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Fruit Rots

- Pscheidt - OSU
- Jones – OSU
- Patten – WSU
- Caruso - WSU
- Peever – WSU
- Harteveld – WSU
Foliar and Cane Diseases

- Loper - USDA
- Mahaffee – USDA
- Pscheidt - OSU
- Putnam - OSU
- Stockwell - OSU
Root Pathogens

- Chang - OSU
- Eastwell - WSU
- Grunwald – USDA
- Loper - USDA
- Moyer – WSU
- Pscheidt - OSU
- Putnam – OSU
- Stockwell - OSU
- Weiland – USDA
- Zasada - USDA
Nematology

- Evaluation of post-plant nematicides in small fruits
- Pre-plant site preparation, including root removal, to reduce soilborne pathogen and inoculum levels in small fruit fields
- Increased understanding of the biology of plant-parasitic nematodes to improve management (spatial and temporal distribution, host range, development, etc)
Nematode Pests in the PNW

- Mesocricnema Ring nematode
- Pratylenchus penetrans Root lesion nematode
- Xiphinema Dagger nematode
- Meloidogyne
Root Rot Pathogens

1. Identification and characterization of soilborne pathogens causing disease (fungi and bacteria)

2. Integrating knowledge of pathogen identity, biology, and crop production methods to develop effective disease control strategies

3. Screening for disease resistance among existing cultivars and in new breeding material

4. Testing organic soil amendments for disease control efficacy

5. Understanding biology of replant disease (multiple crops)
Root Rot Pathogens

5. Phytophthora root rot, strawberry and raspberry Comparative genomics, fungicide resistance, population structure, host resistance, migration pathways within agro-ecosystems

6. Crown gall (Agrobacterium and Rhodococcus), Genomics, diversity, detection, management in nurseries, cold-hardiness acclimation and disease (grapes, raspberry, blackberry, blueberry)
Establishment failure of red raspberry due to *Phytophthora rubi*
Viruses

• Eastwell - WSU
• Karasev – UofI
• Pscheidt - OSU
• Martin – USDA
• Postman - USDA
• Rayapati - WSU
Incidence, Impacts, Vectors and Management of Virus Diseases of Grapevines

- Major diseases: leafroll, red blotch, rugose wood complex

1. Documentation of viruses in PNW vineyards
2. Genetic diversity of grapevine viruses
3. Vectors of leafroll viruses, with emphasis on leafroll virus
4. Impacts of leafroll on vine performance, fruit & wine quality
5. Characterization of viruses associated with new diseases in PNW
6. NCPN for grapevines in the PNW
7. Collaborative research with entomology, enology faculty at IAREC, and with virologists at USDA-ARS, Corvallis and UI, Moscow
Characterize New Diseases of Grapevine in PNW Suspected to be caused by Viruses
Rubus

Characterize viruses associated with crumbly fruit and plant decline (RBDV, RLMV, RpLV, RYNV (BYVD in the SE))

New strains of RBDV? Resistance breaking strain(s), infection of ‘resistant’ cultivars with RNA1, implications for RBDV management

RYNV incorporated into host genome – potential for naturally occurring source of virus-induced gene silencing to control this virus
Incidence, Impact, Vectors and Management of Virus Diseases of Berry Crops

Blueberry / Vaccinium

Characterize virus(es) and vector(s) associated with Fruit Drop and cultivar response

Other possible vectors of scorch, reduced spread of scorch with SWD management, feasibility of detection and removal to eliminate from a field – early detection

Related (Shock and TSV in cranberry – WI; TSV giving shock like symptoms in cranberry (McManus-UW), TSV in cranberry in PNW?

Necrotic ring blotch blueberry in the SE- impact in northern highbush unknown – keep out of PNW
Incidence, Impact, Vectors and Management of Virus Diseases of Berry Crops

**Strawberry**
Virus monitoring in nurseries to identify weak links in the plant production system in terms of virus infection (APHIS)

Virus testing of problematic strawberry fields (US), control strategies depending on viruses detected

**General**
NCPN for Berry Crops – Virus elimination, testing, diagnostics, maintain and distribute ‘Clean Plants’

Assess virus nature in Core Collection of NCGR – Corvallis for the three major berry genera
Grape and Berry Viruses Overarching

Develop improved diagnostic assays that capture the virus diversity

Vector transmission of new viruses and potential vectors of viruses not present in PNW

Impact of viruses and mixed infections on fruit yield and quality and managing critical viruses in complexes to reduce disease

Characterization of newly described diseases

Study epidemiology of virus diseases

Develop and implement control strategies for virus diseases

Monitor for viruses not present in the PNW on imported plant materials (NCPN)

Eliminate viruses from advanced selections prior to release and clean-up established cultivars as needed (NCPN)
Small Fruit Pathology
Fruit, Foliar and Cane Diseases
Mahaffee
Current Research

• Inoculum detection to aid management decisions

• Biology of *Erysiphe necator*
  – *Effects of temperature fluctuation on sporulation and infection*
  – *Factors influence cleistothecia development and overwintering*

• Pathogen dispersion and turbulent airflow modeling

• Disease Forecasting
Mahaffee Future

• Spatialized microclimate and disease risk at the plant scale
  – This is would be a major component of a scalable system integration framework.

