Interior breeding update: interior spruce, Douglas-fir, western larch. -2023-

Trevor Doerksen

O KALAMALKA RESEARCH STATION AND SEED ORCHARD



interior spruce

- 1st-cycle OP families, ~4200+ base parents (some ENA, AB)
 - 9 pops (11 SPU), 17(?) series, 70 trials
- 2nd-cycle controlled crosses ~xxx parents, 7 pops, 7 series, 23 trials
 - 2nd-cycle for Peace River ongoing
- 3rd-cycle mating started for: PG, BV, EK
- Will build db of historical records and use MET analysis (see Fdi) to:
 - delineate deployment zones
 - allocate SO parents & crosses, identify missed parents
 - decide which orchards to rebuild
- traits to evaluate: growth, wood quality, weevil resistance





Interior spruce 2nd-cycle testing

- 11 southern progeny trials, all connected
 - 4 Nelson low (2019), 3-yr M&M in 2021
 - 5 Nelson mid (2020), 3-yr M&M in 2022
 - 2 Thompson-Okanagan (2014), 10-yr M&M in 2023
 - combine with 1st-cycle data -> forward selections
 - may be good weevil info in one trial (Skimikin).
 - will need to analyze all together (or in full-scale MET, see Fdi), to allocate to orchards for GVO.





Interior spruce crossing

- 2nd-cycle Peace River (FN) crossing near completion
 - difficulty/delays getting pollen from Alberta clones -> will delete parents from mating plan
 - supplement future testing with OP seed from AB?
 - help establishing trials in a few years?
- 3rd-cycle mating (PG, EK, BV)
 - crossing forward selections, grafted in arboretum at Kal (plus some backwards)
 - using some forward selection ortets from progeny trial (Skimikin)
 - algorithmically designed to optimize genetic gain & maintain diversity



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Interior spruce Weevil resistance

- artificial infestation (augmentation) screening trials were meant to validate field observations
 - disappointing results, for amount of effort
- refocus on natural infestation in field-based trials and validate a different way:
 - utilize other linked field-based trials with weevil attacks
 - characterize the best vs worst putatively resistant genotypes, e.g. structural, chemical ecology (see Sebastian)



interior Douglas-fir

- 1st-cycle OP families
 - ~1700 interior base parents (+200 SM & coastal)
 - 6 pops (8 SPU), 11 series, 48 good trials (39 env), good connections
- 2nd-cycle controlled crosses
 - ~436 parents, 6 pops, 3 series, 13 trials, all connected
- PECULIARITIES :
 - Thompson-Okanagan (low, high SPU)
 - no base parents, no trials
 - 2nd-cycle trial in some of these environments (e.g. IDFd-)
- traits to evaluate: growth, wood quality, Armillaria resistance

interior Douglas-fir

- yellow 1st-cycle
- orange 2nd-cycle











Interior Douglas-fir 2nd-cycle testing

- establish 13 2nd-cycle trials
 - 5 Nelson high & QL (2021)
 - 3-year measure in 2023
 - 4 Nelson low (2022)
 - 4 Northern (2023)
 - CT, CP, EK
- all trials connected
- 1st- & 2nd-cycle trials can be combined
 - info stacks as program progresses!

Interior Douglas-fir MET analysis

- all historical, 1st-cycle data used
 - 48 trials, 39 locations
- pattern of genetic correlations between trials
 - growth-growth (age 10)
- south (bottom left)
 - within iClass rg>0.91, between iClass rg~0.81
- north (top right)
 - within iClass rg>0.85, between iClass rg~0.81
- N vs S (rg=0.5-0.7)

in Plant Science

methodology being vetted, Pli results
* frontiers

Plant Variety Selection Using Interaction Classes Derived From Factor Analytic Linear Mixed Models: Models With Independent Variety Effects

