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The Impact of Water Quality on Pesticide Performance:

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

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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!**

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Checking Water pH is Important!

- An overview of water pH
- Testing methods
- Options to improve the pH of water

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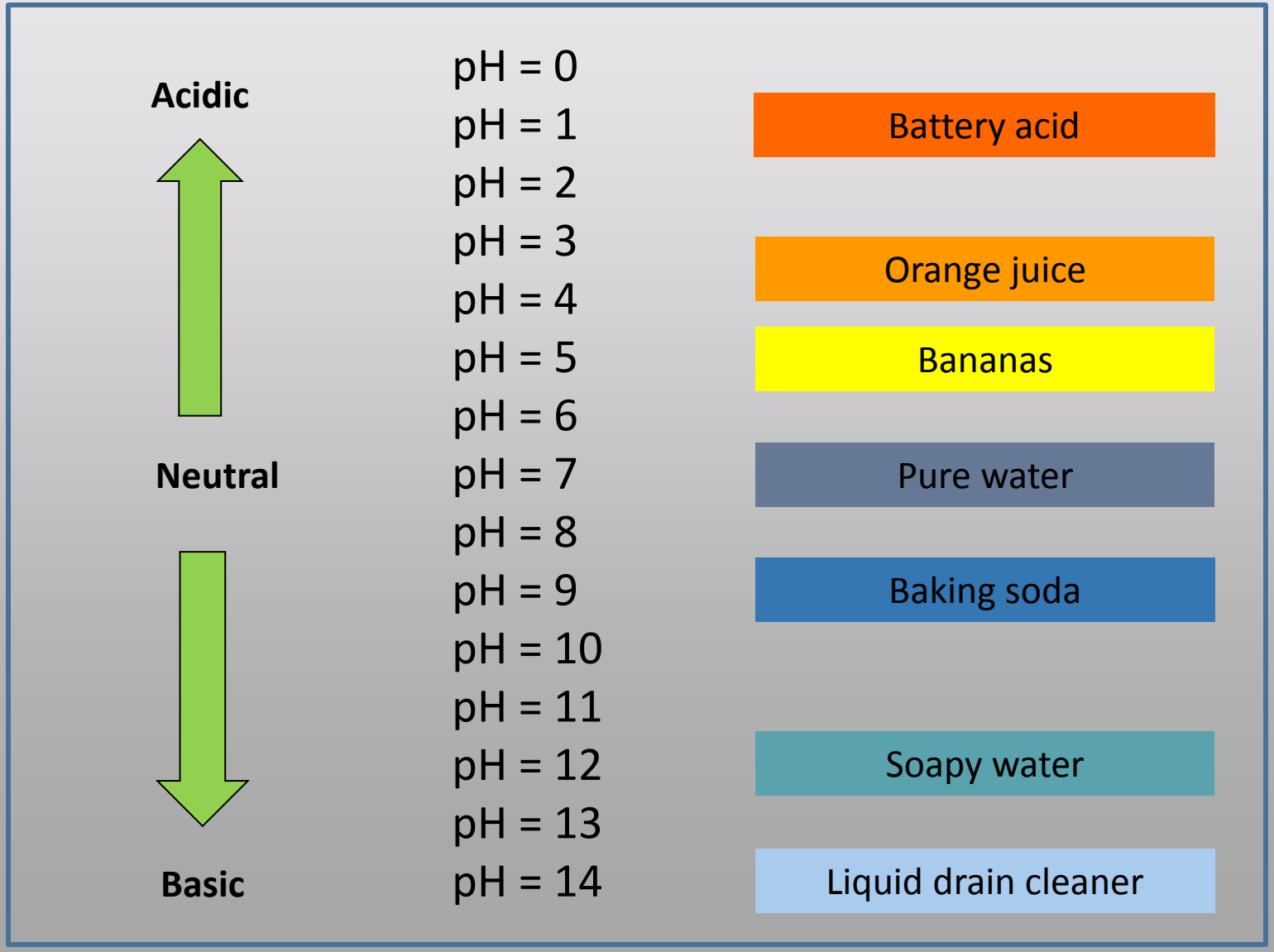
Acidic or Alkaline?

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

The pH Scale


Acidic
Neutral
Basic
pH = 0
pH = 1
pH = 2
pH = 3
pH = 4
pH = 5
pH = 6
pH = 7
pH = 8
pH = 9
pH = 10
pH = 11
pH = 12
pH = 13
pH = 14
Battery acid
Orange juice
Bananas
Pure water
Baking soda
Soapy water
Liquid drain cleaner

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	to	1/2	to	1/4	to	1/8	to	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

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Effect of pH on Pesticides

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

* At pH 4.5

pH half-life data sources are listed at end of presentation.

Effect of pH on Pesticides

- Selected Half-life of Common Pesticides

Captan / Orthocide	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

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Any Questions?

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Use of this presentation or parts of this presentation is encouraged as long as these credit slides are included.

Overall Reference:

- Fred Whitford, Purdue Pesticide Programs. “The Impact of Water Quality on Pesticide Performance: The Little Factor that Makes a Big Difference.” November 2009. (http://www.ppp.purdue.edu/Pubs/PPP-86.pdf)

pH Half-life Data Sources:

- Howard M. Deer and Richard Beard, Utah State University. “Effect of Water pH on the Chemical Stability of Pesticides.” July 2001. (http://extension.usu.edu/files/publications/factsheet/AG_Pesticides_14.pdf)
- F. M. Fishel and J. A. Ferrell, University of Florida. “Water pH and the Effectiveness of Pesticides.” (http://edis.ifas.ufl.edu/pi193)

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):

- Graeme Murphy, Ontario Ministry of Agriculture, Food, and Rural Affairs. "Water pH and its Effect on Pesticides." September 2004. (http://www.omafra.gov.on.ca/english/crops/hort/news/grower/2004/08gn04a1.htm)
- John Rinehold and Jeffrey Jenkins. "Spray-tank Adjuvants" section in the *2012 Pacific Northwest Insect Management Handbook*. (http://insects.ippc.orst.edu/pnw/insects?31ADJV11.dat)

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This presentation was created in partnership with the
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