Three Year Efficacy of Oak Wilt Treatments in Minnesota

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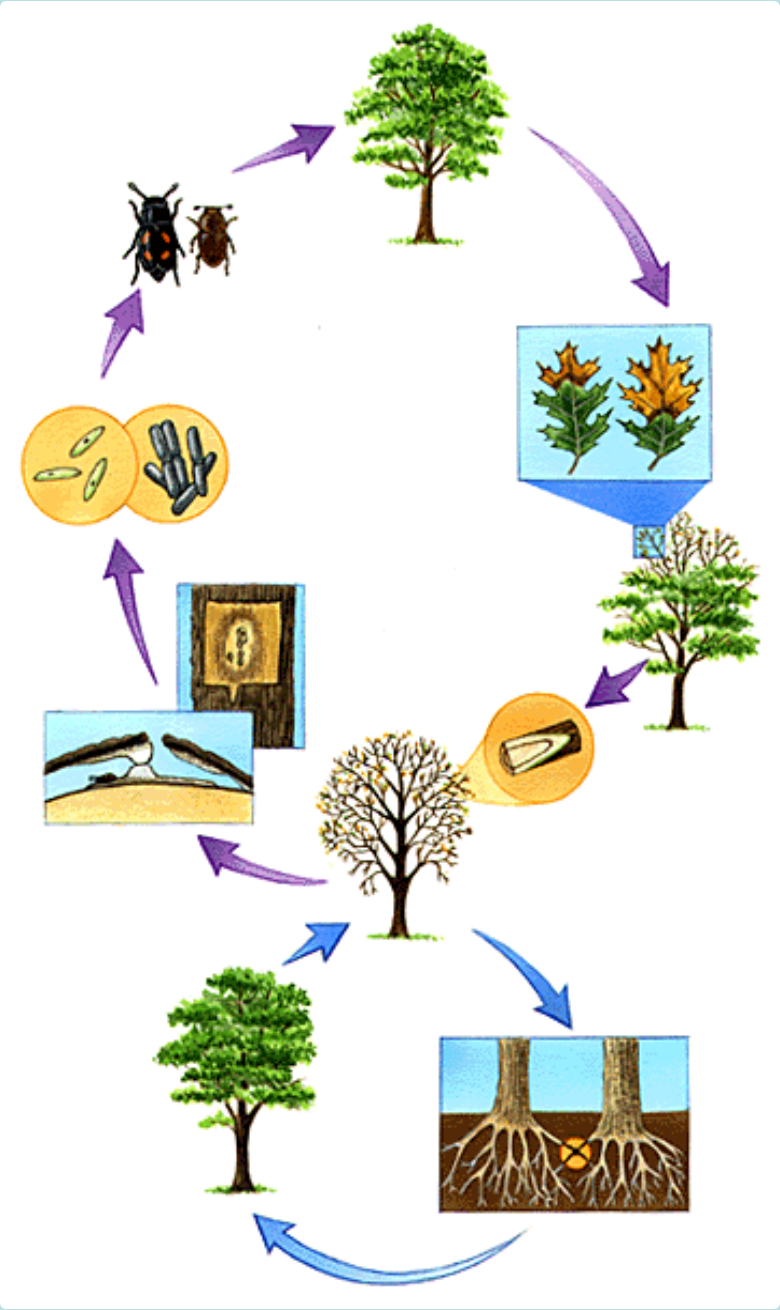
Oak Wilt

- *Ceratocystis fagacearum*
- Serious disease of oaks (*Quercus* spp.)
  - severity of symptoms depends on species

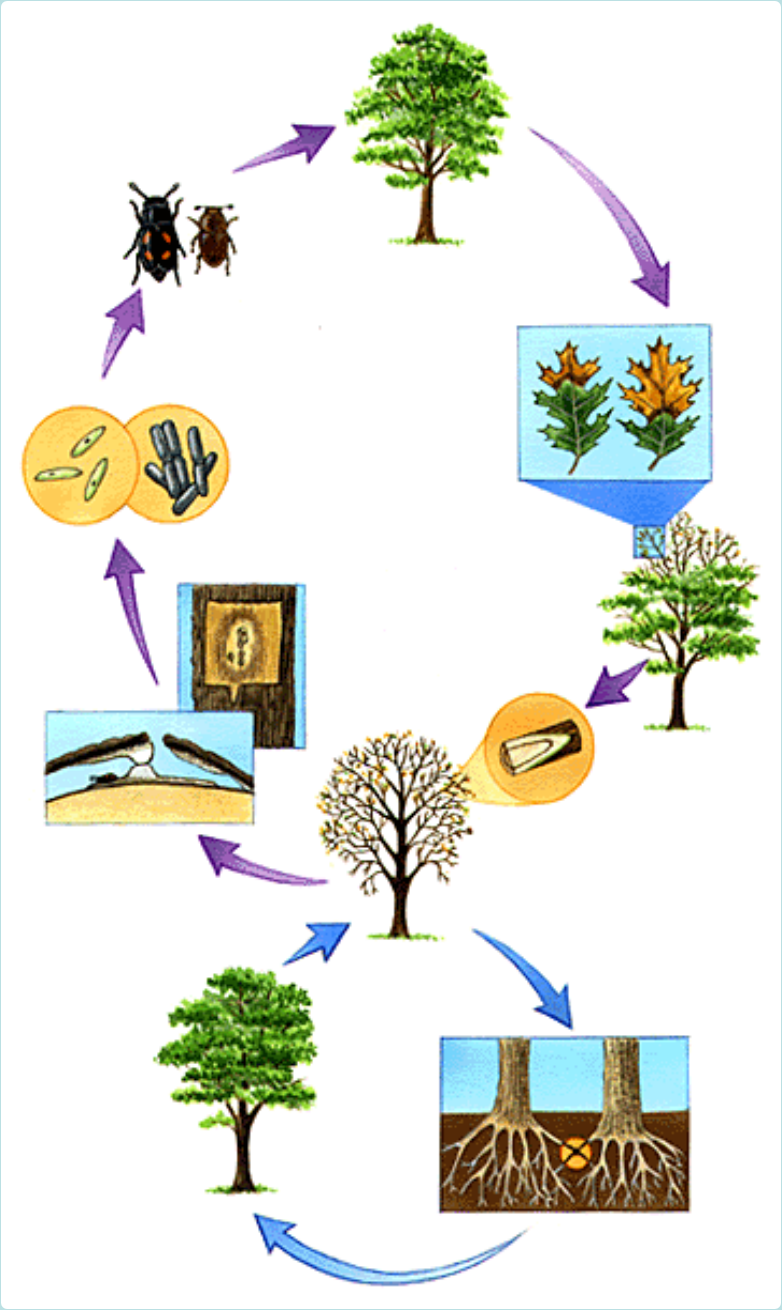


Juzwik, 2000

http://www.na.fs.fed.us/spfo/pubs/howtos/ht_oakwilt/toc.htm

Oak Wilt

- Types of spread:
  - Aboveground
    - Aided by nitidulid vectors, firewood transport
  - Belowground
    - Root grafts