published: 09 September 202 doi: 10.3389/fpls.2021.73746

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ICHmm (QL)-IDFmw1 (NEL)-ICHmw3 (NEL) -SBSwk1 (PG)-SBSdh1 (QL)-ICHmk2 (NEL) -ICHmk4 (EK)-ICHmw2 (NEH) -SBSdw3 (**)-ICHmk4 (**)-SBSmk1 (PG)-MSdk2 (EK)-SBSdw3 (PG)-ICHmw2 (SM)value ICHmw2 (**)-IDFdm2 (EK) -ICHmc1 (NST)-ICHvc (NST)-IDFmw2 (CT)-SBSmw (CT) -SBSdw1 (CT)-ICHwk2 (CT)-ICHmc2 (NST) -ICHwk1 (NEL) ICHmw2 (NEH) ICHwk1 (NEH) ICHmw2 (NEH) ICHwk1 (NEL) ESSFvc (NEL) ICHmw2 (NEL) ICHmw3 (NEL) ICHmw2 (NEL) ICHdw1 (NEL) ICHmw2 (SM) IDFmw2 (**) ICHmw2 (NEL) ICHmw3 (NEL) ICHmw2 (NEL dunc cran kils kim ranch ranch ranch ranch ranch ranch ranch key key key key beav key key stew lum barn fakens stew ranch ranc

0.75

0.50

0.25

ICHmm (QL)-

Alison Smith 1*, Adam Norman², Haydn Kuchel² and Brian Cullis

western larch

- 1st-cycle OP families
 - ~600 base parents, 2 pops, 4 series
 - 14/16 good trials, all connected
- 2nd-cycle controlled crosses
 - ~289 parents, 2 pops, 2 series
 - 10 trials, all connected
 - establishment affected by heat/drought in 2017-2018
 - more poor trials in EK series!
- 90 additional OP forward selections from USA
 - make crosses & store -> test in 3rd-cycle?
- traits to evaluate: growth, wood quality





western larch

- black 1st-cycle
- red 2nd-cycle

Western larch

- graft upkeep/maintenance
- M&M of 10 2nd-cycle trials
 - NE (2017), 6-yr in 2022
 - EK (2018), 6-yr in 2023



overall strategy

evaluate for growth -> update MET

- use estimates for
 - selection, GVOs in SPAR, etc
 - delineate zones
 - allocate parents to zones
- start genotyping selection candidates
 - pedigree checking
 - use additional relatedness adjustments in model

evaluate wood quality in one trial/series

• no GEI, treat as threshold trait to maintain quality

pest resistance

- use augmentation where possible
- where not possible, put trials in high disease hazard areas

Summary of major projects - 2022.

species	activity	breeding pop	purpose
western larch	6-year M&M	Nelson	forward selections
interior spruce	3-year M&M	NE mid, 2 nd -cycle	forward selections
	evaluate, re-infest seedlings with weevils for screening trial	BV, 1 st -cycle	forest health, IWS values, cull worst orchard clones **POOR**
	crossing (staff)	PR (FN, HH), 2 nd -cycle PG, BV, EK, 3 rd -cycle	forward selections
Douglas-fir	grow/lift seedlings	North (CT, CP, EK), 2 nd -cycle	forward selections
	locate 4-5 trial sites	North (CT, CP, EK), 2 nd -cycle	forward selections
	inoculate seedlings	NEL	forest health, Armillaria
	plant inoculated seedlings	NEH	forest health, Armillaria
Barnes Creek	clone bank maintenance	all	clonal archive

Summary of major projects - 2023.

species	activity	breeding pop	purpose
western larch	6-year M&M	ЕК	forward selections
interior spruce	10-year M&M	TO low/high, 2 nd -cycle	forward selections, **good weevil information?**
	sow field-based weevil trial (Skimikin)	BV, 1 st -cycle	forest health, IWS values, cull SO 243 & 250 clones
	crossing (staff)	PR (FN, HH), 2 nd -cycle PG, BV, EK, 3 rd -cycle	forward selections
Douglas-fir	plant 4 progeny trials	North (CT, CP, EK), 2 nd -cycle	forward selections
	sow seedlings	CP (PG)	forest health, Armillaria
	inoculate seedlings	QL	forest health, Armillaria
	plant inoculated seedlings	NEL	forest health, Armillaria
Barnes Creek	clone bank maintenance	all	clonal archive



Kalamalka Lift Crew 2023.

• Lindsay, Nancy, Fatih, Sharman, Elisa, Serena, Leslie, Mark, Kim, Penny.

• Missing: Trevor, Kyle, Val, Sebastian, Sarina, Meredith, Jenny, Linda.