

Three-year performance of trees in CoFirGE-2 plots in Washington, Idaho, and California

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Drawing by: Lukas Chastagner

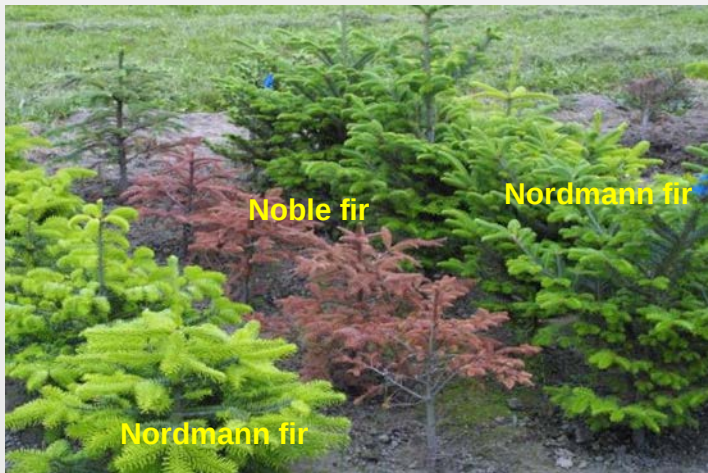




2003 CTRE Conference



Industry Wide Increased Production of True Firs



Increased Interest in Exotic *Abies* Species

Nordmann fir

Turkish fir

Trojan fir

Tolerance to diseases and pests, such as:

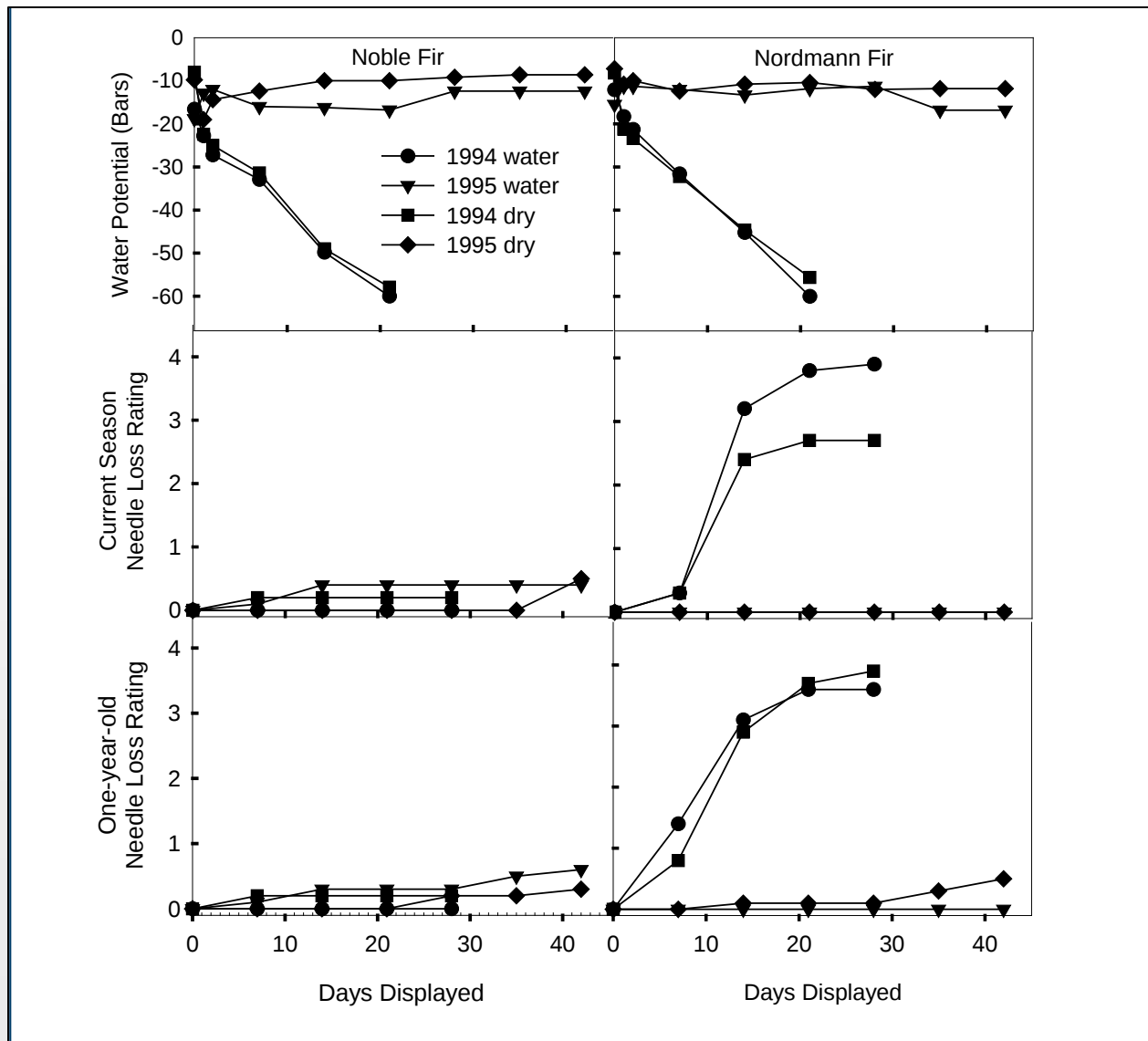
- Phytophthora root rot
- Balsam woolly adelgid
- Spider mites
- Others?

Climate change resilience?

Increased product diversity



Noble and Nordmann fir Keepability



Detached shoot NL tests





Grade and Value Assessments of Different Sources of Nordmann (NF) and Turkish (TF) Firs in 2012

Best performing sources:

NF Vallo 18

TF Adapazan Hendek*

TF Adapazan Akyazi*

NF Koberhaven 076/00

Worst performing sources:

TF Artvin Yayla*

NF Nordjylland Tversted 623

NF Vallo 13

An 89% increase in value from the lowest to best sources. This translates to a difference of \$7,865 per acre. (Chal Landgren, Oregon State University)

Genetic variation in the growth of Nordmann fir families in Denmark





Collaborative Fir Germplasm Evaluation Project -The CoFirGE Project-

GOAL: To cooperate in obtaining seeds and evaluating seedlings of Turkish and Trojan fir species for use as Christmas trees across production regions of the United States and Denmark.

Turkish fir = *Abies bornmuelleriana*

Trojan fir = *Abies equi-trojani*

North Carolina Christmas Tree Association	North Carolina State University
Pacific Northwest Christmas Tree Association	Oregon & Washington State Universities
Michigan Christmas Tree Association	Michigan State University
Connecticut Christmas Tree Association	Connecticut Agricultural Experiment Station
Pennsylvania Christmas Tree Growers Association	Penn State University
New York Christmas Tree Association	
Danish Christmas Tree Growers Association	University of Copenhagen





