

Overview of Azole Use in Agriculture

Wayne M. Jurick II, Ph.D.
Lead Scientist & Research Plant Pathologist
USDA-ARS, Food Quality Laboratory
Beltsville, MD 20705

ABOUT ME

- I. Ph.D. – University of Florida (2006)
- II. USDA-ARS (Agricultural Research Service) in house research arm of USDA
- III. Lead researcher on multiple projects dealing with Anti Microbial Resistance (AMR)

AZOLE INTRO

- I. Azoles aka SBI (Sterol Biosynthesis Inhibitors)
- II. Only fungicide class used in agriculture and medicine
- III. FRAC group 3 = medium risk
- IV. Greatest usage in EU and US

CROP PROTECTION

- I. Control fungal plant pathogens in the field, on seeds, and in stored fruit
- II. Azole resistance in agriculture = crop loss, reduced food quality, lower grower profits, increased chemical applications
- III. Specific examples:
 - a. tetraconazole: Cercospora leaf spot (sugar beet)
 - b. ipconazole: smut (barley)
 - c. difenoconazole: blue mold (apple and pear)



Blue mold – apple
(*Penicillium* spp.)



M.D. Bolton, USDA-ARS

Cercospora leaf spot –
sugar beet
(*Cercospora beticola*)



Forestyimages.org

5410690

Smut – barley
(*Ustilago hordei*)

Top left – apple from cold storage with blue mold caused by *Penicillium* spp.

Middle – barley in the field with smut caused by *Ustilago hordei*

Top right – sugar beet leaf with cercospora leaf spot caused by *Cercospora beticola*

APPLICATION TECHNOLOGY

- I. Preharvest (in the field) – air blast, backpack, airplane
- II. Postharvest (in storage) – drenches, line sprays, fog



