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Pesticides Fact Sheet

EFFECT OF WATER pH ON THE CHEMICAL STABILITY OF PESTICIDES

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Most pesticide formulations such as dry flowables, emulsifiable concentrates and wettable powders are designed to be diluted with water as the carrier. A water pH higher than 7 which creates alkaline conditions can cause some pesticides to undergo degradation or chemical breakdown, a process known as hydrolysis. In general, insecticides are much more susceptible to hydrolysis than are fungicides, herbicides, defoliants or growth regulators. Organophosphate and carbamate insecticides are more susceptible than chlorinated hydrocarbon insecticides. Some pyrethroids exhibit susceptibility to hydrolysis.

Tables reporting the pH of water sources across the U.S. list only a few states that have water with a pH below 7 which is in the acid range. The rest all have sources with varying degrees of alkalinity. Both surface and ground water supplies usually contain sufficient natural alkalinity to produce pH levels between 7 and 9.

Some pesticides hydrolyze very rapidly. The hydrolysis rate can be rapid in the pH range of 8 to 9. For every pH point increase, the rate of hydrolysis will increase by approximately 10 times. The severity of losses due to alkaline hydrolysis is governed by the degree of water alkalinity, the susceptibility of the pesticide, the amount of time the pesticide is in contact with the water and the temperature of the mixture.

The solution to the problem is lowering the pH of the water to the optimum range of 4 to 7 before mixing with the pesticide. This is accomplished by adding the recommended amount of buffering or acidifying agent. It should be noted that the buffering does not affect the residual activity of the pesticide. The buffering effect starts at the time of mixing, continues during storage in the tank, and does not stop until the water has evaporated from the spray droplet. Some materials, such as fixed copper fungicides including basic copper sulfate, copper oxide, and Bordeaux mixtures, should not be buffered as the acid solution may make the metals soluble and produce a phytotoxic effect when sprayed on plants. Products used to acidify tank solutions may be straight acidifying agents or in combination with surfactants or nutrient materials like trace elements or fertilizer products.

A pH meter is the most accurate method of determining the pH of water. The use of test papers, such as litmus paper can be non-reliable and can be as much as two pH points in error. There air liquid color indicators (example: Bromothymol Blue) available which can indicate pH to within a half point. Water sources, both surface and ground, can and do change in pH with the passage of time. The change in pH is usually towards a more alkaline condition.

In summary, it is important to know the pH of water used with a pesticide and the susceptibility of the pesticide to hydrolysis. It is best to mix pesticides just prior to the time of application and to mix only the quantities that will be used within the shortest time possible. If conditions dictate, the pH of the water should be adjusted to an optimum level

Common Name	Trade Name	Half-life* at Different pH Values**
2,4-D amine	Weedar 64	stable at pH4.5-7
acephate	Orthene	pH5 = 40 days, pH7 = 46 days, pH9 = 16 days
azinphos-methyl	Guthion	pH5 = 17 days, pH7 = 10 days, pH9 = 12 hours
bendiocarb	Turcam	pH5 = 48 days, pH7 = 3 days, pH9 = 45 minutes
benomyl	Benlate	pH5 = 80 hours, pH6 = 7 hours, pH7 = 1 hour
captan	Orthocide	pH5 = 32 hours, pH7 = 8 hours, pH8 = 10 minutes
carbaryl	Sevin	pH7 = 24 days, pH8 = 2.5 days, pH9 = 1 day
carbofuran	Furadan	pH6 = 8 days, pH9 = 78 hours
chlorothalonil	Bravo, Daconil 2787	stable over wide range of pH
chlorpyrifos	Dursban, Lorsban	pH5 = 63 days, pH7 = 35 days, pH8 = 1.5 days
diazinon	Knox-Out, D.Z.N.	pH5 = 14 days, pH7 = 70 days, pH9 = 29 days
dicamba	Banvel	stable at pH5-6
dimethoate	Cygon, Dimate	pH4 = 20 hours, pH6 = 12 hours, pH9 = 48 minutes
disulfoton	Di-syston	pH5 = 60 hours, pH6 = 32 hours, pH9 = 7.2 hours
fluazifot-P-butyl	Fusilade	pH4.5 = 455 days, pH7 = 147 days, pH9 = 17 days
malathion	Cythion, Fyfanon	pH6 = 8 days, pH7 = 3 days, PH8 = 19 hours
maneb	Dithane Manzate	pH5 = 20 days, pH7 = 17 hours, pH9 = 34 hours
methomyl	Lannate	stable in pH below 7
paraquat	Gramoxone Extra	not stable in pH above 7
pendimethalin	Prowl	stable over a wide range of pH
phosmet	Imidan	pH4.5 = 13 days, pH7 = 12 hours, pH8 = 4 hours
propargite	Omite, 6E & 30W	effectiveness reduced in pH above 7
simazine	Princep	pH 4.5 = 20 days, pH5 = 96 days, pH9 = 24 days
trichlorfon	Dylox	pH6 = 3.7 days, pH7 = 6.5 hours, pH8 = 63 minutes
trifluralin	Treflan	very stable over a wide range pH

* Half-life is the period of time it takes for one-half of the amount of pesticide in the water to degrade. Each half-life that passes reduces the amount of pesticide present in the water by one-half, i.e., 1 to 1/2 to 1/4 to 1/8 to 1/16, etc., or 100% to 50% to 25% to 12.5%,etc.

** These values are generalized estimates and reflect trends, but half-life periods may vary considerably. Hydrolysis depends on other factors besides the pH of the solution, including temperature, solubility, concentration, type of agitation, humidity, time of day of application, mixture time in the spray tank, and other pesticides and adjuvants that are in the mixture.

Source: Loveland Industries, Inc. 11/91 and Wilbur-Ellis 3/30/94

PRECAUTIONARY STATEMENT

All pesticides have both benefits and risks. Benefits can be maximized and risks minimized by reading and following the labeling. Pay close attention to the directions for use and the precautionary statements. The information on pesticide labels contains both instructions and limitations. Pesticide labels are legal documents and it is a violation of both federal and state

laws to use a pesticide inconsistent with its labeling. The pesticide applicator is legally responsible for proper use. Always read and follow the label.

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