Interior resistance programs

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Breeding for resistance programs - considerations

Impacts:

- Biological
  Pest

  Host
- Ecological/Environmental:

  Role of host, other species affected, sensitive habitat
- Social – recreational, public/stakeholder concern
- Cultural - host or pest may have cultural significance
- Economic

Slide adapted from R. Sniezko, 2023 Resistance Workshop- DGRC 25-27 July

Breeding for resistance programs - considerations

Demand

Feasibility of success

Cost of resistance

Consequence of no action

Slide adapted from R. Sniezko, 2023 Resistance Workshop- DGRC 25-27 July

Pest resistance screening strategies

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
- labour intensive

Considerations for establishment of an artificial inoculation and screening program

Obtaining the pest/pathogen

- Collecting from the environment
- Obtaining from partners
- Long term storage, rearing, maintenance of cultures/pests

Slide adapted from K. McKeever, 2023 Resistance Workshop- DGRC 25-27 July

Considerations for establishment of an artificial inoculation and screening program

Propagating host material for screening:

- Collecting seed/scion from environment
- Propagating
- Obtaining from partners

Slide adapted from K. McKeever, 2023 Resistance Workshop- DGRC 25-27 July

Considerations for establishment of an artificial inoculation and screening program

- Applying pest/pathogen to host:
  - What propagule/form/life stage do we use
  - How much is needed for disease?
  - What method de we use to apply?

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Considerations for establish an artificial inoculation and screening program

- Post inoculation/infestation treatment and storage?
- Experimental design
- Post screening objectives
- Funding
- Personnel
- Facilities

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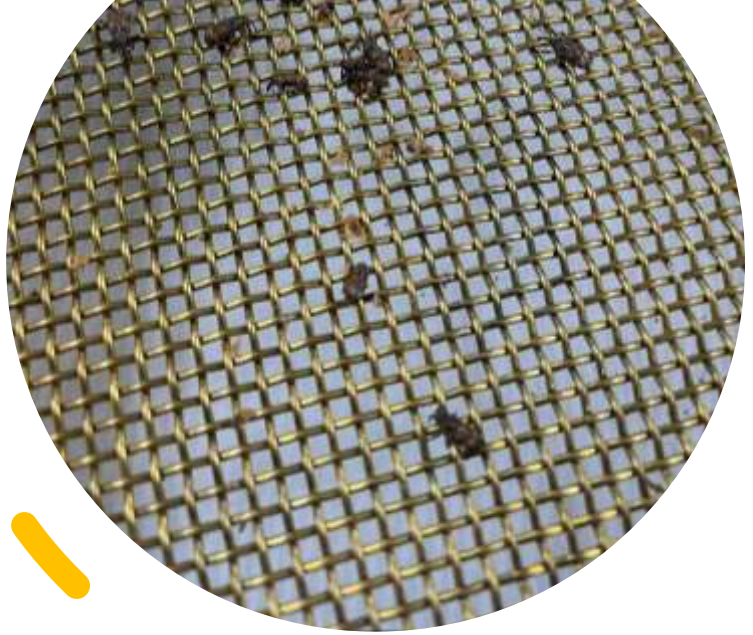
Current programs

- *Armillaria ostoyae* (Fdi)
  - Artificial inoculations and progeny trials
- *Pissodes strobi* (Sx)
  - Augmentation and field trials
  - Proposed in 2024: Chem ecology – host/pest interactions
- *Dothistroma septosprum* (Pli)
  - Artificial inoculations and progeny trials
- *Cronartium ribicola* (Pa & Pw)
  - Artificial inoculations and progeny trials



Additions in 2024

- Proposed *Phytophthora spp.* root rot (Pw)
  - Product efficacy trial, collaboration with orchard colleagues. Likely to start 2025 or 2026.

- *Cronartium comandrae* (Pli)
  - Planting new site and future site selections

- *Endocronartium harkenessii* (Py)
  - Isolations and challenge method develop.

Fdi *Armillaria* resistance screening

- Initial inoculations on 1+0 stock, using birch stems as inoculum source

  - Year 1: grow 1+0
  - Year 2: inoculate, grow to 2+0
  - Year 3: plant in field-based trial
  - Years 4-6: Assess vigor (1-4), infection (Y/N), and mortality (Y/N).

Fdi *Armillaria* resistance screening

- 60 families/year
  - top 2 crosses/parent from pop being evaluated in the field
- 20 reps, 4 blocks, single tree plots
- Planted at ONE common location

Fdi *Armillaria* resistance screening

- Populations inoculated:
  - 2021 inoculations, planted in 2022: NEH
  - 2022 inoculations, planted in 2023: NEL *
  - 2023 inoculations, to plant in 2024: QL **
  - 2024 inoculations, to plant in 2025: CP
  - Sowing in 2024, to inoculate in 2025: CT

* Heat of 30 C in May 2023, at transplanting, could be reason of failed trial

** To avoid potential heat stress at transplanting, putting trial in raised beds at KRS

Fdi *Armillaria* resistance screening

- Plan to expand *A.o.* isolate collection:

  Test pathogenicity of isolates

  Test pathogenicity over time in subculture on artificial media

- Expand silver or paper birch bank at Simkinin or Bailey

Pissodes strobi (Sx)

- Moving on from raised beds with Sx for augmentation trials
- We have addressed media and historical patterns from old raised beds; however, allocated space for Fdi trial
- In 2023 we sowed a short-term trial for weevil screen – 140 families – to be planted in Skimikin in 2024

Pissodes strobi (Sx)

- Proposing a chemical ecology pilot study in partnership with PI at UBC/UNBC

- Test for host choice by weevil with referenced host genetic material -> testing for olfactory and physical cues that drive host selection. Keep source of weevil as a factor to test for differences in weevil structure

