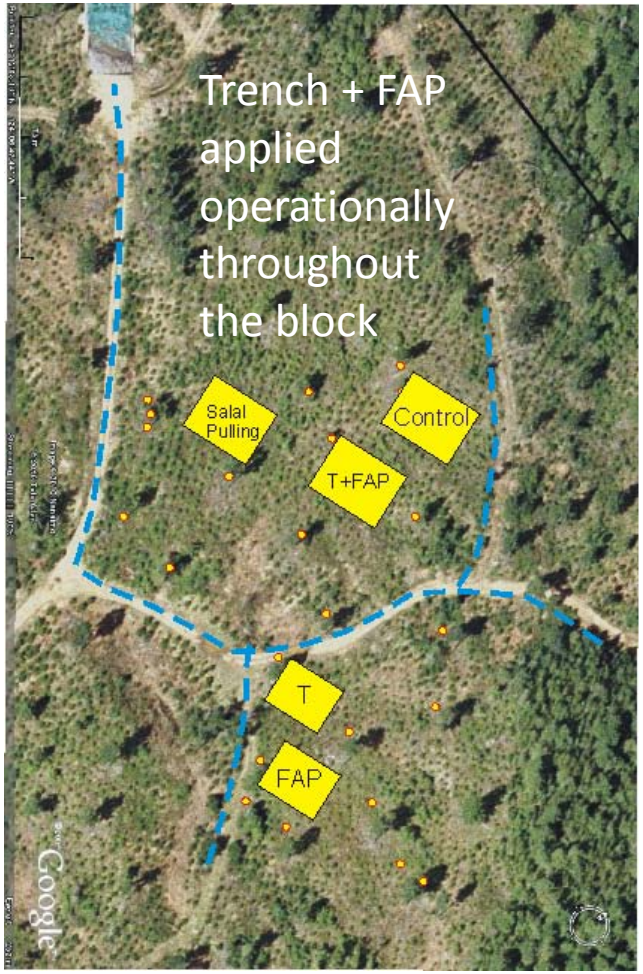
2. Trench.

3. Trench + **FAP**. This was the 'operational treatment' applied throughout the block.

4. Trench + **FAP** + Salal removal: repeated salal clipping.

5. Control: Planting only (Douglas-fir PSB 1+0 415B).

6. Biosolid application, perhaps when the plantation is 5 years old was also being considered.

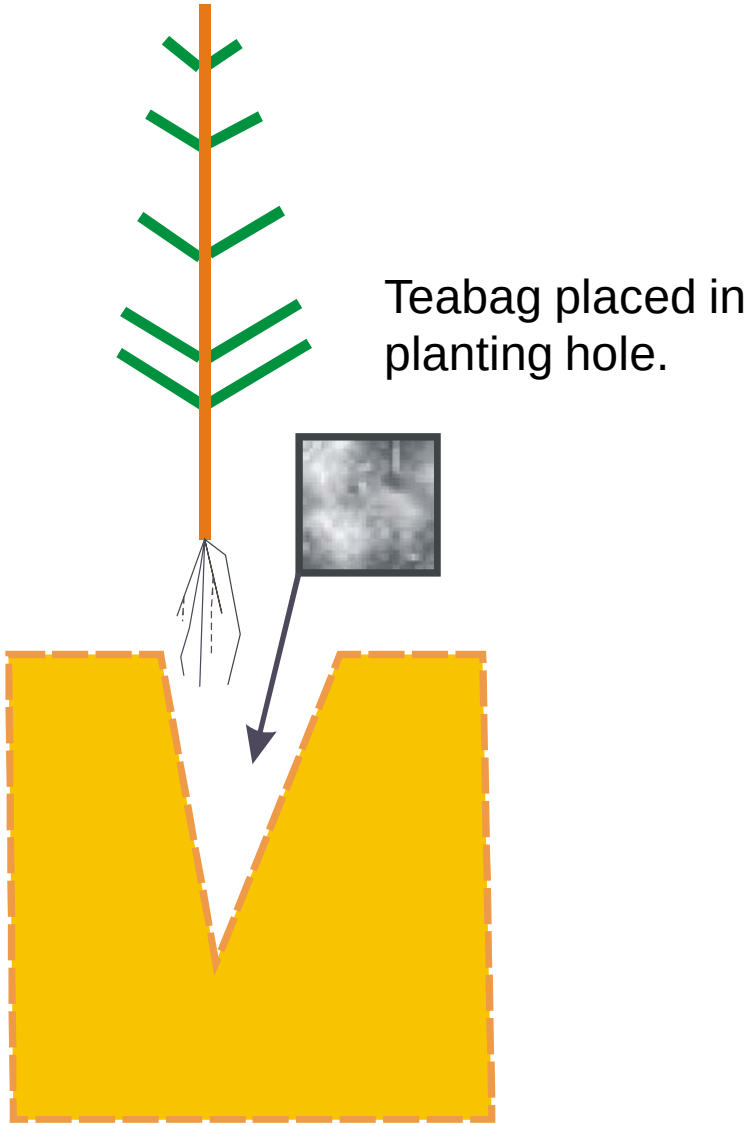


Treatment blocks: 600 to 1000m2

Treatment: Fertilization At Planting

(FAP) Gromax® 21-6-2 w/Gel (Dry Site) teabag;

9.0 g wt; 1.9g N.



Treatment: Trenching

A John Deere 748E skidder ….

…. pulling a TTS Disc trencher creating parallel non-continuous trenches (trenches depth of 20 cm 2.7 meters apart).

D Wayne Diedrichsen,
Silvatil services (Nanaimo)
Trenching: $200/ha.

