

Draft 7/31/2018

**International Union of Forest Research Organizations (IUFRO)  
International Workshop  
TREE RESISTANCE TO INSECTS & DISEASES: PUTTING PROMISE INTO PRACTICE**

**(August 5 - 10, 2018 in Mt. Sterling, Ohio USA)**

<https://treeresistance2018.ca.uky.edu/agenda>

*(Note: all meals shown in the agenda are included for those who have paid the full registration fee)*

**ARRIVAL: Sunday August 5, 2018**

5:00 – 6:00 pm: Registration

6:30 – 7:30 pm: Welcome social (cash bar)

**Day 1: Monday August 6, 2018**

7:00 – 8:00 am: Registration and breakfast

**8:00-8:20 Welcome & logistics Sniezko/Koch**

**8:20-8:45: Stephen Woodward: A Short History of Tree Resistance Selection and Breeding Through the Journal *Forest Pathology***

**SESSION 1: BREEDING FOR RESISTANCE TO INSECTS:**

Moderator: Jennifer Koch

**8:45-10:00:(15 min. talks + 15 min Discussion)**

1. Jennifer Klutsch, **Screening for resistance against insect herbivores using chemical and anatomical defenses in lodgepole pine and white spruce**
2. Ward Strong, **Screening for spruce budworm adult host selection in Douglas-fir**
3. Ben Smith, **Screening for genetic resistance to the hemlock woolly adelgid**
4. David Carey, **Beech bark disease resistance breeding program in American beech**

**DISCUSSION:** How to make programs more efficient, guidance for new programs, likelihood of success in developing applied product, what is needed ...more breeding or are you done?

**Coffee Break: 10:00-10:30 am**

**SESSION 2: GENUS FRAXINUS-THREATENED BY EMERALD ASH BORER AND ASH DIEBACK DISEASE:**

Moderator: Richard Buggs

**10:30 am -12:05 pm (15 min talks + 15 minute discussion)**

5. Michelle Cleary, **Phoenix from the ashes: exploiting host resistance to conserve and restore populations of European ash** (20 min)
6. Jennifer Koch, **Restoring green ash (*Fraxinus pennsylvanica*): Breeding for resistance to the emerald ash borer (*Agrilus planipennis*)**
7. Frederic Miller, **Evaluation of resistance of Asian and European ash species and cultivars to emerald ash borer (*Agrilus planipennis*)**
8. Kim Steiner, **Population and family differences revealed in the demise of a green ash provenance test following attack by the emerald ash borer**
9. Jonathan Stocks, **Variation and genomic basis of *Fraxinus excelsior* (common ash) susceptibility to *Hymenoscyphus fraxineus* (ash dieback) throughout Britain**

DISCUSSION: The future of ash? Potential for increased international cooperation...Lessons learned – what to do next time...The value of field trials

**Lunch 12:05 – 1:05 pm**

**1:05 – 1:20 pm.** Mike Born, Fender guitar and ash.

**SESSION 3: BREEDING FOR RESISTANCE TO PATHOGENS:**

Moderator: Mark Coggeshall (10-14) and Enrico Bonello (15-18)

**1:20-2:50(15 min talks + 15 min discussion)**

10. Nicklos Dudley, **Progress of an applied disease screening and selection program for resistance to vascular wilt in Hawaiian *Acacia koa***
11. Marc Hughes, **The development of a resistance screening program of ohia to *Ceratocystis* pathogens causing widespread mortality on Hawaii island**
12. James McKenna, **Screening range-wide black walnut seed families for thousand cankers disease (TCD) resistance and measuring the regional adaptability of resistant seed sources**
13. Richard Reich, **The search for resistance in lodgepole pine to comandra blister rust in the central interior of British Columbia**
14. Richard Sniezko, **Genetic resistance to *Phytophthora lateralis* in Port-Oxford-cedar (*Chamaecyparis lawsoniana*)**

DISCUSSION – Where are we on road to success? What is left to do? Have genomic resources played a significant role to date? What role have genomic resources played? Will this change in the future? How does one start a new program (priorities) – several new programs being consider or just underway.

