Fungicide Sensitivity in *Phymatotrichopsis omnivora*, causal agent of cotton root rot

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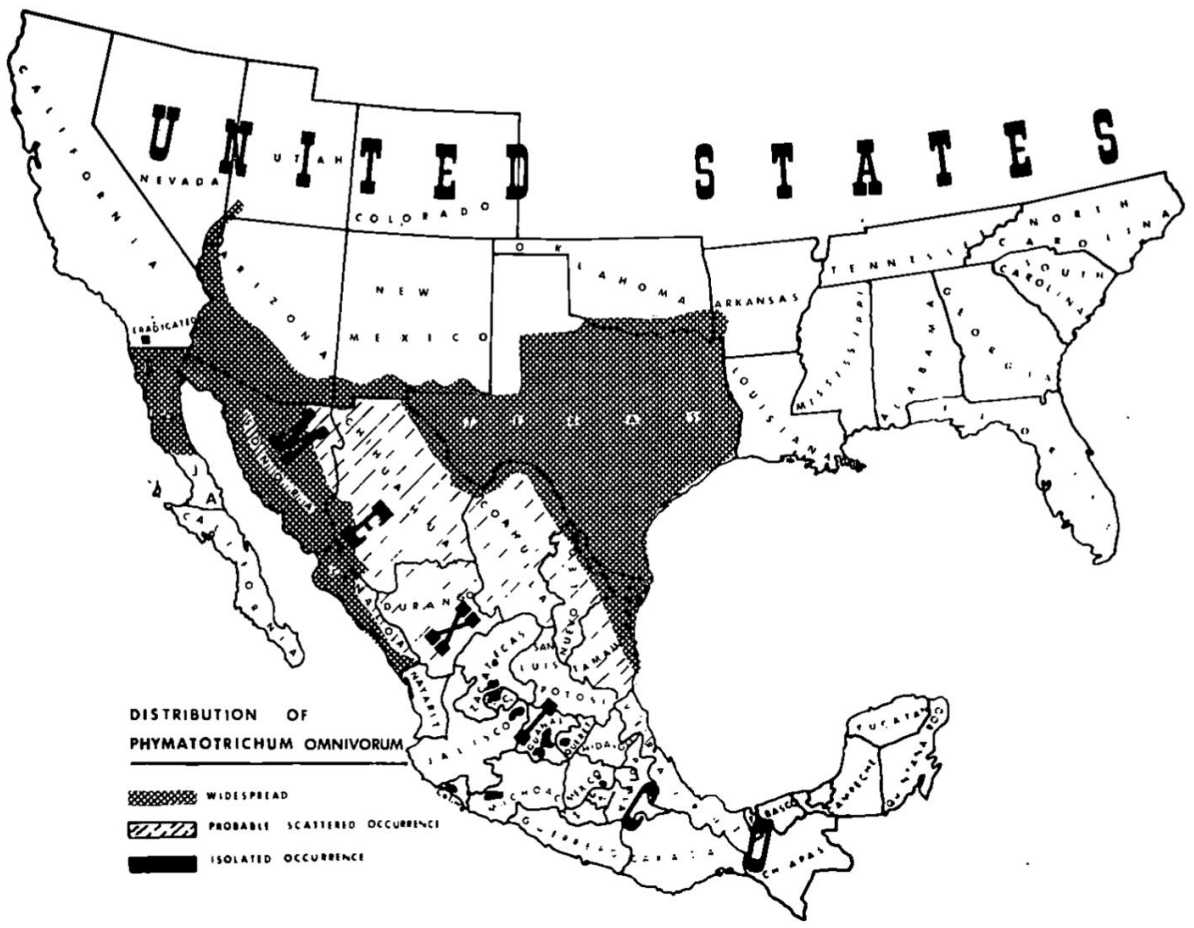
Introduction

Cotton root rot (CRR) is caused by the soilborne fungal plant pathogen *Phymatotrichopsis omnivora*

Present in the American southwest due to optimal soil conditions – alkaline, calcareous, and rarely freeze deeply