Juzwik, 2000

http://www.na.fs.fed.us/spfo/pubs/howtos/ht_oakwilt/toc.htm

Management Options

- Vibratory plowing (VP)
  - disrupts root grafts
  - prevents belowground spread

Photo: Joseph O'Brien, forestryimages.org

Appel, 2001

Management Options

- Vibratory plowing (VP)
  - primary vs. secondary line

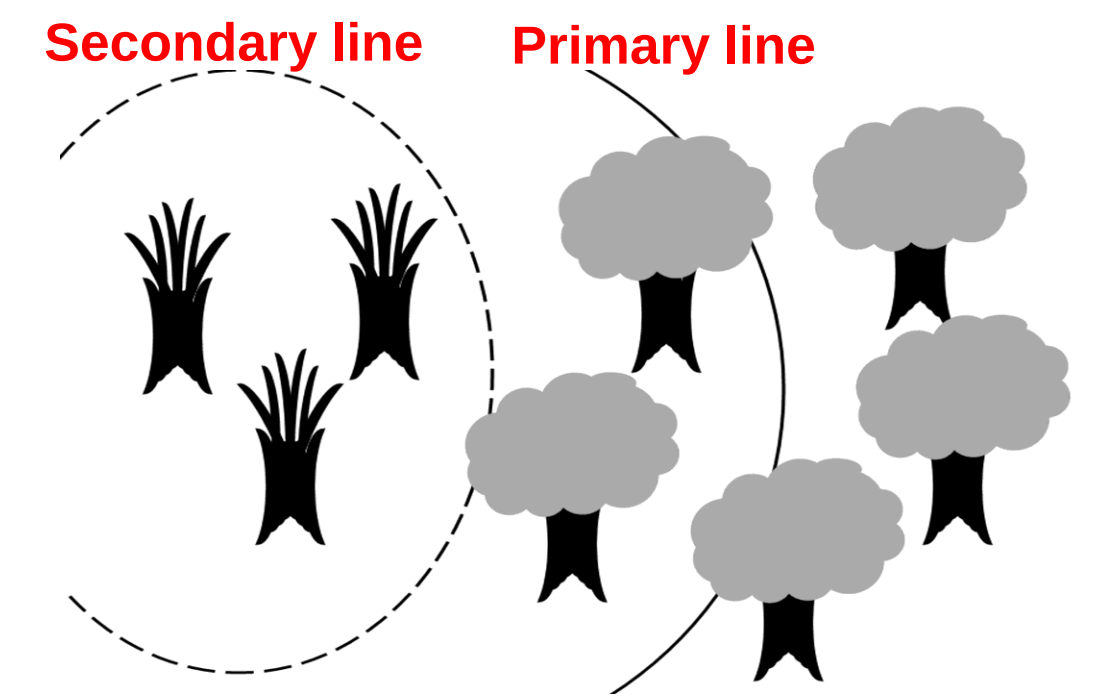


Figure from Koch et al. 2010

O'Brien et al., 2000; Wilson and Lester, 2002

Management Options

- Potential spore-producing tree (PSPT) removal
  - red oak, killed by oak wilt the previous year
  - produces infective spores
  - requires removal *and* proper sanitation

Photo: Fred Baker, forestryimages.org

Cook, 2001; Bruhn, 1995

Management Options

- Fungicide Injection
  - propiconazole
  - protects high-value trees
  - prevents spore mat production

Photo: Joseph O'Brien, forestryimages.org

Wilson and Forse, 1997; Osterbauer and French, 1992

Management Options

- Combinations of these options:
  - VP + PSPT removal
  - VP + fungicide injection
  - PSPT removal + fungicide injection
  - VP + PSPT removal + fungicide injection

Objectives

1. To determine if particular treatment combinations were associated with increased efficacy in preventing oak wilt spread within or beyond an infection center
2. To determine if there is a spatial relationship among successful or failed treatments

