New Problems with an Old Invasive:

The status of black stem borer in Michigan

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Black stem borer background

Coleoptera, Curculionidae, Scolytinae, *Xylosandrus germanicus* (Blandford)

- Originated in Asia
- Found in central Europe & U.S.
- United States
  - 1st reported in1932, greenhouse on Long Island, NY;
  - Infests many forest & ornamental trees; deciduous & coniferous
  - Common pest of ornamental nurseries & forests throughout U.S.
  - Attacks ~200 plant species

Black stem borer biology*

- female 2 mm long, male smaller, ambrosia beetle
  - symbiotic relationship with “ambrosia” fungus (*Ambrosiella* spp.)
  - sole food for larvae & adults
- females lay up to 18 eggs; hatch in 6 days (75°F)
- 3 larval instars; about 12 days to pupa
- 1 week to pupate
- Egg to adult 25 days
- Female:Male ratio 10:1
  - males from unfertilized eggs; don’t fly

Black stem borer biology

- Adults OW in base of tree in galleries
- Active in spring*
  - ~100DD50 from Jan 1
  - 1-2 days of 68°F days; forsythia bloom
- Mated females infest new trees
    - tunnels, brood chambers, lay eggs
- Does not feed on tree
  - Cultivate ambrosia fungus in brood chambers
- Signs of infestation
  - 1mm round holes, sawdust “toothpicks”
  - oozing sap, flaking bark, dark discoloration
- 2 gen/yr.

Bottom photo credit: Bill Shane, MSU Extension

What attracts beetles?

- Stress to trees
  - ethanol released
- Stressors*
  - flooding / drought; frost injury / heat injury;

girdling; pollution; pathogens; impaired root function

Female black stem borers attracted to

- small diameter (≤4”) = young trees, newer varieties
- usually stressed trees; *sometimes not noticeably stressed*

Black stem borer as orchard pest

- Western NY 2013: apples
- Ohio, North Carolina: apples
- Reported in all regions of U.S.

  except southwest
- First reported in MI 1980
  - SW MI 2010-11: apricot & plum
  - Fruit Ridge 2014: apples
  - All tree fruits grown in MI susceptible

Distribution, biology and management of black stem borer in Michigan

Objectives:

- *To identify areas of black stem borer activity within Michigan's apple producing regions and improve our understanding of the biology in MI apple*

- *To determine the effectiveness of potential control measures for black stem borer*

Black stem borer research objectives

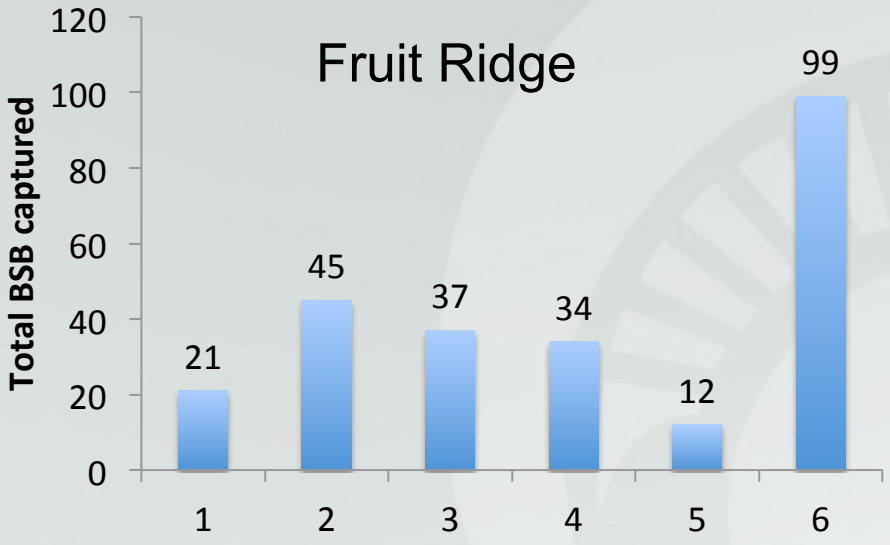
1) Understand pop'ln level & distribution
   - Monitor with traps
   - Investigate trap efficiency
     - -Trap height
     - -Placement, i.e. distance from edge
2) Evaluate chemical control measures

