Fundamentals of Grape IPM for beginners

Mizuho Nita
(Me-zoo-jo, or rhyme with Idaho or Navajo)
Grape Pathologist
Virginia Tech
AHS AREC at Winchester, VA

For Beginner's Workshop
13 March 2014

Outline

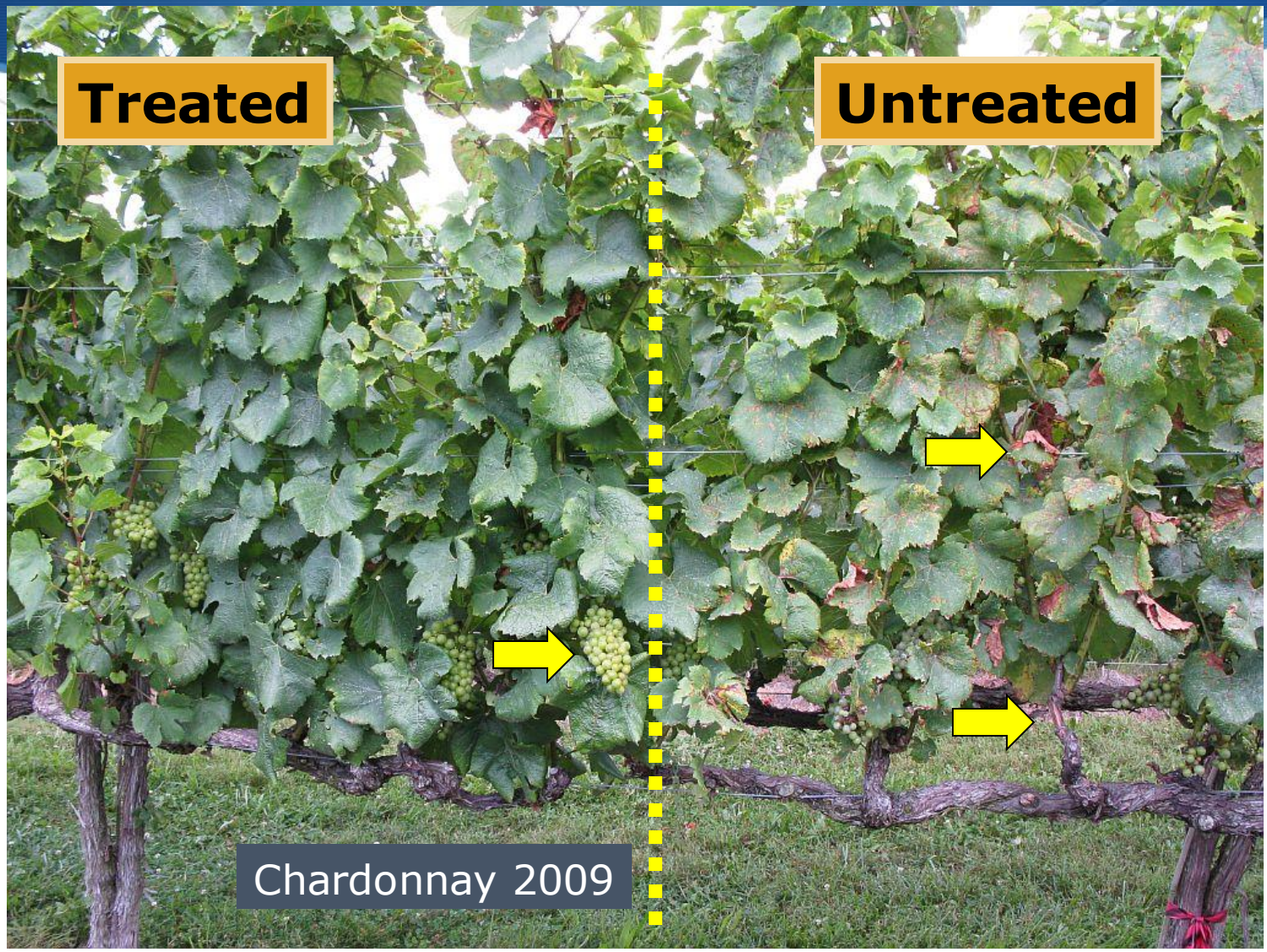
- Plant diseases and Integrated Pest Management
- Fungicide Resistance
- Pictures of common diseases
- Resources

Fungal diseases are very common in VA vineyards (or vineyards located east of Rockies)