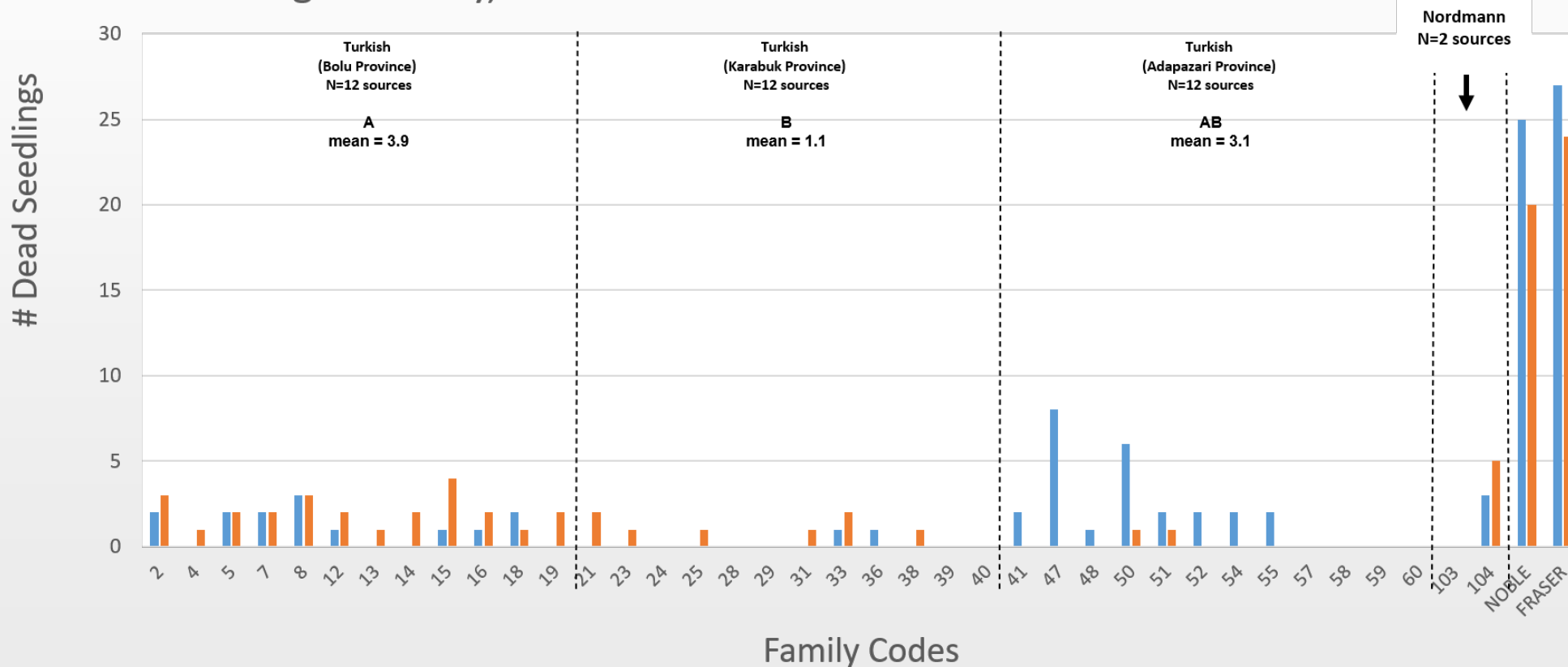
Zone	Minimum Temperature				Trojan Fir	Turkish Fir	CT		MI		NC		PNW		PA/NY	
	F		C				1	2	3	4	5	6	7	8	9	10
4	-30	to	-20	-61	to	-51										
5	-20	to	-10	-51	to	-41										
6	-10	to	0	-41	to	-31										
7	0	to	10	-31	to	-21										
8	10	to	20	-21	to	-11										
9	20	to	30	-11	to	-1										



Field Susceptibility of CoFirGE Turkish fir Families to PRR

Noble and Fraser firs are very susceptible to *Phytophthora* root rot

Seedling Mortality, 14 Weeks Post Inoculation





Identification of Top Preforming Turkish and Trojan fir Trees

True firs (*Abies* spp.) in WSU CoFirGE Plots

Species/Source	No. of Families		
	Nisqually	TF-114	AD-113
Turkish fir (Bolu)	19	12	15
Turkish fir (Aky)	20	12	16
Turkish fir (Kar)	17	10	16
Trojan fir (Kaz)	19	4	6
Trojan fir (Can)	16	4	3
Nordmann fir (Amb)	1	0	1
Nordmann fir (Bor102)	1	0	1
Nordmann fir (Aps)	1	1	1
Nordmann fir (Tve)	1	1	1
Nordmann fir (Uss)	1	1	1
Nordmann fir (Bor115)	0	0	1
Noble fir (RF15)	1	1	1
Balsam fir (NS)	1	0	1
White fir (CNF)	1	0	1
Fraser fir (RMt)	1	1	1
Grand fir (ID)	1	0	1
Korean fir	1	0	1
Turkish fir (KMtH)	1	1	1
King Boris fir (OSU/K)	0	0	1
Total	103	45	64

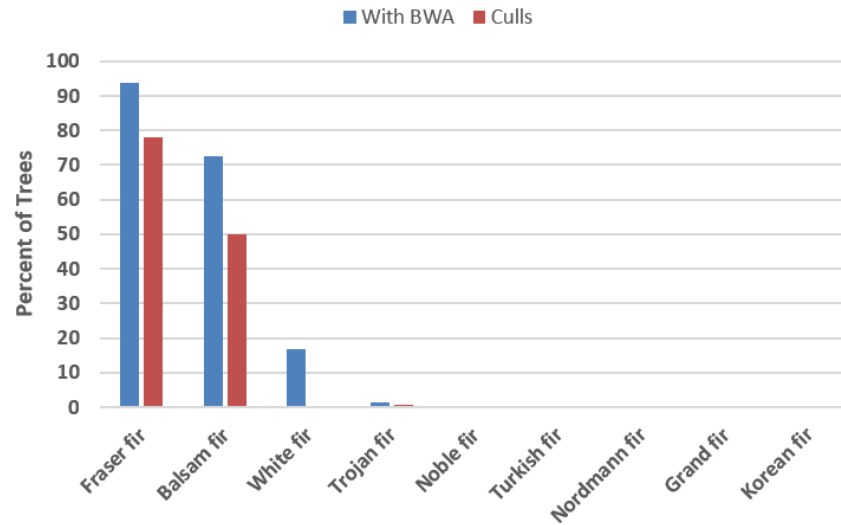
- Evaluated 1,962 Turkish and 870 Trojan fir trees
- Tree survival and health
- Bub break: Yearly (6-yr-BB rating <1.8)
- Height at “harvest” (top 10%)
- Postharvest needle loss (4-yr-NL rating avg ≤ 1)
- 2021 “Harvest” Quality Ratings (1-5, 1 = premium & 5 = cull; <2 and <3)



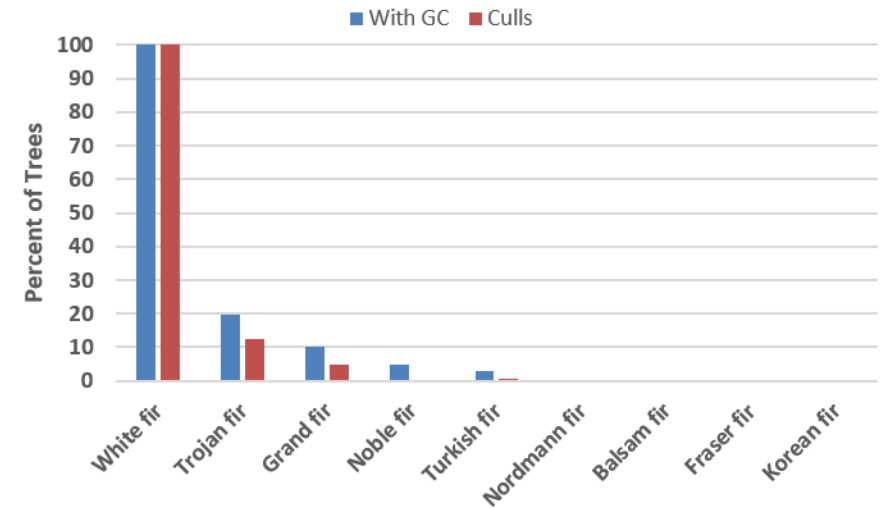


Susceptibility of CoFirGE Families to BWA, GC, and INB (2024)

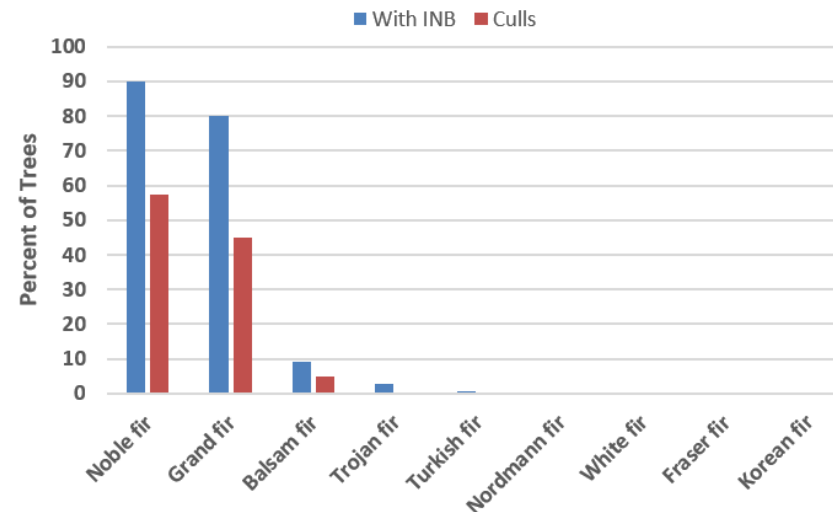
Susceptibility to Balsam Woolly Adelgid (BWA)



Susceptibility to Grovesiella Canker (GC)



Susceptibility to Interior Needle Blight (INB)





