62 Tree Fruit

Where: Ballroom D
MI re-certification credits: 2 (1C, COMM CORE, PRIV CORE)
OH re-certification credits: 1 (presentations as marked)
CCA Credits: CM (0.5) PM (1) SW (0.5)
Moderator: Scott Hassle

9:00 AM **Ethanol and a Fungal Feast: Black Stem Borer Colonization of Fruit Trees**
- Sara Villani, North Carolina State University

9:30 AM **Biorational Management of Pear Psylla with Modern Delivery Systems (OH 2B, 1)**
- John Wise, Michigan State University

10:00 AM **Precision Orchard Irrigation**
- Hemant Gohil, Rutgers Cooperative Extension - Gloucester County

10:30 AM **What We Know About Spotted Lantern Fly**
- Julianna Wilson, Michigan State University

10:45 AM **How the Michigan Tree Fruit Commission is Helping the Tree Fruit Industry**
- Phil Schwallier, Michigan State University

11:00 AM **Session Ends**

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Ethanol and a Fungal Feast: Black Stem Borer Colonization of Fruit Trees

Sara Villani and Jim Walgenbach
Department of Entomology and Plant Pathology
North Carolina State University

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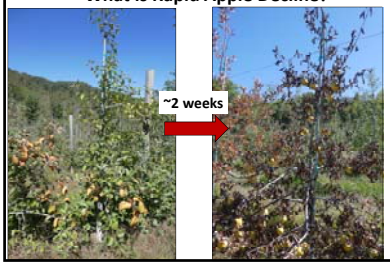
What is Rapid Apple Decline?



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Characteristics of RAD (Rapid Apple Decline)

- Young (≤6 years) dwarfing trees in high density orchards
- Several dwarfing rootstocks involved: Malling (M-series), Budagovsky (B-series), Geneva (G-series)
- Several cultivars involved
- Graft union necrosis: Proceeds up the tree
- Root system usually appears healthy
- Random dispersal of affected trees throughout a block
- Leaves: Chlorotic (pale green/yellow) ⟶ red

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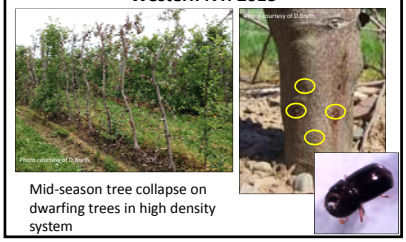
Apple Tree Decline in the Eastern U.S. Western NY: 2013



Mid-season tree collapse on dwarfing trees in high density system

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Apple Tree Decline: Adams County, PA, 2013

- 2013: Massive die-off of 2-yr-old multiple cultivar planting (M.9)
- 2014-2017: Collapse of trees extends to commercial orchards in county

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Apple Tree Decline: Henderson County NC, 2016

- Tests (-) for Phytophthora, Fire Blight
- Borer holes in scion and rootstock: *Xyleborinus saxeseni*

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Apple Tree Decline in the Eastern U.S. Henderson County, NC: Aug-Dec 2016

- Sporadic distributions throughout orchards
- Budagovsky + M9/26/106 rootstocks
- Rapid Apple Decline (RAD) reports: NY, PA, New England, Canada

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Apple Tree Decline: Western NC: April-May 2017

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Apple Tree Decline: Western NC: April-May 2017

Ambrosia Beetle/BSB: Life of the Party!

- Attracted to ethanol produced by tree during a stress event

- Fungal Farmers: Cultivate symbiotic fungi (and auxiliary fungi) to provide food for developing offspring

Ethanol

Biotic: Pathogen Attack

Drought stress
- Lack of rainfall
- Under/no irrigation

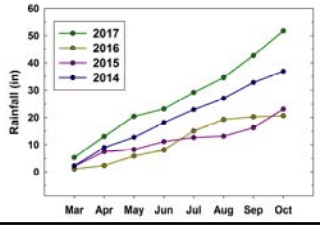
Flood Stress

Temperature Stress
- Winter Injury
- Late spring freeze

Herbicide accumulation/injury

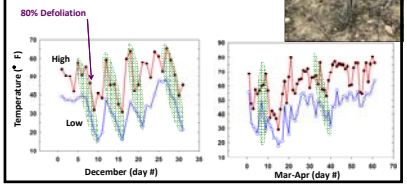
Why the Sudden Arrival of BSB/Ambrosia Beetles?