Treatment: Trenching

All seedlings vexared

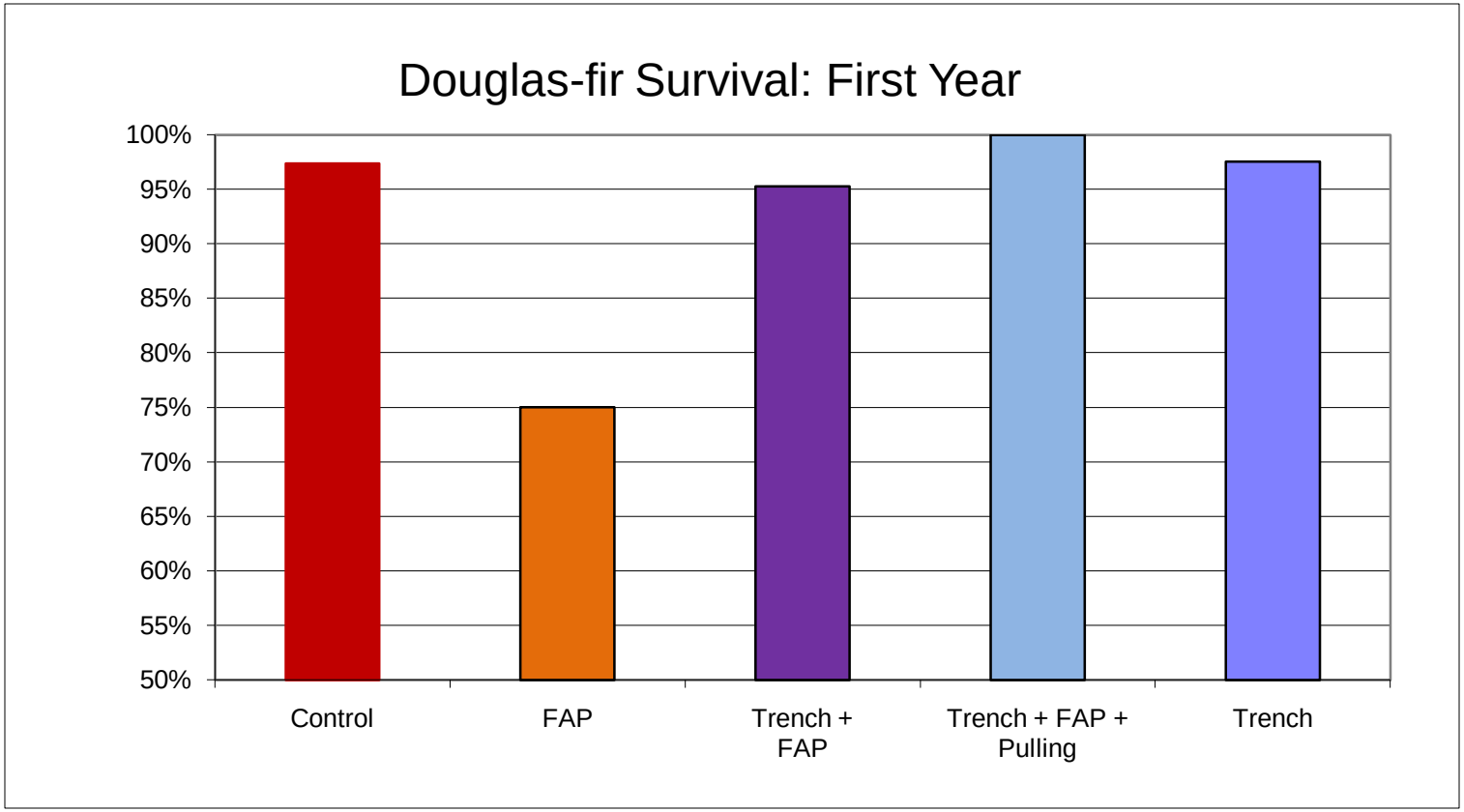
trenches 2.7 meters apart

Treatment Costs: 1500 seedlings per ha: Not including vexar costs

Activity		Control	Trench Only	Fertilize Only	Fertilize + Trench
Trenching	$200 / ha	$ -	$ 200	$ -	$ 200
Seedling (Fc 1+0 415B)	18¢ /seedling	$ 420	$ 420	$ 420	$ 420
Planting	Trenches: 18 ¢/seedling, untrenched :21¢ /seedling.	$ 315	$ 270	$ 315	$ 270
Fertilizer	Fertilizer: 10 ¢/seedling. Application: 4 ¢ / seedling,			$ 210	$ 210
	Total	$ 735	$ 890	$ 945	$ 1,100
	Cost difference from Control		**+ $155**	**+ $210**	**+ $365**

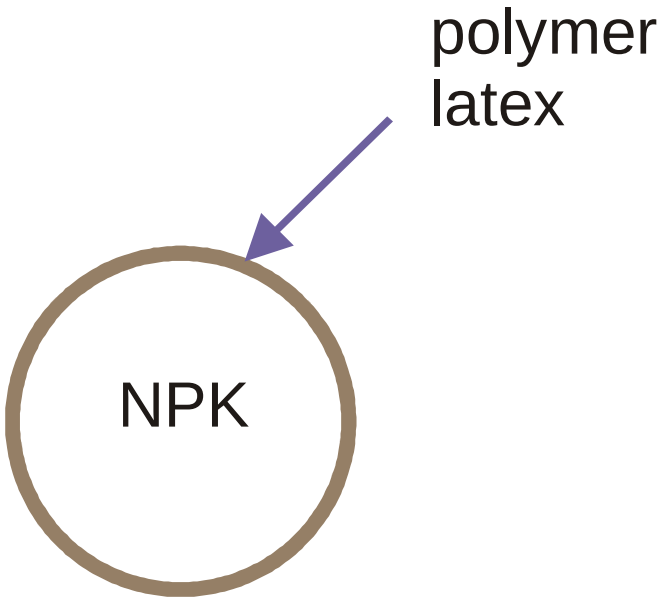
First Year Survival Issue

- Lowest survival in the FAP (Fertilize at Planting) treatments (75%). seedlings turned yellow weeks after planting and died.
- An interaction between FAP and trenching is evident as fertilized seedling in trenches did not show negative effect of FAP alone.
- Control Seedlings survival is high; salal competition not an issue



