University of Idaho
College of Natural Resources

SITE TYPE INITIATIVE: PHASE 3
DOUGLAS-FIR
REALIZED GAIN – SEED SOURCE TRIALS

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41ST ANNUAL TECHNICAL MEETING
MARCH 23, 2021

Inland Empire Tree Improvement Cooperative

Intermountain Forestry Cooperative

PRESENTATION OVERVIEW

- Project Rationale
- Goal and Objectives
- Background
- Hypotheses
- Experimental Design
- Timeline
- Measurements
- Outputs

RATIONALE

2020 MEMBER SURVEY

IFC member survey identified two action items of greatest importance to their organizations: 1) Stand Establishment Research and 2) Collaboration with IETIC.

This led to the development of a study plan that would address three broad research areas:

- Evaluation of site growth factors on seedling survival and growth
- Realized gains in survival and growth as a function of first-generation improved seed
- Assess seedling performance following transfer from warmer/drier to cooler/ moister seed zones

GOAL

TO STUDY THE DIFFERENTIAL EFFECT OF SITE TYPE ON WOODS RUN AND IMPROVED DOUGLAS-FIR GROWTH AND MORTALITY FROM ESTABLISHMENT TO 30+ YEARS

IFC & IETIC OBJECTIVES

GENETICS

Select 10 clonal seed lots representative of elite performers at the PotlatchDeltic Cherry Lane Seed Orchard and the selected seed zone

Compare against 10 woods run seed lots provided by IFC members within the selected seed zone

SITE TYPE EFFECT

Evaluate Douglas-fir growth and survival in two distinct IFC regions:

1. Inland Northwest
2. Klamath/Siskiyou Mountains

Evaluate Douglas-fir growth and survival within a seed zone across environmental gradients:

1. Seed zone defined by elevation and Rehfeldt's GPI
2. Within zone environmental gradients defined by a derivative of FBRI's Site Type grid

SEED SOURCE TRANSFER

Select 6 elite clonal seed lots from Cherry Lane Seed Orchard and 6 woods run seed lots from a similar GPI, but lower elevation band

Outplant and track lower elevation seed lot performance relative to target elevation seed lots

WHY?

CONTEXT

Site Effects

1. High growing season vapor pressure deficit, coupled with low precipitation can lead to high physiological stress
2. Stress immediately following outplanting can lead to reduced seedling growth and high mortality events
3. Soil-site modifiers of climatic conditions can mitigate stress
4. Preliminary evidence is indicating greater growth rates in improved clonal seed lots, but poorer survival – a tradeoff between growth and survival as posited by Philpson et al. 2014

WHY?

CONTEXT

Genetics

1. To date there are no long-term, operational realized gain trials for Douglas-fir within the Inland Northwest
2. We are reliant on progeny trials to indicate diameter, height and volume outplanting performance (~5-25% response)
3. It is unknown how improved clonal seed lots perform relative to woods run in an operational setting, relative to differing site types
4. To inform our G&Y models, we need to quantify growth and survival in an operational setting that is sensitive to varying site types

WHY?

CONTEXT

Seed Transfer

1. If climate projections hold for the future (warmer/drier) will this induce lower survival and volume production in improved clonal seed lots relative to woods run?
2. Can we mitigate potential mortality and/or volume reduction by transferring seed sources from warmer/drier climes to higher elevation seed zones?
3. Does lower elevation seed source performance differ between woods run and improved clonal seed lots?