Photo: John Gibbs, forestryimages.org

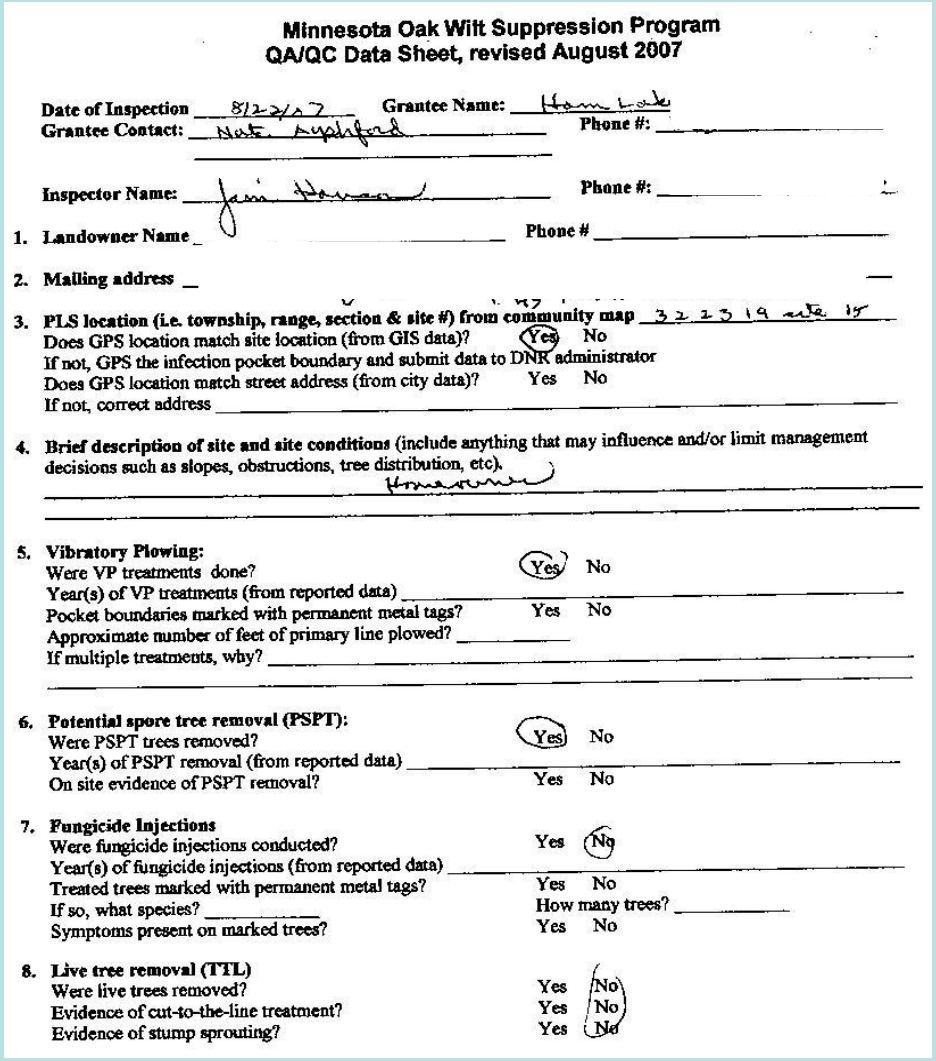
Methods: Data Collection

- Quality assurance / quality control checks
  - Minnesota DNR's ReLeaf program
  - returned to infection centers and checked efficacy of oak wilt treatments
  - in 2005-06 and 2007 checked infection centers treated in 2002-03 and 2004, respectively

Quiram et al. 2010, *under internal review*

Methods: Data Collection

- 2005-06 checks
  - Nov 2005 – May 2006
  - 98 infection centers
- 2007 checks
  - Aug – Sep 2007
  - 129 infection centers



Minnesota Oak Wilt Suppression Program
QA/QC Data Sheet, revised August 2007

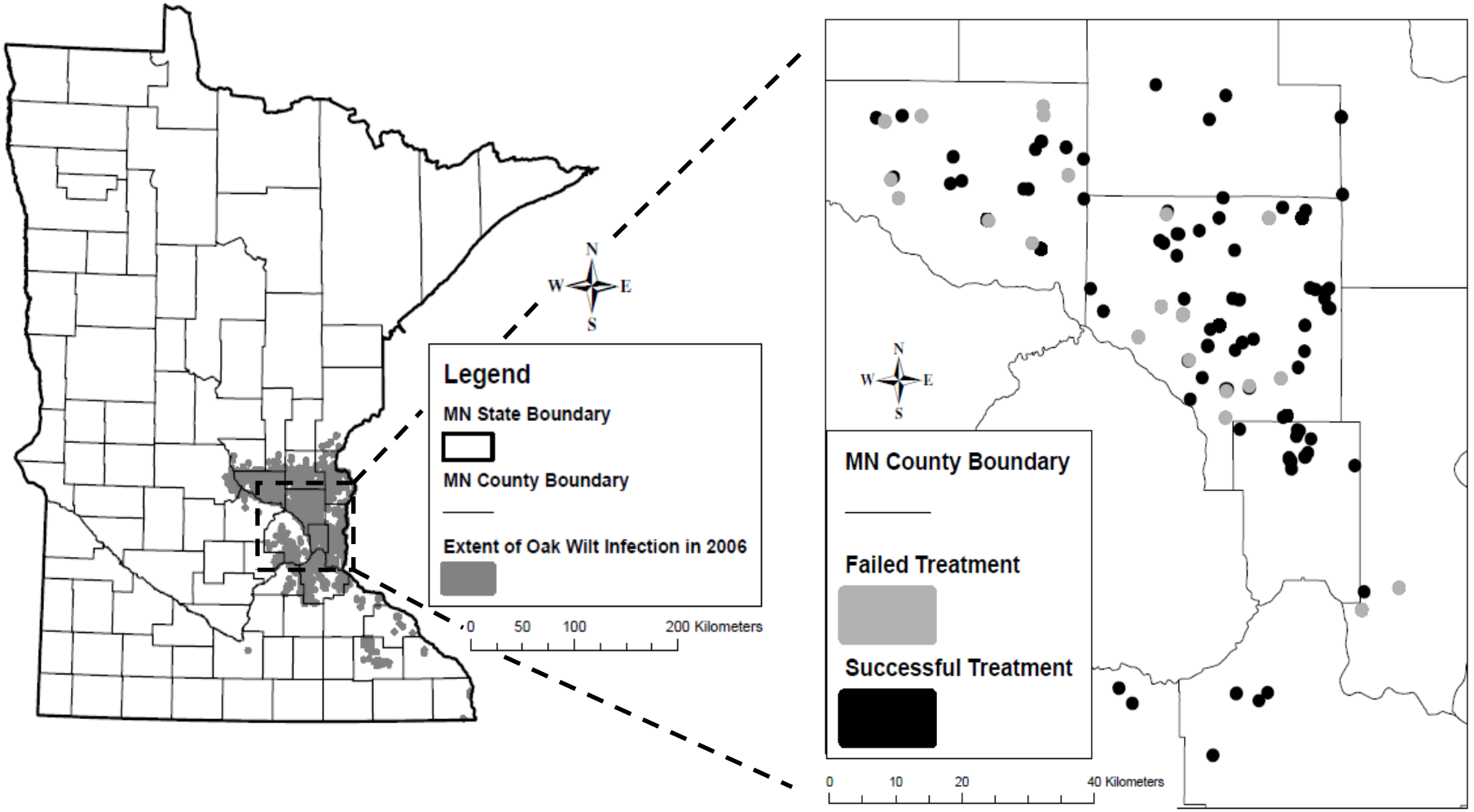
Date of Inspection 8/22/07 **Grantee Name:** Ham Lake
Grantee Contact: Nate Asphford **Phone #:**