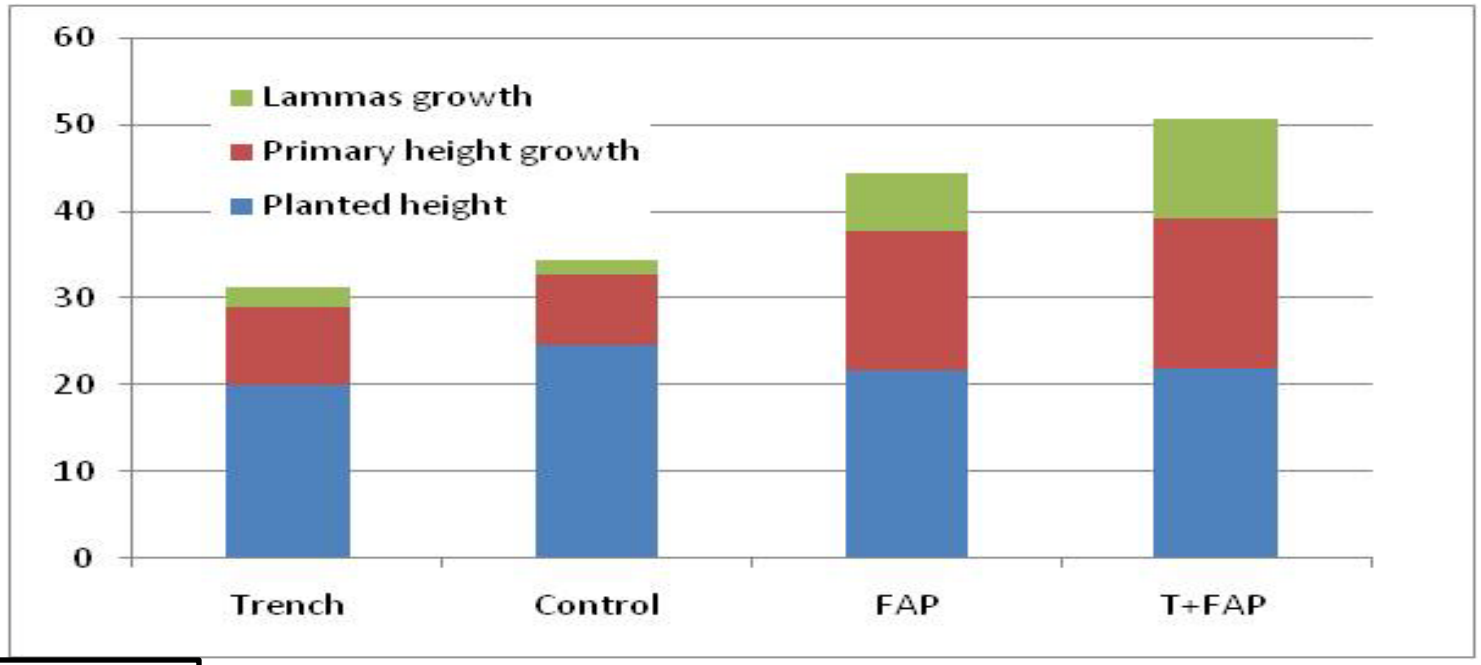
First Year Survival Issue

- Gromax® 21-6-2 w / Gel (Dry Site).
- An osmocote formulation, originally developed for Gromax product:
- Polymer latex coating was brittle. Fractures prematurely released nutrients, potentially burn roots[1].