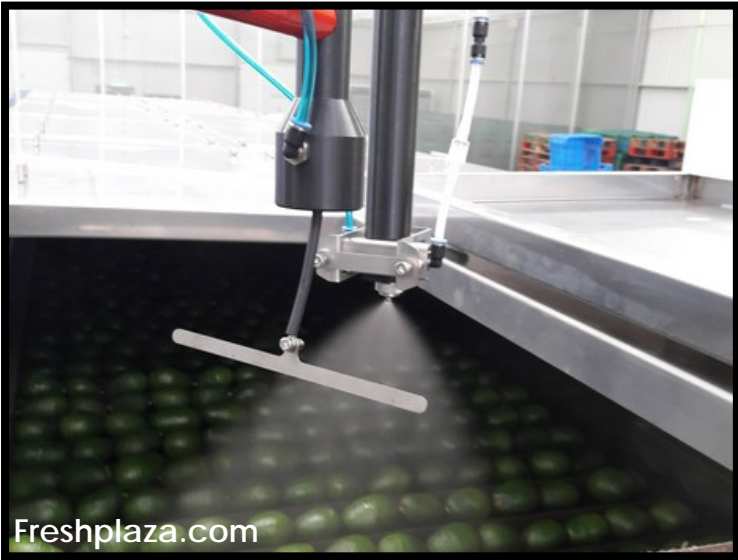
Commondreams.org



Medicalnewstoday.com



YouTube



Freshplaza.com

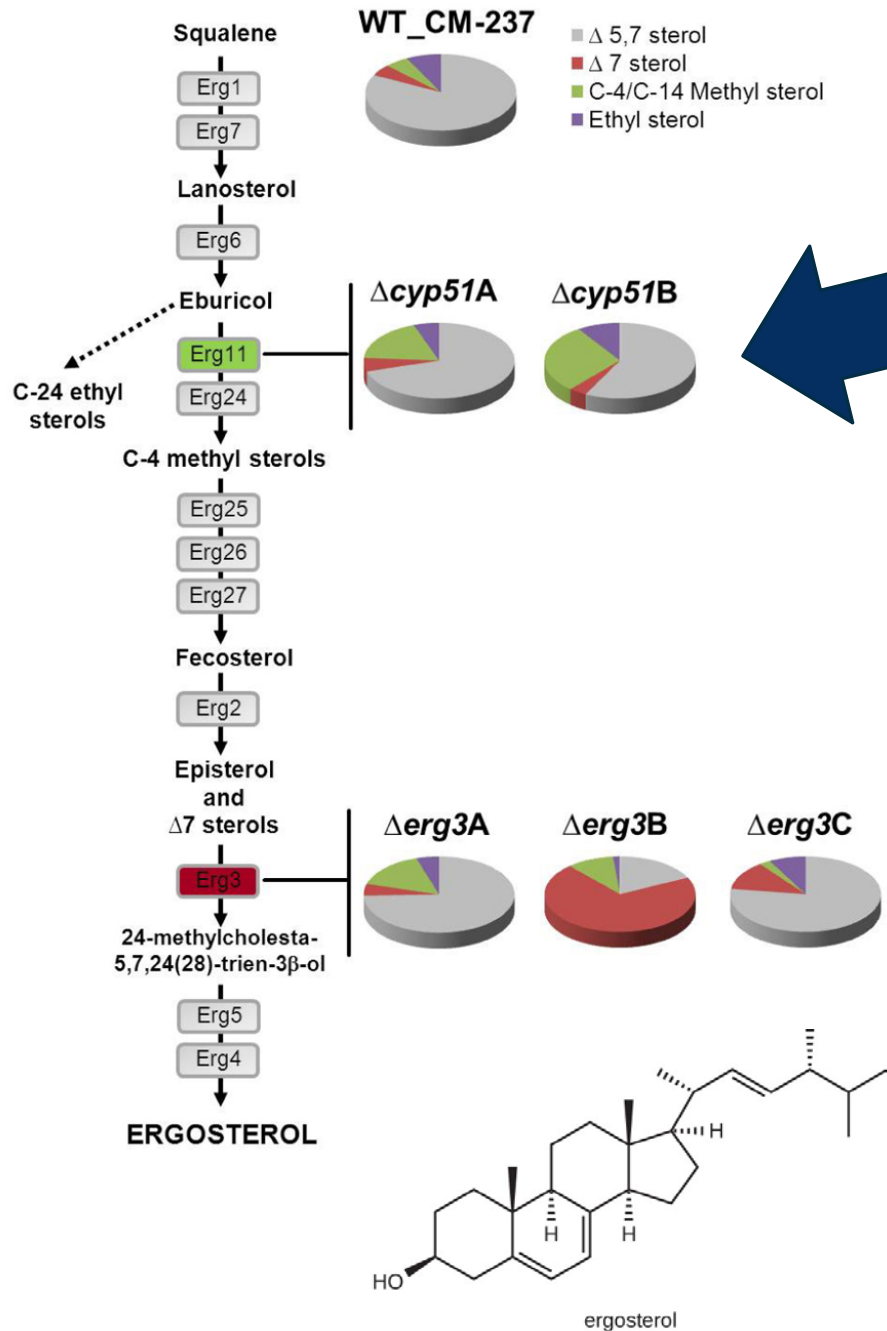


W.J. Janisiewicz, USDA-ARS

Top left – crop dusting fungicides, bottom left – line spray in apple packinghouse, middle – tractor boom spray, top right – backpack sprayer, bottom right – truck drencher

HOW DO AZOLES WORK?

- I. Sterol biosynthesis inhibitors
- II. Target ergosterol biosynthesis in fungi via CYP51 inhibition
- III. Ergosterol essential for fungal cell membrane permeability and fluidity



- Pathway from *A. fumigatus*
- CYP51 occurs in multiple isoforms
- Encoded by Erg11

Figure 1 from Alcazar-Fuoli and Mellado 2013 – *Frontiers in Microbiology*

Left – pathway on how fungi make ergosterol

Bottom left – structure of ergosterol

AZOLE RESISTANCE MECHANISM(S)

- I. Mutations in CYP51 gene target
- II. Overexpression of CYP51 target
- III. Efflux
- IV. Detoxification

AZOLE RESISTANCE MECHANISM(S)

