

## Maximizing Glyphosate Activity in Glyphosate-Resistant Crops

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The goal of all growers should be to maximize glyphosate activity whenever it is applied to glyphosate-resistant crops. This goal should maximize profitability and weed control and reduce the risk for herbicide resistance. Below are the most important management strategies for improving glyphosate activity. For additional information, consult pages 68 and 69 in the 2008 North Dakota Weed Control Guide.

1. Apply glyphosate to small (< 4") annual weeds.
2. Apply glyphosate to perennial species in the bud to early-flowering stage of development.
3. Apply the most effective rate for the most difficult to control species in the field. For many annual species the minimum rate of glyphosate should be 0.75 pounds acid equivalent/acre (lb ae/A). Species such as lambsquarters, velvetleaf, wild buckwheat, common ragweed, common mallow, smartweeds, horseweed/marestail, and waterhemp can be difficult to control with glyphosate. Consider using the maximum single-use rate of glyphosate for these species, especially if a reduction in control has been observed over time. Rates of glyphosate greater than 0.75 lb ae/A usually improves control of perennial species, compared to lower rates. Multiple glyphosate applications can also improve control of perennial species.
4. Always add ammonium sulfate (AMS) to glyphosate mixtures. Ammonium sulfate should be added at a minimum of 4 pounds per 100 gallons of spray mixture (lbs/100 gal) for most of North Dakota. Add additional AMS if water hardness is greater than 1600 ppm.
5. Allow at least a 6 hour rainfast period for all glyphosate formulations for maximum activity. A shorter rainfree period can be acceptable for the most susceptible species. Lambsquarters control is usually reduced if the rainfree period is less than 6 hours.
6. Apply glyphosate during the warmest and most humid weather conditions to maximize activity.
7. Most glyphosate formulations include nonionic surfactant (NIS) at a high enough concentration for maximum activity. However, some glyphosate formulations do not include NIS. For these formulations add a quality NIS product at 0.5 to 1.0 % v/v. Some weed species, especially lambsquarters, may be more effectively controlled with the addition of NIS at 0.25 % v/v to "loaded" glyphosate formulations. Know which glyphosate formulations prohibit the use of additional NIS.
8. Glyphosate activity is influenced by the time of day of the application. Maximum activity occurs between 10:00 AM and 4:00 PM. Velvetleaf and common ragweed control may be the most negatively affected by the time of the glyphosate application.
9. Application of glyphosate in low water volumes improves glyphosate activity. However, when spraying large weeds and/or dense weed canopies, higher spray volumes usually improves glyphosate activity.
10. Glyphosate is strongly and irreversibly absorbed to clay particles and organic matter. Therefore dust of any amount, especially initiated by the wheels of the sprayer, will cause a reduction in glyphosate activity. The best methods for decreasing this problem are to

drive slower and put higher volume nozzles in the boom over the wheels. These solutions will not completely solve the problem and growers must remember to not apply greater than the single-use rate of glyphosate when using the higher volume nozzles.

11. When mixing other herbicides with glyphosate, add the most effective adjuvant for the herbicide being added. This strategy will maximize the activity of the herbicide(s) being added to the glyphosate mixture. If the herbicide being added to the glyphosate mixture recommends the addition of an oil adjuvant for maximum activity, then add an adjuvant which will perform like an oil adjuvant, but not antagonize the glyphosate. This is important because most oil adjuvants antagonize glyphosate activity. Current NDSU research indicates that Superb HC and Destiny HC, high surfactant oil concentrates, will perform like oil adjuvants, but will not antagonize the glyphosate. Superb HC and Destiny HC should be added at 0.5% v/v.