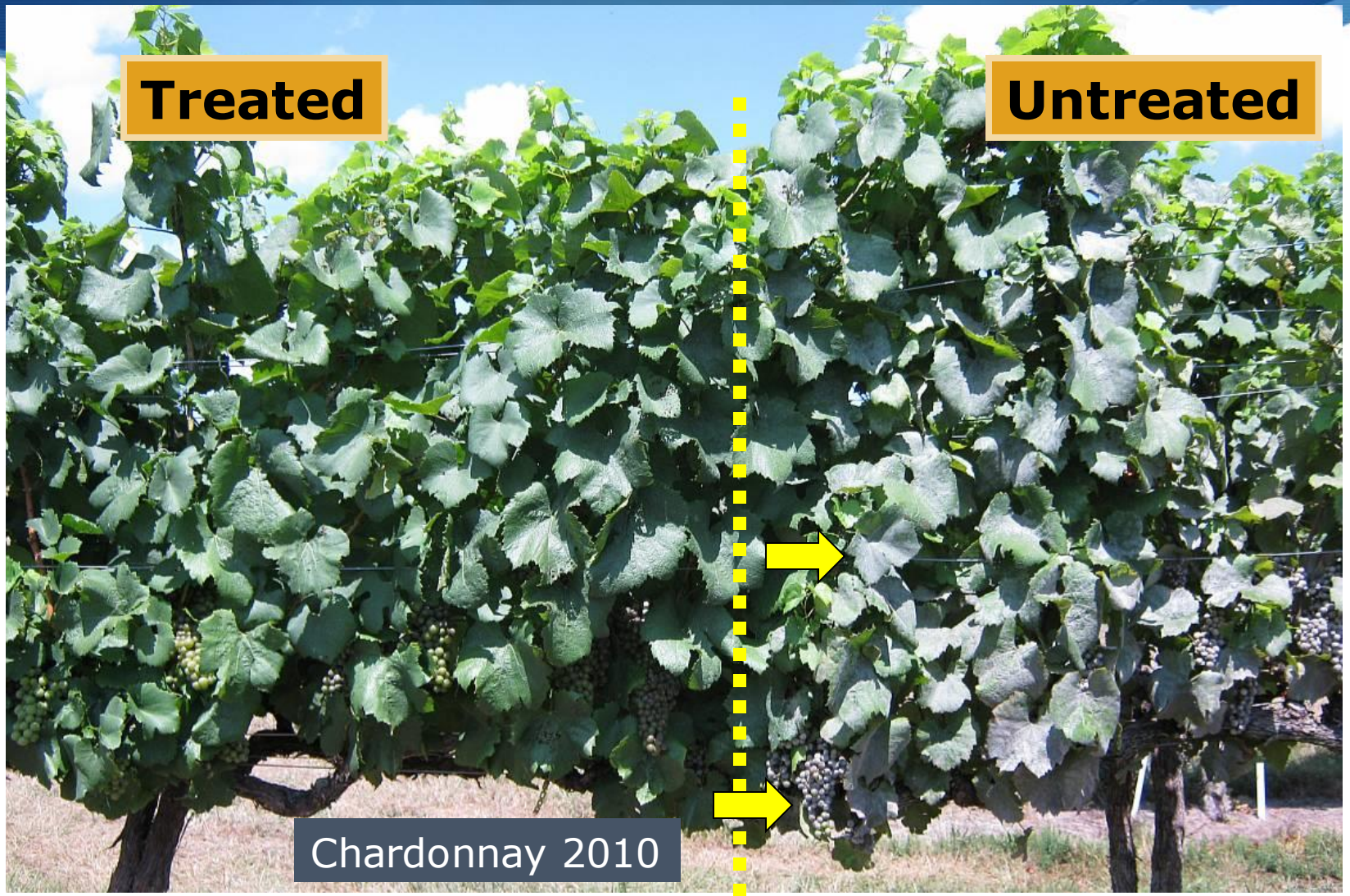
- Due to high humidity (rain and relative humidity) during the growing season
- Variety selection
  - Susceptible varieties such as 'Chardonnay' are preferred

A commercial vineyard in Loudoun county, VA

Grape diseases can be very serious!



It is not possible to grow susceptible variety without fungicides



How do these disease occur?

- Pathogens need to have a certain conditions to infect and cause disease

Host (grape)

Environment (esp. Rain & Temp)

Pathogen

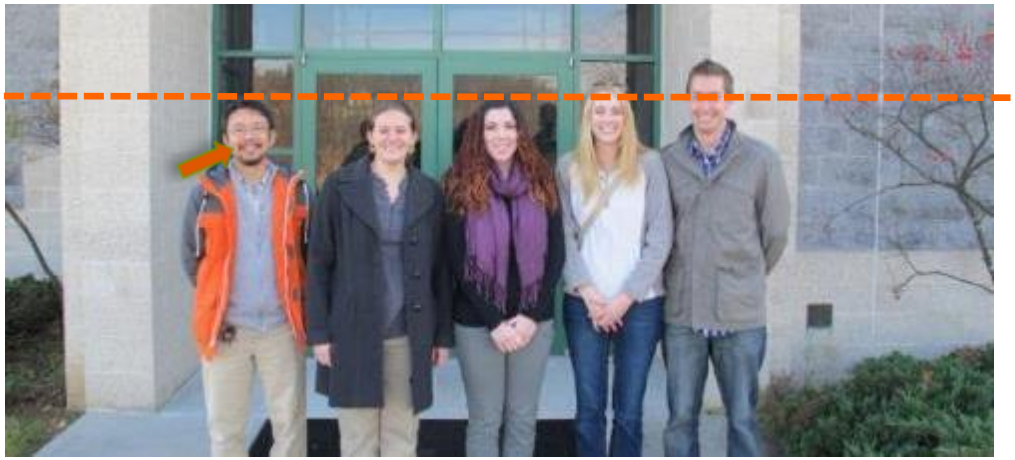
Downy mildew of grape

Fungicide resistance

- After several years of use, some of fungicides, especially newer ones, become less effective
- Many of new fungicides are targeting a specific gene or gene function
  - Highly specific and thus often safer to other organisms.
  - Other benefits such as movement of the chemical into plant tissues
- The target pathogen can develop a resistance to the function = mode of action = how the pesticide kills or inactivates the target pathogen