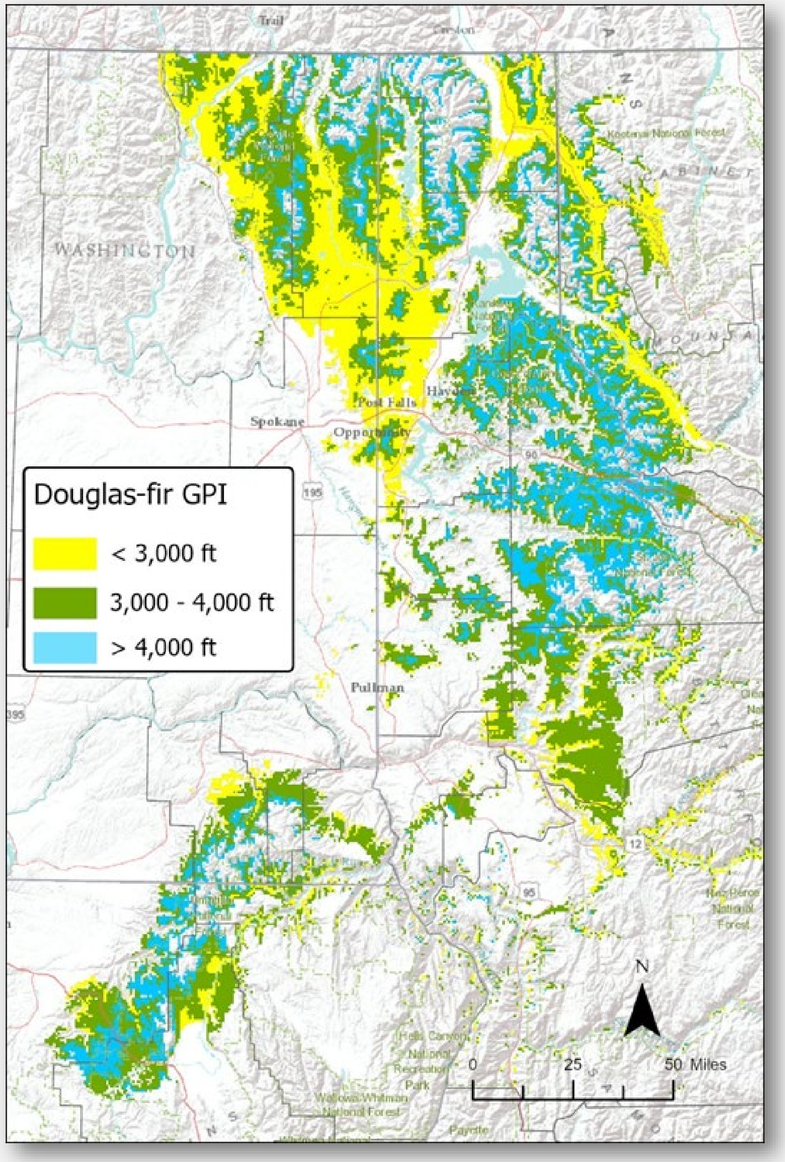
HYPOTHESES

1. Douglas-fir seedling survival does not significantly differ between elite clonal and woods run seed lots across site types within a selected seed zone,
2. Douglas-fir diameter, height and volume growth does not significantly differ between elite clonal and woods run seed lots across site types within the selected seed zone and region,
3. Douglas-fir elite clonal seed lots from a warmer/drier seed zone do not show greater survival and growth relative to woods run seed lots found within the selected seed zones of this study

EXPERIMENTAL DESIGN

DEFINING THE SEED ZONES

1. Improved CLSO DF clonal seed lots generally span three broad elevation zones: <3,000 ft, 3,000 – 4,000 ft, and >4,000 ft
2. For the Seed Source and Core seed zones we selected the <3K (6 lots) and 3-4K ft (10 lots) elevation zones, respectively
3. Rehfeldt's Growth Potential Index (GPI) was computed for elite performing clonal seed lots at CLSO – used as seed transfer guidelines
4. A mean GPI was estimated with a range of +/- 1.5 C.I: 270-290
5. This GPI range will be used to define site placements