- Water stress in NC?



Why the Sudden Arrival of BSB/Ambrosia Beetles?

- Cold stress/winter injury in NC?



Tree Stress: Winter Injury

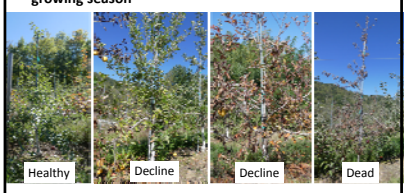
- Result of rapid changes in temperature in late fall/early winter, warming and cooling cycles during winter, and extreme cold temperatures

Tree Stress: Winter Injury

- Last part of tree to harden off is lower part of tree: lower scaffolds to soil line
  - Avoid poorly drained and low-lying areas
  - Irrigation/fertilizer management: too much water or fertilizer > trees growing late into fall
  - Take care with herbicide use > mild damage may decrease cold hardiness
  - Late summer pruning > decrease cold hardiness
  - Rootstock selection: MM.106 slow hardening: Geneva series G.935 good cold tolerance

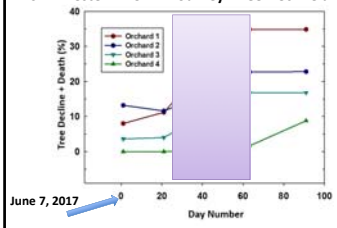
2017 Western NC RAD Survey: Field Evaluations

1. **Determine progression of tree decline during 2017 growing season**



10 to 15 reps of 25 trees at 7 NC high-density orchard locations in Henderson and Haywood counties

2017 Western NC RAD Survey: Tree Decline and Death



- Additional orchard sampling locations followed similar trend

2017 Western NC RAD Survey: Field Evaluations

2. **Determine ambrosia beetle species and flight timings**
   - Ethanol baited traps set at row adjacent to wood edge; 15 m, and 30 m into orchard
   - Traps set at 5 HD orchard locations 7 June and monitored weekly

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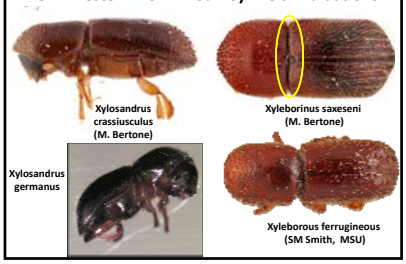
2017 Western NC RAD Survey: Field Evaluations



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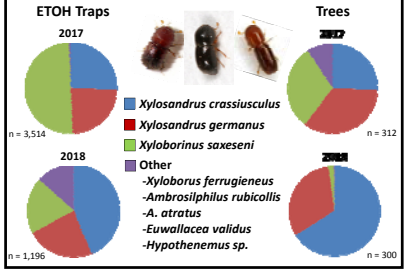
2017 Western NC RAD Survey: Field Evaluations



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2017 Western NC Beetle Survey: Field Evaluations

3. **Evaluate association between ambrosia beetle attack and apparent tree health status**
   - Single assessment (Aug 2017) 10 single-tree replicates per tree health status 4 orchards evaluated

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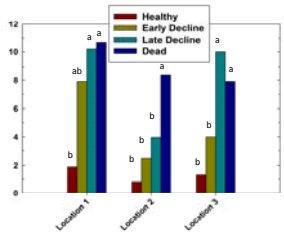
2017 Western NC Survey: # of Ambrosia Beetle Attacks



- Early Decline: 3-8 attacks/tree; Late Decline: 4-10 attacks/tree

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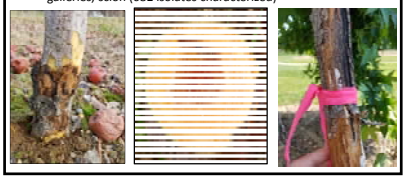
2017 Western NC RAD Survey: RAD Tree Evaluations

1. Determine fungi and other pathogens (Phytophthora, *E. amylovora*, viruses) associated with rapid apple decline in North Carolina
   - Phytophthora and fire blight: Graft union/rootstock region only
   - Associated fungi: Graft union/rootstock, ambrosia beetle galleries, scion (682 isolates characterized)



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2017 Western NC Ambrosia Beetle/RAD Survey: Phytopathogen/Fungal Associations

