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

Trevor Doerksen

O KALAMALKA RESEARCH STATION AND SEED ORCHARD



- PR 2nd-cycle crossing ongoing
 - difficulty/delays getting pollen from Alberta clones -> will delete parents from mating plan
 - OP seed from AB to supplement future testing
- NE, TO 2nd-cycle testing ongoing (see next)
- PG, BV & EK 2nd-cycle testing complete.
 - Forward selections (progeny) released to seed orchards.
 - PG(S2) FWDSEL (67xx-) \rightarrow VSOC
 - BV FWDSEL (70xx-) → FIRM (Skimikin), VSOC
 - EK FWDSEL (65xx-) \rightarrow FIRM (KSO)
 - hope to provide IWS (R) values to rogue most susceptible parents (see next)
- 3rd-cycle –2nd x 2nd-cycle FWDSEL (& some backwards)
 - both genetic gain & coancestry optimized
 - crossing starting \rightarrow 3rd-cycle trials



- Nelson 2nd-cycle progeny trial series
 - 9 trials, 3-yr M&M
 - 4 Nelson low (2021)
 - 5 Nelson mid (2022)
 - heat damage
- Thompson-Okanagan
 - only 2 trials
 - will combine with NE trials (above) for forward selections
- weevil pressure
 - 1 trial/series (see forest health)



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 - For all: will update GVO in next large MET analysis (see Fdi).
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Forest health (weevil resistance)

Field-based

- more parents evaluated
- longer time (10 years)
- easier to link to growth on landscape
- no guarantee proper disease incidence
- less work

Artificial

- fewer parents evaluated
- shorter time (3-4 years)
- harder to link to growth on landscape
- good homogeneous infection
- MORE WORK!!



Aiming for BOTH sources of info, where artificial screening is used to validate what we observe in the field.

Forest health (weevil resistance)

population	screening data (artificial)	field-based data (natural or artificial)
PG	YES	YES
NE	NO/poor	HOPEFUL! (2030)
BV	CURRENT	YES (?)
ТО	NO	YES
EK	NO	NO
PR	NO	NO

Please contact if weevil problematic in your area.

I'm discovering old weevil evaluation data, in old spruce data \rightarrow upcoming database project!

Sebastian Jimenez to support going forward.





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- 3rd-cycle –2nd x 2nd-cycle FWDSEL (& some backwards)
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 - crossing starting \rightarrow 3rd-cycle trials
 - Plan to evaluate growth (multiple sites), IWS & wood quality (one site each).

Interior Douglas-fir MET analysis



- large MET analysis complete (mostly!).
- Includes all 1st-cycle data. Proposed to:
 - delineate deployment zones & guide testing.
 - standardize breeding values across populations.
 - GVOs comparable between orchards.
 - predict breeding values into zones where no progeny testing, eg TO

Interior Douglas-fir

MET analysis



- If genotypes (G) are tested in different environments (E), we can test for an interaction (GxE or GEI).
 - goal is to select for generalists.
 - no/little GxE (crossover) within deployment zone
 - eg pattern (c) for growth.
 - trials that provide similar information (no GEI), can be grouped to define a deployment zone (E) for given parents (G)
 - \rightarrow basis of Nick's new Pli zones.
 - gives breeder flexibility to organize populations, test hypotheses, use selection to our advantage
 - eg drought or disease environment

Interior Douglas-fir MET analysis

ICHdw1 (NEL) -ICHmw3 (NEL) -ICHmw2 (NEL) -IDFdm2 (EK) -ICHmw2 (NEL) -IDFmw2 (**) -ICHmw2 (SM) -ICHmw2 (SM) -ICHmw2 (**) -IDFmw1 (NEL) -ICHmw2 (NEL) -ICHmw2 (NEH) -ICHmw2 (NEH) -ICHmw2 (NEH) -ICHwk1 (NEH) -ICHwk1 (NEL) value ICHwk1 (NEL) -ICHmw2 (NEL) -ICHmw3 (NEL) -ICHmm (QL) -ICHmm (QL) -SBSdh1 (QL) -SBSwk1 (PG) -ICHmk2 (NEL) -SBSdw3 (**) -ICHmk4 (**) ICHmc1 (NST) ICHvc (NST) ICHmk4 (EK) SBSdw1 (CT) MSdk2 (EK) IDFmw2 (CT ICHmw3 (NEL) SBSmk1 (PG) SBSmw (CT) SBSdw3 (PG) · ICHwk2 (CT) -ICHmc2 (NST) · ESSFvc (NEL)

