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The pH of the Spray Water is Very Important

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Dr. Raymond A. Cloyd, associate professor and extension specialist in ornamental entomology/IPM, in the Department of Entomology at Kansas State University does an excellent job of explaining the impact that pH can have on spray water used to apply pesticides. http://www.oardc.ohio-state.edu/floriculture/images/FloriBytes1009-pest.pdf He offers a list and provides links to other lists.

Griffin Greenhouse & Nursery Supplies staff offers a current list of many of the commonly used pesticides at http://www.ggspro.com/pdfs/bull/Opt-Pest-Spray.pdf

There was no need to re-invent the wheel. You will encounter some slight inconsistencies between sources, especially older lists compared to newer lists. Some formulations may have been improved. Lists are convenient but refer to the label when in doubt.

Public water in Warren County, Tennessee is maintained at 7.0 - 7.4. Well and surface water in the immediate area falls within this range as well.

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I pulled the following information together May, 1998. It appears to still be accurate. Notice how quick Benlate could have issues.

The pH of the soil affects nutrient availability. Now, we are learning that the pH of the water used to spray various pesticides affects the stability of the solution and how long the pesticide will remain effective while in solution.

Have you ever mixed up a pesticide, only to run out of time or daylight before emptying the tank? What happened to the solution? Did you finish the next day, or did it rain, and delay the spraying 2 or 3 days? Did the pesticide perform well and provide good control? Or did you notice?

Alkaline spray water (above pH 7.0) can reduce the effectiveness of some pesticides in less time than it takes to empty the tank. The result can be poor pest control, crop losses and lost money.

As a rule, most pesticides work best in a slightly acidic solution. Unfortunately, water used for spraying frequently will be alkaline. This may dramatically shorten the effective half-lives of many pesticides. Acidifying spray solutions may be worthwhile.[6]

A safe pH for a spray solution is 4.5 - 7.0, with the best pH reading in the 5.0 - 6.0 range. Seven is neutral, 1-7 is acid and 7-14 is alkaline on the pH scale. The pH numerical readings are expressed on a logarithmic scale. In other words, a pH of 8 is ten times more alkaline than a pH of 7, a pH of 9 is 100 times more alkaline than a pH of 7 and a pH of 4 is 1000 more acidic than a pH of 7.[4]

The term **half-life** refers to how long it takes for half of the pesticide to break down. If a pesticide is 100 percent effective when first added to the spray tank and has a half-life of 30 minutes, the effectiveness is cut in half every 30 minutes, becoming essentially worthless after 60 minutes.[7]

In general, the loss in effectiveness is due to **hydrolysis**; and the rate of hydrolysis is determined by pH, the chemistry of the pesticide, time of exposure in the spray tank, and the temperature of the spray water. Because pH is measured in logarithmic units, the hydrolysis rate of an alkaline sensitive pesticide will increase by a factor of 10 for every pH unit.[4] Alkaline hydrolysis is irreversible.[7]

Studies indicate that insecticides are less stable in alkaline water than are fungicides or herbicides. And organophosphate and carbamate insecticides are affected more by alkalinity than are other types of insecticides.[5]

The fungicide Captan seems to be the least stable pesticide. The half-life is 3 hours at a pH of 7.1 and only 10 minutes at a pH of 8.2. We should apply Captan within 3 hours.[2]

Benlate has a half-life of 60 minutes at a pH of 7.0.[2]
Cygon has a half-life of 12 hours at a pH of 6.0.[2]
Diazinon has a half-life of 37 hours at a pH of 6.0.[2]
Sevin has a half-life of 24 days at a pH of 7.0; 2.5 days at pH 8.0; 24 hours at pH 9.0.[2]
Dursban has a half-life of 63 days at pH of 5.0; 35 days at pH 7.0; 23 days at pH 8.0.[4]

Pesticides that should be used quickly are Cygon (Dimethoate), Cythion (Malathion), Di-Syston, Imidan (use within hours), Meta Systox, Meta Systox-R, Supracide, Systox, Captan, Diquat, Paraquat and Gramoxone.

Pesticides that will remain more stable in solution include: Diazinon, Kelthane, Dursban, Lorsban, Furadan, Guthion, Lindane, Orthene and Sevin (Carbaryl). Chlorothalonil (Daconil, Bravo, Thalonil) has a half-life of 38 days at pH 9.0; is fully stable for 89 days at pH's of 7.0 and 5.0.[1]

It is never a good idea to allow a solution to stand idle for several hours or overnight, as settling may occur. Always plan to spray today what is mixed today. What comes out of

the spray tank during the first hour of spraying could be more effective than what comes out during the last hour of spraying.[4]

An increase in temperature of 18 degrees F will double the speed of decomposition. The sun's rays beating down onto the spray tank will effect hydrolysis and the constant agitation will tend to warm up the solution.[4] A good temperature for the solution is 68 degrees F.

