

Weed Control Alert



Importance of AMS Use With Roundup PROMAX® Herbicide When Hard Water is an Issue

Ammonium sulfate (AMS) is often recommended to be used with Roundup® herbicides. AMS conditions hard water and makes it easier for the herbicide to penetrate into the plant resulting in better weed control.

Hard Water. Glyphosate, the active ingredient in Roundup PROMAX®, can be tied up by hard water thereby reducing the performance of the herbicide. The glyphosate molecule is often negatively (-) charged when dissolved in water and can be tied up by hard water elements which are positively (+) charged. There are several elements in hard water that bind to glyphosate including calcium, magnesium, and iron. Water hardness is a measure of the amount of these elements in water, and is usually expressed as parts per million (ppm) or as grains per U.S. gallon (one grain per gallon = 17.1 ppm). Water with a hardness of 200 ppm or more is considered “hard” and can reduce glyphosate performance.

Reclaimed Water. Reclaimed water is being used more frequently by landscapers and others in the green industry as the cost of domestic water supplies increases and the availability decreases. Generally, the quality of reclaimed water is lower than the original irrigation supply. Elements such as calcium and magnesium may be found at higher concentration levels in reclaimed water than in domestic or original irrigation supply water. That’s because the waste-water-treatment process usually does not deal with inorganic salts. The “salt” content of reclaimed water varies with location. If you are using reclaimed water in your spray mixture, consider the possibility that it may contain enough hard water elements to negatively affect glyphosate performance.

Water pH. Water pH is a measure of the H⁺ ion concentration in water. As water pH decreases, it becomes more acidic and the number of H⁺ ions increases. Slightly acidic water (pH 5 to 6) is most suitable for mixing a weak acid herbicide, like glyphosate. Glyphosate dissociates less under acid conditions where H⁺ ion concentration is high. If water pH is alkaline (pH > than 7) the glyphosate molecule will dissociate, leaving the glyphosate acid (which is negatively charged) available to complex with hard water cations in the spray solution. Oftentimes, water with a high pH will also be a “hard” water.

Scientists have tested a variety of possible solutions to address glyphosate’s reduced effectiveness when mixed with hard water. Possible solutions such as reducing the spray volume, adding more surfactants to the spray solution, adding a chelate like EDTA or citric acid to sequester the calcium and iron, acidifying the spray solution with sulfuric acid, or adding an ammonium-based fertilizer (like AMS or urea ammonium nitrate). After years of extensive testing, most researchers have concluded that AMS is the most consistently effective and economical approach to overcome hard water antagonism.¹

How AMS Works. When AMS is dissolved in water, it breaks down into ammonium (NH₄⁺) and sulfate (SO₄⁻). The negatively (-) charged sulfate binds to positively (+) charged hard water elements. Therefore, these elements are not available to bind with glyphosate when it is added to the spray tank solution. Additionally, the positively (+) charged ammonium binds to the negatively (-) charged glyphosate, further blocking hard water elements from tying up and deactivating the herbicide. AMS also prevents glyphosate from binding to dirt particles on the surface of the leaf, and it reduces antagonism with several residual herbicides.

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Testing the hardness of your water is recommended to determine the need for adding AMS. If you add AMS, it should be added to the spray tank first, before the addition of Roundup® herbicides or any other tank mix partners. Ensure that dry AMS is completely dissolved in the spray tank before adding herbicides.

Use 8.5 to 17 pounds (1 to 2 percent by weight) of dry spray grade AMS per 100 gallons of water. Liquid AMS products are also available and are as effective as dry AMS. When selecting one of these products, it is important that they deliver enough AMS at the recommended rate to provide performance equivalent to dry AMS product. The equivalent amounts of liquid AMS are 2.5 to 5 gallons of AMS per 100 gallons of spray solution. Check the liquid product's concentration of AMS to determine the actual amount of AMS you're adding to the spray tank. In university trials designed to test the limits of adjuvant effectiveness, many water conditioners or adjuvants containing AMS did not perform as well as granular AMS. To get enough AMS from an AMS substitute, a rate of 2.5 gal/100 gal or higher may be necessary, if allowed by the product label.²

Table 1. Amount of dry or liquid AMS to add to the spray tank

Type of AMS	100 gallons water	1 gallon water
Dry	8.5 – 17 pounds	1.4 – 2.7 ounces (wt.)
Liquid	2.5 – 5.0 gallons	3.5 – 6.5 ounces

- Use higher rates in tank mixes with residual herbicides, or when targeting tough-to-control weeds (such as marestail, flax-leaf fleabane, russian thistle, or annual bursage).
- Thoroughly rinse the spray system with clean water after use to reduce corrosion.

A number of spray enhancement products are sold as alternatives to AMS. These are often recommended at much lower rates and may or may not include AMS. However, Kansas State University research has shown that many of these materials do not enhance glyphosate performance as well as AMS.²

¹ AMS - What Is It Doing In My Tank?, University of Nebraska-Lincoln Extension, Institute of Agriculture and Natural Resources, April 20, 2007

² AMS Substitutes - What Does University Research Show, University of Nebraska-Lincoln Extension, Institute of Agriculture and Natural Resources, April 20, 2007

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the benefits of Roundup PROMAX®.