**Coffee Break: 2:50-3:20 pm**

**3:20-4:45 (15 min talks + 25 Min discussion)**

15. Tyler Dreaden, **Genetic diversity in the laurel wilt pathogen, *Raffaelea lauricola*, and the consequences for resistance breeding**
16. April Meeks, **Fusiform rust resistance in an elite population of loblolly pine population**
17. Eddie Lauer, **Genetic parameter estimates for fusiform rust disease from a multi-environment trial of loblolly pine (*Pinus taeda* L)**
18. Sarah Federman, **USDA advances in plant breeding and innovation: Resistance breeding, germplasm collections, and genetic diversity**

DISCUSSION: Q&A for 4 above talks + Critical needs to achieve success in breeding programs and how to achieve them? Balancing resources between tree breeding and genomic resources – including fusiform rust example (25 min)

**4:45-6:00: POSTER SESSION #1 (cash bar)**

**6:00 – 8:00 pm: Dinner with Special Presentations by (1) Kim Steiner: The past is prologue: Understanding the current state of tree improvement in the United States, (2) Discussion session: Advancing the cause of resistance in the public sphere (Enrico Bonello/Fred Hain/Caterina Villari)**

**8:00 – 9:30 pm: Bonfire, corn hole, giant jenga**

**Day 2: Tuesday August 7, 2018**

**6:00 – 7:00 am: 5K fun run (meet at Lodge's front entrance at 6:00 am, run begins at 6:05)**

**7:00 – 8:00am: Registration and breakfast**

**8:00-8:05 am Logistics**

**SESSION 4: GENOMIC & METABOLOMIC APPROACHES TO IDENTIFY RESISTANCE GENES**

Moderator: Dana Nelson

**8:05-9:35 (15 min talks + 15 min discussion)**

19. Richard Buggs, **Genomics of Fraxinus (Oleaceae); A genus under severe threat**
20. Rita Costa, **Expression profiling of candidate genes of resistance to *Phytophthora cinnamomi* determined in different genotypes of *Castanea spp.***
21. Jared LeBoldus, **Exploiting natural variation in a tree species to combat an invasive forest pathogen**
22. Mukrimin Mukrimin, **Genome-wide exon-capture approach identifies genetic variants associated with susceptibility of Norway spruce trees to *Heterobasidion parviporum* infection**

23. Miguel Nemesio-Gorriz, **Metabolomic comparison of European ash genotypes with different tolerance levels against ash dieback**

DISCUSSION: Q&A + how have these tools helped applied programs or forest health to-date? In the future? How to improve tool development to maximize chance of operational implementation?

**Coffee Break: 9:35 – 10:05 am**

**SESSION 5: USE OF TRANSCRIPTOMICS/GWAS TO DISSECT MECHANISMS OF HOST-PARASITE INTERACTION**

Moderator: Jared LeBoldus

**10:05-11:45 pm (15 min talks + 25 min discussion)**

24. John Carlson, **A major gene for beech bark disease resistance identified in American beech by genome-wide association study**
25. Sanushka Naidoo and Caryn Oates, **Factors underpinning resistance against the galling pest *Leptocybe invasa* in *Eucalyptus grandis***
26. Ines Modesto, **Identification of genes involved in the resistance response of *Pinus pinaster* to the pinewood nematode infection**
27. Kelsey Sondreli, **Identifying and validating necrotrophic effectors in the *Populus trichocarpa-Sphaeulina masiva* pathosystem**
28. Junli Zhang, **Characterization of molecular mechanisms in the laurel wilt disease pathosystem**

**11:20 – 11:45 pm Discussion lead by LeBoldus, others? Which approaches are best for identifying resistance genes/mechanisms** – development of community standards and discussion of cost/benefits. Short term funding: what is the best use of this to achieve goals? (is goal to develop genomic tools to accelerate breeding? Is goal academic, understanding mechanisms of host-pest interaction?). What should be the gold standard? What is acceptable by journals? Validation required for publication? Conifers have very large genomes – how much does this restrict progress and when will this limitation be minimal? How do we avoid ‘putting the cart before the horse’? Q&A + Limitations to work to date? What are the true successes (to date)?