Inspector Name: Jim Howard **Phone #:**

1. **Landowner Name** _ **Phone #**
2. **Mailing address** _
3. **PLS location (i.e. township, range, section & site #) from community map** 32 31 19 site 15
   Does GPS location match site location (from GIS data)? (Yes) No
   If not, GPS the infection pocket boundary and submit data to DNR administrator
   Does GPS location match street address (from city data)? Yes No
   If not, correct address
4. **Brief description of site and site conditions** (include anything that may influence and/or limit management decisions such as slopes, obstructions, tree distribution, etc).
   Homeowner
5. **Vibratory Plowing:**
   Were VP treatments done? (Yes) No
   Year(s) of VP treatments (from reported data)
   Pocket boundaries marked with permanent metal tags? Yes No
   Approximate number of feet of primary line plowed?
   If multiple treatments, why?
6. **Potential spore tree removal (PSPT):**
   Were PSPT trees removed? (Yes) No
   Year(s) of PSPT removal (from reported data)
   On site evidence of PSPT removal? Yes No
7. **Fungicide Injections**
   Were fungicide injections conducted? Yes (No)
   Year(s) of fungicide injections (from reported data)
   Treated trees marked with permanent metal tags? Yes No
   If so, what species? How many trees?
   Symptoms present on marked trees? Yes No
8. **Live tree removal (TTL)**
   Were live trees removed? Yes (No)
   Evidence of cut-to-the-line treatment? Yes (No)
   Evidence of stump sprouting? Yes (No)

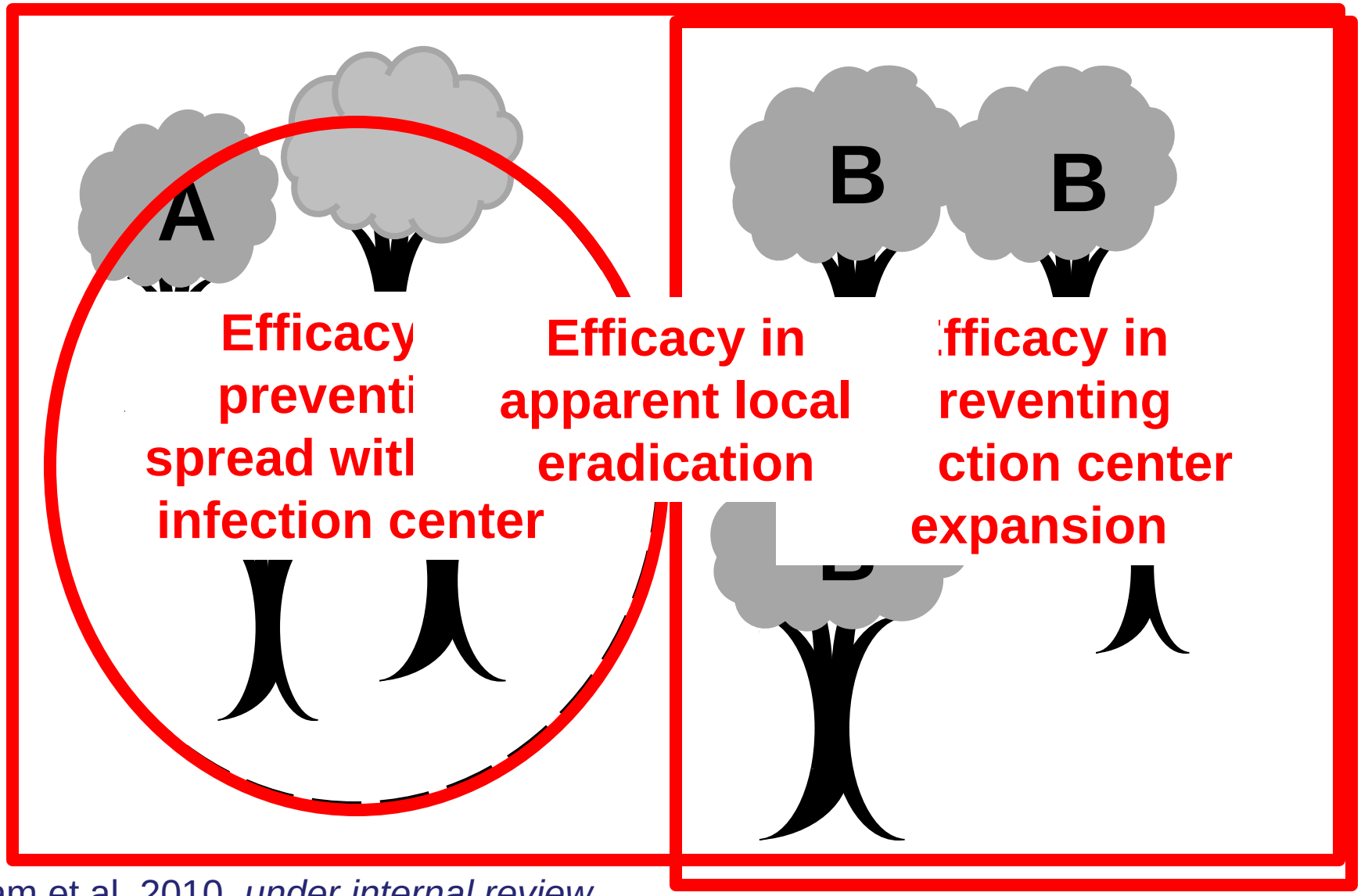
Quiram et al. 2010, *under internal review*

Methods: Study Area



Quiram et al. 2010, *under internal review*

Methods: Defining ‘Efficacy’



Quiram et al. 2010, *under internal review*

Methods: Analysis

- Logistic regression
  - analyzed 2005-06 and 2007 data separately
  - $n \geq 10$ for inclusion
  - Proc Logistic (SAS© 9.2)
- Spatial analysis
  - only 2007 data linked to GIS database
  - spatial relationships among successful or failed treatments
  - High/Low clustering analysis tool using the G statistic (ESRI®ArcMap™9.3)