[1] Neil Anderson **Reforestation Technology International**

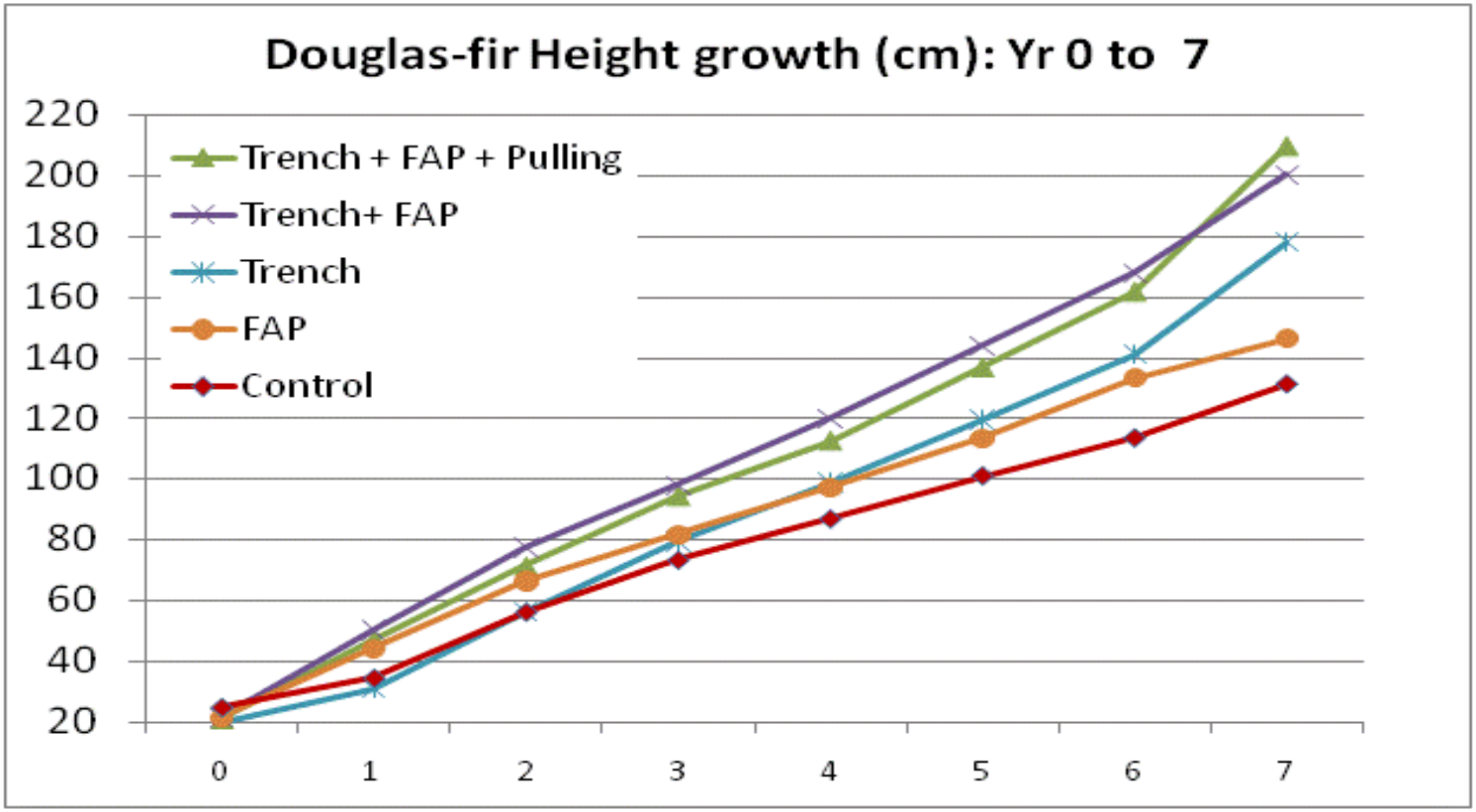
First Year Height growth



Lammas frequency	13%	28%	69%	71%

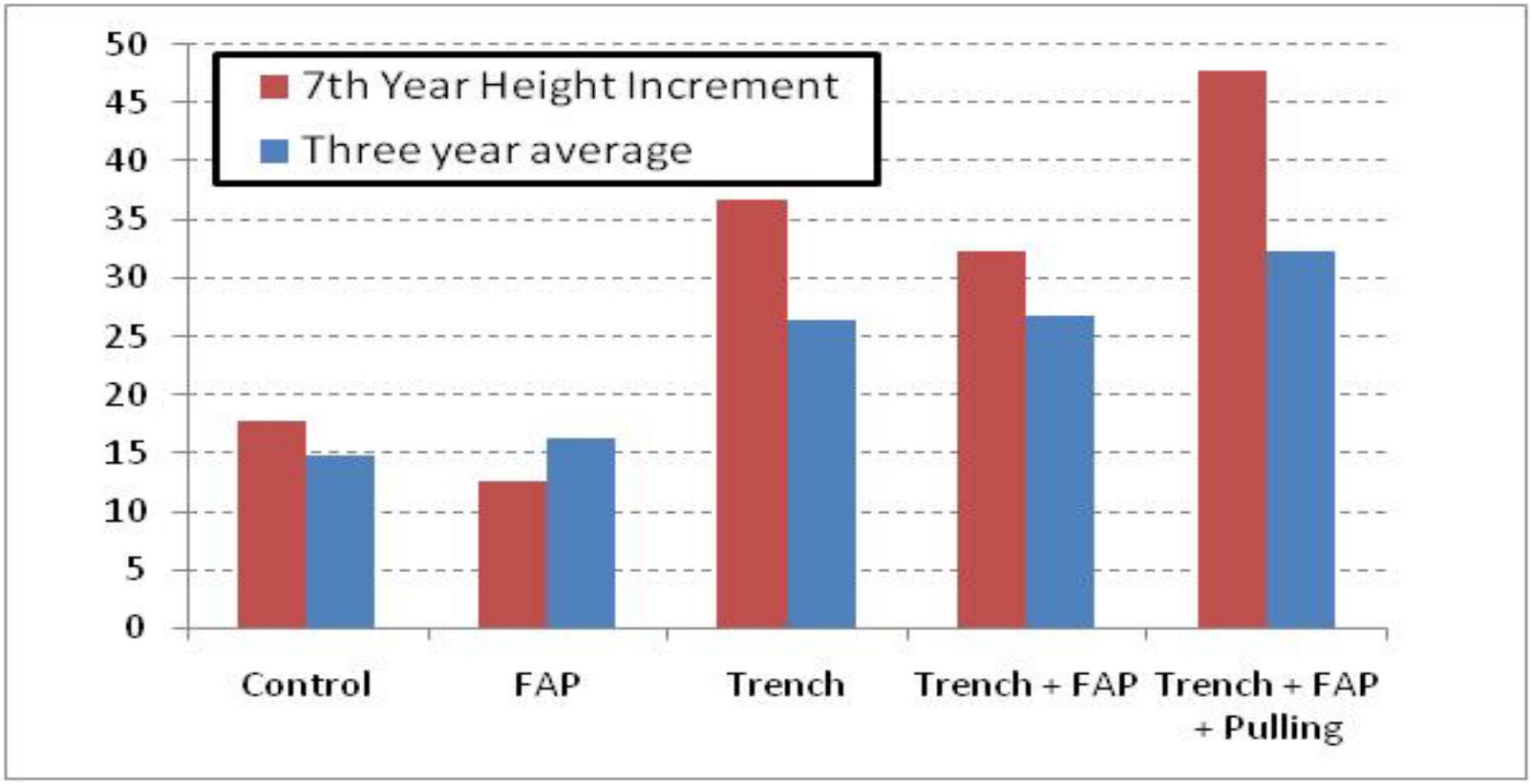
- Best height growth with the combination Trench + FAP
- Fertilization enhances primary height growth, and lammas frequency.
- Note poor 1st year growth in trenches: significant displacement of nutrients?

Height growth: Year 0 to 7



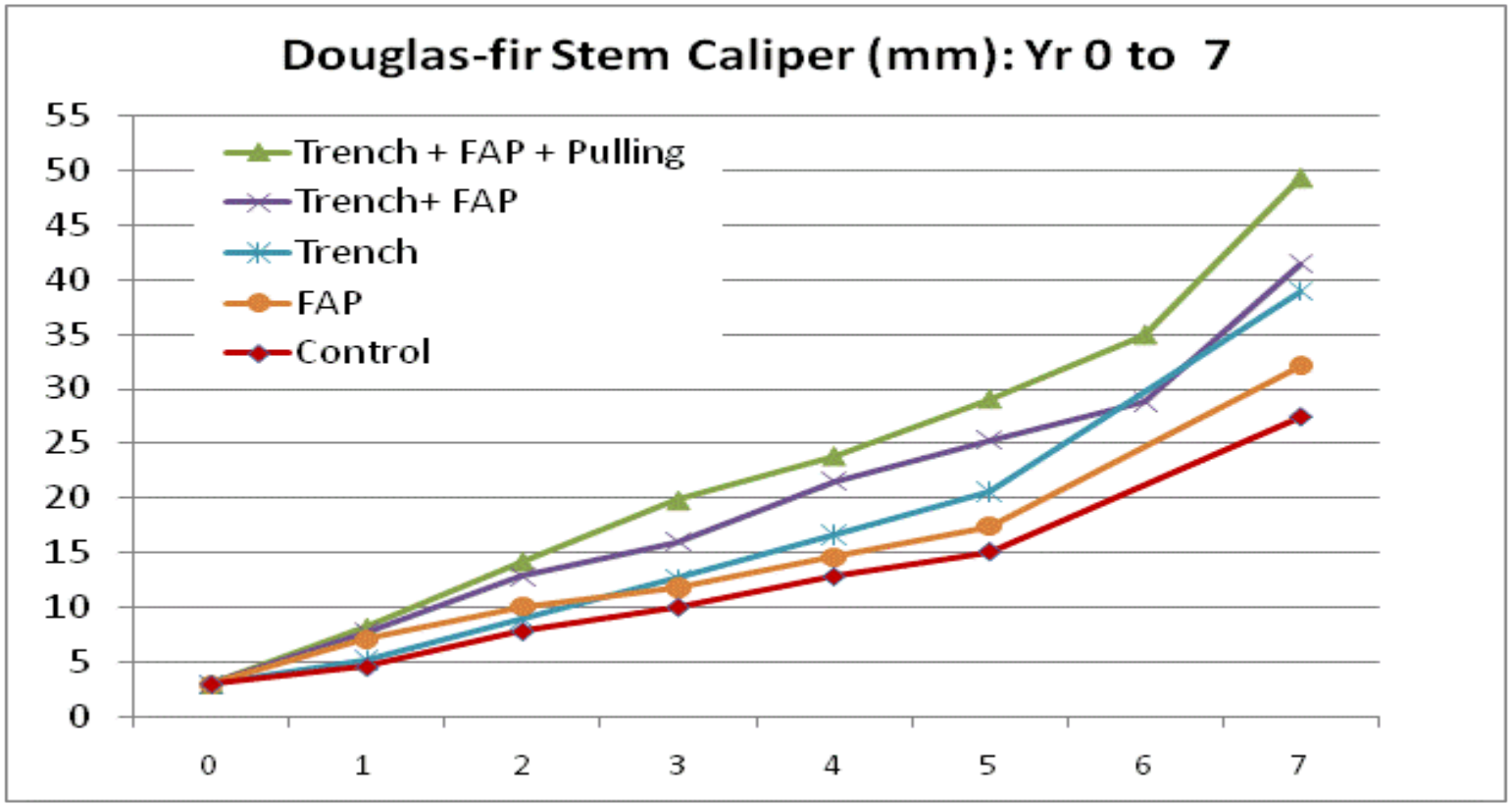
- FAP seedling growth parallel to control suggests one year growth benefit.
- Trench + FAP treatment met free-growing ht (2.0 m) in year 7.
- Little enhancement in height growth from salal pulling !

Height growth (cm): 7th Year & 3 year average (Year 5 to 7)



- 7th year height increment range from 17 cm to 47 cm.
- Three year height increment (Year 5 to 7) ranged between 15 to 32 cm.

