The Impact of Water Quality on Pesticide Performance: 

The *Little* Factor that Makes a *Big* Difference 

Bill Riden and Kerry Richards 
Penn State Pesticide Education Program 
[extension.psu.edu/pested]
Factors that Influence Product Performance

• Product Selection
• Label instructions
• Equipment Calibration
• Application Timing
We Also Learn from:

- Trial and Error
- University Recommendations
- Industry Recommendations
- Other Applicators
What about the Quality of the Water Used to Spray Pesticides?

- Over 95% of the spray solution is water!

- **FACT:** Research clearly shows that the quality of water used for spraying can affect pesticide performance!
Why is this Seldom Noticed?

• Water is viewed as a relatively clean input.
• Concise, easy-to-read information on water quality and the effects on pesticide performance is scarce.
What Kinds of Problems Can Poor Water Quality Cause?

• Interact with product
• Reduce solubility of pesticide
• Decrease absorption by target pest
• These performance issues may not be obvious! We tend to blame other factors!
Checking Water pH is Important!

- An overview of water pH
- Testing methods
- Options to improve the pH of water
Acidic or Alkaline?

• The pH value describes the acidity (concentration of hydrogen ions) or alkalinity of any solution.
# The pH Scale

<table>
<thead>
<tr>
<th>pH</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Battery acid</td>
</tr>
<tr>
<td>1</td>
<td>Orange juice</td>
</tr>
<tr>
<td>2</td>
<td>Bananas</td>
</tr>
<tr>
<td>3</td>
<td>Pure water</td>
</tr>
<tr>
<td>4</td>
<td>Baking soda</td>
</tr>
<tr>
<td>5</td>
<td>Soapy water</td>
</tr>
<tr>
<td>6</td>
<td>Liquid drain cleaner</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>
pH Value

• Most herbicides, insecticides, and fungicides perform best in slightly acidic water.
  – A pH of 4 to 6.5

• However, some pesticides, such as sulfonylurea herbicides perform better in water that is slightly alkaline.
  – A pH above 7
pH Rule

• When water pH falls outside of the preferred upper and lower boundaries, product performance can be compromised.

• In some cases, the pesticide will precipitate out of solution.
pH Rule

• pH can influence how long a pesticide product remains active.

• The effect of pH usually proceeds faster as the temperature of the water increases.
What Does Half-Life Mean?

• The amount of time for one-half of the substance to break down.

  – Example:

    $$1 \text{ to } \frac{1}{2} \text{ to } \frac{1}{4} \text{ to } \frac{1}{8} \text{ to } \frac{1}{16}$$

    100%  50%  25%  12.5%  6.25%
What Does Half-Life Mean?

• The amount of time for one-half of the substance to break down.

  – Example: Thiophanate Fungicide has a Half-life of 1 hour (pH of 7)
    
    At application = 100%
    1 hour later = 50%
    2 hours later = 25%
    3 hours later = 12.5%
Effect of pH on Pesticides

• Another example: Flumioxazin Herbicide:

• As pH varies, so does the Half-life:
  – pH 5 = Stable
  – pH 7 = Half-life of 24 hours
  – pH 9 = Half-life of 15 minutes
### Effect of pH on Pesticides

<table>
<thead>
<tr>
<th>Common/Trade Name</th>
<th>Half-life with pH 5</th>
<th>Half-life with pH 7</th>
<th>Half-life with pH &gt;8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbaryl / Sevin</td>
<td>did not find data</td>
<td>24 days</td>
<td>1 day</td>
</tr>
<tr>
<td>Chlorothalonil / Bravo</td>
<td>Stable</td>
<td>Stable</td>
<td>Stable</td>
</tr>
<tr>
<td>Chlorpyrifos / Lorsban</td>
<td>63 days</td>
<td>35 days</td>
<td>1.5 days</td>
</tr>
<tr>
<td>Phosmet / Imidan</td>
<td>13 days*</td>
<td>12 hours</td>
<td>4 hours</td>
</tr>
<tr>
<td>Simazine / Princep</td>
<td>96 days</td>
<td>Decreases →</td>
<td>24 days</td>
</tr>
<tr>
<td>Thiophanate / Topsin</td>
<td>80 hours</td>
<td>1 hour</td>
<td>Decreases →</td>
</tr>
<tr>
<td>Captan / Othocide</td>
<td>32 hours</td>
<td>8 hours</td>
<td>10 minutes</td>
</tr>
</tbody>
</table>

* At pH 4.5

Phy half-life data sources are listed at end of presentation.
Effect of pH on Pesticides

- Selected Half-life of Common Pesticides
  - Captan / Orthoxide pH 9 2 minutes
  - Dimethoate / Cygon pH 9 1 hour?
  - Phosmet / Imidan pH 10 1 minute
  - Endosulfan / Thiodan pH 8-9 Unstable? (12 hours)
  - Malathion / Cythion pH 8-9 5 hours? (no data)
How to Combat Alkaline Hydrolysis

• Know your pesticide products
• Know the pH of your water source
  – Test regularly
• Use a commercial buffering agent
  – Buffer-X
  – Buffer
  – Spray-Aide
  – Buffercide
General Rule

• The pH also can change the chemical charge of a pesticide molecule, limiting its ability to penetrate the leaf cuticle and reach the site action, hence reducing its efficacy.
Alkaline Hydrolysis

• A chemical reaction that occurs when some pesticides in the presence of alkaline water (pH of 7 or above) degrade or lose their effectiveness.

• For every pH point increase, the rate of hydrolysis will increase 10X.
General Rule

• Check the label for any recommendations in regards to the addition of water conditioners, additives, or adjuvants.

  – NOTE: The pesticide label may or may not specify the need for additives!
Testing Your Water

• Use a professional lab:
  – Test for Iron, pH, and hardness?
  – What is the cost?
  – How much water to test?
  – Any special guidelines or containers for collecting and transporting the water samples?
Testing Your Water

• Do-It-Yourself Test Kits:
  – Readily available
  – Reasonable priced
  – Easy to use and interpret
  – Reliable
Testing Your Water

• Test Meters:
  – Quick
  – Reliable
Any Questions?
Use of this presentation or parts of this presentation is encouraged as long as these credit slides are included.

**Overall Reference:**

**pH Half-life Data Sources:**
Use of this presentation or parts of this presentation is encouraged as long as these credit slides are included.

**pH Half-life Data Sources (continued):**
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