Quiram et al. 2010, *under internal review*

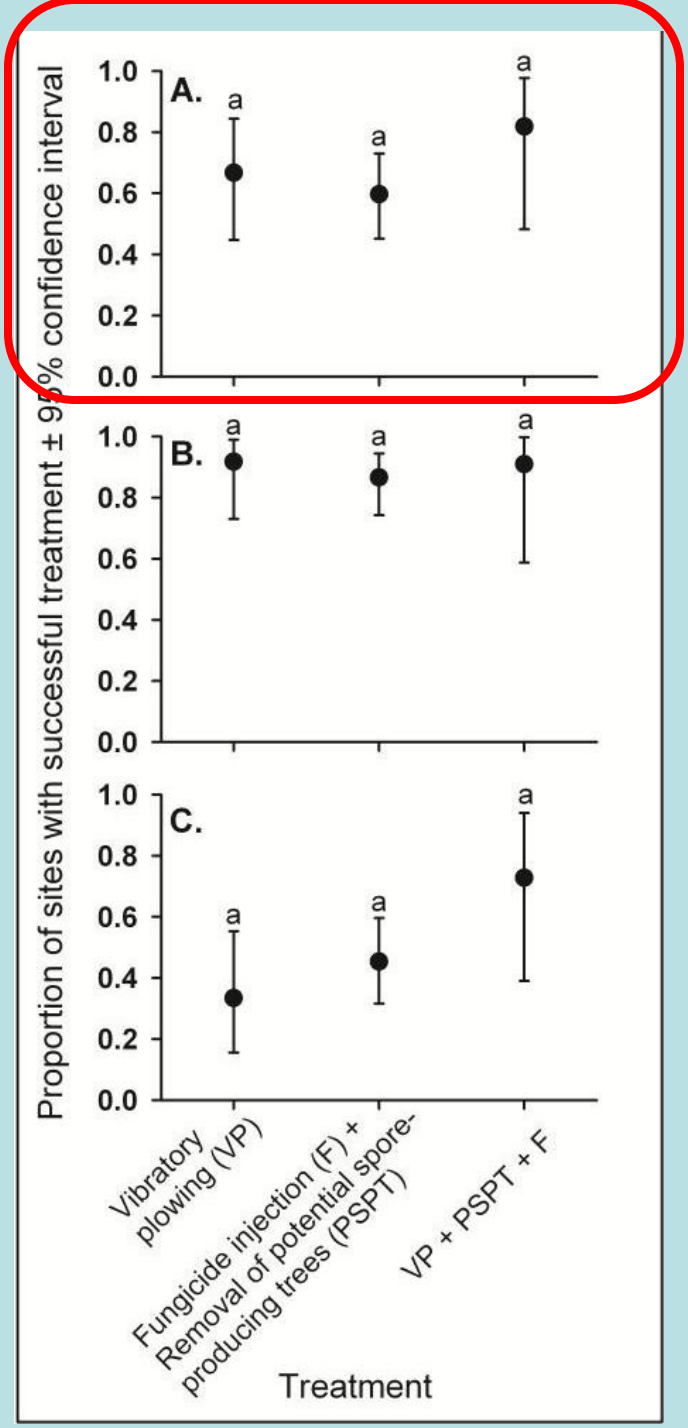
Methods: Analysis

- Treatments included in logistic regression:
  - 2005-06 Checks:
    - VP (*n* = 24)
    - fungicide injection + PSPT removal (*n* = 53)
    - VP + PSPT removal + fungicide injection (*n* = 11)
  - 2007 Checks:
    - PSPT removal (*n* = 13)
    - VP + PSPT removal (*n* = 84)
    - VP + PSPT removal + fungicide injection (*n* = 21)

Quiram et al. 2010, *under internal review*

Results: 2005-06 Checks

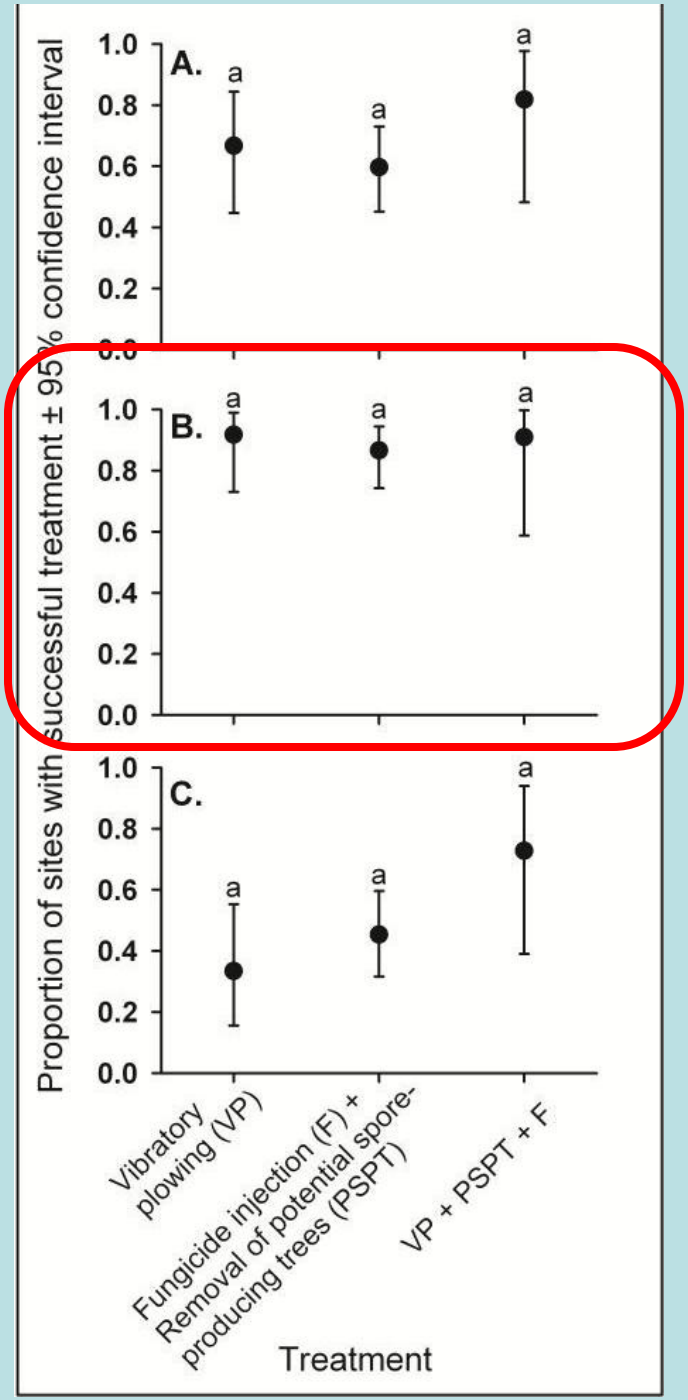
- Efficacy in preventing spread within an infection center
  - No significant treatment effects
  - In 2005: 76% of treatments successful
  - In 2006: 62% of treatments successful