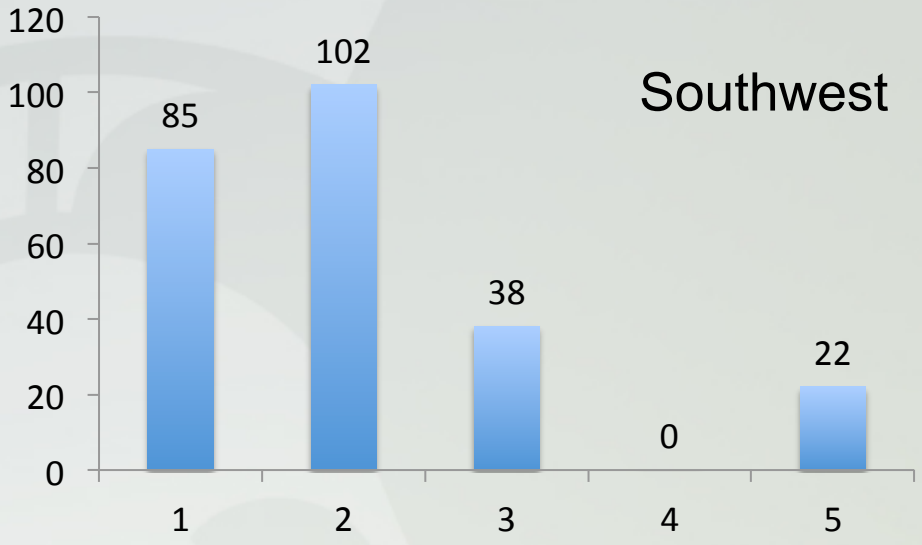
Trapping efficiency-

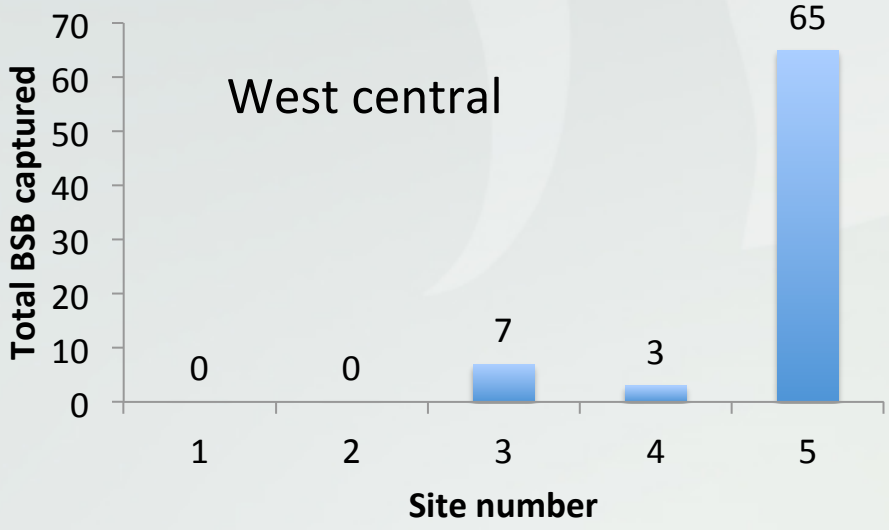
best catch in adjacent woodlands

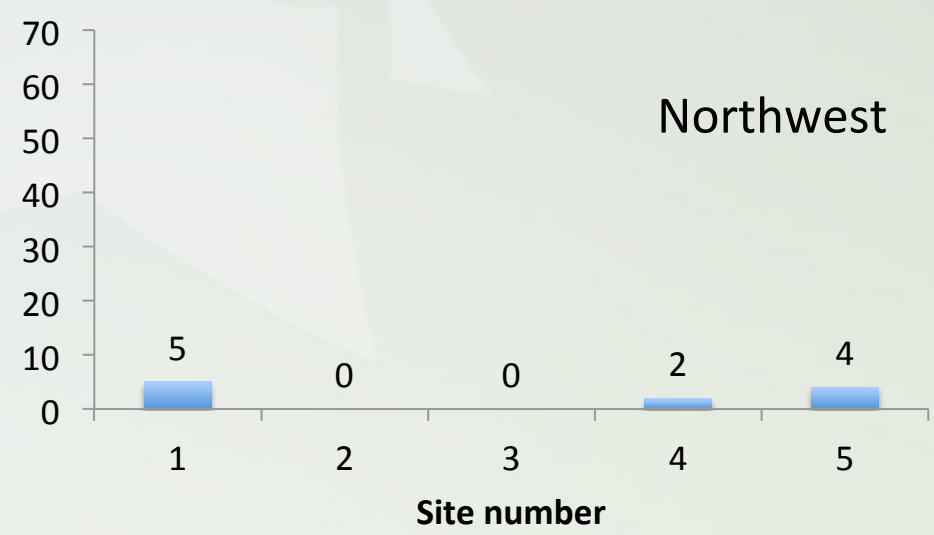
More beetles captured in traps placed low in the canopy compared to traps positioned higher in the canopy

