



The Impact of Water Quality on Pesticide Performance:

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

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Penn State Pesticide Education Program

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Factors that Influence Product Performance

- Product Selection
- Label instructions
- Equipment Calibration
- Application Timing



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We Also Learn from:

- Trial and Error
- University Recommendations
- Industry Recommendations
- Other Applicators



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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!



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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.



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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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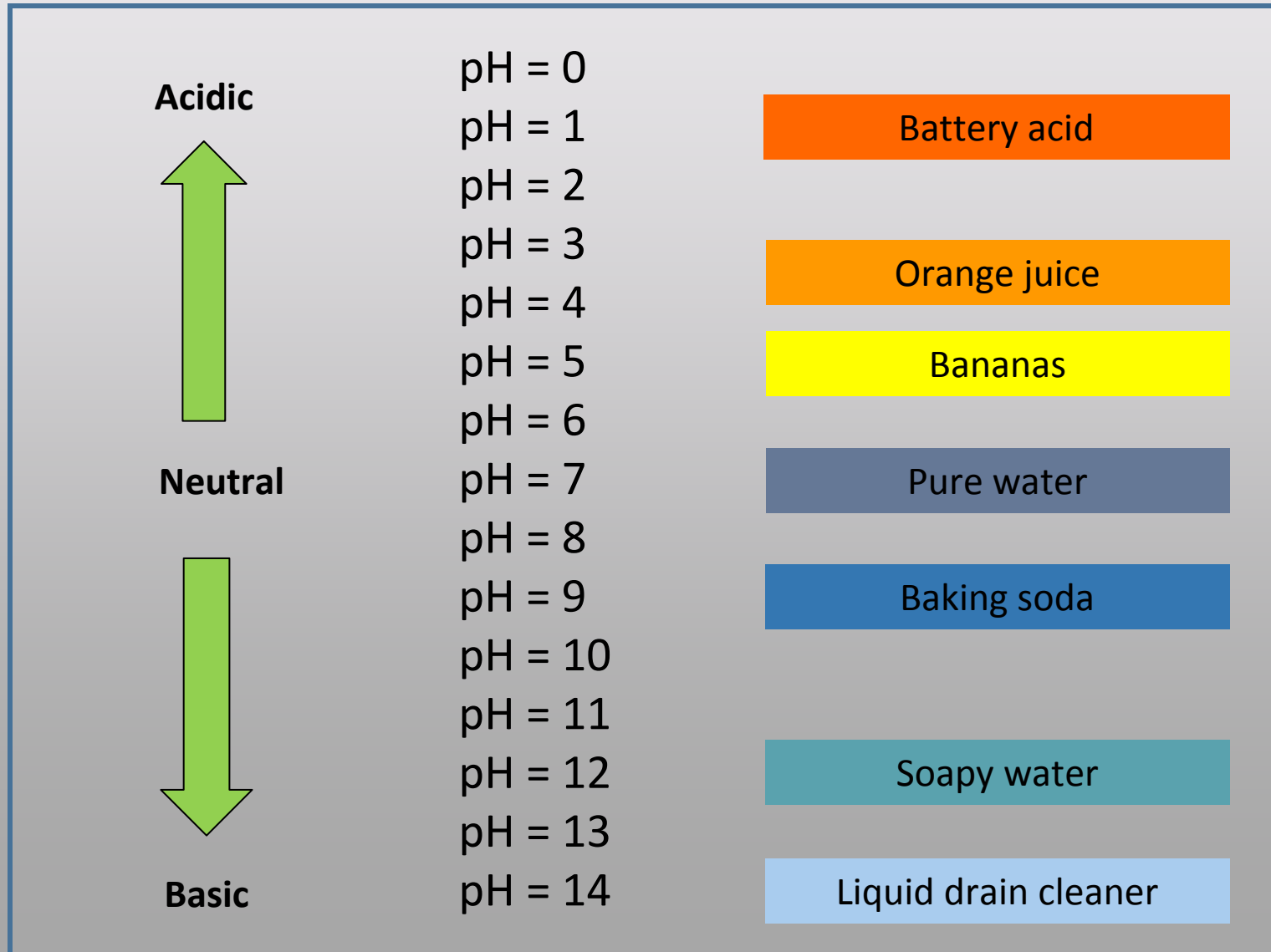
Acidic or Alkaline?

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



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The pH Scale





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



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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.



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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.



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What Does Half-Life Mean?

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

– Example:

1	to	$\frac{1}{2}$	to	$\frac{1}{4}$	to	$\frac{1}{8}$	to	$\frac{1}{16}$
100%		50%		25%		12.5%		6.25%



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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%



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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.



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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)



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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



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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.



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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.



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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!



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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?



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Testing Your Water

- Do-It-Yourself Test Kits:
 - Readily available
 - Reasonable priced
 - Easy to use and interpret
 - Reliable



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Testing Your Water

- Test Meters:
 - Quick
 - Reliable



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Any Questions?



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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>)



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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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