Quiram et al. 2010, *under internal review*

Results: 2005-06 Checks

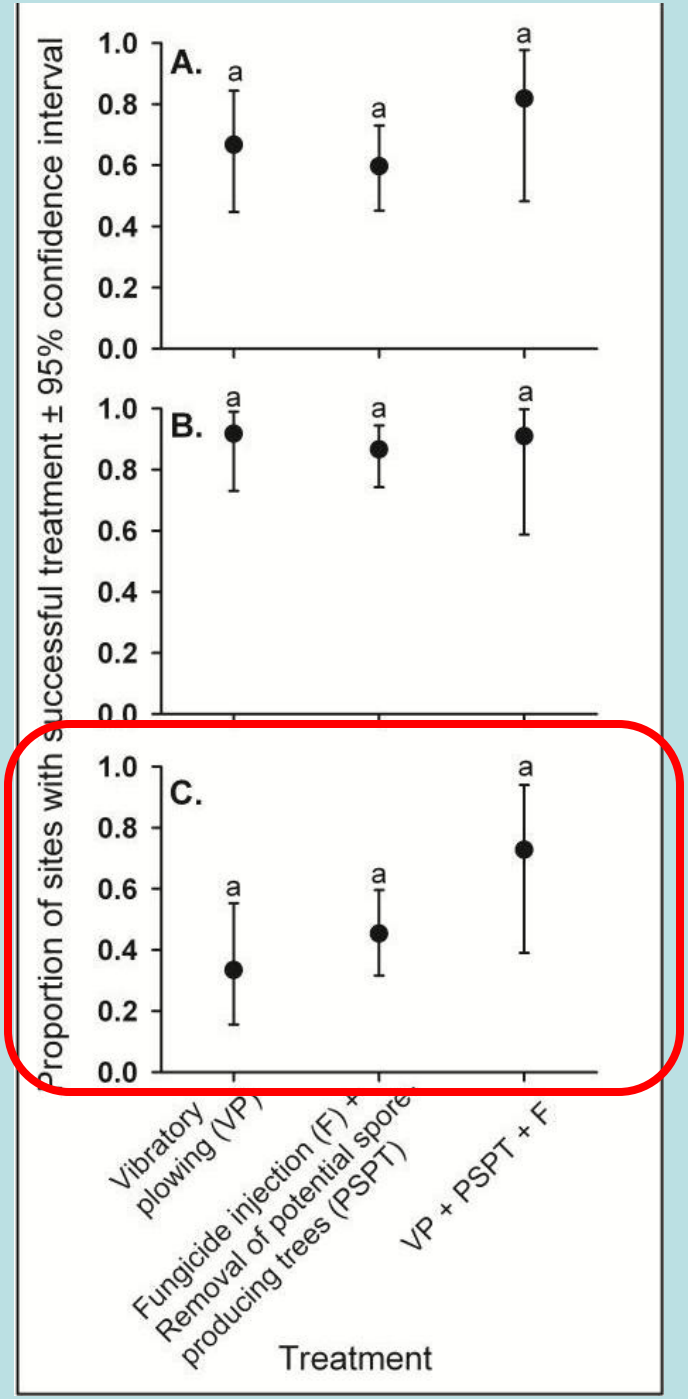
- Efficacy in preventing infection center expansion
  - No significant treatment effects
  - In 2005: 91% of treatments successful
  - In 2006: 91% of treatments successful



Quiram et al. 2010, *under internal review*

Results: 2005-06 Checks

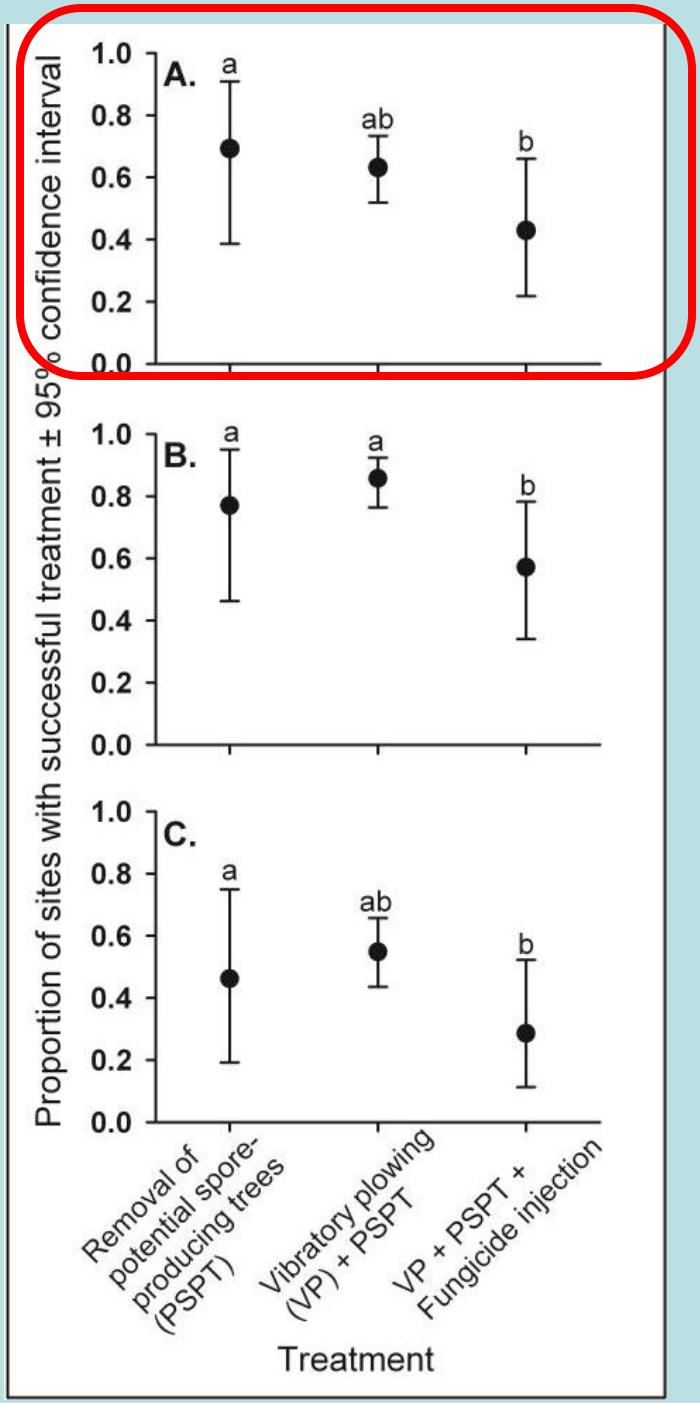
- Efficacy in apparent local eradication
  - No significant treatment effects
  - In 2005: 48% of treatments successful
  - In 2006: 48% of treatments successful