Regional survey - 2015









Black stem borer flight - 2015

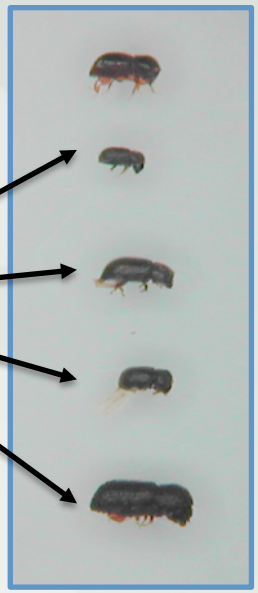
Trapping black stem borer

- Inverted juice container with openings cut in side panels
- Lure
  - Ethanol lure: agbio@agbio-inc.com
    - lasts for 2-3 months; $3.50 each
  - ethanol based hand sanitizer
  - Vodka
- ≤1.7 m from ground*
- Edge of woods or orchard edge
- Check traps weekly

Identification is not easy!

Black stem borer

Other beetles commonly found in traps



Xylosandrus germanus

Ambrosiophilus atratus

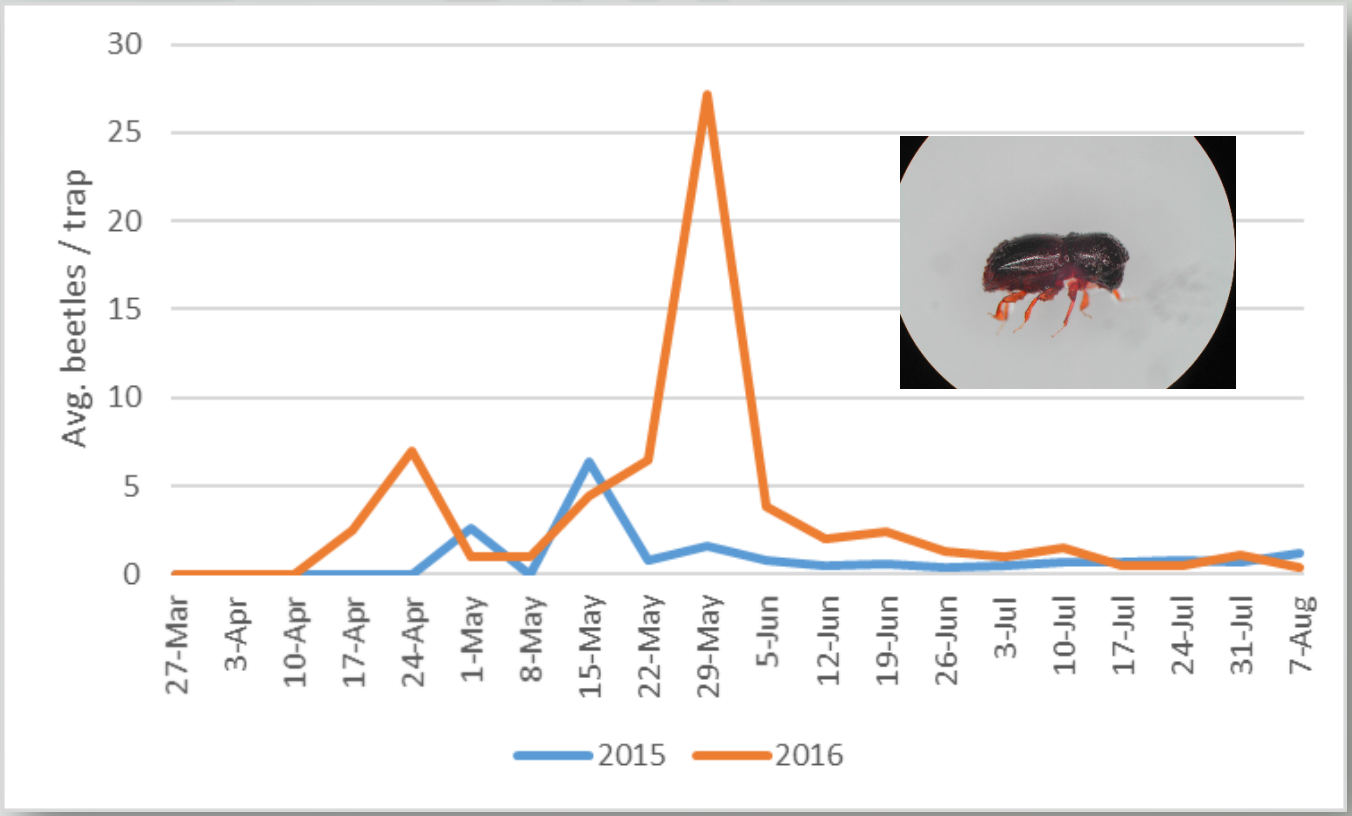
Family Ciidae

Hypothenemus spp.

Xyloterinus politus

Need a microscope.
Takes training.

Seasonal trapping



Management

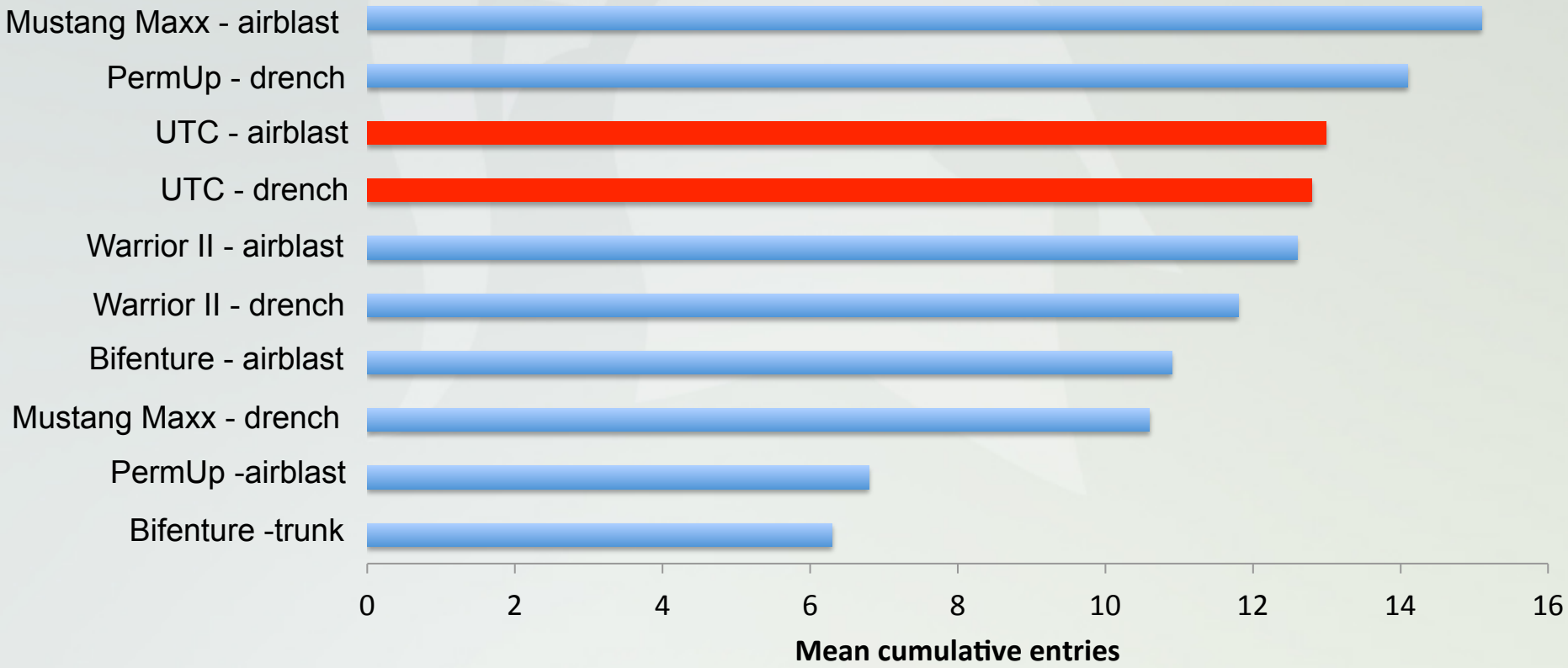
- Keep orchard healthy
- Monitor for beetle activity
  - newer plantings near woods
  - adult traps
    - edge of bordering woods best
    - edge of orchard if no woods
- Spray if appropriate: conventional/biopesticides
- Remove infested trees along with roots
- Thoroughly destroy trees
  - burn, or chip & compost

