

**Attachment C**  
**Real Christmas Tree Board**

Final Research Report

CTPB Project Number: CTPB 22-05-OSU

Project Title: Improving first year noble fir seedling survival and growth.

Principal Investigator: Chal Landgren (note: the listed P.I. was Alex Gorman, now resigned from OSU)

Institution: OSU/ARF

**Final Report**

1. Technical report – A comprehensive technical report to include Introduction, Methods, Results, Discussion, Tables, and Figures.
2. Summary of Research Report for Public Release by RCTB- Summary should be suitable for non-scientific audience and should not exceed one page.

In addition, photograph(s) of research aspects suitable for publication are requested.

3. List of all Publications related to this Research Grant
  - Published papers (include citation or journal/date of submission)
  - Published and projected abstracts (include meeting name(s) and date(s))
  - Projected manuscripts (include target journal name and estimated submission date)
  - Please attach copies to this report

Note: all publications should acknowledge the funding source as “Real Christmas Tree Board”

## Technical Report

Chal Landgren, OSU Christmas Tree Specialist, Retired

Judy Kowalski, Research Technician, Christmas Tree Program

### Improving first year noble fir seedling survival and growth

Noble fir Christmas tree growers have been dealing with the impacts of long, hot summers for at least a decade. Seedling survival rates range from 0 to 80 percent depending on location, planting dates, rainfall patterns, heat dome events and so on.

We have been investigating various treatments to improve planting year seedling survival for over a decade. This effort continues that inquiry. We also have been exploring supplemental watering options.

### Methods

The seedling treatments we included in in 2023 were:

**Fall vs. spring planting.** 220 one-year old Noble fir plug seedlings were planted by machine in October of 2022 at a site near Monroe, Oregon. No other treatments were applied to these seedlings. Space was left adjacent to these rows for 220 identical seedlings to be planted in spring 2023. Ground preparation included a previous application of lime at two tons per acre and a pre-plant fertilizer, as per this grower's usual procedure. The seedlings were unfortunately devoured by rabbits during a cold snap, effectively ending this part of the experiment.

**Soil amendments/additions.** We evaluated three treatments (plus an untreated check) on three test sites in the Willamette Valley with 300 Noble fir seedlings at each location. All sites were planted in spring of 2023 and treatments were applied soon after. We evaluated tree growth and mortality at the end of the growing season.

### Treatments were:

**Simplot Product:** Best Paks, Controlled Release Fertilizer (CRF) 20-10-5, 12-month release formula. One bag per seedling placed on uphill side of seedling 1-2" below soil line, next to plug.

**Medium Biochar** (from Biochar Now, Loveland Colorado): This product has a 3-26 mm particle size and is applied as a top-dress amendment to the soil after planting at two cups of product per seedling, lightly spread around at approximately 1/2-1 inch depth. (*Image 1*).



*Image 1. Biochar applied to noble seedling at site in Banks, OR. April 2023*

**Wood chip mulch:** Wood chip mulch, aged approximately one-year was used at all three sites. Approximately 1.5 gal per tree was applied around the base of each seedling, via a five-gallon bucket dumping/sprinkling to a target depth of 2-3". Half the seedlings in each treatment group, and the untreated check, received the mulch application. We are trying to replicate a simple process that a grower could implement with a crew.

## Results

The first-year leader growth results show no statistically significant growth difference between the untreated check trees, Biochar and Simplot treatments (*Table 1*). Leader growth was modestly improved when comparing mulch vs no mulch trees across all sites and treatments (*Table 2*)

Treatments		Average leader length (cm)
Bio-Char		
	Mulch	6.0
	No Mulch	5.3
Simplot		
	Mulch	6.4
	No Mulch	5.1
UTC		
	Mulch	6.5
	No Mulch	5.6

*Table 1 Treatment summary (average cm)*

Treatment	Leader growth-all sites (cm)
Mulch	6.3(a)
No Mulch	5.3 (b)

*Table 2. Leader growth all sites. ANOVA values with different letters ( ) indicate significant differences*

Let's look now at tree survival (*Table 3*). Across all sites, mulch provided a statistically significant 22% improvement in survival (ANOVA evaluation). Yet the benefits of mulch varied by site. The Silverton site had only a 3% survival increase with mulch. The Banks site had poor survival overall, but a 37% increased survival with mulch. The Monroe site showed a 22% improvement using mulch along with the highest overall survival. (Sick or declining trees were not included in the tabulations as it is unclear if they will survive next year.)

Treatment	Site	Tree status			Survival
mulch		Alive	Sick	Dead	
	Silverton	88	10	49	64%
	Banks	50	22	78	39%
	Monroe	121	25	4	97%
	Totals	259	57	131	66%
No mulch					
	Silverton	88	5	57	61%
	Banks	2	1	147	1%
	Monroe	94	25	31	75%
	Totals	184	31	235	44%

*Table 3 Summary of mulch treatments*

**Supplemental watering strategies:** A video will be available soon on supplemental watering. The video features Kirk Stroda discussing the systems he uses to irrigate first year plantings on sites without fixed watering systems. Check back at <https://agsci.oregonstate.edu/nwrec/programs/christmas-trees>.

The system Kirk uses is summarized below-

Watered 30,000 trees over a 6-week period (early July to Mid-August 2023)

- Runs 2 lines (2 rows of trees) at once:
- Uses .540" diameter, 12" spacing and .26 GPH Netafilm drip line.
- Lines lay on top of mulch.
- Irrigation runs approximately 2-2.5 hours, which equates to at least 64oz. per tree.
- Water penetration of about 10-12".
- 400 gal per set, from an 1800 gallon tank.
- Waters once per growing season.
- Also uses a water tank mounted on a 4-wheeler to water individual interplanted seedlings

Tips for Success

- If using pond or river water, need to add a filter to avoid nozzle clogging.
- Using mulch helps retain added moisture.
- Time watering to occur **before** ground is too dry and trees are already stressed.