EXPERIMENTAL DESIGN

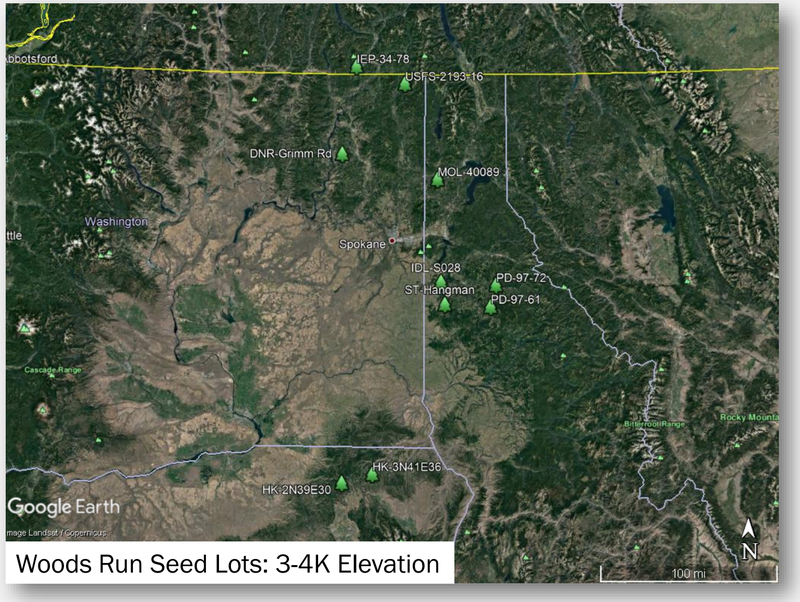
IDENTIFYING THE ELITE CLONAL SEED LOTS

1. CLSO DF elite clones were identified within the 3-4K ft elevation band and within the 270-290 GPI range
2. Elite clones were ranked by volume gains in progeny trials
3. The top ten performers were selected for this study

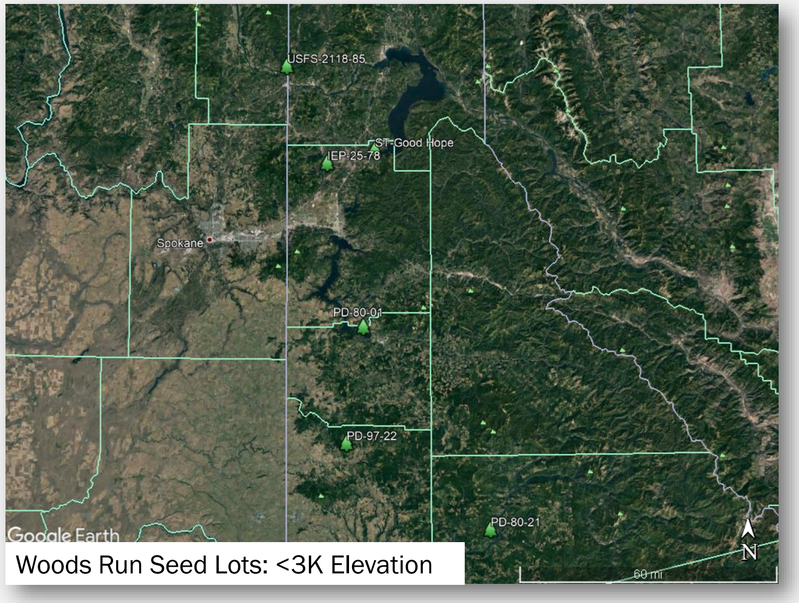
EXPERIMENTAL DESIGN

COLLECTING WOODS RUN SEED LOTS

1. IFC members provided 16 woods run seed lots for this study, spanning multiple States
    1. Northeast Oregon
    2. North Central and Northern Idaho
    3. Northeast Washington
2. 10 seed lots within the 3-4K elevation band, and 6 seed lots within the <3K elevation band
3. Thank you to PotlatchDeltic, Hancock, Stimson, Inland Empire Paper, Molpus, Idaho Department of Lands, Washington Dept. of Natural Resources, USFS – Region 6