P. omnivora can infect over 1800 species of dicots including cotton, pecan trees, winegrape, and alfalfa

Pathogen first coupled with disease in 1888

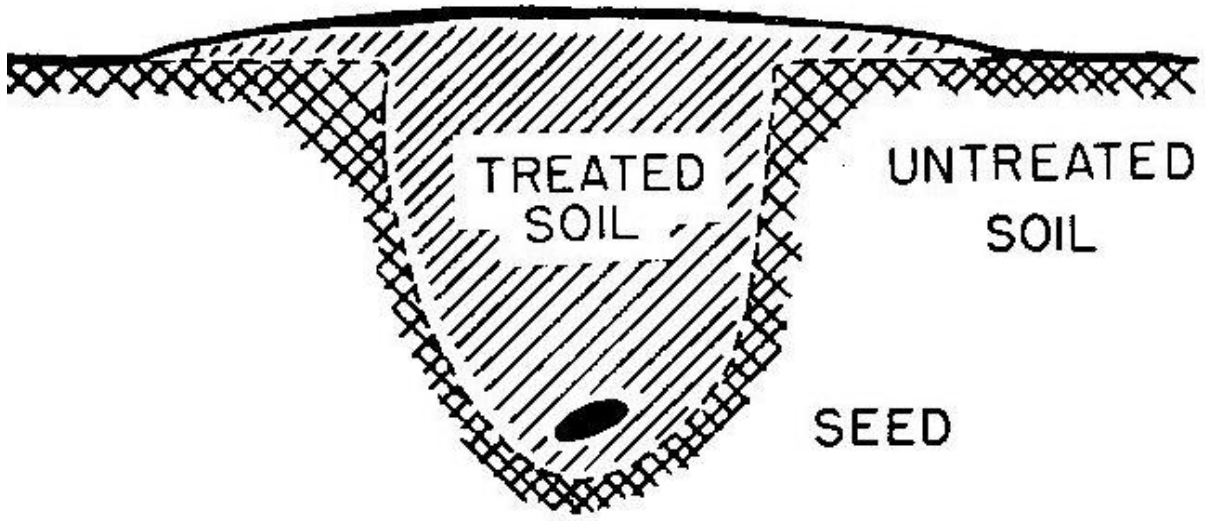


Streets (1973)

CRR in the Field

Control

- The disease can cause up to $29 million in losses annually in the TX cotton crop
  - The current standard for control is a flutriafol fungicide application at planting, either as a Topguard Terra or Xyway LFR formulation



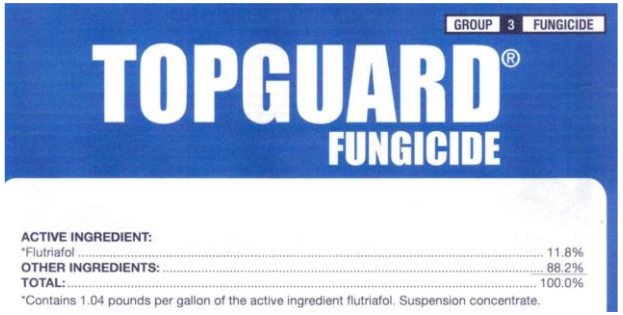
Control

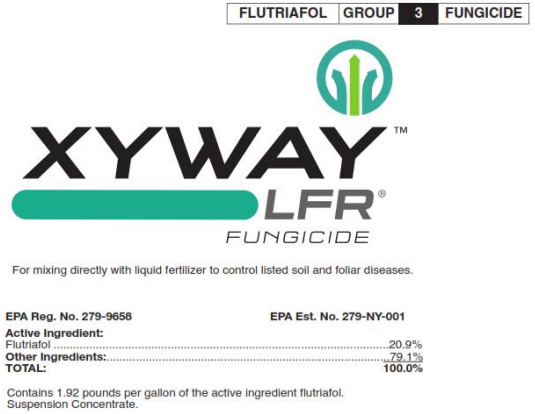
- Application methods
  - At planting: in-furrow or T-banded
  - Through drip tape under the row
  - Pre-plant, up to 30 days
  - 3 – 4” band behind the press wheel
  - Over the top on 1 – 2 leaf cotton
  - Directed spray on 2 – 4 leaf cotton