Correcting the pH of the spray water in the tank is possible, but should not be done haphazardly. The accurate way to monitor pH is with a reliable, good quality pH meter, that is calibrated before each use. Litmus (pH) paper may be used to determine a crude pH, accurate within 0.5. But since a pH of between 6.5 to 7.0 is an acceptable range, one can get by with litmus paper.[4]

The one acid that is readily available to everyone is vinegar. It should be carefully added to the water in the spray tank in small increments, checking the pH periodically. If too much vinegar is added and the pH drops below 6.5, the pH can be brought back with household ammonia. Always adjust the pH of the water before adding the chemicals to the spray tank.[4]

Commercial products are available to lower the pH of spray solutions.

The quality of the spray water is important also. If glyphosate (Roundup, is mixed with pond water or muddy water it will be rendered totally useless. Particles of clay and organic matter tie glyphosate up quickly. Besides, silt and sand particles are very hard on a pump and clog nozzles.

The rest of this information came from Dr. John Ruter's searching from multiple sources.[3] It does not refer to half-life, but the period of time that the pesticide is stable in solution at specific pH's. There are some slight inconsistencies between sources.

Bacillus thuringiensis -Optimal pH is 4 to 8.
Diazinon -pH 5.0 - 14 days; pH 7.0 -70 days.
Kelthane - pH 5.0 stable; pH 7.0 - half day.
Lindane - Avoid high pH.
Malathion - pH 5-7, sensitive to iron.
Mavrik - pH 5.0 - 7.0
MetaSystox-R - pH 6.0 12 hours; pH over 7.0 unstable.
Pentac - pH 6.0 to 7.0 optimal.
Talstar, Tempo, Banner, Subdue - Stable pH 5-9.
Aliette - pH 5.0 - 5 days; pH 8.0 - 12 hours.
Bayleton, Rubigan - Stable over wide pH range.
Captan - pH 7.1 - 8 hours; pH 10.0 - 2 minutes.
Daconil (Chlorothalonil) - Stable for 31 days at pH 9.0.
Dithane - Decomposes under highly acid or alkaline conditions.
Funginex (Triforine) - Stable to pH 10.0.

Kocide - pH 6.5 optimum.
Zyban - pH 4.5 to 7.5 optimal.
Diquat - Decomposes rapidly in alkaline solution.
Fusilade, Goal - Stable at pH 7.0.
Gallery - pH 5.0 to 9.0 for optimal effectiveness.
Gramoxone - Unstable under alkaline conditions.
Poast - pH 3 to 4 optimal.
Predict - pH 6 to 7 optimal.
Princep (Simazine) -Decomposes slowly under alkaline conditions.
Prowl (Pendimethalin) (I assume Pendulum would be same.) - pH 6 to 7 optimal.
Roundup (Glyphosate) - Adjust pH to 7.0 or less; pH 3.5 to 6.0 is optimal. I'm not aware that we have had problems with our 7.0 to 7.4 pH.
Surflan, Treflan -pH 5.0 to 9.0 optimal.

Literature Cited

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2. Grounds Maintenance magazine, Feb, 1987. pg 2. Ultimate source was Univ of Georgia College of Ag, Coop Ext Service, Athens, GA.
3. Ruter, John M. 1997. "pH Stability of Pesticides". A personal gathering of information from multiple sources, typed as a handout. Univ. of Georgia,
4. Sartoretto, Paul, technical director, WA Cleary Chemical Corp. 1991. "The pH Factor". 4 pg handout.
5. Sparks, Beverly. 1990. "Alkalinity and Pesticides". American Nurseryman magazine, August 1, 1990, page 40-41.
6. UT Ext. Pub. 1197, 1997. "Commercial Fruit Spray Schedules". p 5.
7. Unknown collector and year. "Pesticide half-life". Multiple sources: North Carolina Ag Extension, British Crop Protection Council, Univ of Massachusetts, Massachusetts Ag Experiment Station. 1 page

Additional good web sites:
http://www.ppp.purdue.edu/Pubs/PPP-86.pdf contains great background information but no list
http://extension.umass.edu/floriculture/fact-sheets/effects-ph-pesticides-and-growth-regulators from Univ of Mass

For a complete list of pesticides and their optimum pH range, see the article "Spray Solution pH" on the Ohio State University website:
http://floriculture.osu.edu/archive/apr04/SpraySolutionPH.html

http://www.oardc.ohio-state.edu/floriculture/images/FloriBytes1009-pest.pdf