Fungicides for FHB Management: Past, Present, and Future

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Fungicides Important Tool in Integrated Management of FHB

- For fungicides to be effective, we need:
  - Safe products with fairly short PHIs
  - High efficacy in reducing FHB and DON
  - Optimum rates and timing of application
  - Optimum application techniques
  - Reasonably priced products

Fungicides for Control of FHB – A Review

- Roy Wilcoxson, Minnesota Agri. Exp. Stat. Paper # 22,507. 1996.
  - Reviewed international literature: 1977-1995
    - 41 citations
    - 21 different fungicides evaluated for FHB control, alone or in combinations
    - "Most showed potential for reducing disease incidence and severity, but results varied greatly from test to test"
    - "Reduction of mycotoxins was very inconsistent "

Examples of Fungicides Tested 1977-1995

- Benzimidazoles: Benomyl, carbendazim, thiophanate methyl, thiabendazole
- Multi-site activity: Mancozeb, chlorothalonil
- Triazoles: Triademnol, triadimefon, bromuconazole, flusilazole, fenbuconaozle, propiconazole, tebuconazole
- Carboximides: Prochloraz

1st Published US Fungicide Test

- Barry Jacobson, 1977, Phytopath. 67:1412-1414
  - Tested:
    - Benomyl,
    - Benomyl + mancozeb,
    - MBC (methyl benzimadazole carbamate)
  - Winter wheat at the Univ. of Illinois
  - Applied 2x
  - 70% reduction in FHB with benomyl or MBC
  - 50% reduction with benomyl + mancozeb

Use of Benomyl, Mancozebs

- Benomyl (Benlate): alone wasn't effective against leaf diseases; added mancozebs
- Benlate: WP, a mess to mix and apply
- Epidemics of 1990s: only registered products available that could be applied at flowering
- Expensive: relative to wheat price at time and generally had to be applied 2x
- Discontent with their use: sparked multi-state effort to evaluate fungicides

Timetable 1988-1996

- 1988: First US registration of a foliar triazole with some activity against FHB:
  - propiconaozle (Tilt), only to flag leaf emergence
- '94-'97: Multi-state projects to identify most effective fungicides
- 1995: ND, SD, MN request Sec. 18 for Tilt to be applied at flowering; denied
- 1996: Europeans identify tebuconazole (Folicur) as one of more effective products (Suty and Mauler-Machnik)

Timetable 1997-2001

- 1997: First National Fusarium Head Blight Forum, St. Paul, MN. Fungicide Technology Network formed
- 1997: ND, MN, SD request Sec. 18 for Folicur fungicide; denied (Crisis declared)
- '98-'00: USWBSI Uniform trials: 5-9 trts evaluated; 5 wheat classes, 7 -15 states
- 2000: Strobilurins registered in US
- 2001: Benlate discontinued by DuPont

Timetable 2002-2003

- ‘02-’03: More new chemistries, rates, timings, added to USWBSI uniform trials

  Some eliminated:

  - poor efficacy
  - tendency to increase DON
  - or termination by crop protection industry

- 2003: Uniform trial results with Folicur from 1998-2003: average reduction of FHB index = 39.4%; DON reduction =27.4%

  – (D. Hershman and G. Milus, 2003 Nat. FHB Forum talk)