Slide credit: T. Isakeit

Control

- Flutriafol update
  - Topguard 1.04 lbs ai/gal
    - Apply 16 – 32 fluid oz/acre
    - Foliar only
  - Topguard Terra 4.17 lbs ai/gal
    - Apply 4 – 8 fluid oz/acre
  - Xyway LFR 1.92 lbs ai/gal
    - Apply 8.7 – 17.3 fluid oz/acre
  - Regardless of product, 0.13 – 0.26 lb ai (flutriafol) / acre





Slide credit: T. Isakeit

Control – Pre-plant

Pre-plant application in Thrall, TX (2016)

Modified in-furrow treatment

Pre-plant application (2014)

2” deep, 0.26 lb ai/acre (8 oz), 31 days pre-plant

Control – Post-plant

Post-plant application in Thrall, TX (2016)

July 15th lower stem spray treatment

Slide credit: T. Isakeit

Control

Side dressing did not work in many experiments

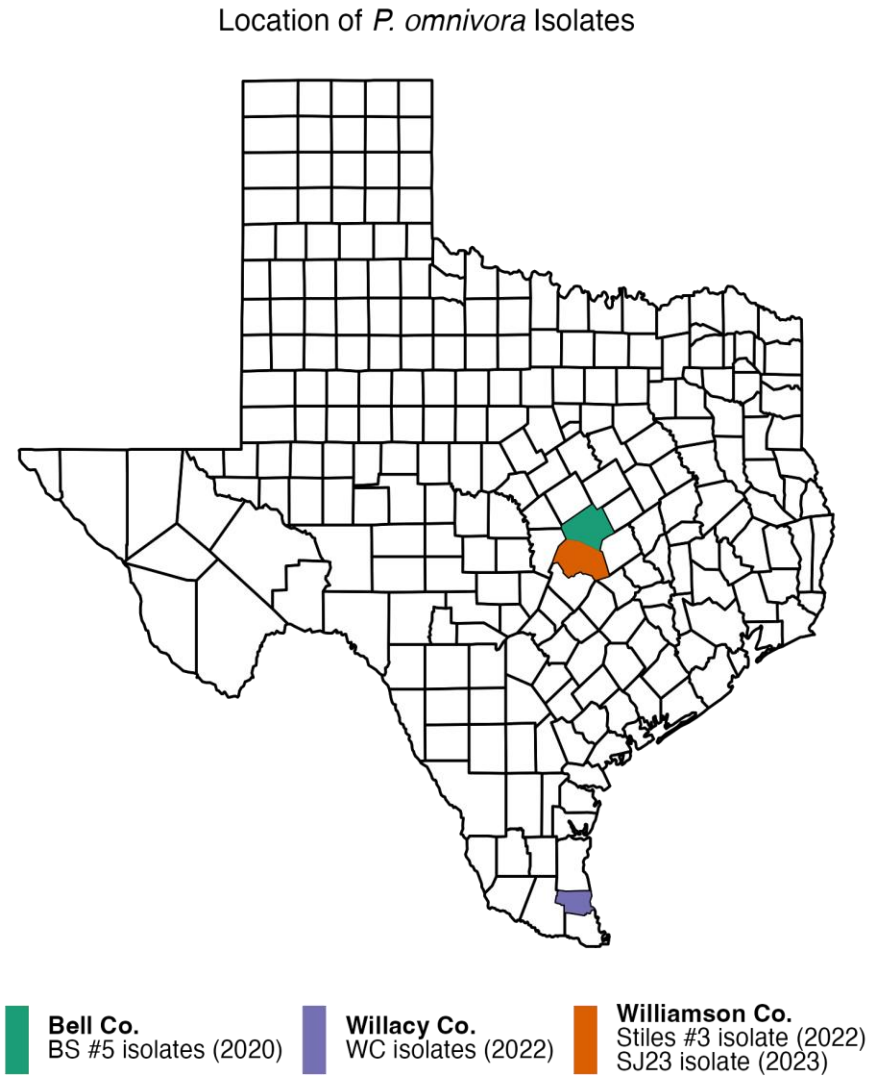
The chemical needs to be very near the seed or stem