2023 CoFirGE2

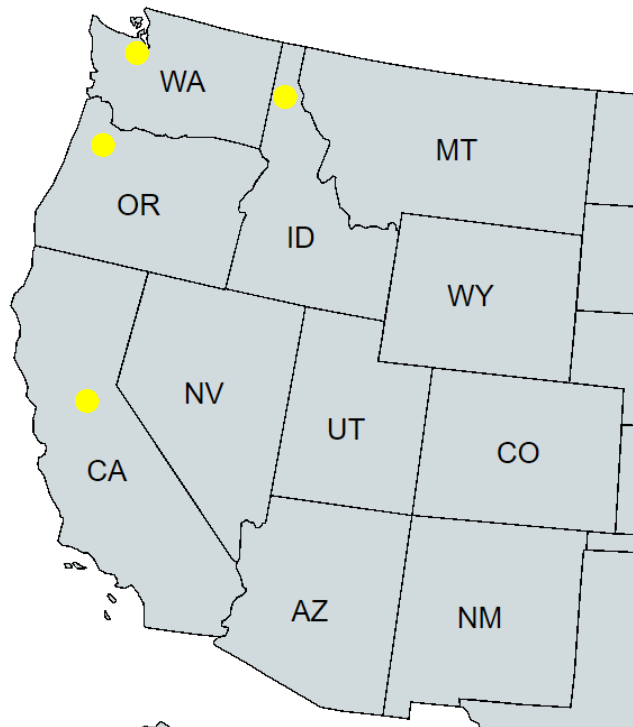


Chal Landgren





Western Regional U.S. CoFirGE2 Test Plot Specifics



2023 Western Regional CoFirGE2 Plots

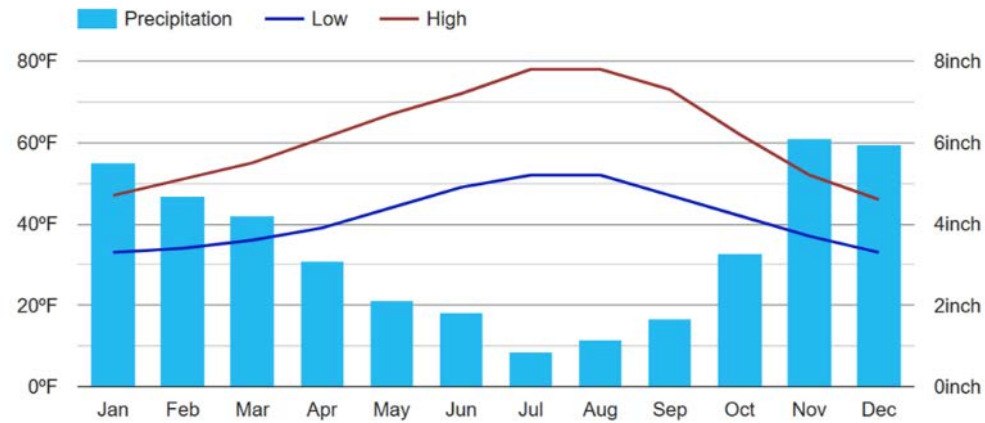
	WA	OR	ID	CA
Location	Puyallup	Salem	Harrison	Placerville
Elevation (ft)	39	590	2,788	2,784
USDA PH Zone	8b	8b	6b	9b
No. of families	35	32	30	25 (UF) + (LWF)
Total No. of trees	875	795	730	440
Planting date	3/6/2023	3/8/2023	4/28/2023	4/11/2023
Irrigation	Yes	Once	Yes	Yes



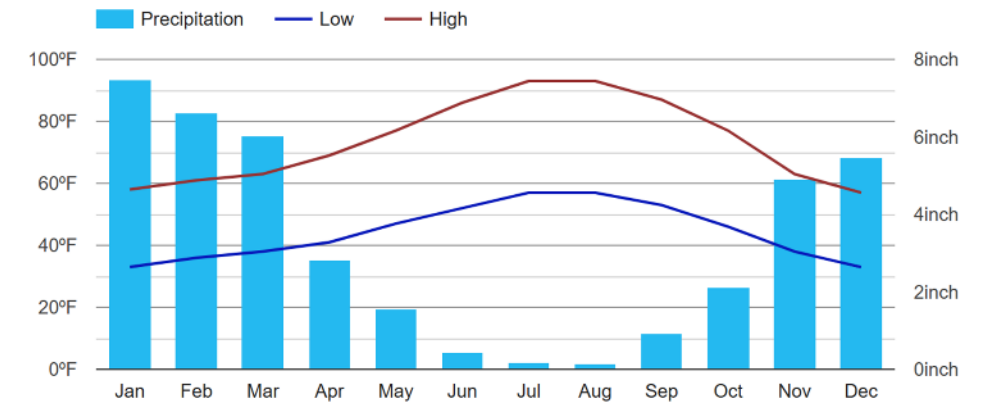


Regional Differences in Average Monthly Temperature and Precipitation

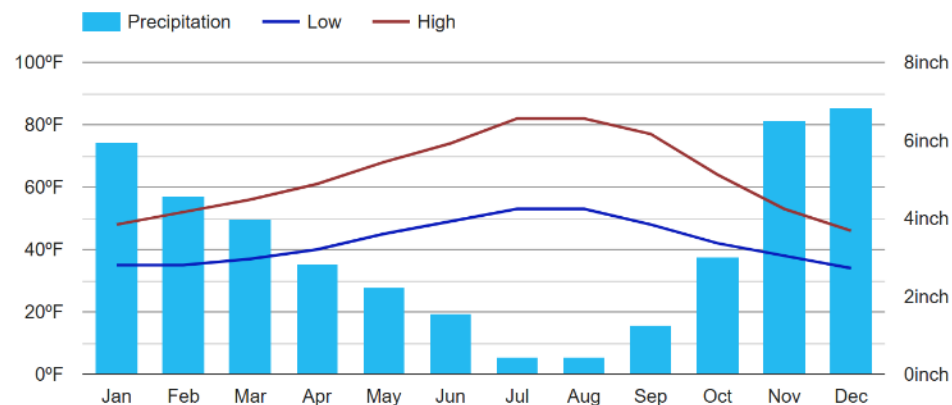
Puyallup, WA



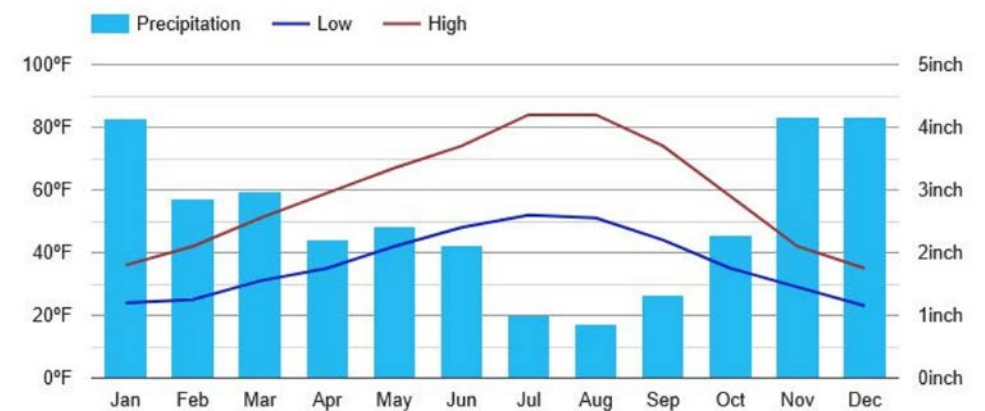
Placerville, CA



Salem, OR



Saint Maries, ID





Sources of trees in western regional CoFirGE2 plots

Sources of trees in western regional CoFirGE2 plots

Code	Species	Province	WA/OR	ID	CA
1	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F62)			
2	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F76)			
3	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F80)			
4	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F72)			
5	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F67)			
6	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F79)			
7	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F75)			
8	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F65)			
9	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F66)			
10	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F77)			
11	Trojan fir	Balıkesir/Kazdaği (CofirGE 1 F74)			
12	Trojan fir	Balıkesir/Kazdaği (CoFirGE 1 F78)			
31	Turkish fir	O5 OR SO			
32	Turkish fir	O8 OR SO			
33	Turkish fir	Ry SO			

