How pH affects Pesticide Effectiveness

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HYDROLYSIS OF PESTICIDES

Many commonly used organophosphate and carbamate pesticides are known to degrade rapidly under mildly alkaline conditions as are found in some natural waters throughout the U.S. Buffering adjuvants can extend the effective life of alkaline-sensitive chemicals when properly mixed in the spray tank at time of spraying. Alkaline hydrolysis, the breakdown of chemicals due to the high pH of the water carrier, is one of the leading problems in obtaining effective pesticide control. The amount of acidity or alkalinity (pH) of the spray water can greatly influence how pesticides and other products perform in the spray tank. The pH of most well and stream waters fall within the range of 4 to 9. Most waters are slightly basic because of the presence of dissolved carbonate and bicarbonate salts. Alkaline hydrolysis may also occur—clogging sprayer nozzles, causing plant phytotoxicity, and/or poor pesticide control.

The breakdown or hydrolysis of pesticides is measured in terms of half-life. If a product is 100% effective when first added to water and has a half-life of 4 h—its effectiveness is reduced 50% during this 4-h period. During the next 4 h, its effectiveness is halved again. The shorter the half-life, the greater the effect of alkaline water. Hydrolysis is affected by water pH, the chemistry of the pesticide, length of time the mixture is in the spray tank, the pH of leaf surface, and temperature of spray solution. The source of the irrigation water will determine how often one must check for compatibility with the pesticide to be mixed. Well water would be a water source less likely to change over a short period of time. Conversely, municipal water should be sampled and tested before each spray application.

ADJUVANTS

Adjuvants are materials that are added to a pesticide mixture in the spray tank to improve chemical mixing, application, or otherwise enhance pesticide performance. While pesticides are formulated to be suitable for many types of application conditions, they cannot be formulated for all possible situations. Adjuvants are used to customize the formulation to specific needs and compensate for local water conditions, etc. Adjuvants are used for many things, including adjusting the pH of the spray solution. Most pesticide labels will provide instructions and precautions for mixing adjuvants. Be sure to read and follow label directions.

OPTIMUM PH

The term pH is a measure of the acidity or alkalinity of a solution. Many pesticides are unstable in alkaline solutions, but quite stable if the solution is slightly acid. The optimum pH for most pesticide spray solutions is around 6.0. Some pesticides are most effective when the solution is acidified to a pH of 3.0 - 3.5. A high pH normally causes accelerated breakdown of the pesticide. Many growers know the pH of their soil, but few know the pH of their water supply.

COMPATIBILITY TEST

A simple test to check pesticide compatibility is given below.

1) Measure 473 ml (1 pt) of the intended spray water into a clear 946 ml (1 qt) glass jar.

2) Adjust the pH of the water if necessary.

3) Add ingredients as listed below. Be sure to stir each time an ingredient is added.

- Surfactants, compatibility agents, and activators are added to water at the rate of 5 ml (1 tsp) for each 473 ml (16 oz) of pesticide per 379 liters (100 gal) of planned final spray mixture.
- Wettable powders and dry flowable formulations are added at the rate of 15 ml (1 tsp) for each 0.5 kg (1 lb) pound per 379 liters (100 gal) of planned final spray mixture.
- Water- soluble concentrates or solutions are added at the rate of 5 ml (1 tsp) for each 473 ml (16 oz) of pesticide per 379 liters (100 gal) of planned final spray mixture.
- Emulsifiable concentrate and flowable formulations should be added at the rate of 5 ml (1 tsp) for each 473 ml (16 oz) of pesticide per 379 liters (100 gal) of planned final spray mixture.
- Soluble powder formulations are added at the rate of 5 ml (1 tsp) for each 473 ml (16 oz) of pesticide per 379 liters (100 gal) of planned final spray mixture.
- If required, additional adjuvant is added at the rate of 5 ml (1 tsp) for each 473 ml (16 oz) of pesticide per 379 liters (100 gal) of planned final spray mixture.
- After mixing, stir and let the solution stand for 15 min before observing the mixture.

If the mixture is compatible, it will be of one consistency and combine well after stirring. However, incompatible mixtures will exhibit clumps, layering, graininess, or particle separation. Incompatible emulsifiable concentrate (EC) mixtures will not have the desired milky formation, but may have an insoluble sludge or contain layers of pesticide within the mixture. Wettable powders (WP) are usually lumpy indicating that the material did not go into suspension. If a pesticide mixture is incompatible after initial mixing, an additional compatibility agent should be added at the rate of 6 drops and the solution allowed to sit for 1 h. If, at the end of the hour, the material still doesn't seem compatible, add an additional 6 drops and wait 1 h. If problems persist, dispose of the mixture and start over by adding compatibility agent first.

BUFFERS AND ACIDIFIERS

Buffers are substances capable of changing the pH of a water solution to a certain level and maintaining a relatively constant pH, even if water alkalinity changes. On the other hand, acidifiers (acidulaters) are acids that can be added to spray mixtures to neutralize alkaline solutions and lower the pH. Acidifiers do not have buffering action, therefore acidic or alkaline materials added to the spray solution later will change the pH of the solution.

Always read the pesticide label before mixing or combining with another pesticide or fertilizer. Usually, a statement can be found on the label regarding compatibility at various pH and precautions about mixing with other pesticides.

Several companies, including W. A. Cleary, Terra International, Riverside, Miller, DuPont, Valent, and others make adjuvants for use in obtaining compatibility with pesticide mixtures. If your spray solution isn't doing as well as you think it should, check the water pH.