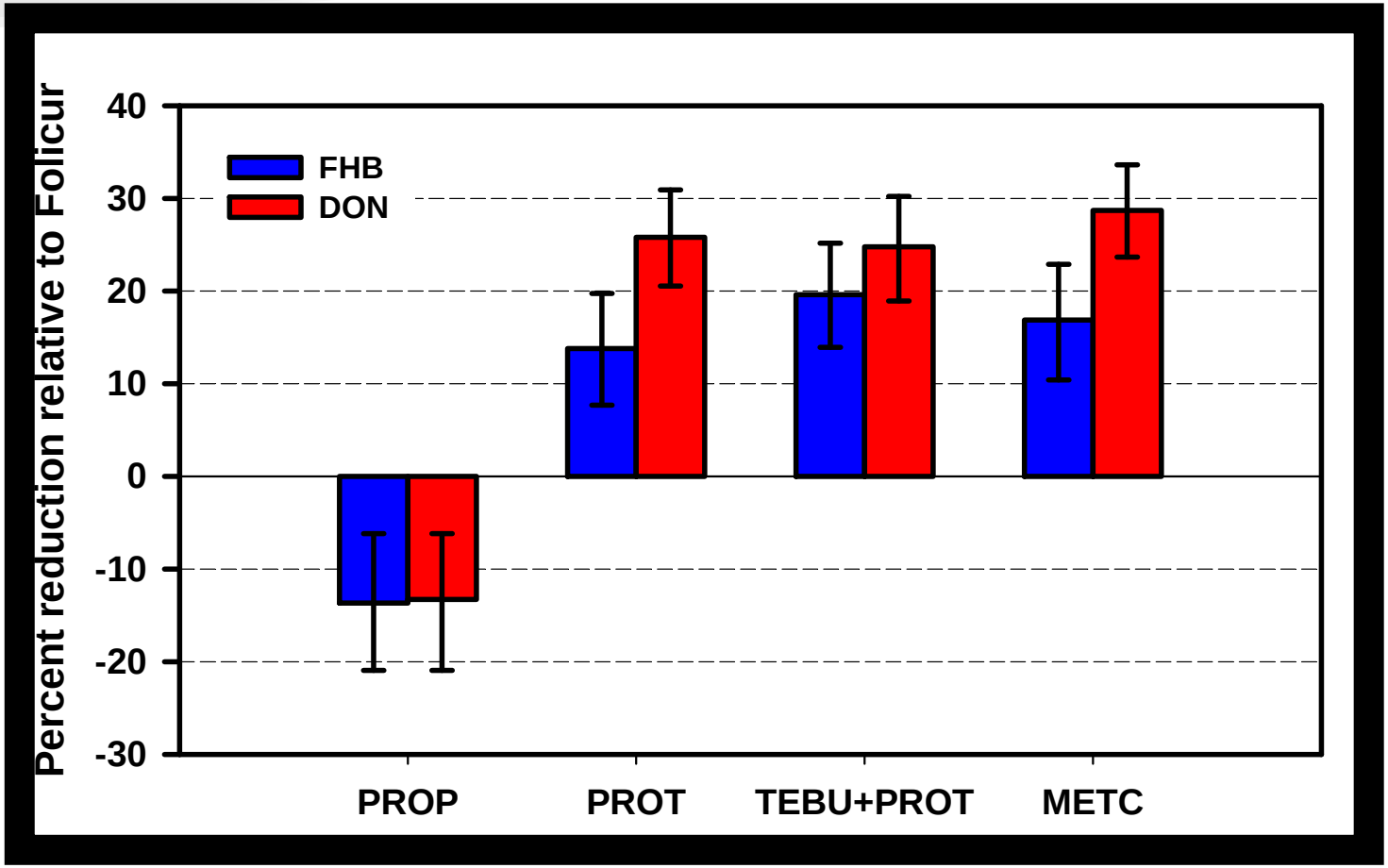
Folicur (tebuconazole)

- Sec. 18 emergency exemptions for FHB control in multiple states 1998-2007. Why?
  - No other fungicides registered that had comparable, consistent control
  - EPA wouldn't grant full registration because of a special review of triazole fungicides
- Mesterhazy, A. 2003: In Chapter titled "Control of FHB of Wheat by Fungicides" (*Fusarium Head Blight of Wheat and Barley,* APS Press, St. Paul, MN).
  - "We may conclude that at the present time we do not have fungicides to control FHB with a very high efficacy, as has been obtained for rust or powdery mildew. Among the active ingredients in the tested fungicides, tebuconazole was the best".

Where are we now?

- 2007
  - Proline (prothioconazole) was registered by the U.S. EPA for control of FHB and other wheat diseases
- 2008
  - Caramba (metconazole), Folicur (tebuconazole), and Prosaro (prothioconazole + tebuconazole) all registered on wheat

How do Proline, Prosaro, and Caramba stack up against Folicur?



Paul et al. *Phytopathology* 98:999-1011 (2008)