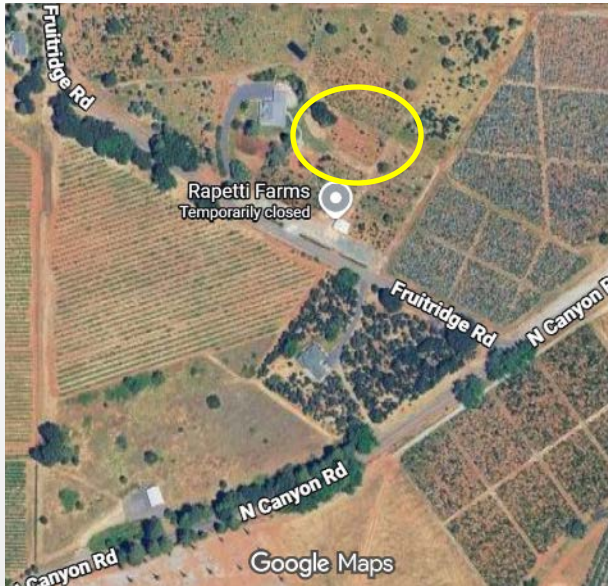
Plot Designs

Site	Design	Blks	Trees/F/ Blk
WA	AC	25	1
OR	RCB	5	5
ID	RCB	5	5
CA	RCB	4	5

Code	Species	Province	WA/OR	ID	CA
13	Nordmann fir	Ambrolauri, Tlugh			
14	Nordmann fir	Ambrolauri, Tlugh			
15	Nordmann fir	Ambrolauri, Tlugh			
16	Nordmann fir	Ambrolauri, Tlugh			
18	Nordmann fir	Ambrolauri, Tlugh			
19	Nordmann fir	Ambrolauri, Nikortsminda			
20	Nordmann fir	Ambrolauri, Nikortsminda			
21	Nordmann fir	Ambrolauri, Nikortsminda			
22	Nordmann fir	Okriba, Dzmuisi			
24	Nordmann fir	Bakhmaro			
25	Nordmann fir	Borjomi			
30	Nordmann fir	KB8/11 OR SO			
34	Nordmann fir	Levinsen (Tversted) FP1004 SO			
35	Nordmann fir	Lundbygaard FP1000			
36	Nordmann fir	Berritzgård F 665			
38	Nordmann fir	Vallo 9 (Pyatigorsk, Russia)			
26	Balsam fir	NS SO			
27	Cannan fir	OR SO			
28	Fraser fir	NC SO			
Ck	Noble fir	Hostetler SO			



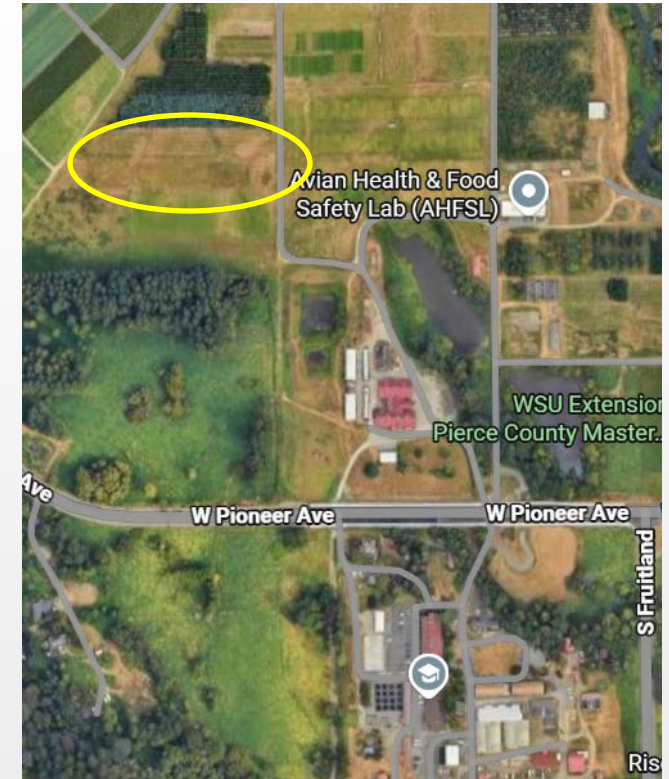
CoFirGE2 Evaluations



Data Collection

Evaluation	2023	2025	2025
Survival			
Bud Break			
Height			
Terminal Buds			
Condition*			

*Frost, winter burn, disease, pest, etc.