Management

- Time sprays according to adult activity
  - peak flight; target females seeking new trees
  - prior to female sealing entrance
  - labeled pyrethroids: Warrior II, Mustang Max
  - some success with permethrin, bifenthrin, chlorpyrifos
  - neonics, diamides NOT effective
  - systemics NOT effective

BSB chemical efficacy trials

Product	Active ingredient	Rate/A (fl. oz)
Warrior II with Zenon	lambda-cyhalothrin	2.56
Mustang Maxx 0.88EC	zeta-cypermethrin	4.0
PermUp 3.2EC	permethrin	10.0
Bifenture 2EC	bifenthrin	12.8



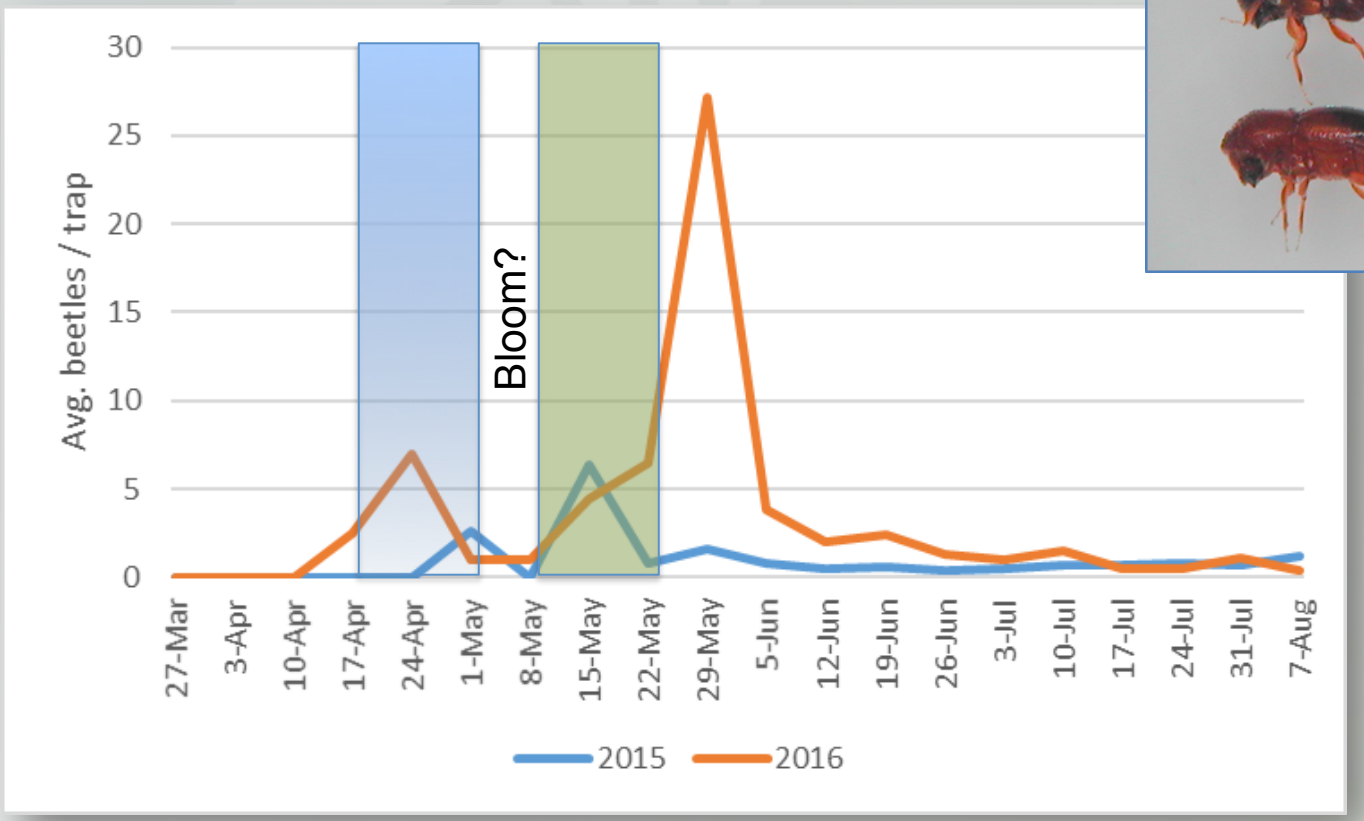
Management*

- Ranger et al., 2011
  - botanicals = essential oils
  - trunk drench application; magnolia trees
- Amorex (Soil Technologies, Fairfield, IA)
  - Sesame oil 84.5%, Garlic oil 2%, Clove oil 2%, Rosemary oil 1%, White pepper 0.5%
- VeggiePharm (Pharm Solutions, Inc., Port Townsend, WA)
  - Coconut soap 12.5%, Soybean oil 3%, Pure garlic oil 2.5%, Peppermint oil 0.1%
- suppressed injury

