FACT SHEET

THE IMPORTANCE OF pH CONTROL IN SPRAY SOLUTIONS

Often we ask what affect does the pH in our spray solution have on pesticides and fertilizers that we apply to crops. In this article I will try to outline some of the information that we have acquired from various sources to try and shed some light on this topic.

The theory behind pH measurement is quite complex; the concept of pH is quite easy to understand. pH is a measure of the acidity or alkalinity of aqueous solutions. On a scale of 1 -14, pH 7.0 is neutral. In the range pH 0 - 7, the lower the number the more acidic the solution. In the range pH 7 - 14, the higher the number the more alkaline the solution.

For a number of years, attention has been paid to soil pH as an indicator of availability of nutrients, the presence of undesirable components, and suitability of the soil as a medium for growth of various crops. Until recently, however, no thought was given to the pH of spray solutions applied to plant foliage. It now appears that solution pH is important in several different respects.

pH INFLUENCE ON STABILITY OF PESTICIDES

One of the most important practical effects of pH is its relationship to pesticide stability.

Many commonly used pesticides are susceptible to alkaline hydrolysis in spray solutions. This means that a measurable amount of the pesticide decomposes to an inactive form if the spray solution is alkaline. Water supplies in many areas range from pH 7.5 - 9.0.
Decomposition of pesticides in water of this alkalinity may result in poor insect control. Such decomposition may be slowed or prevented by acidifying spray solutions to a pH of 6.0 or below with an acidifying product. Acidified pesticide sprays frequently give improved initial pest control and longer residual control.

pH EFFECT ON SOLUBILITY OF PRODUCTS

Any products having a neutral pH and low initial water solubility have a limited amount of nutrients that are available for immediate plant uptake. Nutrients must be present in water-soluble form for plant uptake. In order to make nutrients more soluble in spray solution and more readily available for plant uptake we need to acidify the spray solution to a safe level. Where quick response is desired, such as in fast-growing crops or where deficiency correction is urgent, this effect is especially important.

pH EFFECT ON RESPONSE TO FOLIAR SPRAYS

Foliar absorption is pH dependent. This is attributed to the effect on the cuticle of complex electrostatic repulsion and attraction phenomena, which are regulated by pH. It is believed that for each Phosphate, for example, has its greatest absorption and utilization at a pH 3-3.7. There is evidence that Zinc is absorbed best at pH 4.1-4.9. The optimum pH probably varies somewhat with each nutrient and its carrier. Information on optimum pH values for nutrient absorption is extremely limited at this time.

pH EFFECT ON LEAF SURFACES

While pH plays an important part in penetration of spray solutions through the cuticle, its further effect on the leaf surface must also be considered. The principal concern is

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for phytotoxicity or other adverse plant reaction. Plants are generally tolerant of sprays having a wide range of pH. Extremes at either ends of the pH scale naturally should be avoided. Lime is sometimes added to Whitewash, Bordeaux, or minor element sprays. These sprays may have a pH of 12 or higher. After spraying, lime is converted to neutral Calcium carbonate by carbon dioxide in the atmosphere. Within less than 12 hours, the pH falls to under 9.0, even so, lime is known to have a serious dehydrating effect on plants, and its use is generally kept to a minimum.

On the low end of the pH scale, Phosphoric Acid is reported to burn foliage at a pH of 2.0 but not at pH 3.0. Within the limits pH 2 - 12 there is a wide variety of materials that may show phytotoxicity. pH may be involved in some of them. Soluble metal sulfates, for example, have a tendency to exhibit phytotoxicity in acid sprays. This is due to their ability to hydrolyze with the formation of Sulfuric Acid. For this reason, metal sulfates are frequently reacted with hydrated lime (Ca (OH)2) or soda ash (Na2C03) to raise the pH to the range where Sodium or Calcium salts of Sulfuric Acid are present instead.

Other factors besides pH that affect phytotoxicity is concentration, salt index, chemical reactivity, and weather conditions.

ADDITIONAL pH EFFECT

There is evidence that acidified sprays may be helpful in suppressing mite populations. In areas where Sevin is applied with Captan in post-bloom sprays on deciduous fruit trees, it is frequently necessary to spray the trees later for control of European red mites. This is attributed to reduction by Sevin of the mite-predator population since mite populations do not normally increase if Captan is applied by itself. When the Sevin-Captan spray is acidified with an acidifier, mite populations remain suppressed. It has not been determined whether this is due only to a pH effect or whether other components in the spray material may also contribute.

Acidification of Dylox with Sorba-Spray Mg an excellent source of foliar Mg in orchards, increases the effectiveness of the Dylox against lygus bugs but does not increase its hazard to alkali bees, alfalfa leafcutter bees, or other beneficial insects such as damsel bugs and big-eyed bugs. This suggests the possibility that the resistance mechanisms of these beneficial insects may be reinforced in some manner by certain components of the Sorb-Spray. Another interpretation is that the body fluids of these insects have a pH high enough to rapidly hydrolyze the Dylox.

Certain diseases may also be susceptible to control by pH. Cedar apple rust spores, for example, are prevented from propagating when apple trees are sprayed with solutions acidified with ZKP. This control is reported to be strictly pH-dependent.

pH CONTROL IN THE SPRAY TANK

It is apparent from the previous comments that there are advantages to be gained from pH control. The evidence suggests that, with certain exceptions, spray solutions should be acidic. Pesticides are most effective at a pH of 6.0 or below. Phosphate is absorbed best at a pH slightly below 4.0. Most spray products become more soluble as pH decreases. Acid spray solutions help control certain fungi and may be a factor in maintaining populations of some beneficial insects. Spray solutions should not be acidified if they contain lime, lime sulfur, or fixed copper products such as Bordeaux, carbonate, hydride, etc. where copper may become solubilized by the acidity resulting in possible plant injury.

The question; may arise as to whether it is possible to get the pH too low. Solutions having a pH of 2 .0 or lower could be expected to cause leaf burn. Dilute spray application will seldom approach pH 2.0.

In summary, the evidence suggests that spray solutions should be adjusted to the pH range 4 - 6 unless they contain fixed Copper compounds, lime, or lime sulfur. In this pH range, many pesticides are more effective. Nutrient uptake and utilization is best, certain fungi are more susceptible to control, beneficial insects may be more resistant to pesticides, and safety of spray solutions is at a maximum.