Fungicide resistance

- Pathogens can become less sensitive to a fungicide because…
  - Some of population (isolates) were not sensitive to begin with
  - Mutation of the target gene (or gene function) happened after exposed to the fungicide.



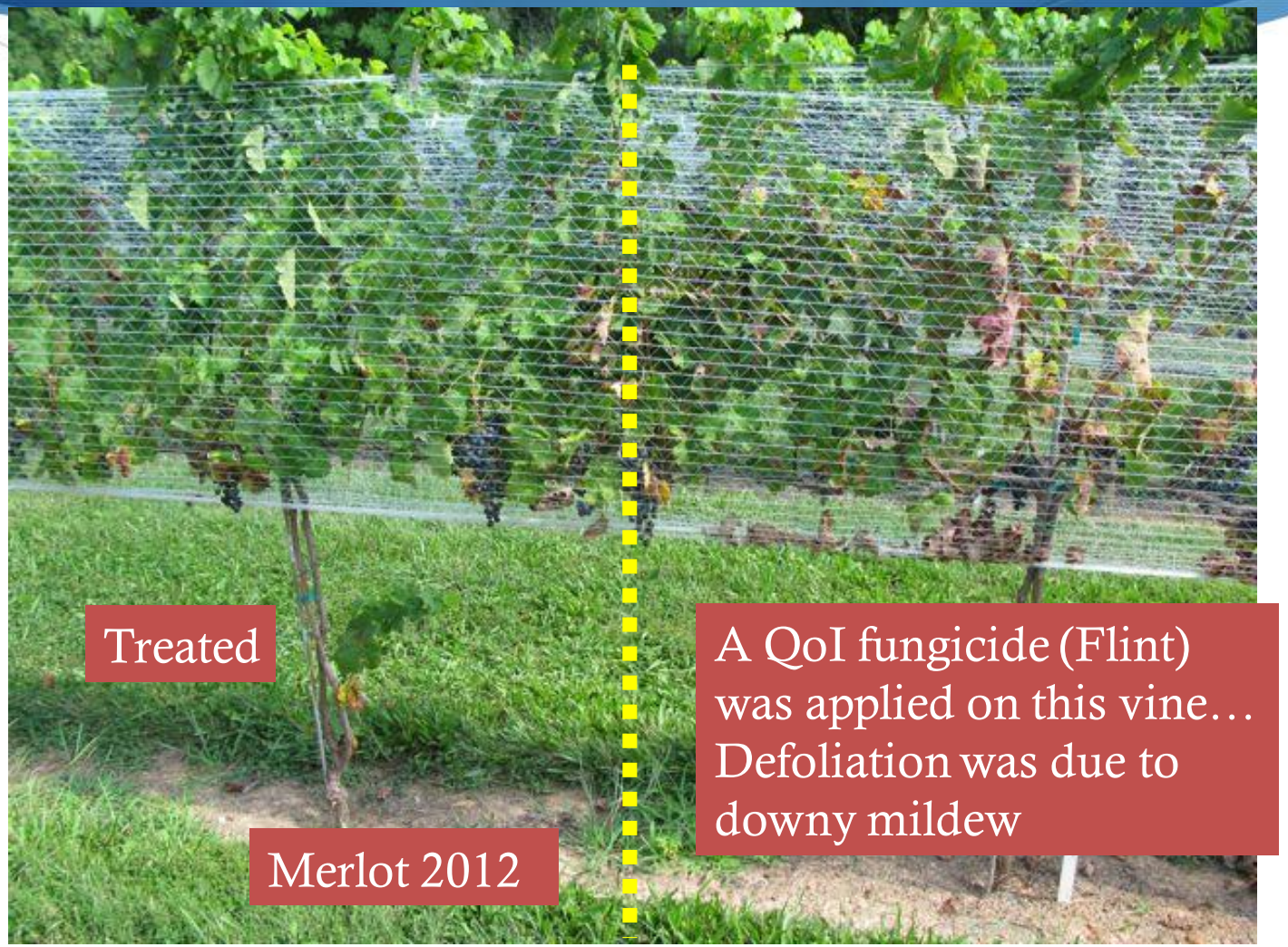
An example of fungicide resistance development QoI or Strobilurin fungicides

- The first fungicides in this family were isolated from wood-rotting mushroom fungi, including one called *Strobilurus tenacellus*.
- All QoI fungicides share a common biochemical mode of action:
  - Interfere with energy production in the fungal cell.
  - They block electron transfer at the site of quinol oxidation (the Qo site) in the cytochrome bc_1 complex, thus preventing ATP formation.
- It has curative activity against some of pathogens = you can apply after infection takes place.