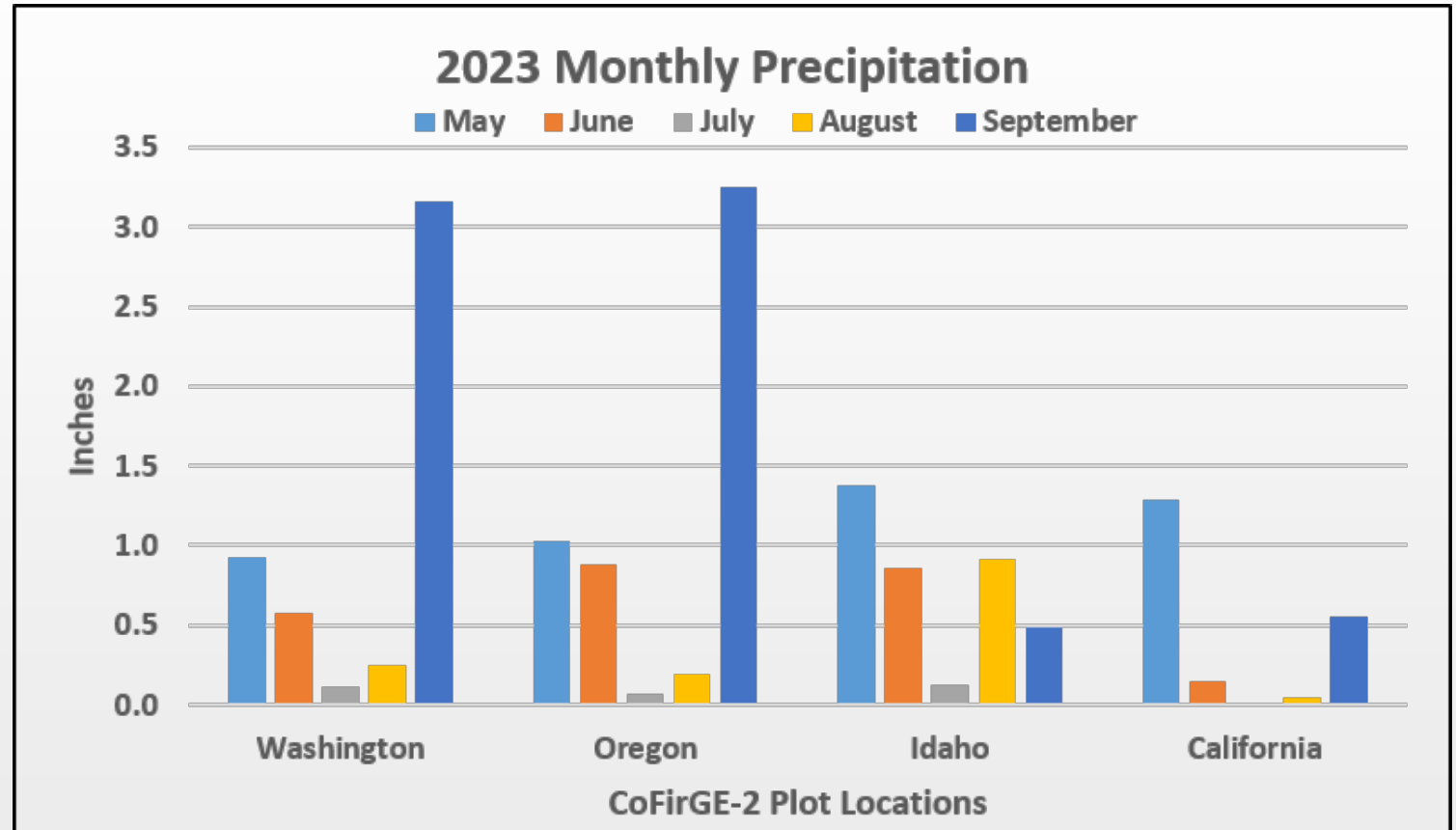


First Year Mortality in CoFirGE2 Plots – May-Sept 2023

Overall Mortality in CoFirGE2 Plots

Site	Yr. 1
WA	0.3%
ID	0.5%
CA	1.6%
OR*	33.6%

*Rabbit/gopher damage



OR plot data provided by Judy Kowwalski, OSU



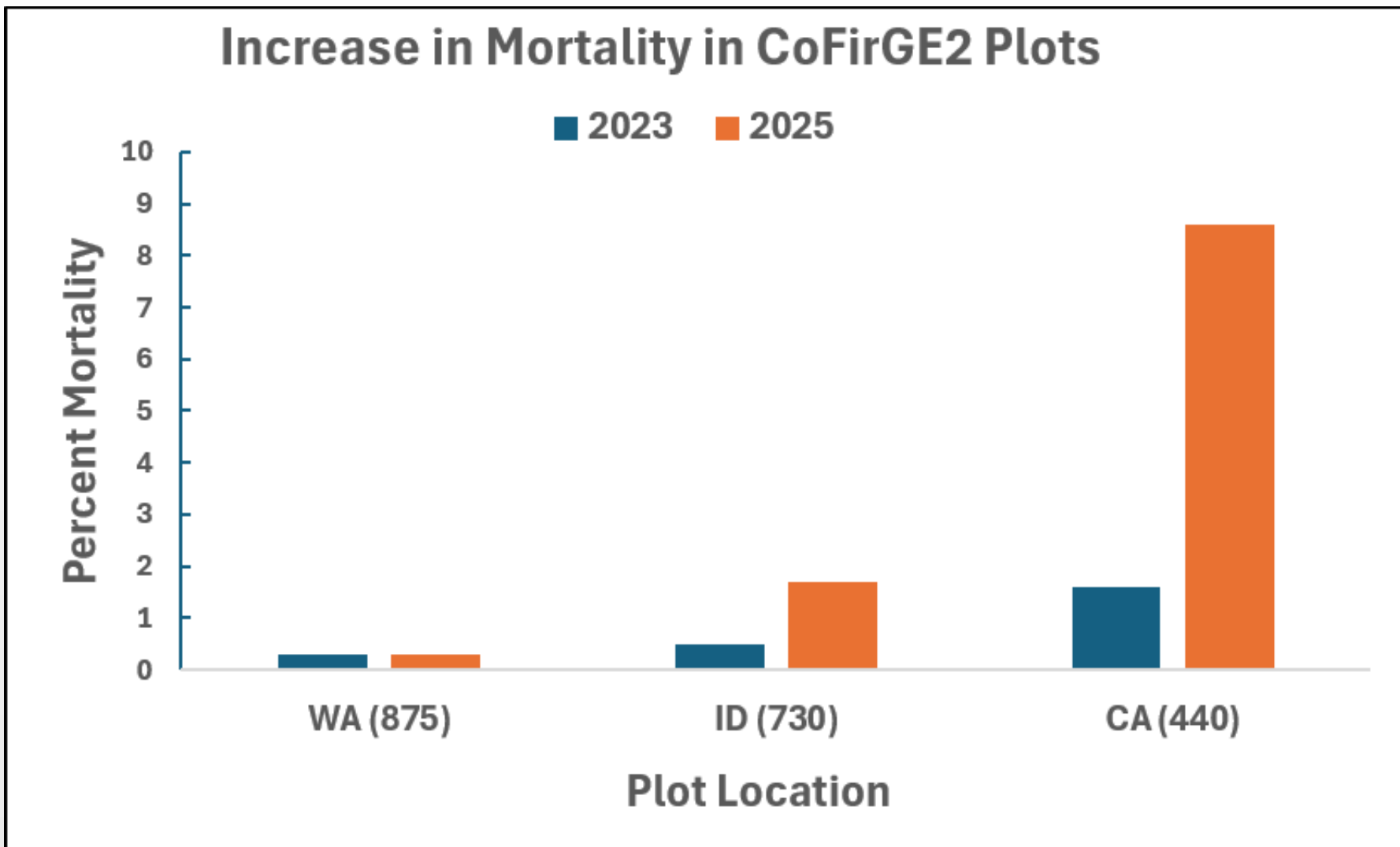
Tree Mortality

Mortality of seedlings in non-irrigated OR plot			
	No. of Seedlings	% Mortality	
		July '23	June '24
Overall	795	16.0	33.6
Trojan fir	293	15.1	24.1
Turkish fir	73	13.7	26.0
Nordmann fir	335	12.5	31.9
NA Species*	94	33.0	72.3

*Includes balsam, Canaan, Fraser, and noble fir.

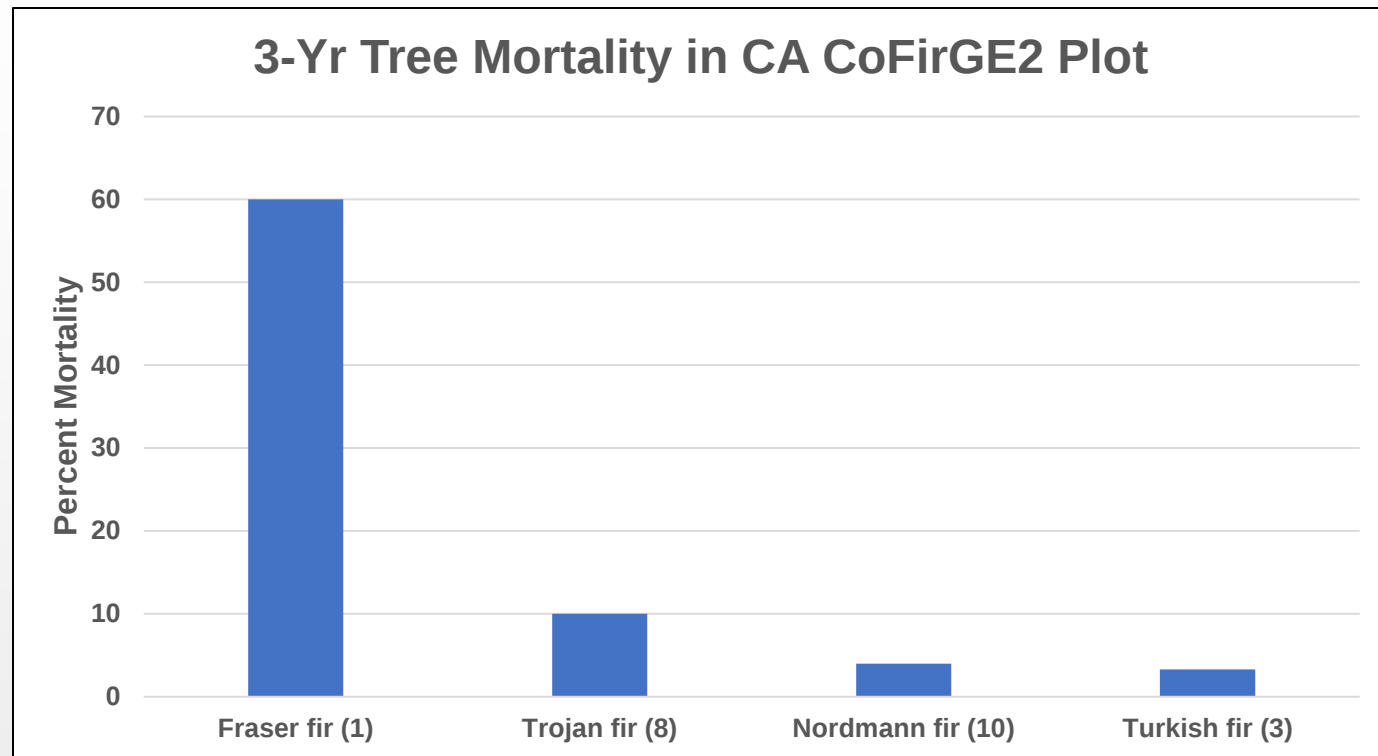


Increase in Mortality in CoFirGE2 plots: 2023-2025





Increase in Mortality in CA CoFirGE2 plot: 2023-2025



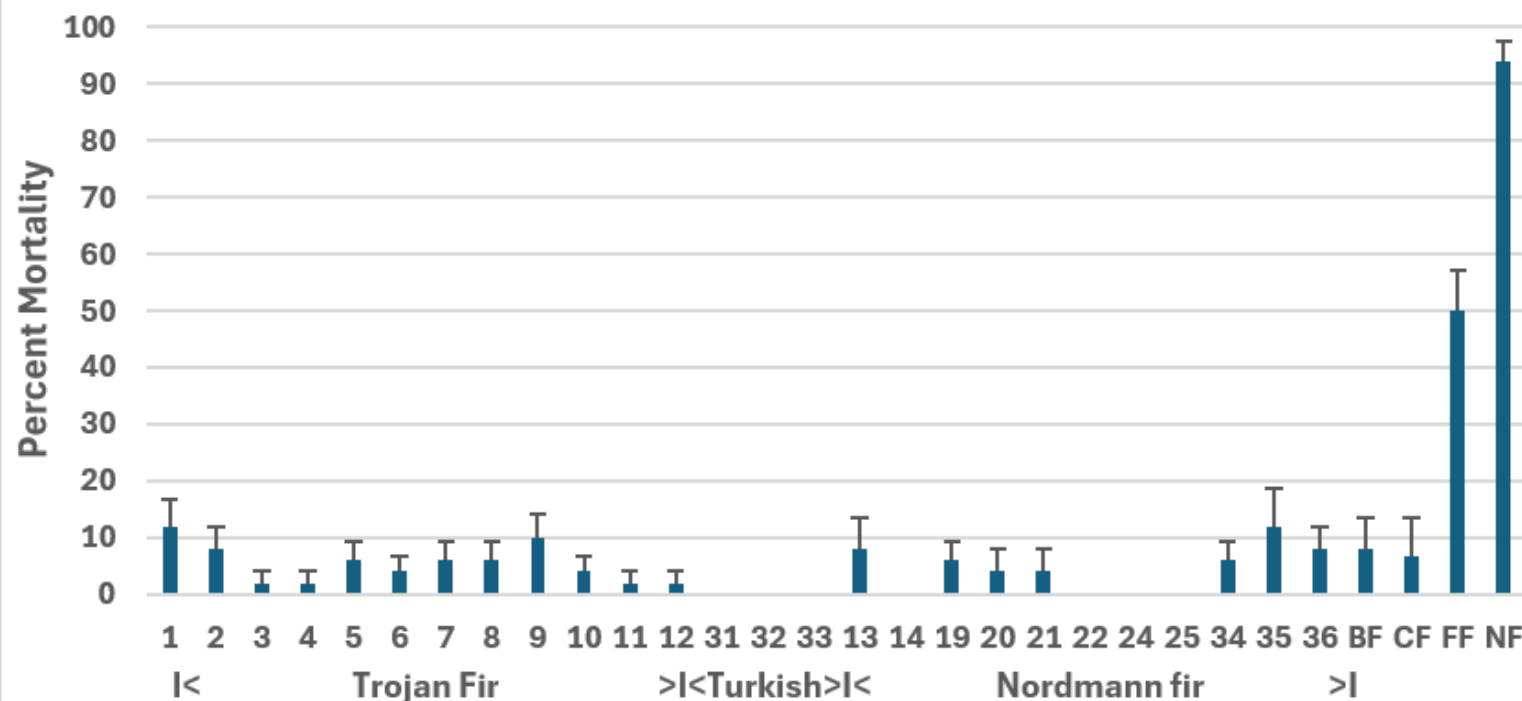
Most of the mortality is associated with PRR (*P. cinnamomi*)