Stem caliper growth: Year 0 to 7



- Treatment ranking based on stem caliper growth identical to those for height growth.
- Salal pulling is promoting stem caliper, suggesting the remaining salal is reducing caliper growth (more than height).
- Trenching only treatment seems to be looking better?

Planted Douglas-fir Foliar nutrient status: 5th year assessment

Foliar nutrient status	N%	P%	K%	Ca%
Adequate Levels	**> 1.35**	**> 0.15**	**> 0.65**	**> 0.25**
Control	1.198	0.212	0.641	0.225
Fertilzed	1.162	0.204	0.591	0.192
Trench	1.284	0.184	0.587	0.204
Trench + fertilize	1.298	0.194	0.570	0.222
Trench+ fertilize+ salal pulling	1.232	0.192	0.611	0.204

- Foliar N and K below adequate levels, even in the those treatments promoting the most rapid growth.
- Perhaps additional nutrient input could improve seedling growth .

Biosolid Application: Applied before the 7th growing season

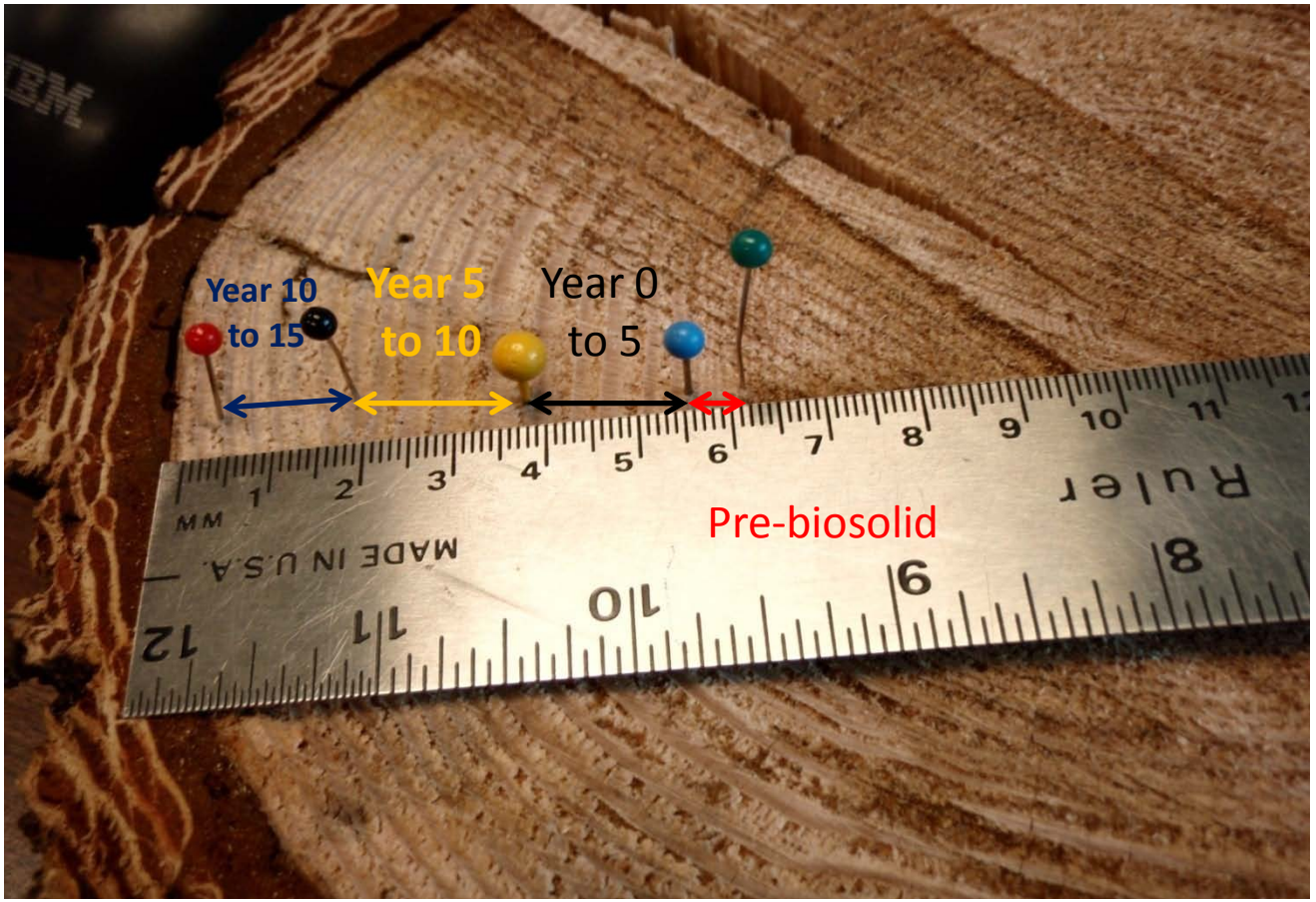
- Source: Organic solids from Nanaimo wastewater treatment plant
- Constituents: water, sand, nutrients & organic matter.
- Initial application: 700-800 kg N / ha with 50% of nitrogen available first year. Applied every 4 years.
- Project nets about $1,000/ha. This figure does not include the initial infrastructure costs such as paved storage pads, lock blocks, and equipment.

.

Past biosolid application locally

In 1991. Applied on an older stand (45 year old): Diameter growth benefits plus 2 meter height growth[1] 6 growing season after application.