QoI fungicide was introduced in late 1990's, and it was working against multiple pathogens

- However, this entire group was found to be no longer effective against both grape downy and powdery mildew in VA by 2007-09
- Only 10-12 applications were enough for fungal pathogens to develop resistance to the QoI
  - A single mutation site was often associated with the resistant isolates
- Once developed, the resistance highly likely stay for good = you cannot use the same mode of action any longer.

Once developed, fungicide resistance will stay…



Best way to avoid fungicide resistance are tank mix, limitation of the use, and rotation of mode of action

- Some of fungicides are less prone to the development of resistance because they have multiple modes of action
  - Sulfur for powdery mildew, mancozeb for downy mildew, black rot, and Phomopsis, and captan for downy mildew, Phomopsis and Botrytis bunch rot
  - Mixing them with a newer fungicide has shown some evidence of delaying onset of resistance with some of pathogens

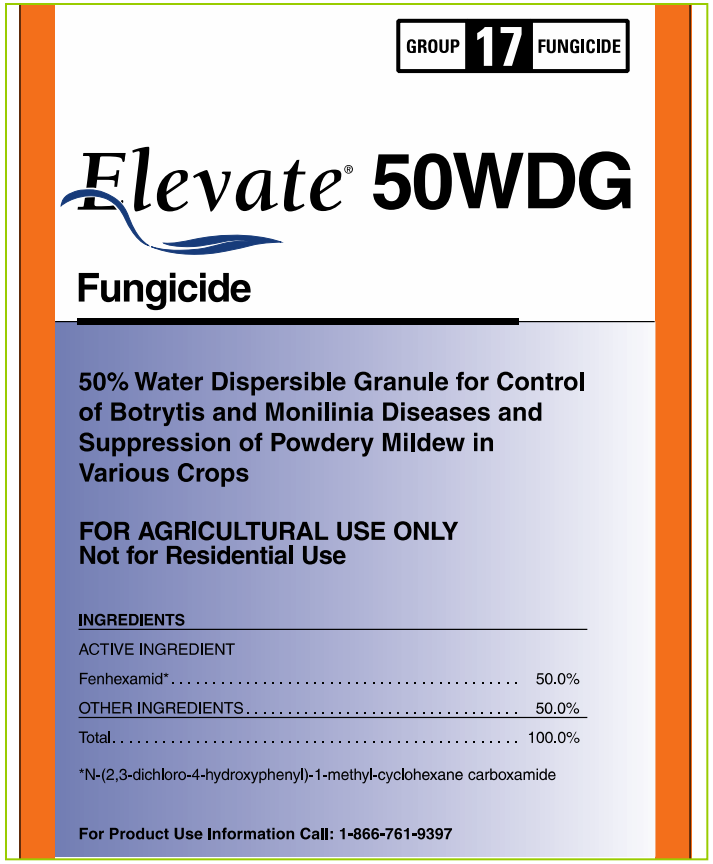
You cannot use the same materials repeatedly

- Often time there is a legal limitation in number of applications or amount of the chemical you can use per season
  - Example with grape: Mancozeb's PHI (Pre-Harvest Interval) is 66-day, *plus* there is a limitation on the amount (19.2 lb of a.i./ acre/ season)
- Recommendations on new fungicides are to apply no more than two applications per season (listed on the label = legal)
- → Rotate with different modes of action!
  - **Mode of action = actual pathway or mechanism for the fungicide to inactivate fungal activities**

I hope things are more straightforward, but it is not…

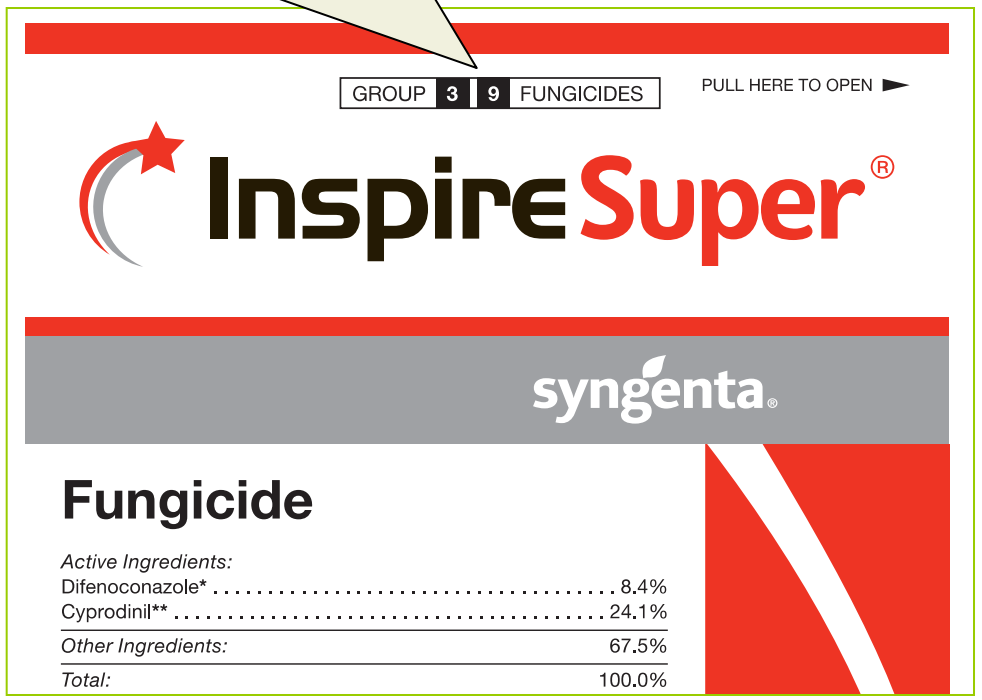
- **Different products may have the same mode of action**
  - Both 'Elite' and 'Orius' have a tebuconazole as an active ingredient (a.i.), and tebuconazole belong to a mode of action DMI (de-methylation inhibitors, or also called sterol inhibitor or SI)
- **Different chemicals may have the same mode of action**
  - Both 'Elite' (a.i. = tebuconazole) and 'Rally' (a.i. = myclobutanil) belongs to DMI group

