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FUNGICIDE RESISTANCE MANAGEMENT

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What hearing “fungicide resistance” can initially feel like…
• Resistance is an important issue

• Most other regions of the world deal with some form of fungicide resistance

• Strategies can be used
  – Some are tried-and-true
  – Some are theory

• Knowledge is power
WHY SHOULD YOU CARE?

• All management efforts could be for nothing
  – Spend money to lose money?
  – Loss in quality

• Consumers purchase based on reputation
  – Regional reputation still important for WA
  – Poor quality fruit from one vineyard can hurt everyone
• Brief overview on how we classify pesticides / fungicides

• What fungicide resistance is
  – How it occurs
  – Different types of resistance
  – A case study

• Strategies for mitigating resistance
UNDERSTANDING FUNGICIDES

Overview
### FUNGICIDES CLASSIFIED IN MANY WAYS

<table>
<thead>
<tr>
<th>Classification Scheme</th>
<th>Trade Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flint</td>
</tr>
<tr>
<td>1) Active Ingredient</td>
<td>trifloxystrobin</td>
</tr>
<tr>
<td>2) Mode of action</td>
<td>QoI</td>
</tr>
<tr>
<td>3) Chemical group/class</td>
<td>strobilurin</td>
</tr>
<tr>
<td>4) Mobility in plant</td>
<td>Locally systemic</td>
</tr>
<tr>
<td>5) Role in protection</td>
<td>Protectant</td>
</tr>
<tr>
<td>6) Breadth of activity</td>
<td>Single-site</td>
</tr>
<tr>
<td>7) FRAC Code</td>
<td>11</td>
</tr>
<tr>
<td>Code</td>
<td>MOA</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>2</td>
<td>Signal transduction (osmotic signal transduction)</td>
</tr>
<tr>
<td>3</td>
<td>DMI- Sterol biosynthesis in membranes (demethylation inhibitors)</td>
</tr>
<tr>
<td>7</td>
<td>SDHI- Respiration (succinate dehydrogenase inhibition)</td>
</tr>
<tr>
<td>9</td>
<td>AP- Amino acid and protein synthesis (methionine biosynthesis)</td>
</tr>
<tr>
<td>11</td>
<td>QoI- Respiration (ubiquinol oxidase)</td>
</tr>
<tr>
<td>13</td>
<td>Signal transduction (mechanism unknown)</td>
</tr>
<tr>
<td>17</td>
<td>Sterol biosynthesis in membranes</td>
</tr>
<tr>
<td>44</td>
<td>Microbial - Lipid synthesis and membrane integrity</td>
</tr>
<tr>
<td>M’s</td>
<td>Multi-site modes of action</td>
</tr>
<tr>
<td>U’s</td>
<td>Unknown</td>
</tr>
</tbody>
</table>
Two main groups of pesticides:

- **Contact** Pesticide
- **Penetrant** Pesticide
Welcome

Welcome To FRAC

Fungicides have become an integral part of efficient food production. The loss of a fungicide to agriculture through resistance is a problem that affects us all.

FRAC works to prolong the effectiveness of fungicides liable to encounter resistance problems and to limit crop losses should resistance appear.
WHAT IS “RESISTANCE” ANYWAYS?

How resistance occurs.
HOW RESISTANCE OCCURS

Some small level of natural resistance

First fungicide application; no complete coverage

Resistant population grows

After third fungicide application

Resistant population grows

Second fungicide application
TYPES OF RESISTANCE

**Qualitative**
(sudden)

**Quantitative**
(gradual/rate dependent)

QoI
Flint (trifloxystrobin)
Pristine (pyraclostrobin + boscalid)

DMI
Procure (triflumizole)
Rally (myclobutanil)
Vintage (fenarimol)
Elite (tebuconazole)
RESOURCES FOR UNDERSTANDING RESISTANCE

- PNW Pest Management Handbooks
  - https://pnwhandbooks.org/plantdisease/pesticide-articles

- Pesticide Environmental Stewardship
  - https://pesticidestewardship.org

- Fungicide Resistance Action Committee
  - http://www.frac.info/resistance-overview
THE NY LESSON

• Strobilurin resistance already in NY
  – Azoxystrobin (QoI, FRAC 11)
  – Labeled for use in 1997; resistance found in 1999
• In vineyards where 15-20 applications had been made since introduction
  – Note: typically more fungicide applications in NY than in WA
  – Programs may include 4-6 (or more!) QoI applications in a single season
• Also noted partial cross-resistance with myclobutanil (DMI, FRAC 3)

THE NY LESSON TAKE-HOME?

• Resistance can develop rapidly with new fungicides

• There is a ticking bomb for number of applications before resistance is likely

• Completely eliminating one class and relying on another sets one up for failure
  – Must have multiple FRAC classes represented in a spray rotation
FRAC 11’s Aren’t the Only Concern

- Resistance to metrafenone (Vivando; FRAC U8) found in Italy
- Resistance to quinoxyfen (Quintec; FRAC 13) found in Virginia
- Resistance to boscalid (Endura; FRAC 7) in Botrytis in multiple regions
CULTURAL PRACTICES

• Irrigation management

• Canopy management
SPRAY PRACTICES

WHEN

WHERE

HOW

Vertical Deposition Profile

(Grapes, Airblast Sprayer)

% of applied a.i.
TANK-MIXING

• Tank-mixing involves applying 2 MOAs simultaneously in the field
• Some product formulations already do this for you
  – Pristine, Unicorn, Inspire Super, etc.
• A cheap tank mix is the addition of sulfur (or another contact product)
  – Example: 3-5 lbs sulfur
  – Check for phytotoxicity
  – Check for chemical incompatibility
Rotating MOAs helps reduce the build-up of resistant populations
  - Within FRAC groups, there is often cross-resistance
  - Most of the time, resistance has not developed to multiple products
Rotation should occur within a growing season
Some products need to be rotated for non-resistance issues (e.g., sulfur, oil)
CURRENT RECOMMENDATIONS FOR MANAGEMENT:

1. **Option 1:** Avoid the FRAC group for at least 1 year

2. **Option 2:** Limit the FRAC group to 1 application in a season
   - Tank mixed with a contact if possible

3. **Option 3:** If you have to spray the FRAC group twice, then:
   - Tank mix with a contact
   - Never spray back-to-back
   - Avoid late-season spraying (i.e., FRAC 11 for Botrytis)
PLAN--- THEN EXECUTE! 😊
1. Resistance isn’t the end of the world…
   – Has occurred in other locations
   – We have other chemistry options
2. …but we shouldn’t ignore it
   – Loss of products = loss of control options
   – Loss of control options = increase in costs
3. Fungicide program planning and appropriate spray techniques are great insurance
STILL TIME FOR 2017 PLANNING!

YOU GOT THIS
QUESTIONS?

VITICULTURE EXTENSION
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