**Lunch 11:45-12:45 pm**

**SESSION 6: GENETIC MAP-BASED APPROACHES TO IDENTIFY RESISTANCE GENES**

Moderator: Jill Wegrzyn

**12:45 – 2:00 pm (15 min talks + 15 min discussion)**

29. Malin Elfstrand, **Do allele-specific expression patterns control resistance to *Heterobasidion annosum* S. L. in *Picea abies*?**
30. Jun-Jun Liu, **Development and application of high density genetic map of limber pine (*Pinus flexilis* James) for genomics-based breeding**

31. Bert Abbott, **Genetic mapping and functional genomics analyses of the resistance/susceptible response in chestnut seedlings to *Phytophthora cinnamomi* infection**
32. Dana Nelson, **Multiple approaches to dissect Fusiform rust resistance in *Pinus taeda* L**

DISCUSSION: Are we there yet? What will be possible or be done in the next five years?

**Coffee Break: 2:00-2:30 pm**

## **SESSION 7: INTEGRATING GENOMICS/BIOTECHNOLOGY WITH TRADITIONAL TREE BREEDING**

Moderator: Jeanne Romero Severson

**2:30 -3:55 (20\* min talks + 1 hour discussion)**

33. Kara Laney, **Overview on potential for biotechnology to address forest health – based on pending National Academy of Science, Engineering and Medicine (NASEM) report**
34. Jared Westbrook, **Restoration of American chestnut: A marriage of breeding and biotechnology**
35. Jeremy Johnson, **New frontiers in forestry: Combining phenomics, common gardens, and landscape genomics to address disease resistance and climate change**
36. Jeanne Romero-Severson, **Wise use of genomics for improving forest health**

3:55 – 4:45 Discussion: lead by Romero-Severson, Westbrook, Koch, Johnson, Laney: **Best approaches for integrating genomics with breeding**

Industrial systems/agroforestry approach maybe different that ecological restoration approach – due to opportunity for return on investment. Goals may differ – industrial, agroforestry species- success means increased production, etc. Ecological restoration/gene conservation – goal is to prevent extinction, maintain ecosystem services, may only need enough resistance to allow self-sustaining populations to continue to evolve via natural selection.

Short term funding: what is the best use of this to achieve goals? (is goal to develop genomic tools to accelerate breeding? Is goal academic, understanding mechanisms of host-pest interaction?)

**4:45-5:15 Business meeting: The future of resistance workshops** (moderated by R.Sniezko) – **bring ideas!**

Overview (10 min) Discussion, Potential hosts for next workshop?

2018 meeting: PPP Journal (R. Buggs), and Proceedings (D.Nelson)

**5:15 – 6:30 pm: POSTER SESSION #2 (cash bar)**

**6:30 – 8:00 pm: Dinner**

**8:00 – 9:30 pm: Bonfire, corn hole, giant jenga**

### Day 3: Wednesday August 8, 2018

**7:00 – 8:00 am: Breakfast**

**8:00 – 8:15 am: Board buses, depart for Field Trip**

**Field Trip Agenda (tentative):**

- 1. 9:15 am to 11:00 am. Cantwell Cliffs, Hocking Hills State Park, OH-374, Rockbridge, OH**
  - Tom Macy, Ohio State Department of Natural Resources, Forest Health Program. **Treatment strategies for control of hemlock woolly adelgid in Ohio.**
  - Ben Smith, North Carolina State University. **Biology of the hemlock woolly adelgid.**
  - Ellen Crocker, Forest Health Research and Education Center, University of Kentucky. **Demo/training on the use of TreeSnap, an app to engage citizen scientists and other partners in the search for resistant trees.**
- 2. 12:30 pm to 4:00 pm. US Forest Service, Northern Research Station, Forestry Sciences Laboratory, 359 Main Rd., Delaware, OH**
  - **Lunch:** will be provided
  - Mary Mason and Aletta Doran, The Ohio State University. **EAB egg bioassay demonstration.**
  - Dave Carey, US Forest Service. **Hybrid breeding for EAB-resistance and experiments to assess influence of parasitoids and host-resistance.**
  - Jim Slavicek, US Forest Service. **Overview of testing of full-sib progeny from crosses between known Dutch elm disease tolerant selections of American elm and known DED tolerant selections crossed with large survivor elms.**
  - Kathleen Knight and Leila Pinchot, US Forest Service. **New England survivor elm propagation and testing; breeding strategy incorporating new germplasm.**
  - Mary Mason, The Ohio State University. ***Fraxinus* species trial and archive plots – a look at inter and intra-specific variation in responses to EAB.**
  - Dave Carey, US Forest Service. **Bioassay, mapping family, and QTL analysis of beech bark disease resistance in American beech.**