Dothistroma septosprum (Pli)

- Collected samples from Witset and Prince George in 2023
- Expanded our archive to 17 isolates
- Currently working on propagation and sporulation techniques
- Have shared isolated with UNBC

Isolates from Pli needles

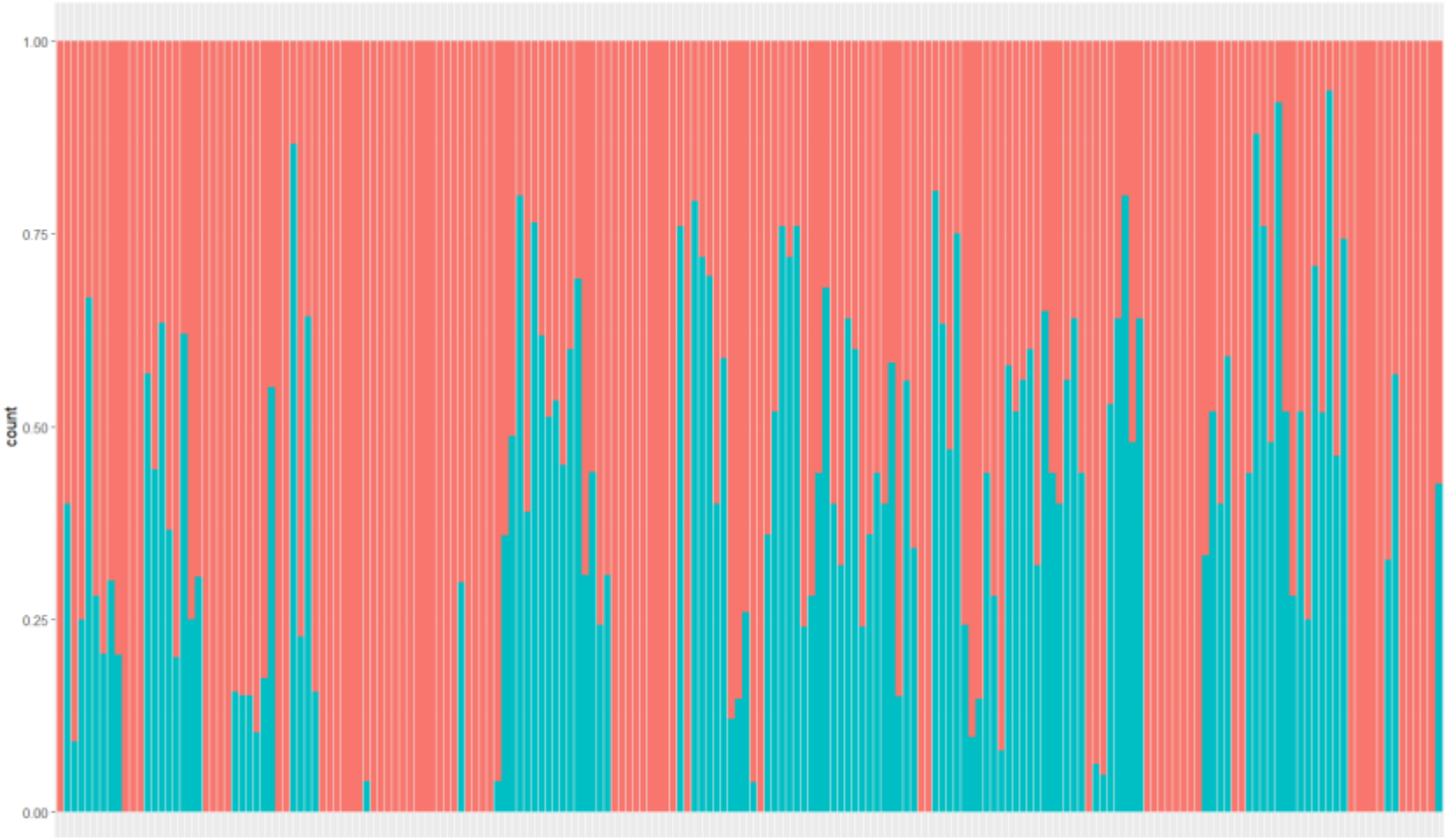
Identity	Count
Dothistroma septosporum	17
Alternaria spp.	1
Cladosporium spp.	10
Epicoccum italicum	2
Genolevuria spp.	3
Hormonema macrosporum	1
Peniophora spp.	2
Pezizales spp.	1
Phaeotremella spp.	1
Pragmopora spp.	1
Pseudotremella spp. / Tremella spp.	1
Pseudozyma spp.	1
Ramularia spp.	1
Sydowia polyspora	14
Vishniacozyma victoriae	1

Screening for White pine blister rust in Whitebark pine

Blister rust assessments

- Disease severity index:
  - Vigour (1-4)
  - # of cankers
  - Severity of cankers (1-9)
- Breeding values
  - Infection (Y/N)
  - Mortality(Y/N)

Whitebark pine inoculations



- 168 families inoculated since 2021
- Will continue to inoculate 66 families/year
- 32 seedlings/fam, + 5 non inoculated controls
- Follow them up for 6 years in raised beds
- We observe 50% infection with our methods, robust measurement to screen

In 2024:

- Continue with Fdi and armillaria screening
- Support field-based screening trials of Sx vs weevil
- Develop challenge methodology for Pli and Dothistroma
- Continue with Whitebark screening program vs WPBR
- Support field-based screening of Pli against Comandra rust
- Conduct a chemical ecology pilot on host selection cues by weevil on Sx
- Discuss and pave the way for an efficacy trial to control or suppress Phytophthora root rot in Pw
- Continue with lab and facilities upgrades needed for resistance programs
- Pending capacity, work on isolation and inoculation methodology for western gall rust

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