Quiram et al. 2010, *under internal review*

Results: 2007 Checks

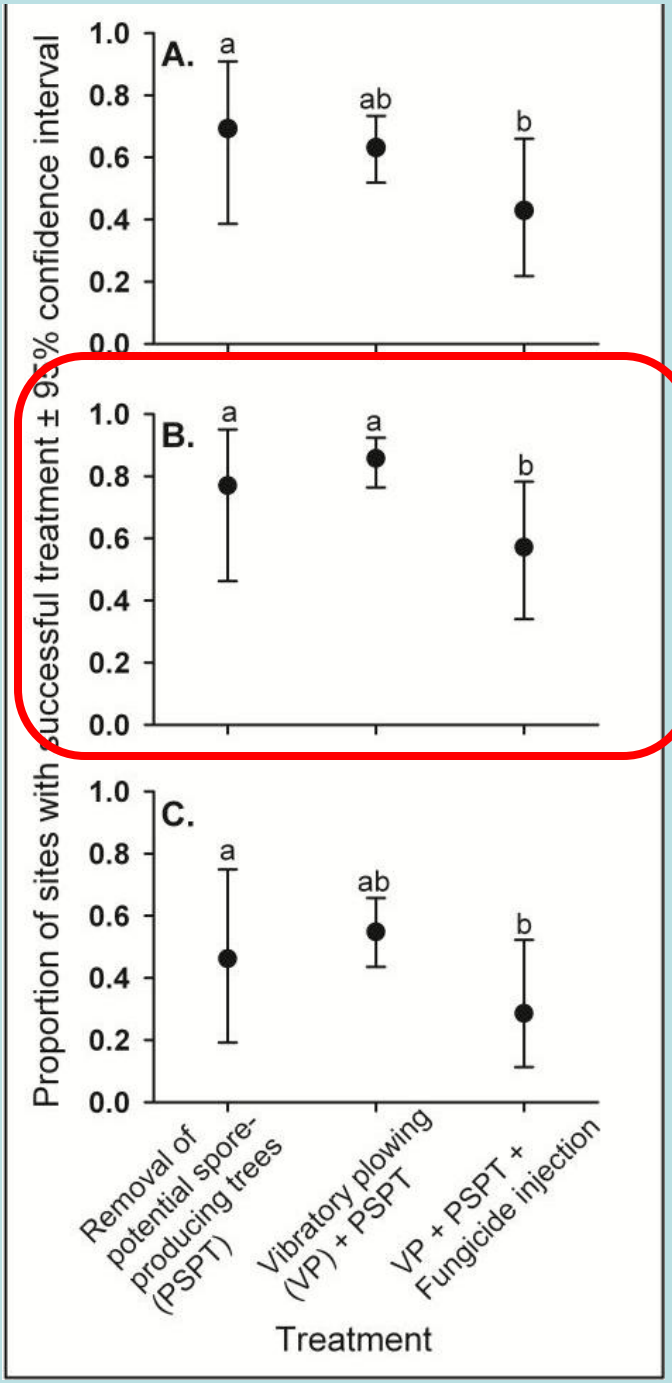
- Efficacy in preventing spread within an infection center
  - Probability of success higher for PSPT removal than VP + PSPT removal + fungicide injection (χ^2=4.45; *P*=0.0350)



Quiram et al. 2010, *under internal review*

Results: 2007 Checks

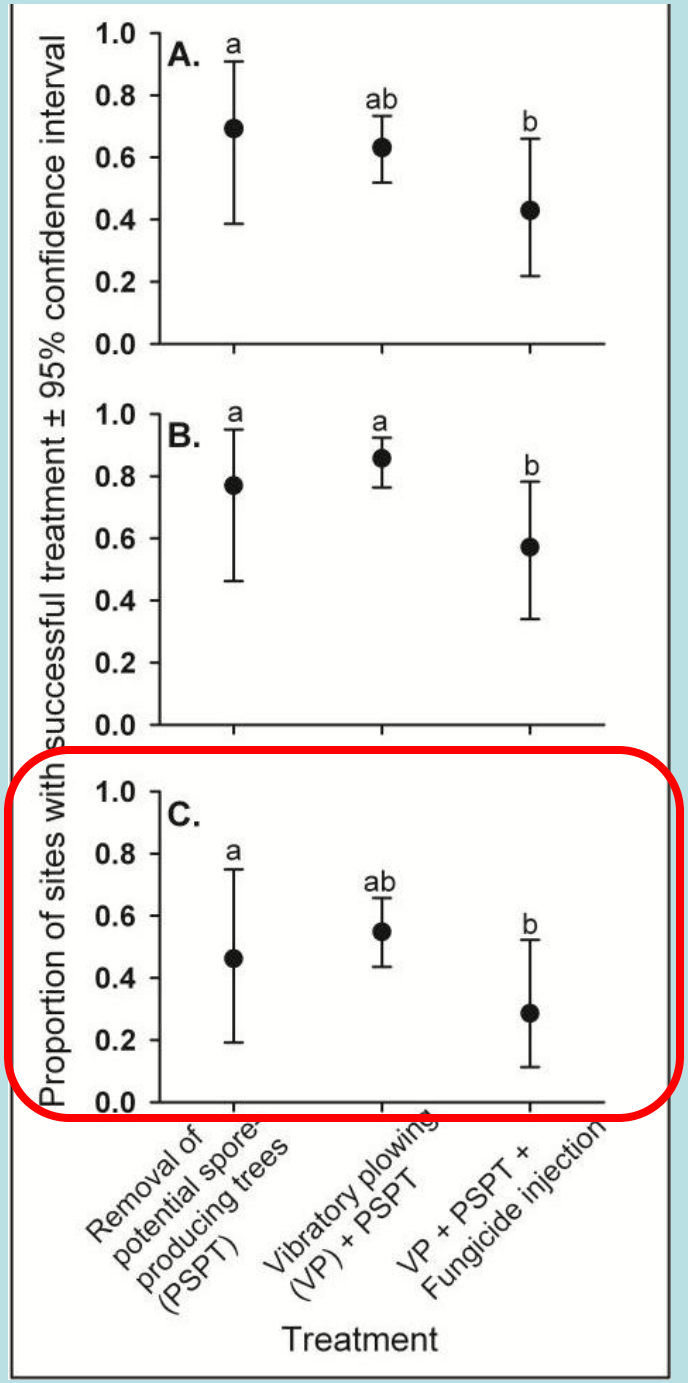
- Efficacy in preventing infection center expansion
  - Probability of success lower for VP + PSPT removal + fungicide injection than PSPT removal alone (χ^2=7.28; *P*=0.0070) and VP + PSPT removal (χ^2=6.22; *P*=0.0126)



Quiram et al. 2010, *under internal review*

Results: 2007 Checks

- Efficacy in apparent local eradication
  - Probability of success higher for PSPT removal alone than VP + PSPT removal + fungicide injection (χ^2=4.10; *P*=0.0430)