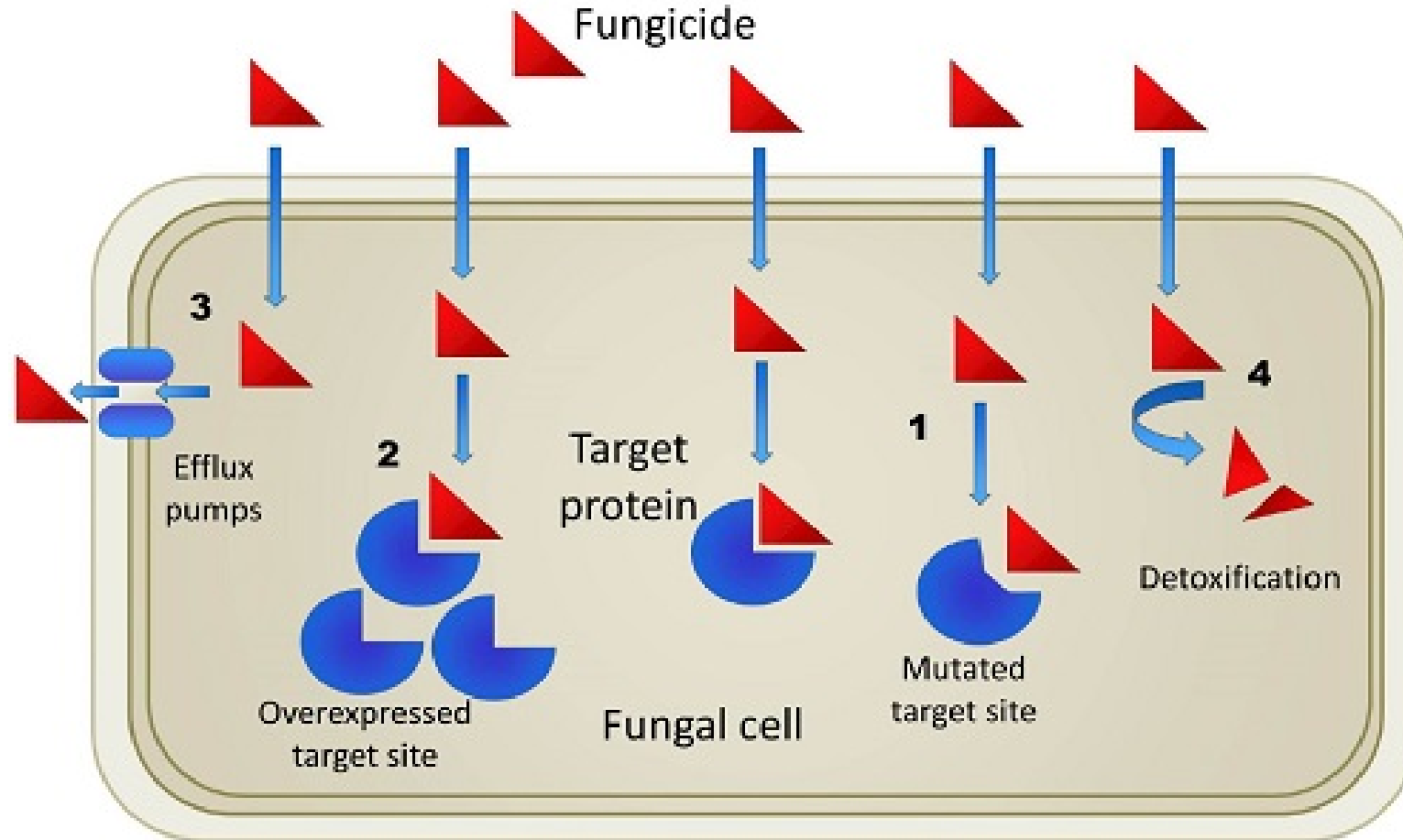


Diagram of a fungal cell showing different mechanisms involving azole fungicide resistance

ACKNOWLEDGEMENTS

Jomana Musmar for the invitation to speak!

Dr. Tim Widmer (NP 303) National Program Leader

Jurick Lab (Food Quality Laboratory)

Dr. Franz J. Lichtner – Postdoctoral scholar

Verneta L. Gaskins – Support Scientist

Otilia Macarisin – Student Researcher



People in my lab – Top = Dr. Franz J Lichtner, Mid right = Ms. Verneta L. Gaskins, Bottom left = Ms. Otilia Macarisin