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Water Quality & Herbicide Performance

Water is the most common liquid used to dilute pesticides and deliver them to the target pests that they are intended to control. There are three water quality variables that can impact the activity of many pesticides 1) Acidity & Alkalinity, 2) Dissolved Minerals, and 3) Suspended Soil Particles.

Acidity & Alkalinity

Acidity or alkalinity is measured in terms of pH. pH indicates the potential for water to breakdown into a positively-charged hydrogen ion (H⁺) and a negatively-charged hydroxide molecule (OH⁻). pH is measured on a scale from 1 to 14 with 1 being highly acidic, 7 being neutral, and 14 being highly alkaline.

In general, the ideal pH for water used with pesticides is slightly acidic (pH 4.0 to 6.0). Make sure to read the label of the pesticide you intend to use as there are always some exceptions. For example, some herbicides can break down in the sprayer tank when the pH is too acidic. The sulfonylureas such as Ally, Escort, Amber, Harmony Extra, Express, and Accent may inactivate if left in a sprayer tank mixed in acidic water. Higher temperatures cause these herbicides to inactivate at a faster rate.

Insecticides, on the other hand, can break down once mixed with water that is too alkaline. Fungicides such as Benlate, Bravo, & Captan can also inactivate quickly if left in a sprayer tank mixed with alkaline water.

Use the following general guidelines once you have determined what the pH is of your spray water. Remember, ALWAYS READ & FOLLOW THE PESTICIDE LABEL DIRECTIONS.

- pH 3.5 – 6.0 Satisfactory for most spraying and short-term (12 to 24 hours) storage of most pesticide mixtures in the spray tank. Read the label.
- pH 6.1 – 7.0 Adequate for immediate spraying of most pesticides. Do not leave the spray mixture in the tank for over 1 to 2 hours to prevent loss of effectiveness.
- pH > / = 7.0 Add buffer or acidifier.

You can offset the effects of water pH by adding certain adjuvants (additives) that can either change the pH of your spray mixture or maintain (buffer) the pH if it is already at the desirable level. These buffering agents / acidifiers include: Buffer Xtra Strength, Buffer PS, Induce pH, and Request (Helena Chemical Co.), LI 700 (Loveland Industries), and Trifol and Super Spread 700 (Wilbur Ellis).

Dissolved Minerals

The activity of some herbicides can be adversely affected by certain minerals dissolved in water. This is especially true of salt-formulated herbicides such as glyphosate (Roundup), Poast, Pursuit, and Liberty. The first important property to measure where dissolved minerals may be a problem is the Total Dissolved Solids (TDS).

Many chemical elements can be dissolved in water but six major ions make up the dissolved material in most water: Calcium (Ca⁺⁺), Magnesium (Mg⁺⁺), Sodium (Na⁺), Sulfate (SO₄⁻), Chloride (Cl⁻), and Bicarbonate (HCO₃⁻). Small amounts of potassium (K⁺), Iron (Fe⁺⁺, Fe⁺⁺⁺), nitrate (NO₃⁻) or other ions may be present, but in most natural waters, the six major ions are the only dissolved minerals usually present in significant quantities.

TDS is generally expressed in parts per million (ppm) and can be quickly determined by measuring the electrical conductivity (EC) of the water. EC is generally expressed in microsiemens per cm (µS/cm) @ 25°C. EC and or TDS is a useful indicator of water quality. 2.0 µS/cm EC equals 1.0 ppm TDS. If the EC is less than 500 µS/cm (TDS is less than 250 ppm), it is unlikely that pesticide performance will be affected.

The term “hard water” refers to the presence of certain minerals in the water. Hard water becomes “hard” because of the presence of carbonates, sulfates, and chlorides of calcium, magnesium, and iron. Hardness is generally expressed in milligrams per liter (mg/L), parts per million (ppm) or grains per gallon of calcium carbonate (CaCO₃) plus the amount of magnesium present as a calcium carbonate equivalent. Water containing calcium and magnesium can reduce the effectiveness of glyphosate and 2, 4-D amine. The following table shows a standard classification system for describing water hardness:

<u>mg/L or ppm</u>	<u>Grains</u>	<u>Relative Hardness</u>
0 – 75	0.0 – 4.4	Soft
75 – 150	4.4 – 8.8	Moderately Hard
150 – 300	8.8 – 17.5	Hard
> 300	> 17.5	Very Hard

In terms of water hardness, alkalinity is defined as a measure of the water's ability to neutralize acids and bases. In other words, it is the buffering capacity of the water and is measured in ppm. In order for water to be classified as hard, its calcium carbonate concentration must be > 150 ppm and its alkalinity must also be > 150 ppm. pH levels are usually relatively stable in hard water, but we can use acidic chlorine to achieve a normal pH balance in water. However, hard water ions can also from insoluble compounds.

Water with a hardness of 600 ppm (35 grains) can almost completely antagonize 2, 4-D amine applied at a low rate of about ½ cup per acre. The use of a surfactant at 0.1% by volume (1/2 quart surfactant per 125 gallons of spray mixture) can overcome these effects.

Suspended Soil Particles

The effectiveness of some herbicides can be reduced by the presence of suspended silt and organic matter, both of which can reduce the activity of the following herbicides: Diquat (Reglone, Reglone A), Paraquat (Gramoxone), and Glyphosate (Roundup, Laredo, Wrangler, Rustler).

These products are very susceptible to inactivation by silt and organic matter so it is important to use only clear, clean water for mixing these products. It should be noted that the same kind of inactivation can occur when these products are applied to plant surfaces that are covered with a layer of dust. Dust kicked up during the spraying operation may also result in reduced control, especially directly behind the sprayer.

Practical Solutions if Water Quality is a Concern

1. Test your water source and assess for suitability for spraying pesticides.
2. Reduce the water volume to the minimum required for good coverage and performance. Check the label for water volume specifications.
3. Use a pesticide that is least affected by water quality. For 2,4-D, use LV ester formulations or use the maximum labeled rate of amine formulation. Use a non-ionic surfactant if an amine formulation of 2,4-D is used.
4. Seek an alternative water source.
5. Spray as soon as possible after adding the pesticide to the sprayer tank.

6. Where hard water is a concern with glyphosate applications, use spray grade ammonium sulfate (21-00-00-24S) at a rate of 8 ½ to 17 pounds per 100 gallons of water. Use the higher rate where water is extremely hard. There are many commercial adjuvants on the market that act as water conditioners. These products include: Bronc and Cayuse Plus (Wilbur Ellis), Choice (Loveland Industries), and Quest and Request (Helena Chemical).
7. Where bicarbonate occurs in water, avoid using Achieve, Select or Poast where there is more than 500 ppm of bicarbonate. When there are concentrations of > 500 ppm, use the maximum labeled rate of herbicide for the target weed and apply the herbicide at the optimum growth stage of the weeds. Liquid ammonium sulfate (08-00-00-09S) at a rate of 1 ½ quarts per acre will overcome the antagonistic effects of bicarbonate in the spray water. Since 2,4-D activity can be affected by bicarbonate ions, use the LV ester formulation if practical. Use MCPA amine or ester rather than 2,4-D amine if MCPA is recommended. Use a non-ionic surfactant.
8. Don not use water where iron is shown to occur. When iron that is dissolved in groundwater is exposed to the air, it can oxidize and produce an orange precipitate that can plug screens and nozzles.

Summary

To be sure that your water supply does not pose a potential problem with pesticides, always have the source of your spray water tested.

Bibliography

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