• Simulation model of vineyard and disease development
  – A foundation for rapidly testing hypotheses and developing novel approaches to vineyard management.
Objectives and findings to date:

1. Characterize strains of *P. syringae* causing disease on blueberry
   - We have isolated more than 200 strains from diseased blueberry plantings throughout Oregon and Washington.
   - Strains are diverse, representing many of the major groups of *P. syringae*.
   - The majority of strains isolated from blueberry are resistant to copper

2. Optimize a disease assay and use it to assess disease management practices
   - Developing a reliable disease assay on blueberry is a major focus of our current work.

3. Survey of blueberry fields to determine the cause of dieback
   - Symptoms of *Pseudomonas* infection are similar to those caused by other pathogens, so we plan to survey fields in spring of 2015 to assess the relative importance of *Pseudomonas* versus other pathogens

Symptoms caused by *P. syringae*
1. Diversity of bacterial pathogens and management of bacterial diseases on small fruit crops
   • Crown gall of raspberry, blackberry and grape

2. Soil health
   • Characterizing the nematode microbiome (in collaboration with Inga Zasada and Dee Denver)
   • Would like to collaborate with others looking at the influence of soil microbial communities on plant health (replant diseases, suppressive soils), offering expertise in microbial genomics
Caruso

Cranberry fruit rots

Objectives

• Determine which fungal pathogens cause fruit rot in both fresh fruit and processed fruit beds
• Compare fungal incidence with fungicide programs utilized by growers
• Devise the best fungicide program to be used by growers in the next growing season
• Diagnosis of other disease problems and their causal agents in order to make control recommendations
Because of MRL issues in the EUP with chlorothalonil, devise the most effective fungicide program for fruit rot management.

With increased use of azoxystrobin, fenbuconazole and propiconazole, monitor fungal pathogens and whether this is any trend of the development of resistance/reduced sensitivity to these fungicides.
Pscheidt and Jones
Epidemiology and Management of Raspberry Cane Botrytis

Left: cane lesion and gray mold fruit rot caused by *Botrytis*. Right: Overwintering *Botrytis* sclerotia on raspberry cane

**Research Goal and Future Directions**: To gain a better understanding of the biology of cane Botrytis for the development of improved management practices in the *Botrytis*-raspberry pathosystem
Peever and Harteveld

Epidemiology of Mummyberry and Fungicide Resistance
Peever and Harteveld

Current and Future Research

• Determine timing of primary inoculum release for mummyberry pathogen related to host phenology and weather data

• Determine baseline resistance levels to fungicides commonly used for control of mummyberry

• Determine resistance levels to fungicides commonly used for control of Botrytis fruit rot of blueberry
Peever and Grunwald
Biology of *Botrytis cinerea* infecting raspberry
Peever and Grunwald  
Current and Future Research

• Determine dynamics of flower and fruit infection by *Botrytis cinerea*

• Determine resistance levels to fungicides commonly used for control of *Botrytis* fruit rot

• Determine population structure of *B. cinerea* infecting raspberry, blueberry and strawberry in PNW (ie. is *B. cinerea* a truly wide host-range pathogen?)

• Estimate gene flow of fungicide resistance alleles among populations infecting different small fruit hosts
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Possible Components for C of E

Soil Health – Soil Microbiome
- Pathogenic and beneficial organisms (Nematodes, Fungi, Bacteria and Viruses)
- Comparing soils with and without replant problems or root rot problems
- Understanding the role of beneficial organisms and how to manipulate them to improve soil health and disease control

Plant Health – Phytobiome
- Pathogenic and beneficial organisms (Nematodes, Fungi, Bacteria, and Viruses)
- On plant surfaces and in plants, fruit, roots, leaves; comparing plants or plant parts (fruit) with and without disease
- Understanding the role of beneficial organisms and how to manipulate them to improve plant health and fruit quality

Adapting to Climate Change
- Disease forecasting based on real-time weather at micro-scale (what are the needs in your field?)
- Degree day models for pathogen and disease development

Extension and Outreach
- Developing more pathogen and disease management guides
- Information access on mobile devices
Questions

• Did we miss some ongoing projects?
• Other ideas for major projects?

• Thanks

BM & TP