

Addition of Ammonium Sulfate (AMS)

Over the last 10 years more and more people have been adding fertilizer solutions to herbicides in their tank mix to increase control of undesirable plants. Ammonium sulfate, ammonium nitrate or urea plus ammonium nitrate added to spray tanks has been shown that it can increase efficacy of postemergent herbicides. How does this work? Well, we don't exactly know, but experiments have shown that these compounds can increase the amount of herbicide that is absorbed into the plant. The most commonly used fertilizer is ammonium sulfate (AMS), although many other options exist.

While we don't know all of the reasons to why adding fertilizer to our spray tank improves control, we do know that adding AMS to our spray tank will overcome negative interactions with salts present in the water. Calcium, magnesium, sodium, and potassium have all been reported to reduce the efficacy of weak acid herbicides. These herbicides include: 2,4-D and glyphosate compounds as well as many other common herbicides (see table for a list of common weak acid herbicides). Including AMS in a spray tank solution with calcium, magnesium, sodium, or potassium present has been shown to counteract this antagonistic effect. Experts have found that as drops of herbicide solution dry on a leaf, they form salts on the leaf surface. These salts that form will have various rates of absorption from the leaf surface into the plant tissue. Researchers found that plants would absorb salts of glyphosate much more readily if the glyphosate ion is bound with ammonium compared to sodium or calcium. When glyphosate is mixed with water that contains calcium and sodium ions, calcium and sodium glyphosate salts will form as the drop dries on the leaf surface. If AMS is added at the correct rate, calcium sulfate and ammonium glyphosate form instead of sodium or calcium glyphosate. Glyphosate bound with ammonium instead of calcium or sodium will be taken up at a greater rate into the plant. Once the glyphosate salt enters the plant it will separate from its attached ion and begin to take its effect. In more simple terms, adding AMS to your tank mix can increase the amount of herbicide that will enter the plant tissue and increase levels of control IF high levels of these ions are present in your water supply.

Do you always need to use AMS? No, but concentrations of calcium as low as 150 ppm have been shown to antagonize glyphosate. Researchers at North Dakota State University developed the following equation to calculate the amount of AMS needed:

$$\text{AMS (lbs./ 100 gallons water)} = (0.009 \times \text{ppm of calcium}) + (0.005 \times \text{ppm of sodium}) + (0.002 \times \text{ppm of potassium}) + (0.014 \times \text{ppm of magnesium}).$$

So if you have access to information about the salts in your water you can add the correct amount of AMS. If not read the label, and apply the recommended amount, this can range from 4.25- 17 lbs of AMS/100 gallons. Fortunately AMS is VERY CHEAP, so this shouldn't inhibit its use. Addition of AMS can dramatically improve control of weak acid herbicides if you have high levels of calcium, magnesium, potassium, or sodium in your water supply.

Table of common weak acid herbicides.

Active Ingredient	Herbicides with this active ingredient
2,4-D	Many; HiDep, Weedar 64, Weedone LV64, Weedmaster
Acifluorfen	Blazer
Bentazon	Many; Basagran
Clopyralid	Many; Transline, Reclaim, Stinger
Dicamba	Many; Clarity, Banvel, Veteran
Glufosinate	Ignite, Liberty, Rely
Glyphosate	Many; Roundup, Rodeo, Glyphomax, Touchdown
Pelargonic acid	Scythe
Picloram	Many; Grazon PC, Tordon 22K
Quinclorac	Paramount, Drive, Facet
Triclopyr	Many; Garlon 3A, Garlon 4, Remedy

Additional information is available in these resources:

Woznica, Z. N., J. D. Nalewaja, C. G. Messersmith, and P. Milkowski. 2003. Quinclorac efficacy as affected by adjuvants and spray carrier water. *Weed Technology* 17:582-588.

Pratt, D., J. J. Kells, and D. Penner. 2003. Substitutes for ammonium sulfate as additives with glyphosate and glufosinate. *Weed Technology* 17:576-581.

Nalewaja, J. D. and R. Matysiak. 1993. Influence of diammonium sulfate and other salts on glyphosate phytotoxicity. *Pesticide Science* 38:77-84.

Bob Hartzler 2001, Iowa State University website. Role of AMS with glyphosate products. <http://www.weeds.iastate.edu/mgmt/2001/ams.htm>