**Lunch:** a boxed lunch will be provided

**5:00 pm – 9:00 pm: Rockmill Brewery, 5705 Lithopolis Rd. NW, Lancaster, OH:** brewery tours, beer-tasting, music and a barbeque dinner

### **Day 4: Thursday August 9, 2018**

**7:00 – 8:00 am: Breakfast**

**8:00-8:05 am Logistics meeting**

**8:05-8:30 am Stephen Woodward, Has history taught us nothing? The case of plant pathogen invasions.**

**SESSION 8: SCREENING FOR RESISTANCE TO PATHOGENS: METHODS DEVELOPMENT**

Moderator: Stephan Woodward

**8:30 – 9:30 am (15 min talks + 20 min discussion)**

37. Susanna Keriö, **Virulence of *Sphaerulina musiva* isolates determined by genome-wide association mapping, host infection, and colonization**
38. Thomas Saielli, **Early screening potentially blight-resistant American chestnut using small stem assays**
39. Pierluigi (Enrico) Bonello, **Defense responses of Austrian pine to two opportunistic pathogens of contrasting aggressiveness under combined drought and temperature stress**

Discussion: lessons learned in screening – how not to underestimate or overestimate resistance...are we evaluating just one type of resistance or all resistances? What about tolerance? Definition of tolerance vs resistance vs reduced susceptibility

**Coffee Break 9:30 – 10:00 am**

**Session 9: Mechanisms of Resistance to Insects**

Moderator: Luis Sampedro

**10:00 – 11:30 pm (15 min talks + 15 min discussion)**

40. Nadir Erbilgin, **Are novel plant chemicals friends or foes of native invasive insect herbivores? Explaining successful host range expansion of mountain pine beetle in Canada's boreal forests**
41. Isabel Carrasquinho, **Volatiles released by two *Pinus pinaster* half-sib genetic contrasting families for pine wilt disease susceptibility, after feeding by *Monochamus galloprovincialis* insect-vector**
42. Chad Rigsby, **Hemlock and hemlock woolly adelgid: Past research, current findings, and future directions in a troubled North American tree-pest system**
43. Shiyang Zhao, **A hint left by mountain pine beetle on anatomical defenses of lodgepole pine trees: larger resin ducts enhance tree resistance**
44. Luis Sampedro, **Variation across populations in resistance to a key herbivore and their relationship with constitutive and induced secondary metabolites in a Mediterranean pine tree**

Discussion: what is known/unknown? At what stage in breeding do we need to know mechanisms and their inheritance? How similar are mechanisms across species?

**11:30 – 12:00 pm Discussion Session:** Entomologist, pathologists & geneticists: what can we learn from each other to better support the development of resistance? Led by Stephen Woodward (pathologist), Geneticist – Richard Sniezko, Fred Hain, Jared LeBoldus

**Lunch: 12:00-1:00 pm**

**SESSION 10: PRIORITIZING & PATHS TO SUCCESS**

Moderator: Bruce Moltzan

**1:00 – 2:45 pm (15 min talks + Discussion)**

45. Dana Nelson, **Better forest health through tree resistance—collaborative approaches**

46. Emily Grau, **TreeGenes: Integrating genotypic, environmental, and phenotypic data for forest health**
47. Kevin Potter, **A national prioritization of United States tree species threatened by pest and pathogen infestation**
48. Margaret Staton, **Searching, downloading and analyzing tree genetic and genomic data with the hardwood genomics website**

DISCUSSION: what information will help fast-track applied programs? How to archive long-term data? What data and databases are needed and how to organize? How do we raise awareness of the value of resistance programs in the public and in funding agencies?