Field Susceptibility of CoFirGE2 Eurasian fir Families to PRR



"Rice Paddy" 3-yr PRR Mortality





Bud Break Evaluations

Onetime Bud Break Rating (ID and CA)

0 = tight bud, no bud swell (winter condition)

1 = buds swelling/elongating, no emergence of needles

2 = bud burst (needles emerging out of scales)

3 = emerging branch buds less than 1", needles still "brushy

4 = elongating shoot 1-2 in" long, shoots and needles still soft

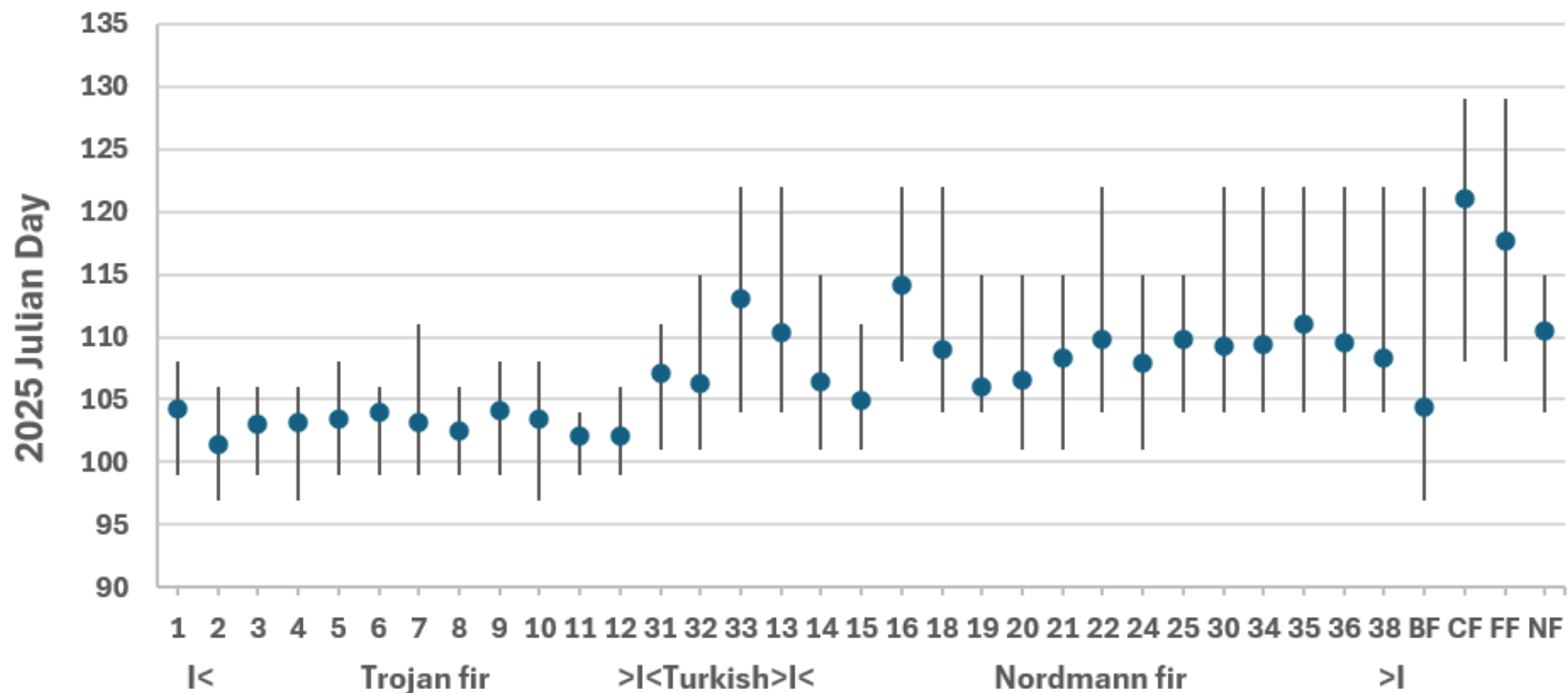
5 = elongating shoot >3" long, shoots and needles still soft

6 = shoot fully elongated

WA Plot: Rated actual bud break (stage 2 above) 2 to 3 times a week to identify date at which bud break occurred

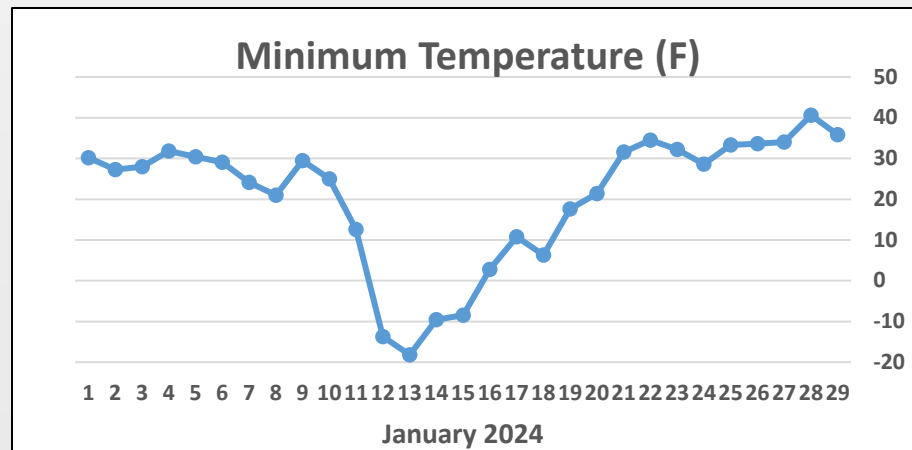
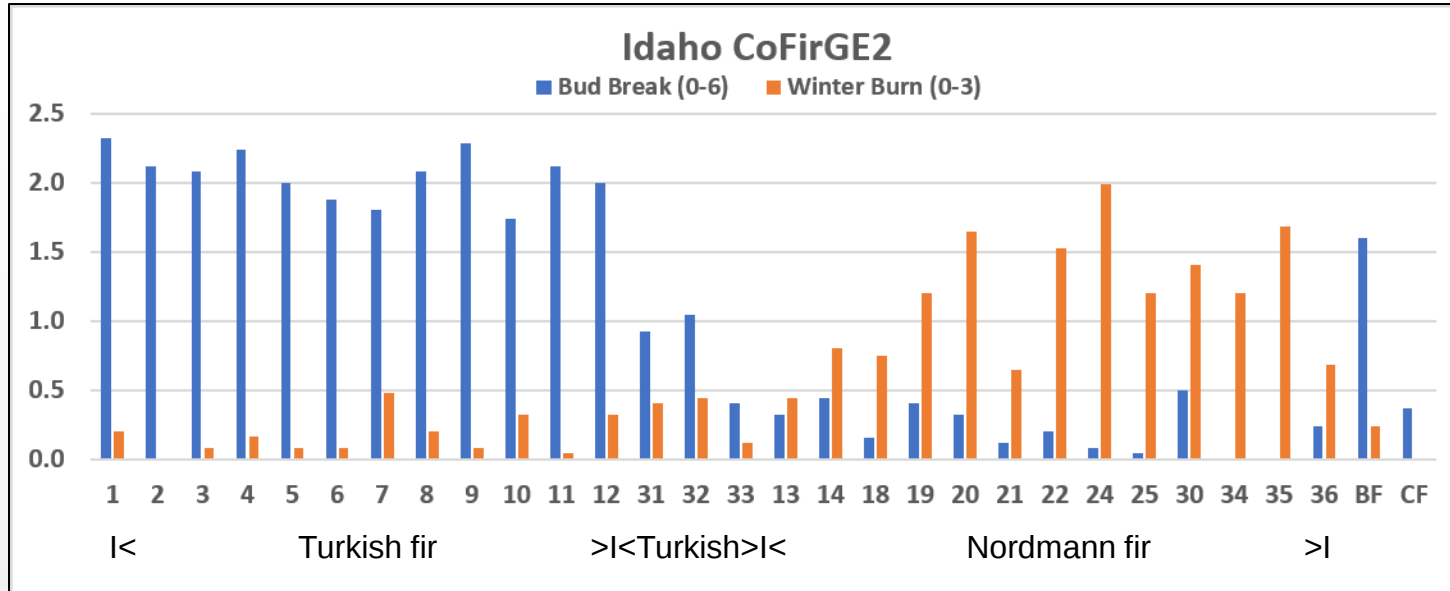