Management

- NY USDA-ARS: Vandenburg & Castrillo
  - Biopesticides
    - Botanigard: *Beauveria bassiana* present in soil
      - must contact; kills larvae & adults
    - Met52: *Metarhizium brunneum*
      - similar activity to *B. bassiana & reduces reproduction*
    - Rootshield: mycoparasite *Trichoderma harzianum* kills fungus eaten by stem borers

When to spray?



Other potential management options

- "Push-Pull" strategy (*Borden et al. 2006,Gillette et al., 2012)*
  - mountain pine beetle, forest tree production
  - Push = anti-aggregation pheromone: Verbenone
  - Pull = trap trees / ethanol traps

- Cultural control
  - different ambrosia beetle *(Hudson & Mizzel, 1999)*
  - use attacked nursery trees as trap crop
  - destroy them after flight activity ends

Thanks to: Heather Stueken, Amy Irish-Brown

Grant Support: Michigan Horticultural Society
Michigan Apple Research Committee
Project GREEEN

*References

- Slide 3- Weber, B. C., and J. E. McPherson. 1983a. Life history of the ambrosia beetle Xylosandrus germanus (Coleoptera: Scolytidae). Ann. Entomol. Soc. Am. 76: 455–462.
- Slide 4- Reding, M. E., C. M. Ranger, J. B. Oliver, and P. B. Schultz. 2013. Monitoring attack and flight activity of Xylosandrus spp. (Coleoptera: Curculionidae: Scolytinae): The influence of temperature on activity. J. Econ. Entomol. 106: 1780–1787.
- Slide 5 Ranger, C. M., P. B. Schultz, S. D. Frank, J. H. Chong, and M. E. Reding. 2015. Non-native ambrosia beetles as opportunistic exploiters of living but weakened trees. PLoS ONE 10: e0131496.
- Slide 13- Reding, M. E., J. B. Oliver, P. Schultz, and C. M. Ranger. 2010. Monitoring flight activity of ambrosia beetles in ornamental nurseries with ethanol baited traps: influence of trap height on captures. J. Environ. Horticult. 28:85–90.
- Slide 18- Ranger, C. M., M. E. Reding, J. B. Oliver, P. B. Schultz, J. J. Moyseenko, and N. Youssef. 2011b. Comparative efficacy of botanical formulations for managing ambrosia beetles and their corresponding mass spectral characterization. J. Econ. Entomol. 104: 1665–1674.
- Slide 21-Evaluation of the push-pull tactic against the mountain pine beetle using verbenone and non-host volatiles in combination with pheromone-baited trees John H Borden, Anna L Birmingham, Jennifer S Burleigh*, The Forestry Chronicle*, 2006, 82(4): 579-590.
- *Slide 21-* The Push—Pull Tactic for Mitigation of Mountain Pine Beetle (Coleoptera: Curculionidae) Damage in Lodgepole and Whitebark Pines Author(s): Nancy E. Gillette, Constance J. Mehmel, Sylvia R. Mori, Jeffrey N. Webster, David L. Wood, Nadir Erbilgin, and Donald R. Owen. Environmental Entomology, 41(6):1575-1586.
- *Slide 21-* Hudson W, Mizell R. Management of Asian ambrosia beetle, Xylosandrus crassiusculus, in nurseries. InProc. 44th Annu. Southern Nursery Assoc. Res. Conf., Atlanta, GA 1999 (pp. 182-184).

Best all-encompassing black stem borer paper:

Biology, Ecology, and Management of Nonnative Ambrosia Beetles (Coleoptera: Curculionidae: Scolytinae) in Ornamental Plant Nurseries. *Christopher M. Ranger, Michael E. Reding, Peter B. Schultz, Jason B. Oliver, Steve D. Frank, Karla M. Addesso, Juang Hong Chong, Blair Sampson, Christopher Werle, Stanton Gill, and Charles Krause.* Journal of Integrated Pest Management, (2016) 7(1): 9; 1–23.

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