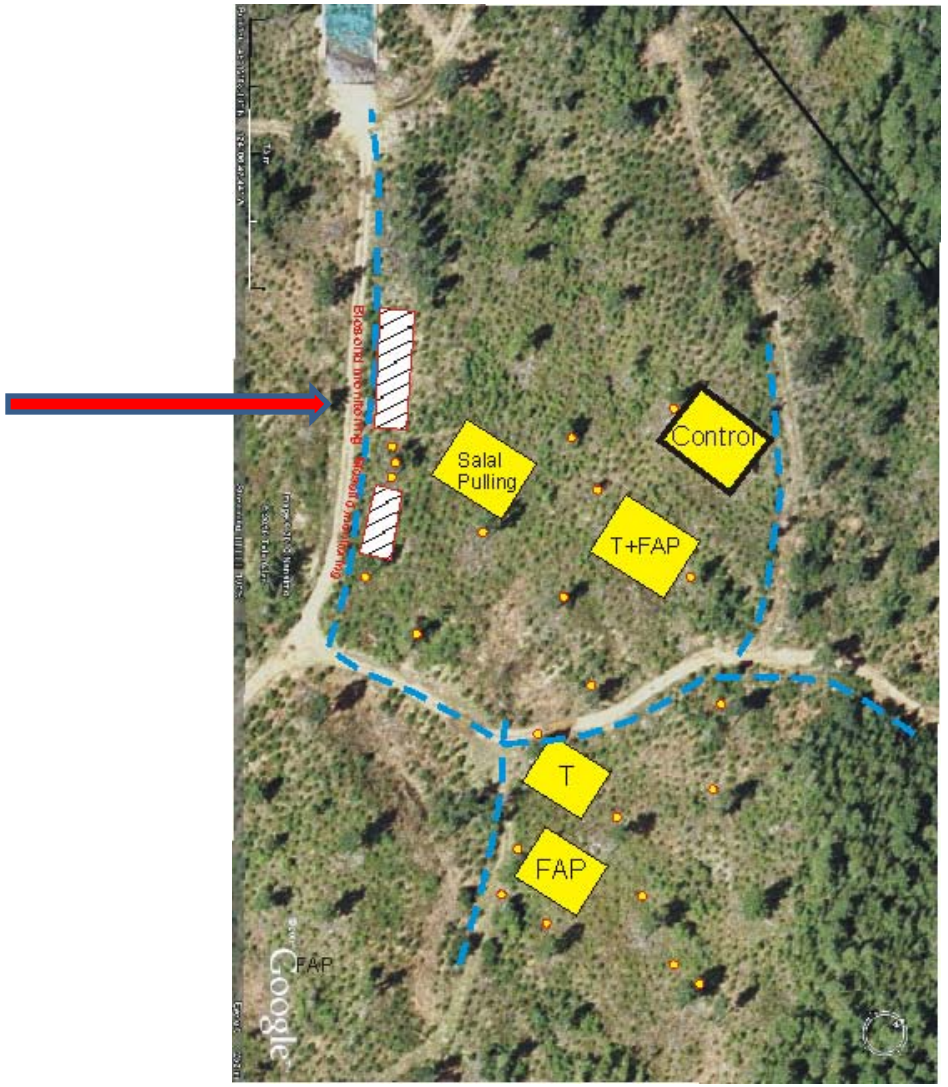
Q. What will be the response of younger trees?



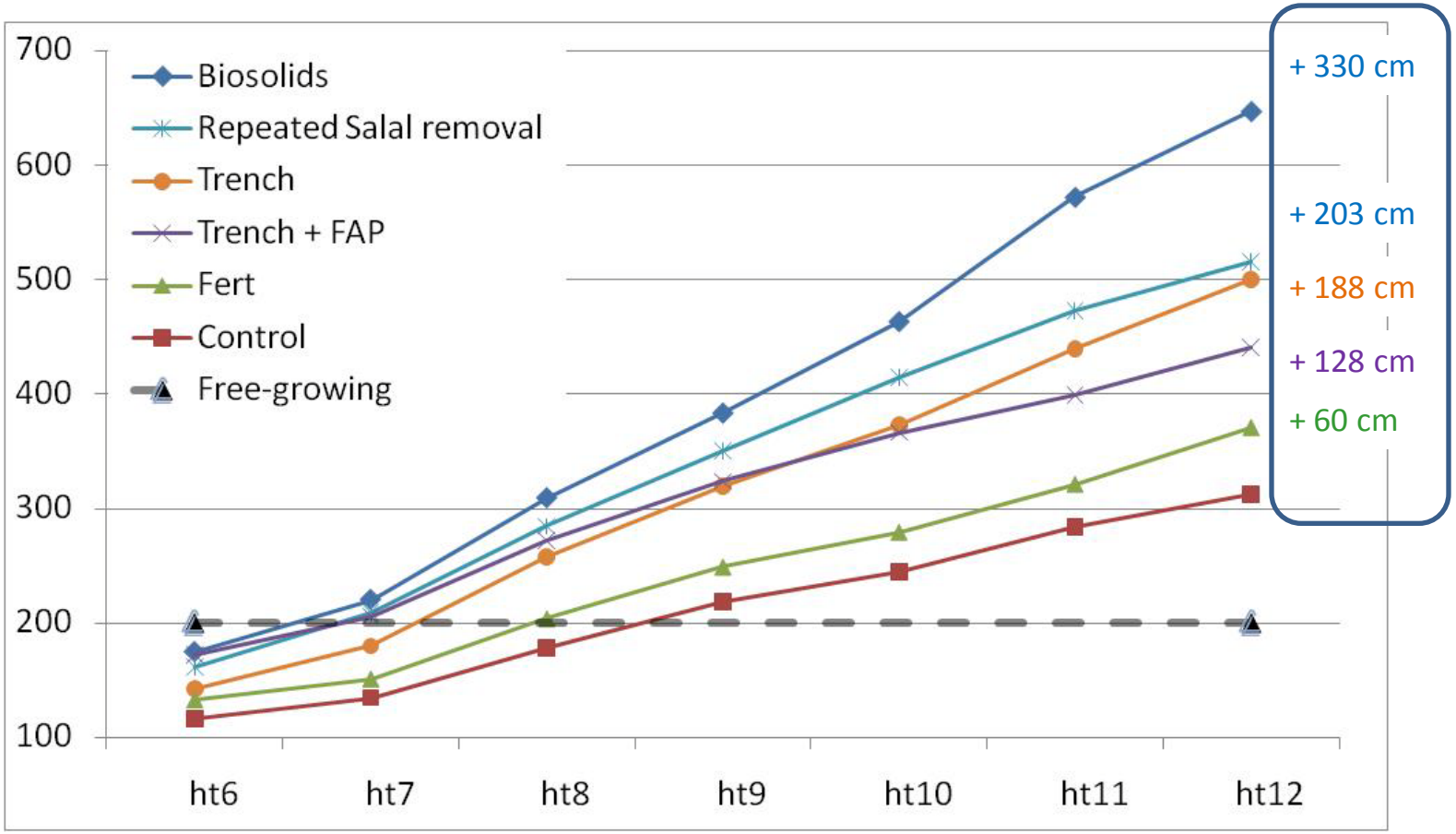
[1] See Kimmins FRBC Final Report. Computer-based decision support tool for biosolids

Biosolid Application: Monitoring began prior to the 7th growing season

Seedlings being monitored after biosolid application were beside the existing study. These seedlings received the Trenching + FAP treatment during the establishment phase