Woods Run Seed Lots: 3-4K Elevation

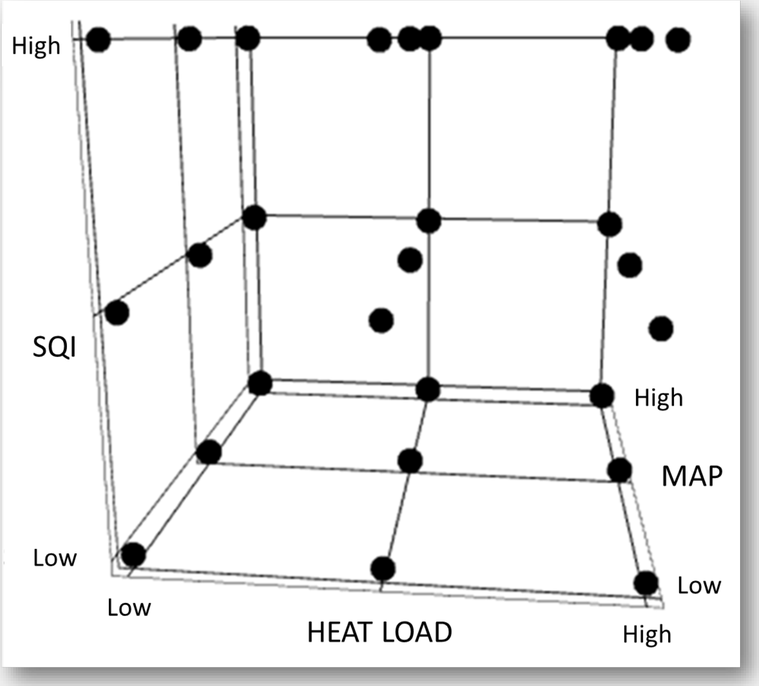


Woods Run Seed Lots: <3K Elevation

EXPERIMENTAL DESIGN

DEFINING SITE TYPE

1. A 3 x 3 x 3 orthogonal site grid will define the range in the following site characteristics within the 3-4k ft elevation band:
    1. Mean Annual Precipitation
    2. Heat Loading (Radiation x DD10-40)
    3. Soil Quality Index
        1. Depth to Soil Restrictive Layer
        2. Available Water Holding Capacity to 100 cm
        3. Soil Parent Material Source



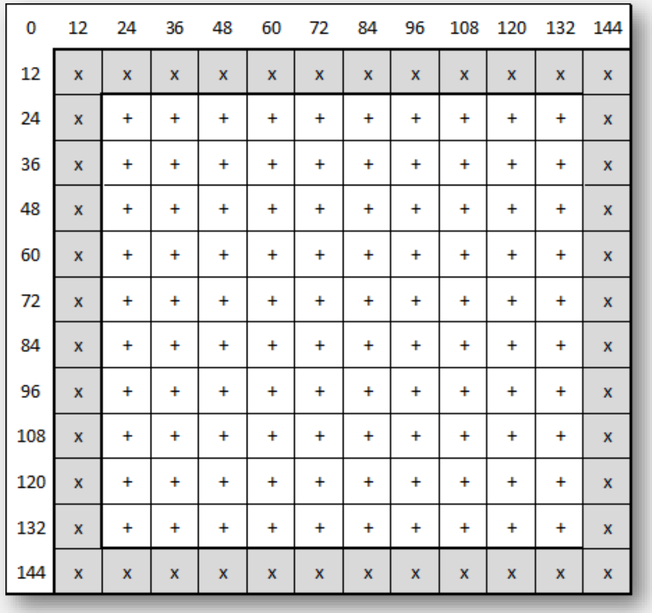
2. 20 installations will be sited across this grid to capture the range in growing conditions within the INW (10) & KS Mtns (10) study areas

EXPERIMENTAL DESIGN

SITE INSTALLATION DESIGN

1. 6 plots per installation – Core Study
    1. 3 plots each for the elite clonal and woods run seed lots
    2. Plot consists of an interior 10 x 10 measurement plot with an outer buffer
    3. Each clonal and woods run seed lot replicated 10 times per plot

2. At 3 of the 10 regional study installations, 12 plots will be installed
    1. 3 elite clonal seed lots from 3-4K ft elevation
    2. 3 elite clonal seed lots from <3K ft elevation
    3. 3 woods run seed lots from 3-4K ft elevation
    4. 3 woods run seed lots from <3K ft elevation



EXPERIMENTAL DESIGN

SITE INSTALLATION MONITORING

In total, this study will monitor across:

1. 2 Regions
2. 20 Installations
3. 156 Plots
4. 15,600 Seedlings*

*Mortality will be replaced annually for the first 2-3 yrs of the study from nurse plots installed at each site