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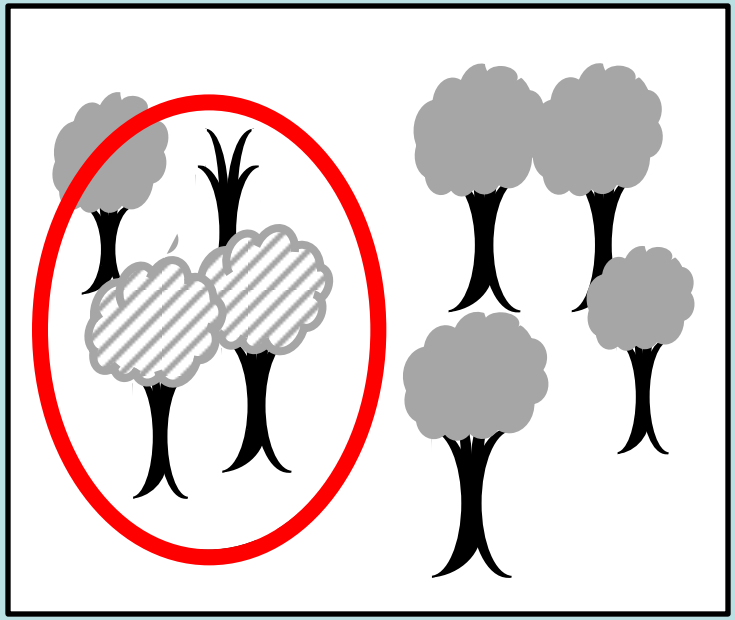
Conclusions

- Adding fungicide to management program may increase the probability of treatment failure
  - using fungicides = less aggressive treatment
    - applications to trees which should have been removed
  - fungicides relatively ineffective at:
    - preventing belowground spread
    - preventing symptom progression in red oaks

Blaedow 2009; Ward et al. 2005

Results: Spatial Analysis

- Efficacy within infection center
  - 45 of 109 experienced treatment failure
  - no significant clustering



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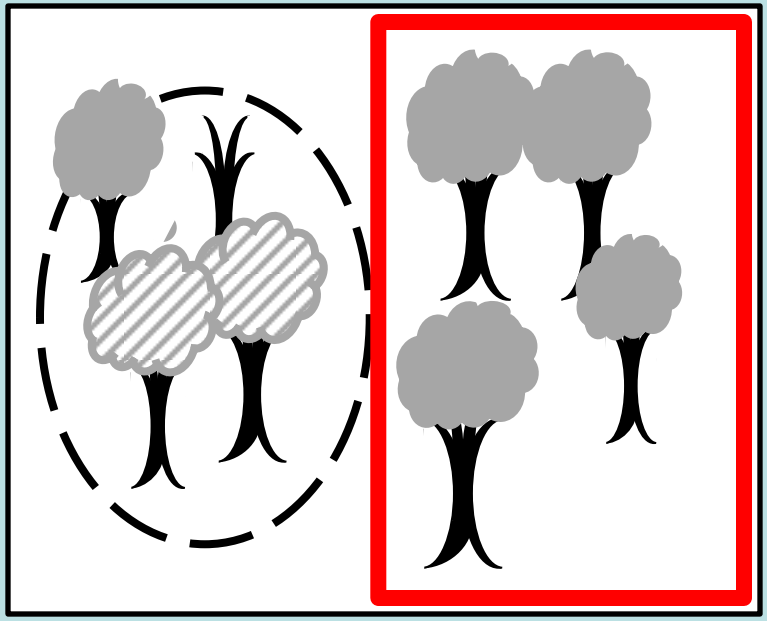
Results: Spatial Analysis

- Efficacy in preventing expansion
  - 24 of 109 experienced treatment failure
  - significant clustering of failures
    - inverse distance weighting matrix



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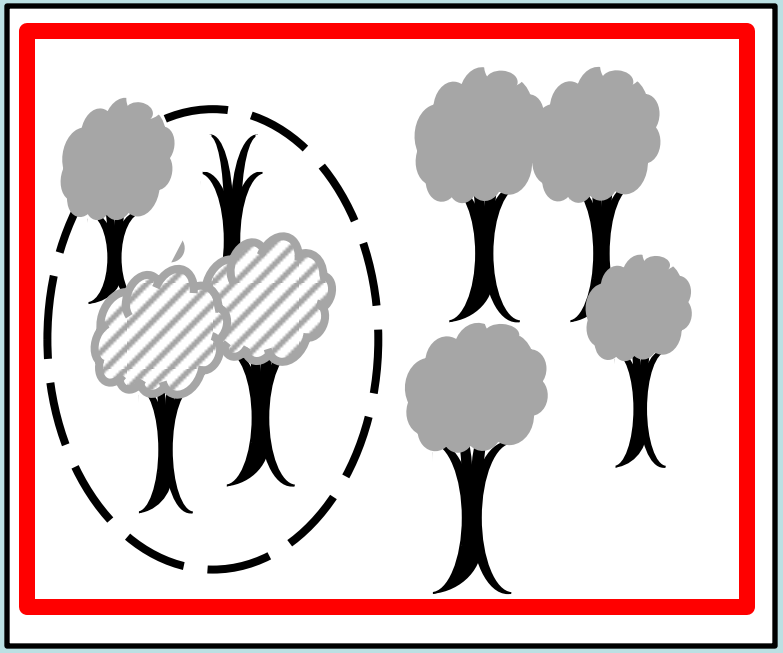
Results: Spatial Analysis

- Efficacy in apparent local eradication
  - 55 of 109 experienced treatment failure
  - significant clustering of successful treatments within 14 km



Quiram et al. 2010, *under internal review*

Conclusions

- Spatial location of infection centers may be related to treatment success and/or failure
  - clustering of treatments failing to prevent infection center expansion
    - abiotic factors?
  - clustering of treatments successfully achieving apparent local eradication
    - differences in local management efforts?

Implications

- Management success can vary with:
  - treatment type
  - location
    - social characteristics
    - environmental features

Photo: Joseph O'Brien, forestryimages.org

Implications

- Treatment choice should consider:
  - abiotic conditions
  - landowner goals and values
  - resources available

Photo: Joseph O'Brien, forestryimages.org

Recommendations?

- Management of oak wilt is a complex problem
  - no single right answer: management programs must be tailored to local conditions
  - should address aboveground and belowground spread

Photo: Joseph O'Brien, forestryimages.org

Acknowledgements

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