FRAC (Fungicide Resistant Action Committee) code http://www.frac.info/

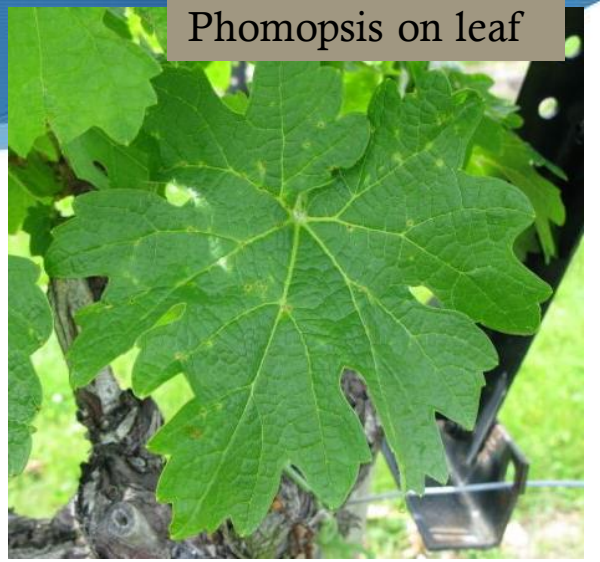


Sometimes, one product has two modes of action

- Increase efficacy
- May delay the onset of resistance
- **Make it more difficult to rotate!**



Rotation of fungicide alone is complicated enough! Please plan ahead!!


Phomopsis on leaf

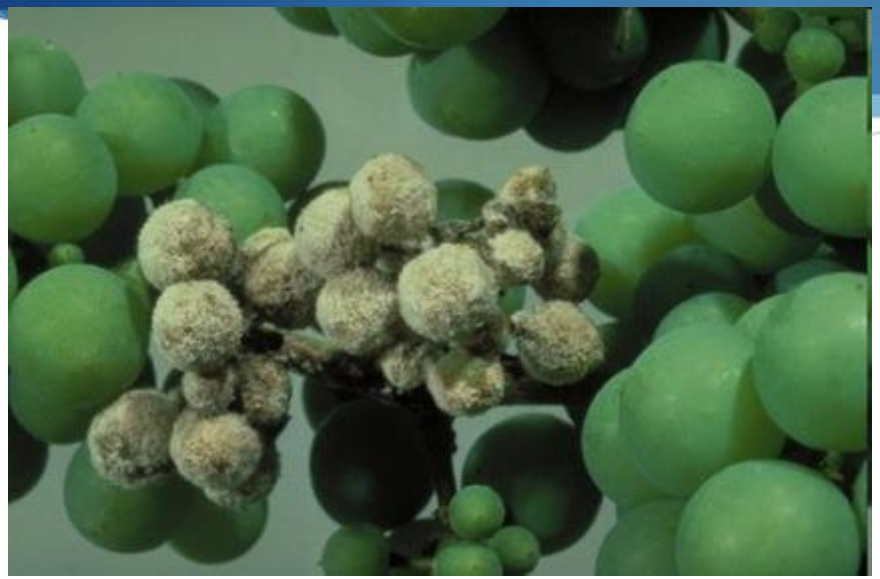
Proper planning will help you to:

- Prepare time and resources
  - Be through and realistic
- Check inventory of your supplies
- Remember what you did last year
  - Lower the risk of making the same mistake
- Recognize which diseases were more prevalent
  - = Adjustment for a challenging season!!

Let's go through common diseases that you probably will see in your vineyards!