GROWING THE STOCK

PITKIN NURSERY

All seed will be grown by the University of Idaho Pitkin Nursery

Pitkin Staff will be responsible for growing conditions and performing Root Growth Potential tests on all seed lots

IFC staff will be responsible for:

1. Sowing
2. Transplanting
3. Weeding
4. Tracking seed from sowing to cold storage

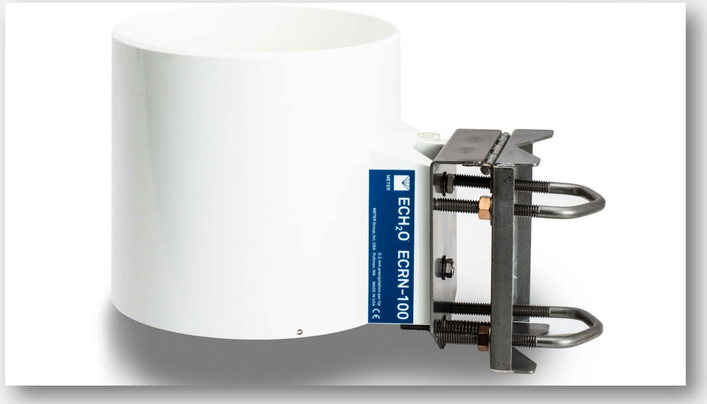
MONITORING SITE CONDITIONS

WEATHER STATIONS

Each installation will be equipped to monitor:

1. Ambient air temperature
2. Precipitation as rain or snow
3. Relative humidity, barometric pressure
4. Soil temperature and moisture
5. Wind speed*

*Dependent on costs



SITE INSTALL AND CARE

RELIANT ON HOST ORGANIZATION AND IFC STAFF

Each host organization will be responsible for:

1. Chemical site preparation
2. Seedling planting and planting crew oversight
3. Any potential release applications in years 2 and 3

IFC staff will be responsible for:

1. Site selection
2. Plot setup
3. Installing seedling protection (PacForest Supply mesh bud caps) annually
4. Aid in planting and future chemical release treatments
5. Mortality replacement
6. Annual measurements

SITE MEASUREMENTS

ANNUAL AND PERIODIC

The following measurements will be taken at Years 1, 2, 3, 5, then every 5 yrs thereafter:

1. Survival counts
2. Caliper/Diameter
3. Height

As sites mature, additional metrics will be obtained:

1. Stem form/taper
2. Crown ratios

All trees will be stem mapped with high resolution GPS and flown with UAS to obtain photogrammetric measurements

PROJECT RESULTS

STATISTICAL METRICS

General linear mixed models will be used to evaluate growth/survival as a function of:

1. Random Effects
    1. Region, Site, Block
2. Fixed Effects
    1. Seed Source, GPI, Genetic Class (woods run vs improved clonal seed)

While controlling for covariates, such as:

1. Slash Loading
2. Vegetation Competition
3. Site factors (Soil, climate)

PROJECT OUTPUTS

FOR G&Y AND REMOTE SENSING

1. At years 10, 20 and 30 we will compute multipliers by seed source for:
    1. Diameter
    2. Height
    3. Volume
2. Evaluate growth responses relative to progeny trial results
3. Utilize plots throughout the life of the study to evaluate and test remote sensing products/derivatives for estimating individual tree growth

ACKNOWLEDGEMENTS

THANK YOU TO ALL WHO HELPED GUIDE AND DEVELOP

1. Dr. Keith Jayawickrama, Director, NW Tree Improvement Cooperative, Oregon State Univ.
2. Marc Rust, Director, Inland Empire Tree Improvement Cooperative, Univ. of Idaho
3. Dr. Brad St. Clair, Research Geneticist, USFS Pacific Northwest Research Station
4. Abbie Acuff, Silviculturist, PotlatchDeltic Corporation
5. Don Patterson, Inventory/GIS Manager + Wearer of Many Hats, Stimson Lumber Company
6. Dr. George McFadden, Silviculturist, Bureau of Land Management
7. The Pitkin Nursery (Dr. Andrew Nelson, Don Regan, and staff)
8. And the numerous individuals who tread this ground and published their results