WA CoFirGE2 Plot: Variation in 2025 Bud Break





Bud Break and Winter Damage – ID Plot



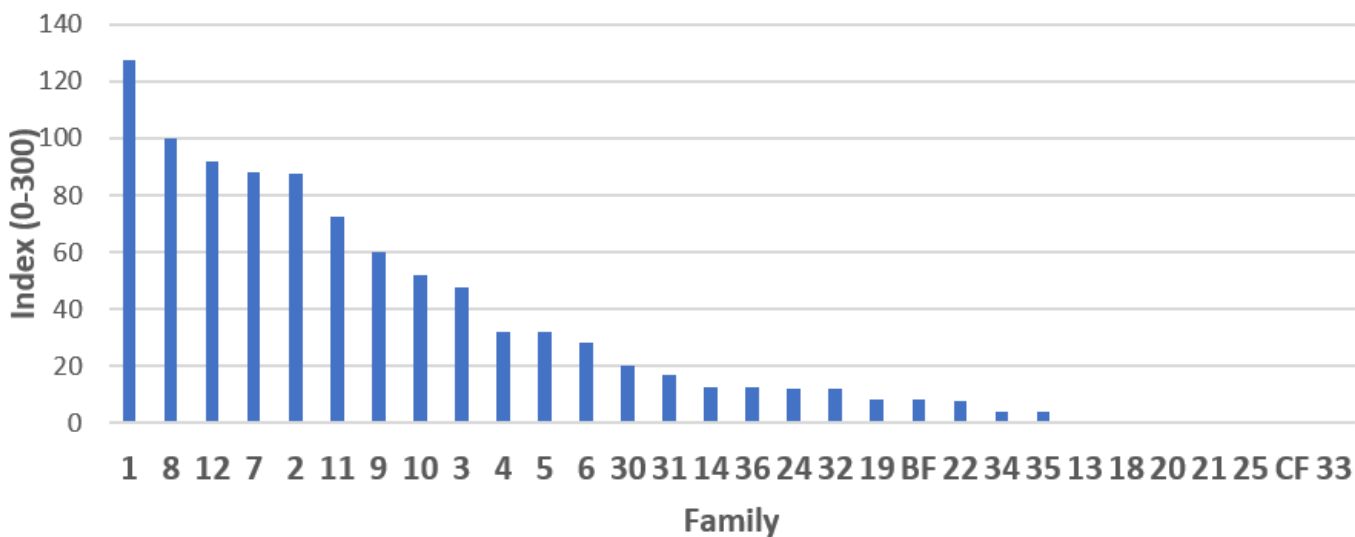


2025 Frost Damage – ID Plot

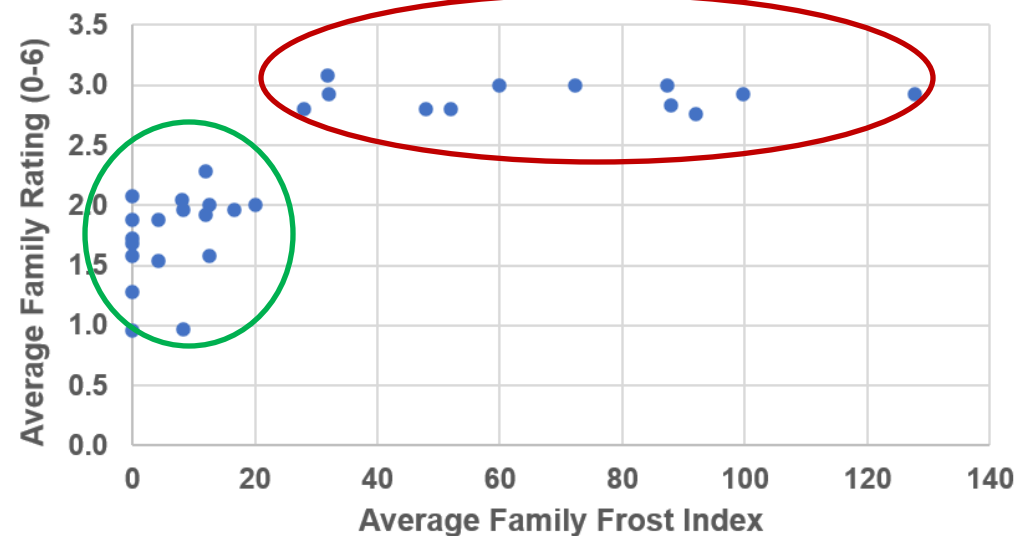
1. Frost damage rated on a scale of 0 to 3
2. Frost Index = Percentage of frost damaged trees within a family X the average family frost rating



2025 Frost Index at ID CoFirGE2 Plot

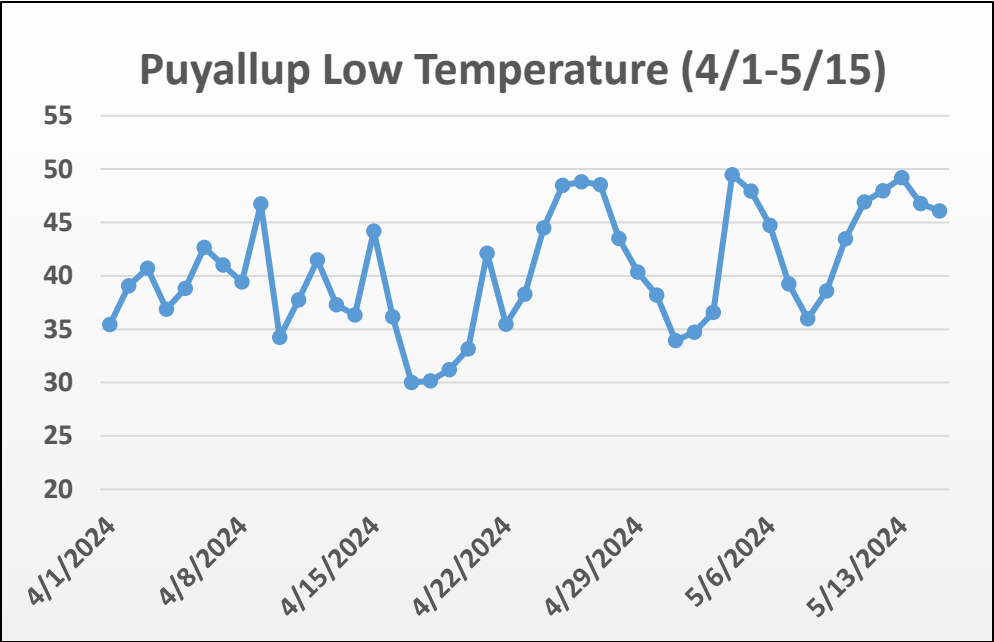


2025 ID Bud Break Rating vs. Frost Index





2024 Frost Damage on Seedlings in WA CoFirGE2 Plot



Frost Damage Ratings

0 = none

1 = slight

2 = moderate

3 = severe



Frost damage at WA site

	Frost (0-3)	
	% of trees	Rating
Trojan fir	66.8	2.1
Turkish fir	10.0	1.8
Nordmann fir	15.3	1.1
Balsam Fir	40.0	1.5
Canaan fir	0.0	0.0
Fraser fir	0.0	0.0
Noble fir	0.0	0.0