Rational & Objective

- Topguard Terra has been used for about a decade to control CRR, but a "baseline" sensitivity in *P. omnivora* populations was never established.
  - Additionally, there have been recent reports of reduced efficacy of flutriafol products in controlling CRR.
  - Is there resistance to flutriafol in Texas *P. omnivora* populations?
- Do isolates of *P. omnivora* from geographically diverse regions of Texas, have different sensitivities to fungicides?
- **The objective of this study** was to assess fungicide sensitivity of several *P. omnivora* isolates by measuring growth on agar media.

Materials & Methods: Agar Assay

- Topguard Terra (flutriafol) and Provysol (mefentrifluconazole): 0.001 – 10 parts per million (ppm), demethylation inhibitors (DMI) mode of action (MOA)
- Fontelis (penthiopyrad): 0.01 – 100 ppm, succinate dehydrogenase inhibitor (SDHI) MOA
- For all technical grade fungicides, the concentrations were $1x10^{-6}$ – 0.1 ppm.
- 11 *P. omnivora* isolates
- Radial growth measured daily for 5 days
- Effective concentration to 50% growth inhibition (EC_{50}) model:
  - Three-parameter log-logistic (LL.3 in R package “drc”)



Results – EC_{50} Estimation

Table 1. Average EC_{50} values of trade and technical grade fungicides used in this study

Fungicide	Average EC50	Standard Error	Maximum	Minimum	N [a]	Sig. Groups [b]
Topguard Terra	6.13E-04	3.67E-04	9.80E-04	2.46E-04	386	A
Flutriafol	9.45E-04	2.07E-04	1.15E-03	7.37E-04	198	B
Provysol	1.18E-03	2.35E-04	1.42E-03	9.49E-04	387	AB
Mefentrifluconazole	7.14E-04	1.79E-04	8.93E-04	5.35E-04	198	AB
Fontelis	0.26	0.11	0.37	0.15	395	C
Penthiopyrad	9.44E-03	3.34E-03	0.013	5.60E-03	198	AB

[a] Number of data points represented in the average EC_{50} for a fungicide across all concentrations and *P. omnivora* isolates.

[b] Fungicides with the same letter are not significantly different from one another.

