# Glyphosate Remediation Program

David N. Sasseville, Ph.D.
**AgriGuardian**

When it has been determined that glyphosate has been applied to a non-target (unintended) crop, these steps can be used to reduce the symptoms and the severity of the damage caused by the herbicide. At present, no scientifically proven treatment is known that speeds the breakdown glyphosate. Free (active) glyphosate does not persist for an extended period of time in the most soils. However, glyphosate bound to nutrient particles has been reported to persist in the soil for 20 years or more. The bound glyphosate compound in the soil (typically bound through chelation of a divalent cation – Fe, Mn, Cu, Ni, Zn, Ca and Mg) does not display herbicidal properties. However, high levels of phosphorus fertilizer can result in the splitting of the glyphosate molecule from the divalent cation, releasing an active glyphosate molecule into the plant-soil environment. The following sets are used to reduce the symptoms of glyphosate damage resulting from unintended application to a plant or crop susceptible to glyphosate damage (i.e. an non-Roundup Ready crop).

Apply the following products to the crop as soon as it is determined that glyphosate damage is a concern or symptoms are already occurring. Apply products as a foliar application, using adequate water to give uniform cover. Ten (10) to twenty (20) gallons of water per acre are typical, depending on the crop. Apply the products so that the spray solution remains on the foliage and is not washed off by heavy rainfall or irrigation. As with all foliar applications, it is best to apply with the temperatures are mild and humidity is high, such as in early morning or late evening.

**Initial Foliar Application** – apply all products together in a single application in 10-20 gallons of water per acre.

1) Foliar Blend – 32 oz foliar application
2) Micro Mix – 12-16 oz*
3) AgriGuardian Zinc – 8-16 oz*

**Follow-up Applications** – every 4 weeks (this may be increased to every 2-3 weeks if the symptoms are severe). Again, mix in 10-20 gallons of water per acre.

1) AgriGro Foliar Blend – 16 oz foliar application
2) AgriGuardian Micro Mix – 6-8 oz*
3) AgriGuardian Zinc – 4-8 oz*

*More severe symptoms use higher rates.

With perennial crops, it is advisable to continue application through the next crop cycle (possibly at less frequent intervals) to ensure that the continued growth and vigor of the crop.

# Mechanisms of Glyphosate Damage and How AgriGuardian and AgriGro Products Help

Glyphosate causes damage to non-target plants in several ways, and here is how these products are used to help reduce the harmful effects of sub-lethal doses of glyphosate to non-target (unintended) crops and plants:

1) **Micronutient Tie-up.** When plants are exposed to a non-lethal dose of glyphosate a common symptom is the yellowing of the leaves. Glyphosate is a strong chelating agent that binds various essential plant nutrients inside the plant making them unavailable for use by the plant, primarily the micronutrients Fe, Mn, Cu, Ni and Zn. When plants are exposed to glyphosate, tissue tests may show that these nutrients are within acceptable ranges within the plant tissues; however, when these nutrients are bound to glyphosate molecules, the nutrient will be included in the results of the tissue test, but the plant cannot use these nutrients. To replenish the crops with usable nutrients, foliar application is the most effective means to get these nutrients back into the tissue and to alleviate the chlorosis (yellowing of the leaves) caused by the glyphosate. The application of micronutrients is done to replenish the tissue with the essential plant nutrients tied up by glyphosate. The nutrients in AgriGuardian Micro Mix and AgriGuardian Zinc are designed for rapid uptake and utilization by the plant. These products do not lose their ability to provide nutrients to plants if they come into contact with glyphosate. These products were originally formulated to be tank mixed with glyphosate for application to Roundup Ready crops to eliminate "yellow flash" observed with Roundup Ready crops when glyphosate is applied to them.

2) **Micronutrient Deficiencies and Plant Metabolic Slowdown.** When glyphosate ties up essential plant nutrients within the plant, it causes the shutdown of many biochemical pathways, which result in the yellowing, stunting and distortion observed in plants exposed to sub-lethal doses of glyphosate. Most biochemical pathways need micronutrients as "cofactors" which are required for these reactions to occur. These nutrients or cofactors are not consumed, so they can be used over and over again, similar to a car key that is used to start a car's engine. When these nutrients are unavailable, the biochemical pathways in the plant cannot produce the compounds and building blocks needed for the plant to grow (just like a car won't get very far down the road without its car keys!).

3) **Growth Promotion and Natural Defense Mechanism Suppressed.** Sub-lethal doses of glyphosate slow down plant biochemical pathways. Consequently, the quantity of essential plant growth promoting compounds produced in the plant is reduced as well. Some of these compounds are

required by the plant to defend it against pathogens and environmental stresses. In addition to the application of essential micronutrients tied up by glyphosate, the application of natural plant growth-promoting and health enhancing compounds helps the plant to recover quickly from the effects of sub-lethal doses of glyphosate. AgriGro Foliar Blend is a biostimulant product that enhances both plant growth and plant health by the addition of naturally occurring growth-promoting compounds. These aid in defending the plants from pathogens and routine environmental stresses. Foliar Blend is not a pesticide, but helps to make plants healthier and better able to defend itself against attack by strengthening the plant's natural defenses.

4) **Promotion of Diseases and Need for Microbial Balances.** Another consequence of glyphosate is the promotion of various pathogens, primarily in the soil. The two most common are pythium and fusarium species, but over 40 different pathogens have been reported to be increased as a result of glyphosate application. Another aspect of Foliar Blend is the promotion of balanced microbial populations in the plant and soil environment. When microbial populations are in balance, diseases caused by pathogens are reduced because other microorganisms help to keep the pathogen in check. Diverse microbial populations 1) compete with each other for food, 2) produce compound that antagonize each other, and 3) microbe even use each other as a food source. Again Foliar Blend is not a pesticide, but by stimulating a wide array of microorganisms, it aids in the suppression of diseases that can harms crops.

*While used here to offset the consequences of unintended exposure of crops to glyphosate, AgriGuardian and AgriGro products routinely increase the yield and quality of all crops, and may be considered as part of a routine crop production program. Ask distributor for more details on the use and benefits of AgriGuardian and AgriGro products.*