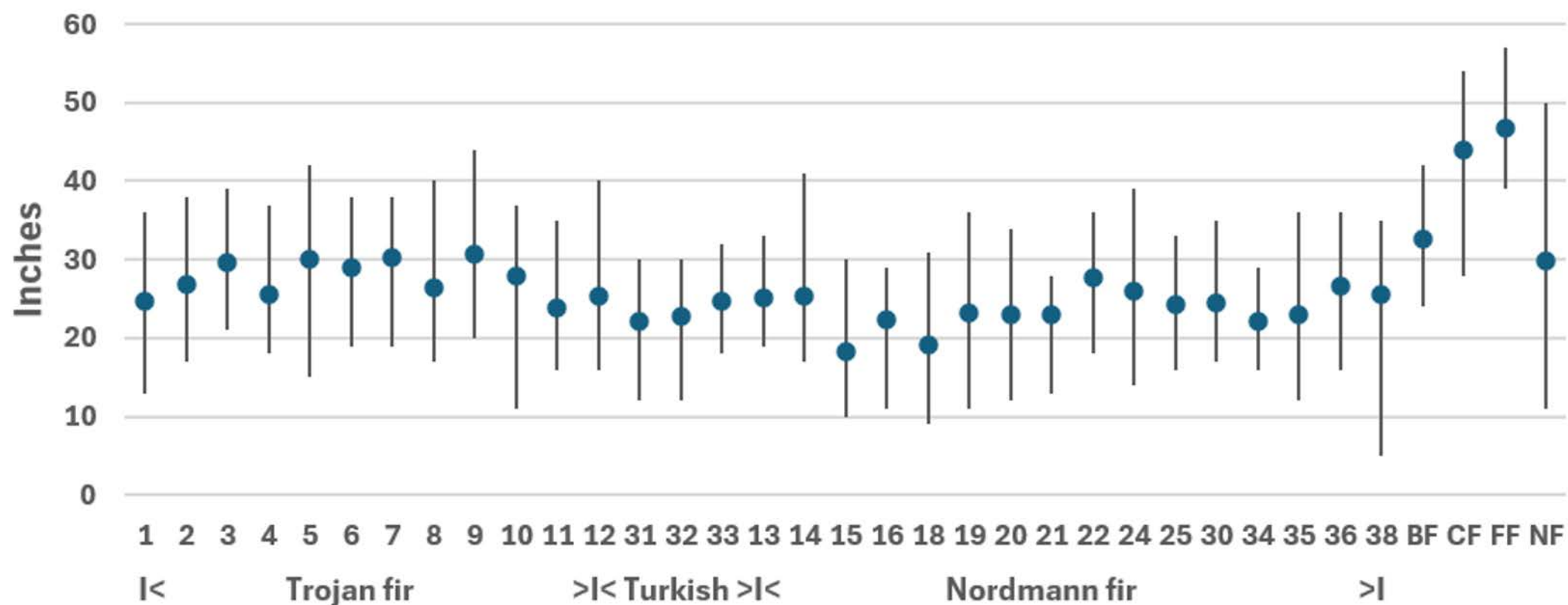
Average height (inches) trees in WA, ID, and CA CoFirGE-2 plots after 3 growing seasons

Species	WA	ID	CA
Trojan fir	27.5	18.2	20.0
Turkish fir	23.2	14.6	16.1
Nordmann fir	23.7	13.3	18.7
Balsam Fir	32.6	22.4	.
Canaan fir	44.0	28.0	.
Fraser fir	46.7	.	15.9
Noble fir	29.9	.	.

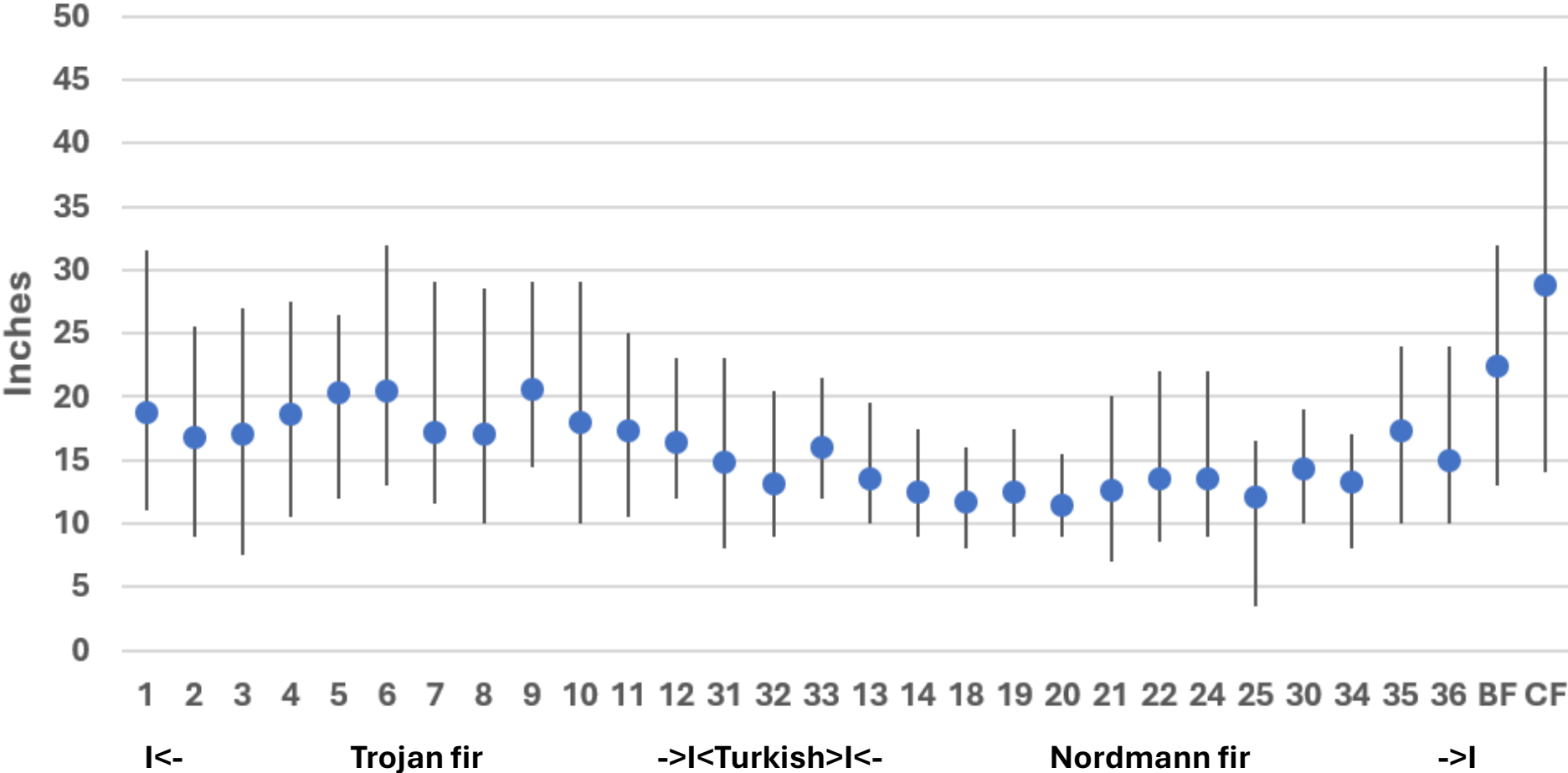
"." =not included in plot



2025 WA CoFirGE2 Tree Height



2025 ID CoFirGE2 Tree Height





CSNN Damage on Trees in WA Plot



CSNN damage at WA site

	CSNN (0-10)	
	% of trees	Rating
Trojan fir	26.4	4.2
Turkish fir	16.0	5.4
Nordmann fir	18.5	4.8
Balsam Fir	0.0	0.0
Canaan fir	4.0	0.6
Fraser fir	0.0	0.0
Noble fir	20.0	4.2

Damage rated on a scale of 0 to 10



Future Activities and Evaluations

What's Next?

- Culturing will begin in 2026
- Height and quality
- Condition of trees
- Disease and pest development
- Needle loss assessments
- Drought tolerance?





Acknowledgments

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A special thanks to:

- Real Christmas Tree Board for supporting the collection of seed, production and distribution of seedlings.
- Silva Seed for the production of seedlings.
- BTN of Oregon, Rusty Gate Tree Farm, and Rapetti Farms for hosting plots in OR, ID, and CA, respectively.
- Seed suppliers
- Everyone who helped sort seedlings.
- Jim Rockis for transporting seedlings to collaborators.





Thank You