- pattern of genetic correlations between trials
 - growth-growth (age 10)
- south (upper right) vs north (lower left) split
 - some evidence for split in the south: upper vs lower elevation
- UPSHOT:

0.9

0.6

0.3

0.0

- short-term supports testing of breeding populations in 3 major deployment environments (see next slide)
- longer-term the number of unique seed orchards could be amalgamated. Don't panic! -> TBD from 2nd-cycle testing.
- TODO:
 - allocate parents to best fit environment
 - check if allocation of elite (seed orchard) parents makes sense
 - update GVO

Interior Douglas-fir

2nd-cycle testing

Breeding pop	Testing env	Seed orchard = trial BEC	SM	NEL	NEH	QL	СТ	СР	EK	NEL midR	b- class	year est.
NEH,		ICHmw,										
(SM) <i>,</i>		(CWHms==ICHmw),										
QL , (тоц)	wat cool	ICHMK,	15	17	07	00				10	E	2021
	wet, cool	(ICHIIW) ICHIIW	15	17	57	30				10	5	2021
(SM).		(CWHms==ICHmw).										
(TOL)	dry, warm	(IDFmw)	15	112	20	30				68	5	2022
CP,		SBSmw,										
СТ,		SBSdw,										
EK		ICHmw										
(TOL <i>,</i> TOH)	dry, cold	(IDFmw, ICHmw)			14	30	75	96	30		5	2023
Parents (Ne)				80	50	100	50	64	20	70 (100)		

Interior Douglas-fir 2nd-cycle testing

• 9 trials to date

- 5 Nelson high & QL (2021)
- 4 Nelson low (2022)
- 4-5 'Northern' pops (CT,CP,EK – 2023)
- all trials connected genetically
- 1st- & 2nd-cycle trials can be combined
 - info stacks as program progresses!



Interior Douglas-fir Forest health (*Armillaria* resistance)

- Initial inoculations on 1+0 stock using two substrates:
 - birch dowels
 - birch stems
- assess 1-2 years following infection
- culture easy to grow on dowels, but no successful infections (yet!)



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Interior Douglas-fir Forest health (*Armillaria* resistance)

- better frequency of successful infections with birch stems
 - found in both live and dead seedlings
- UPSHOT:
 - inoculated NEH pop (dowels)
 - supplement NEH pop planted in field with new inoculum/substrate (NEH)
 - switch to stems for next experiment (NEL)
- Sebastian Jimenez to support going forward.



Western larch

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









Western larch

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Summary of major projects - 2021.

species	activity	sub-breeding pop	purpose	
western larch				
interior spruce	3-year M&M	NE low, 2 nd -cycle	forward selections	
	raise/infest seedlings with weevils for screening trial	BV, 1 st -cycle	forest health, IWS values, cull orchard clones	
	crossing (staff)	PR (FN, HH), 2 nd -cycle PG, BV, EK, 3 rd -cycle	forward selections	
Douglas-fir	grow/lift seedlings	NE low, 2 nd -cycle	forward selections	
	locate 4 trial sites	NE low, 2 nd -cycle	forward selections	
	inoculate seedlings with A.o.	NE high	forest health	
	crossing (staff)	ALL	missing crosses in upcoming trials	
Barnes Creek	clone bank maintenance	all	clonal archive	

Summary of major projects - 2022.

species	activity	sub-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 orchard clones		
	crossing (staff)	PR (FN, HH), 2 nd -cycle PG, BV, EK, 3 rd -cycle	forward selections		
Douglas-fir	grow/lift seedlings	(CT, CP, EK), 2 nd -cycle	forward selections		
	locate 4-5 trial sites	(CT, CP, EK), 2 nd -cycle	forward selections		
	inoculate seedlings with A.o.	NE low	forest health		
Barnes Creek	clone bank maintenance	all	clonal archive		

Kalamalka Lift Crew 2022.

• Trish, Mark, Sebastian, Frederic, Cam, Nancy, Kailey.

• Missing: Trevor, Val, Lindsay, Kyle, Sarina, Heidi, Stephen, Jarrett, Tiff, Mikayla, Celeste, Sue, Jenny, Tanisha.