- 29 high density "orchards" (1 research, 28 commercial), 3 NC Counties: 163 trees total
- Rootstocks: M-9 (NIC 29, 337), -26; G-11, -30, -41; B-9, -118; EMLA-26
- Cultivar: Cameo (2), Gala (5), Fuji (3), Red Delicious (1), Honeycrisp (7), JerseyMac (1), Granny Smith (1), Newton Pippen (1), Crimson Crisp (1), Mixed/unknown (6)
- 23 of 28: No irrigation used
- Maximum 10 trees evaluated per orchard

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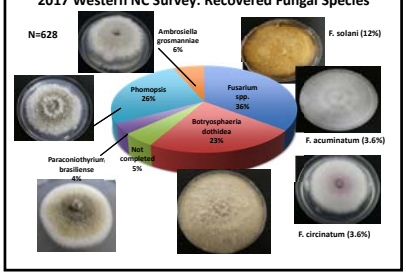
2017 Western NC Survey: Recovered Fungal Species



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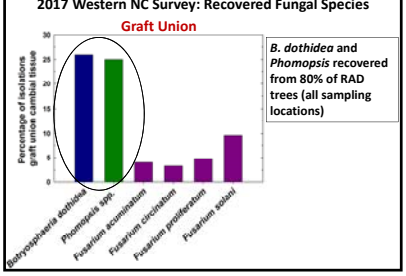
2017 Western NC Survey: Recovered Fungal Species



B. dothidea **and** ***Phomopsis*** **recovered from 80% of RAD trees (all sampling locations)**

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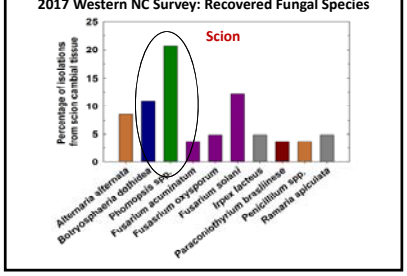
2017 Western NC Survey: Recovered Fungal Species



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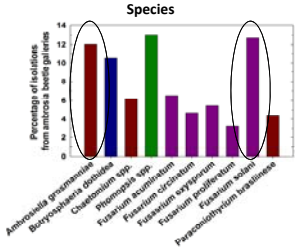
2017 Western NC Ambrosia Beetle Survey: Recovered Fungal Species



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2018 Insecticide Trial

- 1-year old potted trees: 'Granny Smith' on B.9 rootstock
- Pots placed in plastic bag and watered weekly with 2.5% ETOH solution.
- 7-wk exposure period near wooded area of an orchard with high RAD incidence in 2017.
- Treatments
  - Soil applied systemic insecticides applied one month before field exposure period
  - Foliar applications made weekly beginning at exposure period
  - PermaNet: deltamethrin-impregnated netting wrapped around trunk.

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Ambrosia beetle entries in apple trees during 7-wk exposure period. Fruitland, NC. 2018.

Treatment	Rate (/A)	Entries/tree	Entries with adult &/or larva[1]
ETOH Control	—	11.8a	8.6b
Venom (soil)	6.0 oz	11.8a	9.4b
Admire (Soil)	10.5 oz	5.2a	3.4ab
Admire (Foliar)	7.0 oz	7.4a	6.6b
Karate (Foliar)	2.5 oz	6.4a	4.0ab
Lorsban (Foliar)	3.0 qt	6.6a	3.2ab
Cobalt (Foliar)	1.3 qt	3.2a	0.2a
PermaNet	—	2.2a	0.6a

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Final Thoughts

- Management of ambrosia beetle/BSB associated apple decline will require a combination of stress mitigation, well-timed insecticide applications, and possibly fungicide applications
- In NC, extreme drought conditions in 2016 alone or combined with winter injury likely contributed to increased tree stress followed by ambrosia beetle colonization in 2017
- The role of fungal symbionts and auxiliary fungi of ambrosia beetles/BSB in tree decline is still unknown, however, several associated fungi are recognized as weak/opportunistic pathogens in tree fruit

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Estimated Impact of Ambrosia beetle/BSB associated Tree Loss on Economics of High Density Apple Orchards

		Cumulative Income ($/A)	
Tree Loss	Break even year	10 years	15 years
0	6.8	38,080	110,008
10%	7.2	30,711	94,254
20%	7.5	23,351	78501
40%	8.7	8,632	46,994
40% (10%/yr)	8.6	9,438	47,800

Assumptions: $15,000/acre establishment cost, 'Gala' cultiver, $13.43/bushel return, all healthy trees reach yield potential.

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