- For the sake of time, I will focus major fungal diseases; however, there are diseases caused by
- Viruses
  - leafroll viruses, red blotch, etc. (60+)
- Bacteria
  - Pierce's Disease, crown gall
- Phytoplasma
  - grapevine yellows

The collect identification is critical because different management tools will be needed for seemingly similar diseases



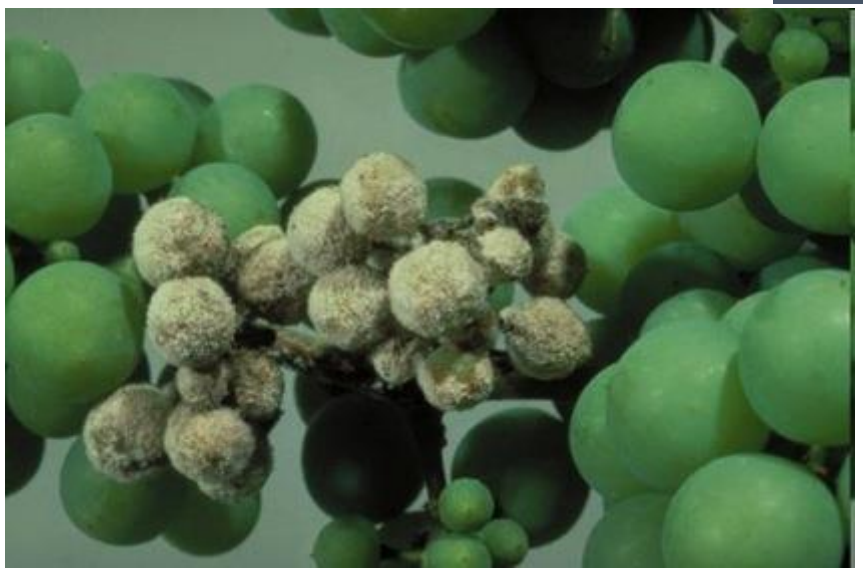
Downy Mildew

Powdery Mildew

The infection conditions and chemical to be used are different!

Downy Mildew

- Caused by Oomycete pathogen, *Plasmopara viticola*, which can infect leaves and berries, berry infection can cause serious damage
- Heavy leaf infection can cause a defoliation



Oily spot appearance on upper surface

Pictures taken from Organic grape production guide: OSU, Ellis and Nita 2004

Downy Mildew

Powdery Mildew

Caused by a fungal pathogen, Erysiphe necator (= *Uncinula necator*)
It can infect leaves and berries, berry infection can cause serious damage
Infection of berries during early season can increase the risk of other diseases

Pictures taken from Organic grape production guide: OSU, Ellis and Nita 2004

Powdery Mildew

It can be found on the both upper and lower surface, but more commonly found on the upper surface

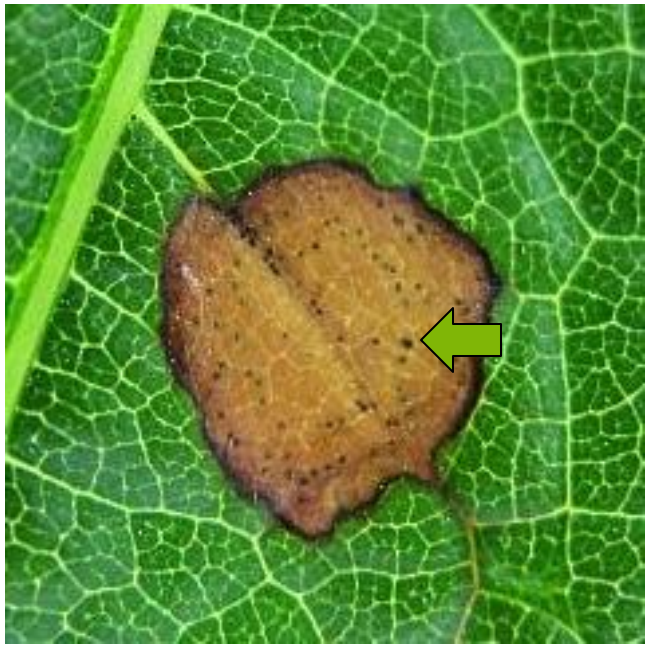
Phomopsis Cane and Leaf Spot

- Caused by a fungus, *Phomopsis viticola*.
- It can infect leaves, canes, rachis, and berries (up to 30% loss of yield has been reported), it can cause premature drop of berries
- Even though it does not cause major damage, it can cause a slow decline of vines