**Coffee Break 2:45 – 3:15 pm**

**3:15 – 3:45 pm** Richard Sniezko, **Durability of resistance and ‘useful resistance’ in forest trees to non-native pathogens**

**3:45 – 4:00 pm Discussion:** Durability, stability, usability of resistance

**4:00 – 4:45 pm Discussion: Best Management Practices for Tree Resistance Breeding.** Koch, Romero-Severson, Sniezko, panel of end-users (Jill Rose, Houping Liu, Anetta Ayers, Kristin Carrington)

Genetic resistance in trees is a powerful management tool for reforestation and restoration .... However funding and other constraints make it imperative that groups be as efficient as possible in formulate how to proceed. Assembling the right team of expertise, beginning at the proper stage, and connecting researchers to the applied developers and end users are vital steps. Too many programs crash and burn, at least partially due to lack of vision of where the program needs to start and where it needs to go and how to get there. Genomic resources are potentially powerful aids in developing resistance, but they themselves are only a tool in the overall develop and cannot be view as either a starting point or as stand alone.... The need is more now than ever for using genetic resistance to help maintain or restore our forests (urban, plantation, natural). Let’s ensure that this tool can be properly harnessed and the goals actually obtained....

**5:00 – 6:30 pm:** Volleyball, corn hole, kayaking, paddle board

**6:30 – 8:00 pm: Dinner/ Cook-out**

**8:00 – 9:30 pm: Bonfire & S’mores**

## **Day 5: Friday August 10, 2018**

**7:00 – 8:00 am: Breakfast**

**8:00 – 8:05 Meeting logistics**

### **SESSION 11: NOVEL TOOLS FOR IDENTIFYING RESISTANCE**

Moderator: Caterina Villari



**8:05 – 9:00 am (15 min talks + 10 min discussion)**

49. Bradford Condon, **TreeSnap: A citizen science project and mobile app to tag trees for science**
50. Anna Conrad, **Development of a tool for rapid identification of resistant trees in species affected by alien invasive pathogens**
51. Judith Nantongo, **Detection of near infrared spectral differences in *Pinus radiata***

DISCUSSION: what tools/technologies are here, which are on the horizon, which should we be dreaming about (a ‘tricorder’) to make resistance breeding cheaper/faster/more feasible? What works in the world of crop breeding? What may be coming online in 5 to 10 years? What is ‘needed’? Should we establish an ‘X prize’?

**SESSION 12: RESISTANCE AND INTEGRATED PEST MANAGEMENT**

Moderator: Anna Conrad

**9:00 – 9:55 am (55 min) 15 min talks + 10 min discussion**

52. Greg Adams, **Endophyte enhancement of spruce and eastern white pine seedlings to improve tolerance to insects and disease**
53. Kathleen Knight, **Monitoring of ash mortality patterns informs EAB resistance breeding efforts: integrated pest management for EAB**
54. Jane Njuguna, **Emerging threats of priority agroforestry trees in Africa: Challenges and opportunities**

DISCUSSION - Include: what is the potential role of biocontrol? When is it useful with or w/o resistance? Endophytes: their role?

**Coffee Break 9:55 – 10:25 am**

**SESSION 13: INTERACTIONS BETWEEN RESISTANCE AND ENVIRONMENT**

Moderator: Rita Costa

**10:25 – 11:20 (15 min talks + 10 min discussion)**

55. Leila Pinchot, **Influence of site quality on blight resistance and growth of planted hybrid chestnut seedlings**
56. Jan Stenlid, **Drivers of disease emergence in boreal conifer forests, importance of phenotypic balance**
57. Carla Vazquez-Gonzalez, **Intraspecific genetic variation in defensive investment varies along the ontogeny of a model Mediterranean pine: a retrospective dendroecological analysis of resin ducts.**

Discussion: Importance of G x E

11:20 – 11:50 pm Wrap up: Bruce Moltzan, Nadir Erbilgin, Jennifer Koch/Dana Nelson/Richard Sniezko

11:50-12:15: Comments from participants & where do we go next?.