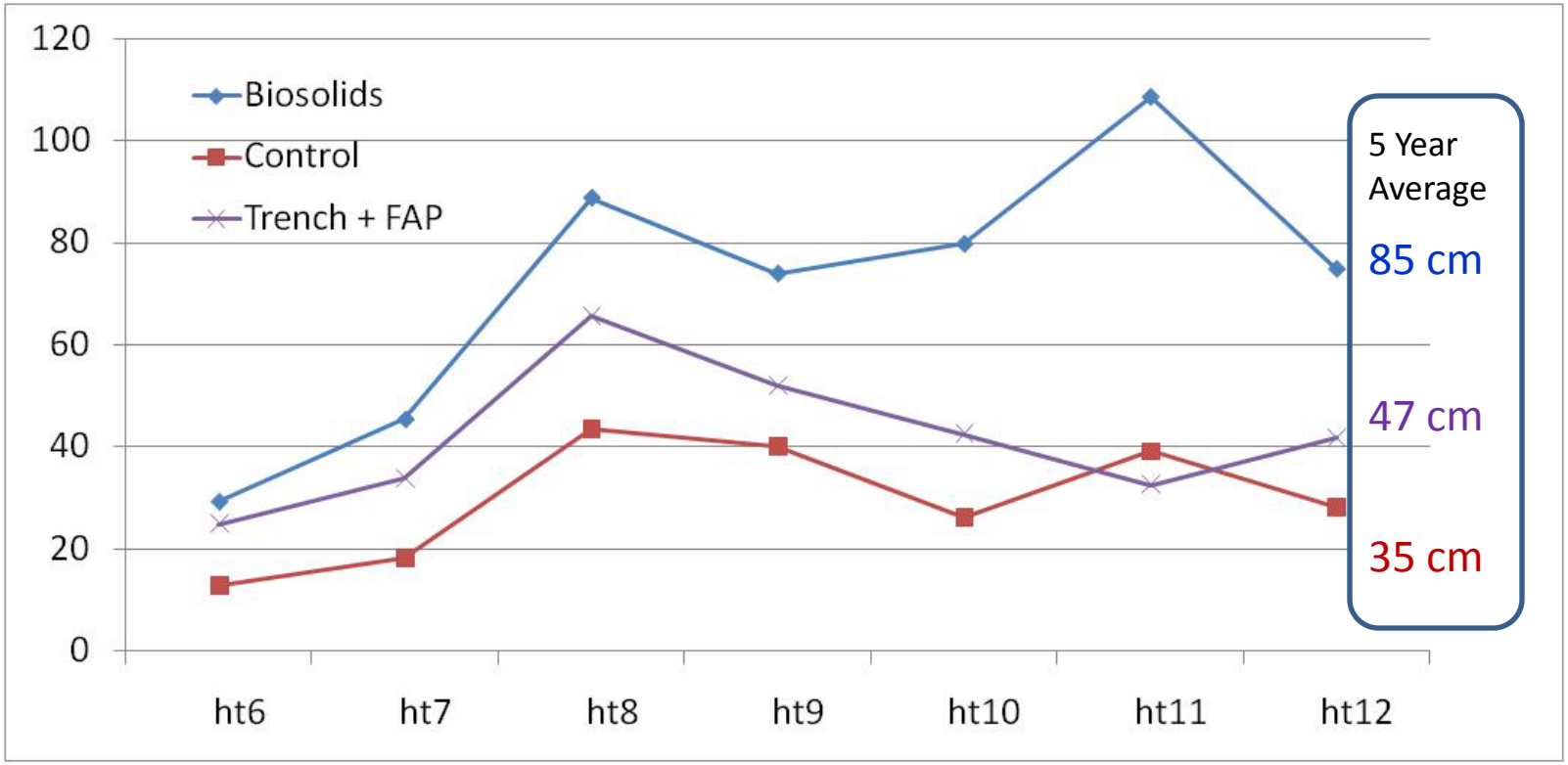


Height Growth: Year 6 to 12 (height advantage over control)



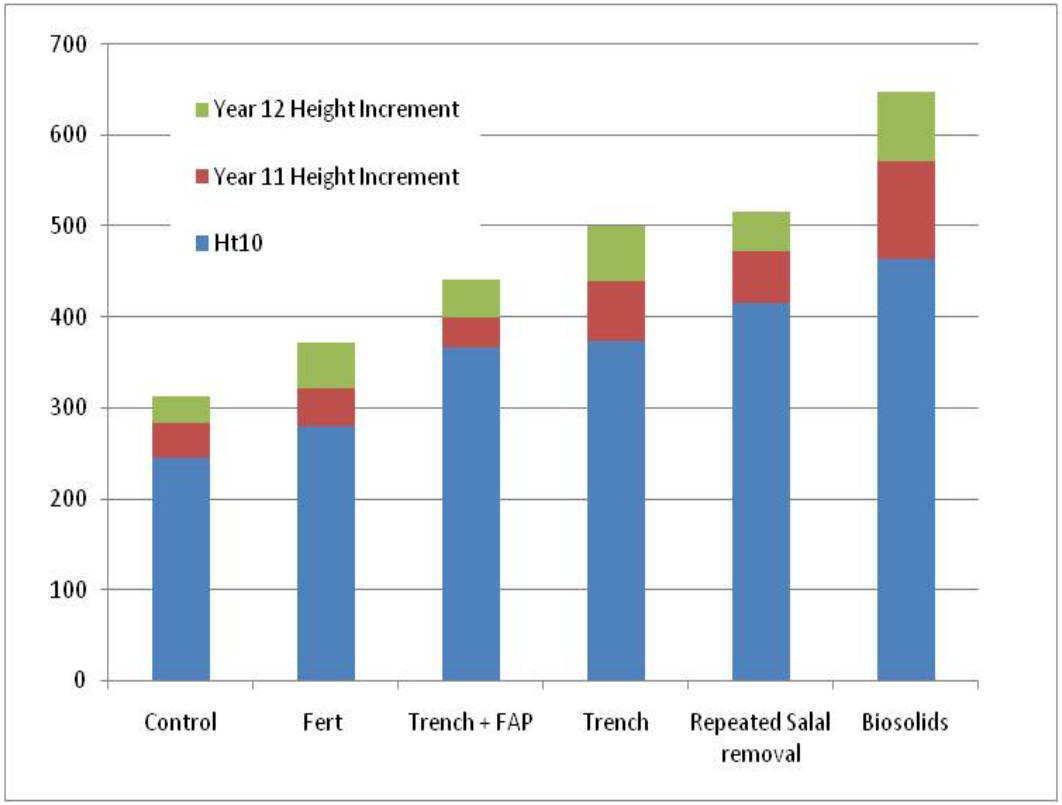
- Biosolid appears to have enhanced height growth over other treatments.
- Seedling height growth in trenches now exceed the Trench + FAP treatment. Q .Whats going on?
- Control seedlings height exceeded free growing height by year 9.

Annual Height Growth: Year 6 to 12



- In the biosolid application, seedling height growth averaged 85 cm in the last five years, reaching a peak of 110 cm. How long will this growth benefit last ??
- Seedlings Trench + FAP treatment have outgrew control seedlings in 6 of the last seven years. Does this suggest an increase in site index?

Site Index Estimates: Douglas-fir (m @50 yr).