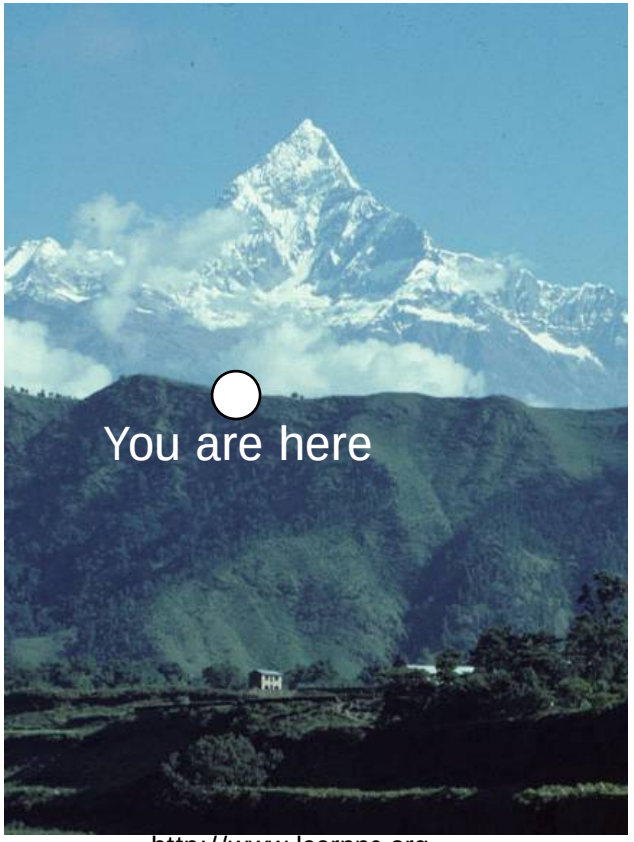
“The toolbox is full”

- For the first time ever, in 2009, wheat growers in many states will have access to multiple fungicides that are effective against Fusarium head blight

- Have we reached the peak of control yet?

Not quite there, yet

- Paul et al. (2008)
  - Prosaro = 52% reduction of FHB index and 42% reduction in DON relative to untreated control
  - Proline = 48% reduction of FHB index and 43% reduction in DON
  - Caramba = 50% reduction of FHB index and 45% reduction in DON



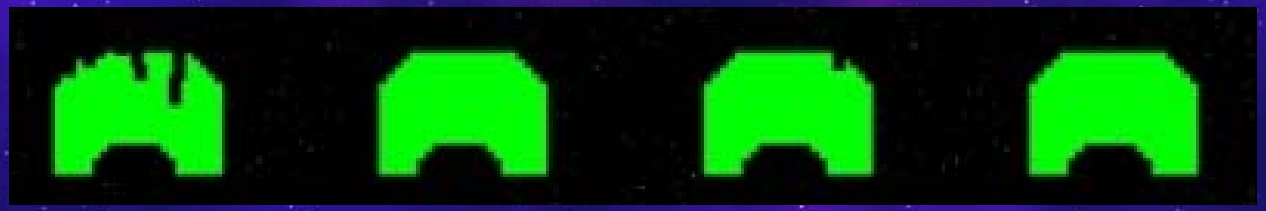
http://www.learnnc.org

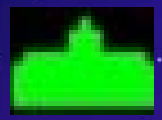
Paul et al. *Phytopathology* 99:999-1011 (2008)

What does the future hold for fungicide control of Fusarium head blight?

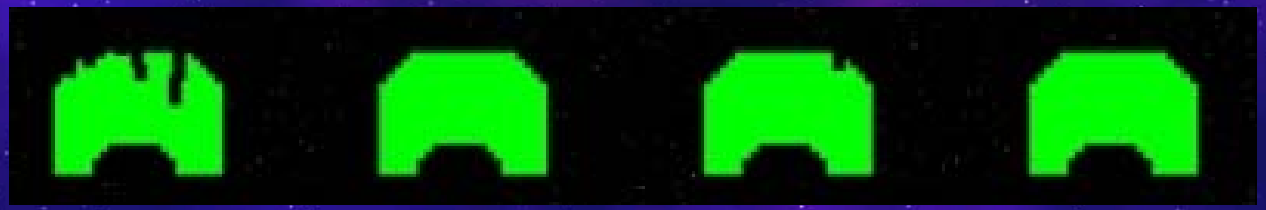
- How long will current fungicides be effective…….fungicide resistance?
- Will there be new, more effective fungicides available?

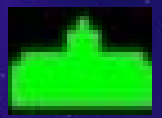
Folicur Prosaro Proline Caramba





Folicur Prosaro Proline Caramba





What is the risk of *F. graminearum* resistance to triazole fungicides?

- Fungicide Resistance Action Committee (FRAC) – classifies triazole fungicides as having a **medium risk** of fungi developing resistance to them

- Already several cases of phytopathogenic fungi with resistance to triazole fungicides