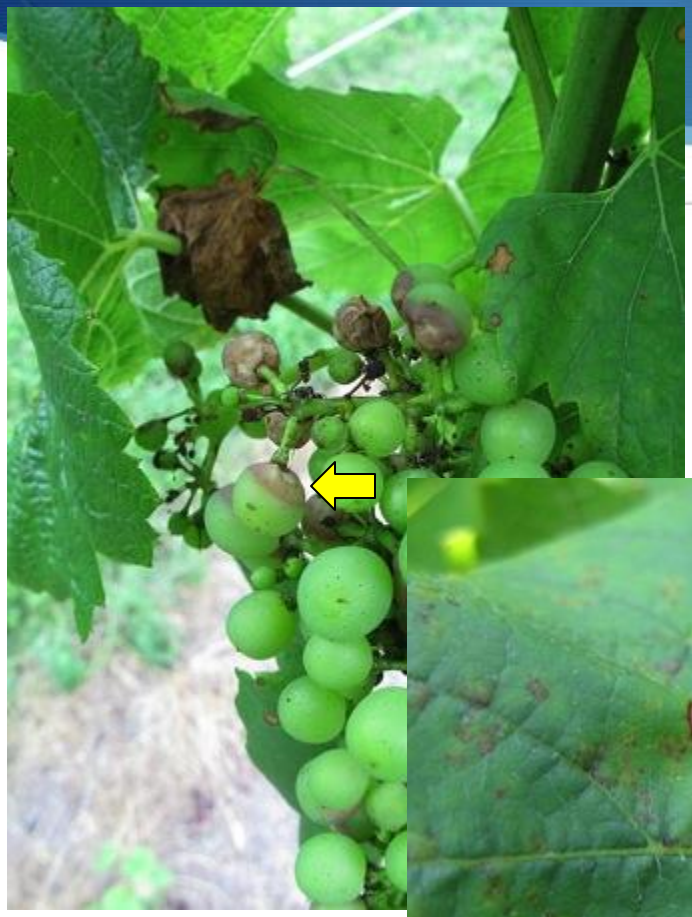
Phomopsis cane and leaf spot

Black Rot

- It is caused by a fungus, *Guignardia bidwellii* that can infect leaves and berries, berry infection can cause serious damage
- Infected berries will produce spores next year



Black Rot



Botrytis bunch rot, or gray mold

- It is caused by a fungus *Botrytis cinerea.*
- It can cause damage to berries, and can be very significant
- The gray moldy appearance is due to mass of conidia
- It has wide range of hosts, strawberry and other small fruits, crop debris, etc…