## Other Measurements-

Temperature sensors were installed at all three sites at planting and placed 6" above the soil level. Average high temperatures for June- August are shown below (Table 4)

	Average monthly high temperature (F)		
Site	June	July	August
Silverton	101	112	110
Banks	91	99	101
Monroe	91	102	99

*Table 4. Average monthly high temperatures by site and month*

Nearby rainfall stations at the three sites reported light rainfall (< .5") in June and August and negligible rainfall in July. It is interesting that the Banks and Monroe sites showed similar temperature profiles, yet Banks showed very poor survival.

## Discussion

In 2023, the Biochar and tea bag fertilizer treatments provided no survival or growth benefit. In fact, among the 10+ treatments we have tested over the years, adding mulch to first-year Noble fir seedlings has been the only consistent tree survival treatment we have tested. The mulch does not appear to tie up soil nitrogen, reduces soil temperature and seems to conserve available moisture.

In some years, on some sites, the fertilizer tea bags have boosted growth and survival, but that was not the case in our 2023 trial.





*Image 2. Silverton, Oregon site, early October final evaluation.*

Though our fall planting effort was a bust due to hungry rabbits, fall planting does offer some potential tree survival benefits along with some complications. The benefits include added root development prior to the coming summer. The complications relate to tree dormancy and seedling availability. Some nurseries are not set up to deliver seedlings in the fall and trees do need to be planted shortly after lifting.

Acknowledgements: This study was funded by the Real Christmas Tree Board. As always, many thanks to the growers allowing us to subject their trees to these trials. Riley Johnson and Dr. Bert Cragg at MSU assisted with data analysis.

## Public Research Summary

### Helping noble fir seedlings survive after planting

Christmas tree growers across the country are looking for strategies to improve tree survival following planting. In the Pacific Northwest, tree survival has been worsened due to longer, hotter, and often drier summers. The premium tree species in the region, noble fir, has been particularly sensitive and subject to, in some cases, complete plantation failures.

Both researchers and growers have been investigating approaches to improve planting success. The varied approaches include applications of anti-transpirants, water absorbing gels, fertilizers of all types, mycorrhizae dips, plant and root stimulants, shading, and a wide assortment of root dips and sprays.

This study, funded by the Real Christmas Tree Board, evaluated four treatments during one year after planting noble fir at three sites. Treatments were- Fall vs. Spring planting, Biochar applied as a top dress at planting, fertilizer “tea bag” additions to the planting hole and coarse wood mulch as a top dressing.

To quickly summarize results, rabbits destroyed the fall planting, despite our high hopes. Rabbit damage is not unique to fall plantings. Our trees just happened to be in the wrong place and the rodents failed to grasp the importance of the research. Biochar and fertilizer tea bag additions were the second and third treatments evaluated. The fertilizer treatments had shown promise in a prior experiment in a year with significant spring rainfall. The Biochar addition was a new treatment that touted improved soil moisture status. In our 2023 trial, neither of these treatments provided improvement in either tree growth or survival. That leads us to the fourth treatment- coarse mulch spread around the trees (approximately 1.5 gallon/tree). This treatment improved survival percentages and had a slight improvement in tree growth. Across the three sites in this experiment, mulch increased survival by 22%. But we saw different survival ranges at the individual sites. At one location, mulch provided only a 4% improvement (to 65%). At another location, mulch provided a 46% improvement (to 48%). At the third site, mulch provided an 18% improvement in survival (to 97%).

Of all the products/treatments we have evaluated, mulch has provided the most consistent tree survival results. Mulch mitigates high soil temperatures and conserves available soil moisture. Yet mulch can only do so much so, a few growers are improvising dryland irrigation strategies. Kirk Stroda, a grower in Monroe Oregon, has devised two irrigation techniques on his farm. A video will be available shortly at <https://agsci.oregonstate.edu/nwrec/programs/christmas-trees>. The challenge for growers will be balancing the added costs of mulch and/or watering vs. costs of replanting, delays in tree harvests and missing trees.



## List of publications relating to this grant/topic

Landgren C, Kowlaski J. 2024. Lookout. Noble fir seedling survival- continued. Awaiting publication.

Landgren C. 2012. The use of soil additives and root dips on Noble Fir Christmas Trees. *Tree Planters' Notes* 55(2): 34-36

Percival, G. Graham, S., Franklin, E. 2023. The influence of soil decompaction and amendments on soil quality. *Arboriculture and Urban Forestry* 49(4): 179-189

Landgren C, Kowlaski J, Cregg B.M. 2021. Can treatments at planting improve Noble Fir seedling survival? *Tree Planters' Notes* 64(1):32-38

Cregg, B.M. 2020. Is there a role for mulch in Christmas tree plantations? *Great Lakes Christmas Tree Journal*. 1(4): 25–29

Landis, T.D. 2006. Protective root dips: are they effective? *Forest Nursery Notes*. Portland, OR: U.S. Department of Agriculture, Forest Service, State and Private Forestry: 11–13

Schaffert E, Lukac M, Percival G, Rose G. 2022. The influence of biochar soil amendment on tree growth and soil quality: A review for the arboricultural industry. *Arboriculture & Urban Forestry*. 48(3):176-202