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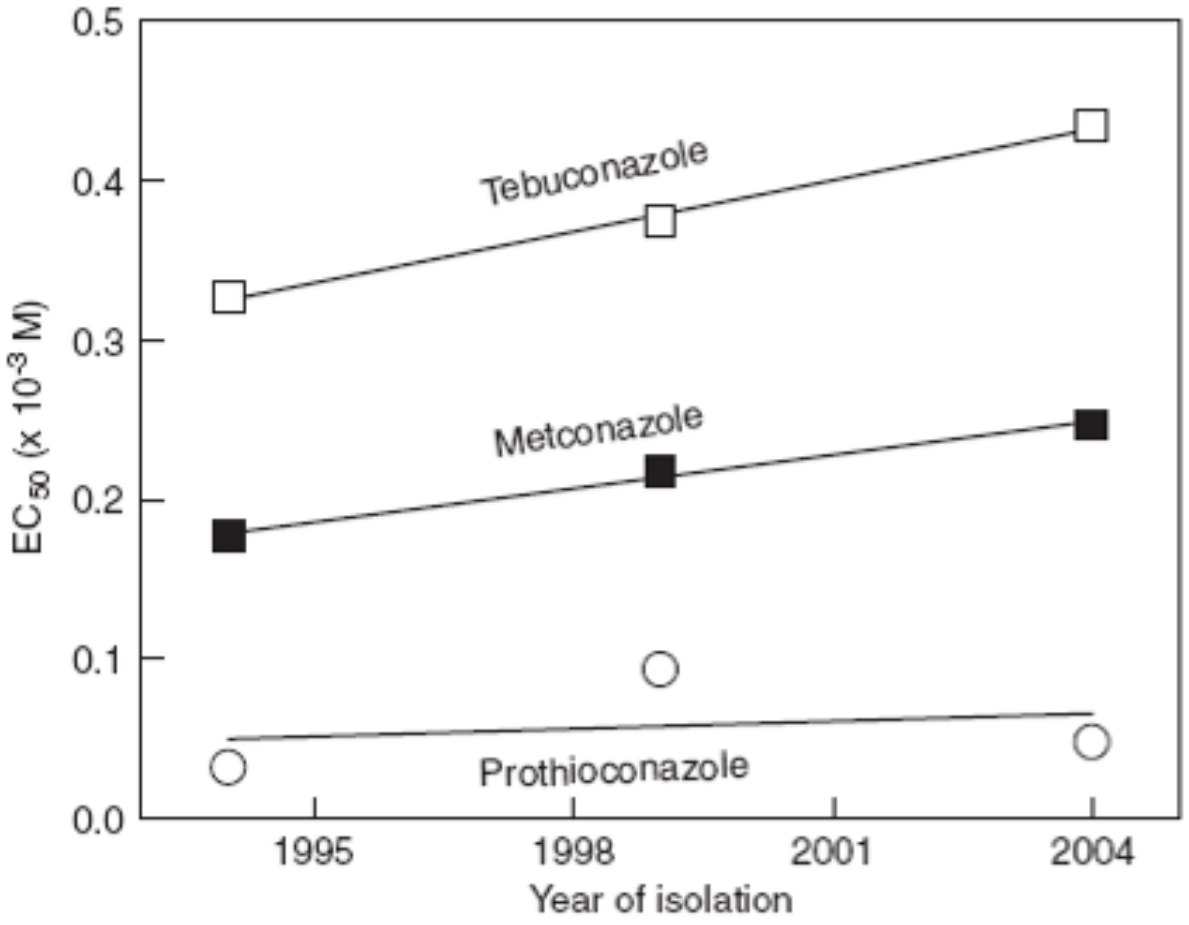

Fig. 4. Relationship between EC_{50} values and time expressed as years that fungal strains were isolated. EC_{50} values were obtained from the interpolations depicted in Fig. 3.

Klix et al. *Crop Protection* 26:683-690 (2007)

Will new chemistries be available?

- Li et al. (2008)
  - JS399-19 (2-cyano-3-amino-3-phenylancryic acetate)
  - Belongs to the cyanoacrylate fungicide group
  - In field and greenhouse tests in China, JS399-19 was more effective controlling FHB than carbendazim (an MBC-group fungicide)

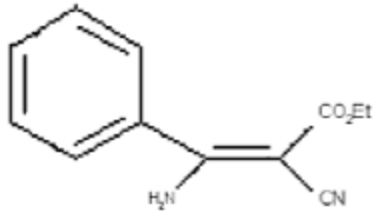

Fig. 1. Chemical structure of JS399-19.

Li et al. *Crop Protection* 27:90-95 (2008)

Will new chemistries be available?

- In 2008, a few “numbered” compounds were evaluated by a few university researchers
- Continued testing is important!

THE FUTURE: Not the time to be complacent

- Current fungicides still only providing ~50% reduction of FHB index and ~40% reduction in DON
- Potential erosion of triazole fungicide sensitivity
- New chemistries with improved efficacy and new modes of action are still needed

Questions?

U.S. Wheat & Barley Scab Initiative

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