Botrytis Bunch Rot

Bloom

- Powdery mildew
- Downy mildew
- Black rot
- Botrytis
- Ripe rot
- Bitter rot

Up to 5-6 weeks after bloom

Pre-bloom

- Powdery mildew
- Downy mildew
- Black rot

Phomopsis

Berry touch

Botrytis

Veraison

- Ripe rot
- Bitter rot
- Sour rot
- Botrytis

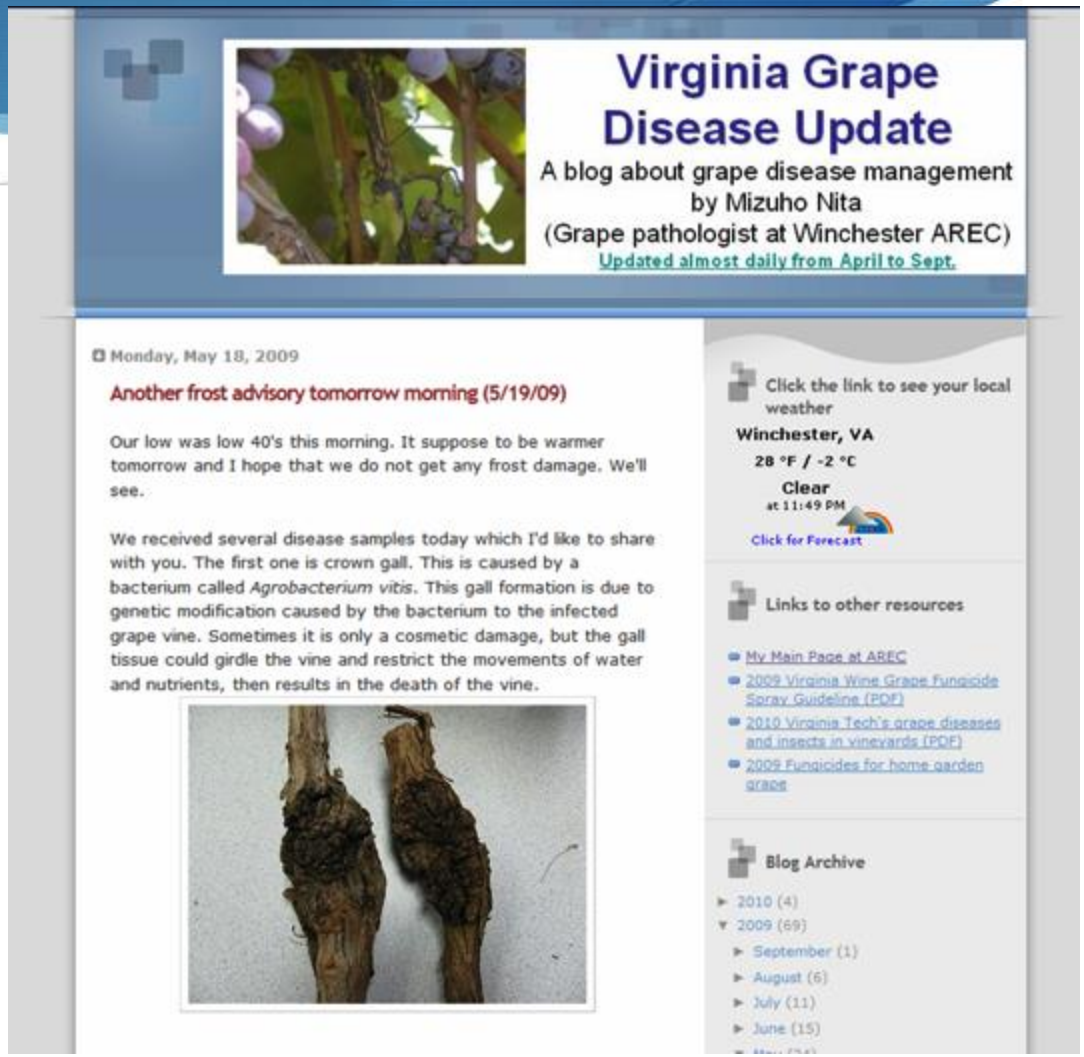
Harvest

Bud break

Critical period timeline

Resources on Grape Disease Management

- My blog
  - Updated almost daily during the season
- Grapepathology.blogspot.com
- I will upload today's presentation!



My Fungicide application workbook

- With pictorial keys for the target host stage
- I have a non-bearing vine version too

Growth stage or timing	*Material and rate/acre*	*Comments*
3- to 5-inch shoot or 7–10 days after the last spray 	Same as ½- to 1-inch shoot spray **------ Note ------** When you wonder about which fungicide to use, think about what was the primary problem in your vineyard, and also what is going on in this season. For example, if you had BR problems last year, and a weather forecast shows a warm rain event, you want to incorporate a fungicide against BR (such as Elite or Rally) and apply it before the rain.	Some of you start your program at this stage. Just remember that from 1-inch to 5-inch takes only a few days! Most of fungicides act only as protectants. Thus, in order to protect new growth from fungal infection, these materials need to be applied before the rain. 7-day interval application needs to be considered if: ▪ you are applying sulfur for PM (which does not require rain to infect tissue), ▪ PM has been a concern in your vineyard ▪ there has been a lot of rain since the last spray, **or** ▪ it is unusually warm, and shoots are growing rapidly. If rain is predicted between 7 and 10 days after your last spray, make another application **before** the rain.
6- to 10-inch shoot or 7–10 days after the last spray 	Same as ½- to 1-inch shoot spray	Please see above. **To lower risk of fungicide resistance development, rotate the mode of action.** In general, 2-3 sprays of a resistance-prone fungicide (3 for SI and 2 for strobilurin) per season are the maximum recommended. Please plan ahead. Refer to Table 2 for the mode of action, and read and follow the label.

VCE's Pest Management Guide (PMG)

- It covers not only diseases, but also insect and weeds

Diseases and Insects in Vineyards

Douglas G. Pfeiffer, Extension Entomologist, Virginia Tech
Anton B. Baudoin, Plant Pathologist, Virginia Tech
J. Christopher Bergh, Extension Entomologist, Alson H. Smith Jr. AREC
Mizuho Nita, Extension Plant Pathologist, Alson H. Smith Jr. AREC

Additional information on pest and beneficial species identification is available online at *http://www.virginiafruit.ento.vt.edu/*. Application rates: The rate per acre column gives rates for low-volume or concentrate applications. Sprays may be applied as semi-concentrate (40-100 gal/A) or concentrate (10-40 gal/A) sprays. Use caution with more concentrated sprays; the smaller droplet sizes associated with low-volume application are more prone to drift. Amount of pesticide to be applied for dilute applications (usually 100 gal/A early in early season, 200 gal/A in mid season, and 300 gal/acre in late season) is usually given on the label.

Table 3.1 - Disease and Insect Control

Pest	Chemical and Formulation	Rate/Acre	Spray Timing and Remarks
Dormant			
Anthracnose (Bird's eye rot), Powdery Mildew, Phomopsis	lime sulfur solution	10.0 gal	Only necessary where anthracnose, Phomopsis, or powdery mildew have been a **serious** problem. Lime sulfur can reduce overwintering inoculum of these diseases.
Mealybugs	Applaud 70DF Venom 20SG Assail 30SG Provado Solupak Baythroid 2EC Movento 2SC	9.0-12.0 oz 0.44-0.66 lb (foliar) 1.13-1.32 lb (soil) 2.5 oz 0.8-1.0 oz 2.4-3.2 fl oz 6.0-8.0 fl oz	If a problem at harvest in the previous year. If a delayed dormant spray does not provide a adequate control, a summer application may be made. Baythroid targets only crawlers. Movento prebloom only in table grapes.
Bud Swell			
Grape flea beetle	Danitol 2.4EC or	8.0 fl oz	If adult beetles are present in damaging numbers. **See Table 3.4 for Restricted Entry**

IPM workshops in VA

- We have a series of IPM workshops where we discuss about disease, insect, and weed management
- **The last workshop for 2014 will be held at Nelson county extension office in March 21st.**

Acknowledgement

- Amanda Bly, Agricultural Technician B
- Sabrina Hartley, Agricultural Technician B
- Charlotte Oliver, Graduate Research Associate
- Taylor Jones, Graduate Research Associate
- Binbin Lin, Post-doctoral Scholar

Thank you very much for your support!!

VirginiaTech
Invent the Future®