Meeting Adjourned 12:15

## POSTER TITLES

1. Richard Buggs – An answer awaiting a question: The UK national tree seed project collections
2. Hernan Capador – Genotypic diversity and reproductive biology of *Thekopsora areolata* in Norway spruce
3. John Carlson – Chinese chestnut genome v2.0
4. Michelle Cleary – Advanced phenotyping using FT-IR distinguishes disease resistance in *Fraxinus excelsior* against *Hymenoscyphus fraxineus*
5. Ellen Crocker– Delphi expert opinion survey to assess threats to oaks in the eastern United States
6. Ellen Crocker and Bradford Condon – TreeSnap: A mobile app to help you engage the public in research
7. Heather Dun – Understanding sudden larch death – From epidemiology to host resistance
8. Marianne Elliott – Geographic and local genetic variation in Pacific Madrone leaf blight
9. Charlie Flower – Back from the brink: Forest Service efforts to create Dutch elm disease tolerant trees for use in urban and rural restoration
10. Abdul Gafur – Field performance of previously selected root rot tolerant tropical Acacias
11. Christian Giardina – Building a Ceratocystis resistance program for *Metrosideros* in Hawaii
12. Ignazio Graziosi – The imminent invasion of the emerald ash borer in Southern Europe and the threat to native Oleaceae
13. Denita Hadziabdic-Guerry – A collaborative research approach for diagnosing and evaluating thousand cankers disease in walnut: Current progress and future directions
14. Jeremy Johnson – Adaptation and acclimation of a tree to disease and aridity
15. Jim McKenna – Butternut conservation & breeding to mitigate butternut canker
16. Dawa Méndez Álvarez – Die back syndrome caused by *Lasiodiplodia theobromae* and *Fusarium proliferatum* in elite genotypes of *Tectona grandis* LF., Costa Rica
17. Scott Merkle – Somatic embryogenesis and cryostorage for restoration of ash forests devastated by emerald ash borer
18. Kyle Mondron - QTL Mapping of *Sphaerulina musiva* Canker Resistance/Susceptibility in a Poplar T x D Hybrid Population
19. Oluwatosin Oduntan – The resistance of mulberry tree species to two foliar diseases in the rainforest ecological zone of Nigeria
20. Oluwatosin Oduntan – Nursery pest resistance of *Mansonia altissima* seedlings to *Godasa sidae* attack in the rainforest ecological zone of Nigeria
21. Erin Pfarr – Quantitative trait loci (QTL) mapping population development in *Cornus florida* using open pollinated seedlings and SSR markers
22. William Plumb – Genetic barcodes for identification of pure and hybrid *Fraxinus* species
23. Lynne Rieske-Kinney – Confocal microscopy confirms the feasibility of gene silencing for emerald ash borer suppression
24. Jana Šedivá – Various propagation ways in *Alnus glutinosa* with different sensitivity to *Phytophthora x alni*
25. Sandra Simon – Using a poplar hybrid to explore host plant genetic control of associating insect and fungal species
26. Richard Sniezko – Genetic resistance to blister rust in declining limber pine (*Pinus flexilis*) in Alberta – The path to restoration?

27. Richard Sniezko – Genetic resistance and restoring a threatened species: whitebark pine at Crater Lake National Park
28. Richard Sniezko – Investigating antagonistic activity of fungal endophytes toward pathogens of western white pine (*Pinus monticola*)
29. Kelsey Sondreli – Sudden oak death in southern Oregon: Comparing the EU1 and NA1 lineages of *Phytophthora ramorum*
30. Ward Strong – Screening for white pine blister rust in whitebark pine: British Columbia, Canada
31. Alex Trouern-Trend – Differential resistance to *Phytophthora cinnamomi* in Trojan fir
32. Caterina Villari – Phenolic component of loblolly pine defense response to blue-stain fungi associated with root-feeding beetles
33. Kwan-Soo Woo – Breeding for resistance to pathogenic pine wood nematode
34. Stephan Woodward – Variations in susceptibility to *Dothistroma* needle blight and pine pitch canker Scottish populations of Scots pine
35. Alvin Yanchuk – Breeding and deployment of insect and disease resistance trees in British Columbia: A 2018 update
36. Junli Zhang – Host-pathogen interaction in leaves of laurel wilt hosts
37. Yu Zhongdong – The effects of leaf wax composition and ratio on rust resistance of poplars