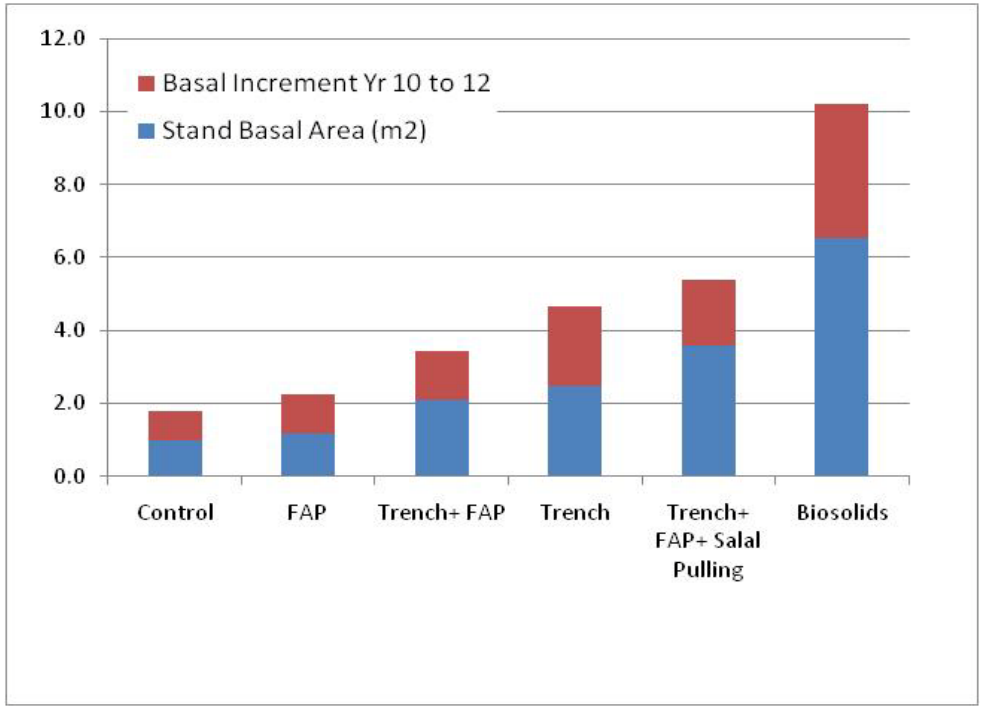


Site Index Estimates	SI	Cost over Control
SI from Prescription	22.0	
Control	21.8	
Trench + FAP	22.8	+$365
Biosolid	**31.4**	**-$1,000**

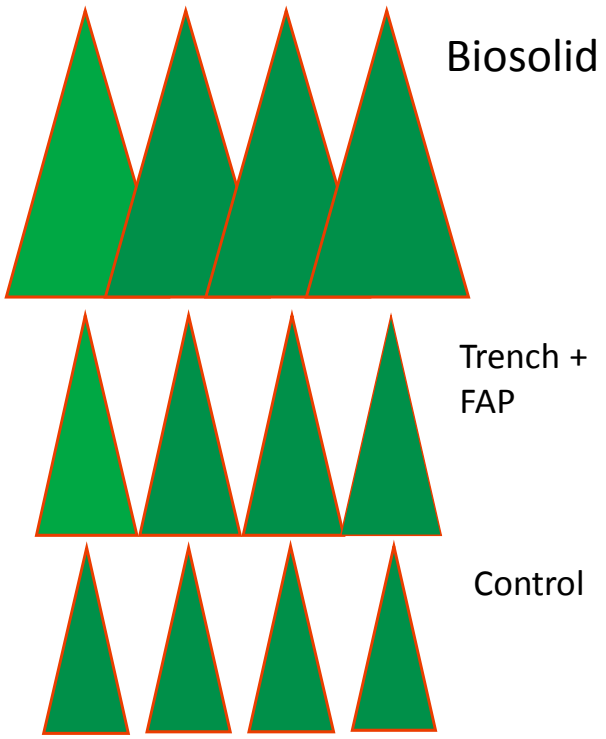
- Trends suggest a 1.0 m increase in site index in the Trench + FAP treatment over the control treatment. Does this increase justify the extra costs ?
- Growth of biosolid treated saplings suggest a 10.0 m site index increase over control.

Future Growth? Long-term consequences of greater basal area and faster crown closure ?

Basal area (m^2)[1] : Year 10 to 12th



Crown Development

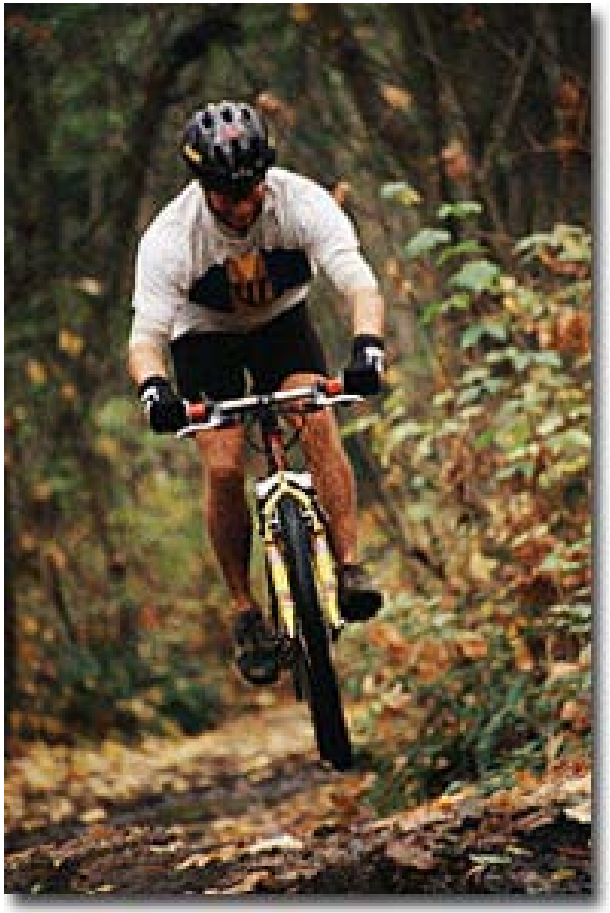


Treatment which accelerate seedling growth appear to have enhanced crown development and potentially will hasten crown closure. This may control future salal abundance and degree of competitiveness.

[1] Based on 1,500 sph and average dbh by treatment

Biosolids: Downsides?

Mountain bikers have issues with the treatment both for the smell and for the biosolid material sticking to their bikes



Conclusions

- Combining site preparation and FAP improved early growth of Douglas-fir growth, reducing time to reach free-growing height requirement and have the potential for long-term growth benefits.

- Large nutrient input as provided by Biosolid provides large increases in Douglas-fir productivity with potential for growth benefits to long-term growth

Questions ?

- How long does the growth benefits of biosolid application last?
- Single versus multiple biosolid applications ?
- Are there downsides to the biosolid application? Nutritional imbalances?
- Application rates / timing ?

Current Malaspina trials

1. **Evaluation of Trenching & Fertilization at Planting for Enhancing Douglas-fir Growth on a Dry Salal-Dominated Sites.**

2. **Fertilizer Type and Placement Trial. Following fertilizers (Tea bags, Loose fertilizer, Tablets) placed a) within planting hole and b) beside seedlings.**

3. **Evaluation of Plantskydd and seedling protectors to Manage Deer Browsing of Douglas-fir seedlings.**