Results – EC_{50} Estimation

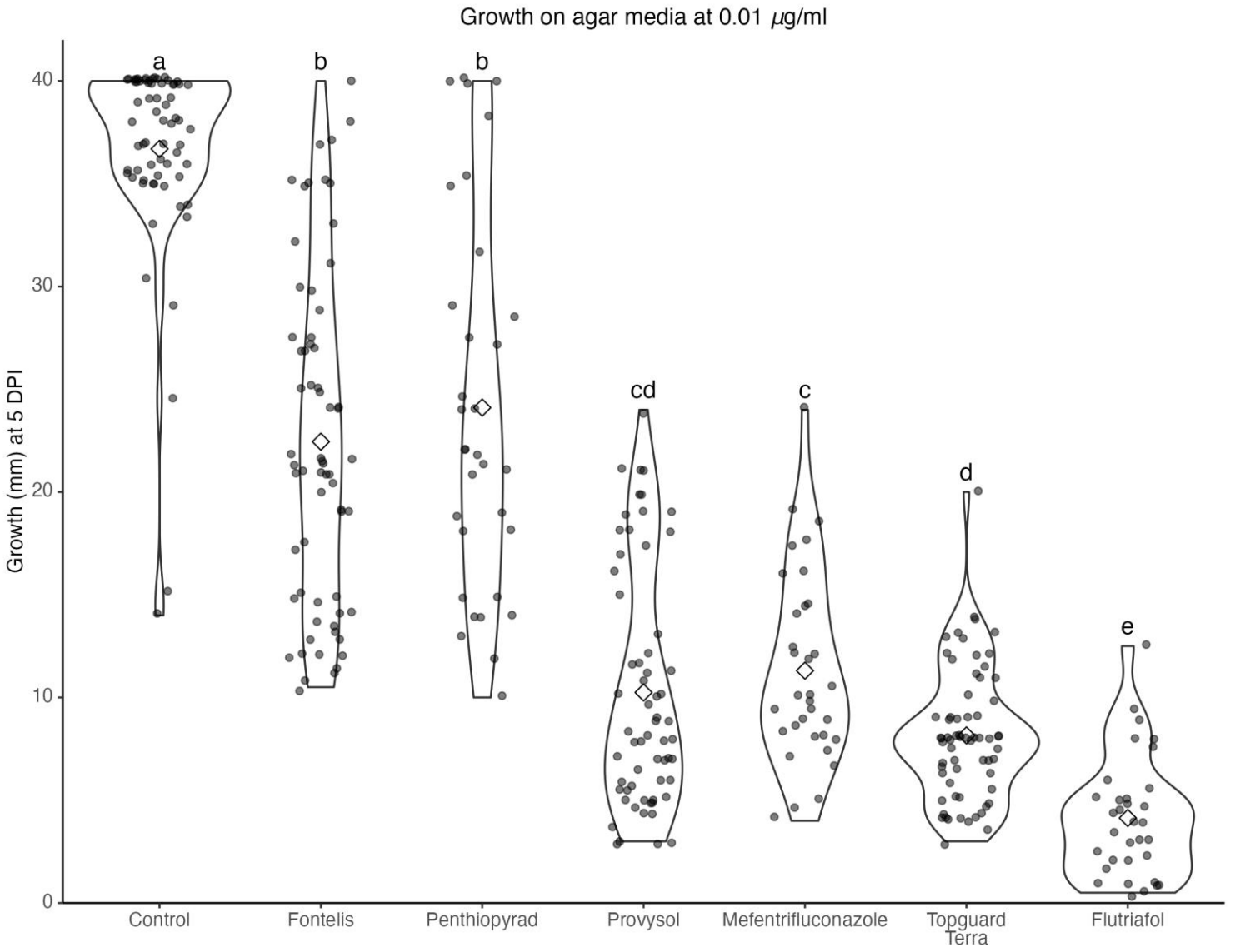
Table 2. EC_{50} comparison between locations where isolates were collected for this study.

Location	Average EC50	Standard Error	Maximum	Minimum	N [a]	Sig. Groups [b]
Bell Co.	0.084	0.055	0.14	0.028	24	B
Willacy Co.	0.02	8.80E-03	0.029	0.012	30	A
Williamson Co.	0.034	0.033	0.067	1.31E-03	12	B

[a] N = (number of isolates from a location) x (6 fungicides treatments).

[b] Locations with the same letter are not significantly different from one another.

Results


Growth on agar media at 0.01 μg/ml
Growth (mm) at 5 DPI
0
10
20
30
40
a
b
b
cd
c
d
e
Control
Fontelis
Penthiopyrad
Provysol
Mefentrifluconazole
Topguard Terra
Flutriafol

Conclusions & Future Directions

- Isolates of *P. omnivora*, from geographically diverse cotton-growing regions of Texas, exhibit different sensitives to fungicides, however, ***P. omnivora* is broadly sensitive to fungicides**.
- Currently, there is no evidence of resistance build-up in *P. omnivora* populations.
- Future work should include the collection and testing of more *P. omnivora* isolates to monitor sensitivity because resistance to flutriafol has been documented in other pathogens.
- Non-labeled fungicides for CRR control need field testing.
- Agar assay work published as:
  - Sturdivant, M. and Isakeit, T. 2025. Fungicide sensitivity in *Phymatotrichopsis omnivora*, causal agent of cotton root rot. Plant Health Progress. https://doi.org/10.1094/PHP-11-24-0108-RS

Thank you!

Committee:

- Dr. Thomas Isakeit (chair)
- Dr. Thomas Chappell
- Dr. Sanjay Antony-Babu
- Dr. Elizabeth Pierson

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Questions?