GLYPHOSATE EFFICACY: INFLUENCE OF ADJUVANTS AND TANK-MIXED PESTICIDES. Brad K. Ramsdale, Sam J. Lockhart, and Calvin G. Messersmith, Postdoctoral Research Fellow, Research Specialist, and Professor, Department of Plant Sciences, North Dakota State University, Fargo, 58105.

Glyphosate use has increased greatly in recent years due to development of glyphosate-resistant crops. Glyphosate-resistant crops in North Dakota include soybean, corn, canola, and potentially hard red spring wheat in the near future. Accordingly, growers would desire to apply glyphosate with insecticides and fungicides to maximize the efficiency of their pest control operations. Numerous glyphosate products are currently available including glyphosate pre-mixed with various herbicides; glyphosate as isopropylamine, ammonium, and diammonium salts; and glyphosate formulated alone or with various adjuvants. Consequently, there are many issues regarding adjuvant recommendations to maximize efficacy of these new glyphosate products. Therefore, a series of field experiments were conducted in 2002 to examine the influence adjuvants, spray water quality, and tank-mixed insecticides and fungicides on glyphosate efficacy.

Bioassay species were seeded side-by-side with a small grain drill with one drill pass of each species per replicate, and plots 10 ft wide were laid out perpendicular to the strips so that each plot contained the seeded assay species. Treatments were applied at 8.5 gpa with a CO_2-pressurized bicycle-wheel-type plot sprayer equipped with four 8001 flat-fan nozzles at 20-inch spacing. Experimental design was a randomized complete block with four replicates, and each experiment was repeated at two or three locations. Glyphosate was applied at a reduced rate of 0.06 lb ae/A to better detect treatment effects on herbicide efficacy. Adjuvants, insecticides, and fungicides were applied at labeled rates. Weed control was evaluated visually where 0 equaled no visible injury and 100 equaled complete death of assay species. Experimental methods and environmental conditions at treatment are further described in individual reports published in the North Central Weed Science Society Research Reports Vol. 59.

Glyphosate as Roundup Custom was influenced less by insecticides and fungicides than Roundup UltraMax and Touchdown formulations applied with 1% w/v ammonium sulfate (AMS). The surfactant in Class Act Next Generation applied with Roundup Custom may have minimized any adverse influence of the tank-mixed pesticides. Overall, pesticides formulated as emulsifiable concentrates, particularly dimethoate and chlorpyrifos, were occasionally synergistic to the reduced glyphosate rate. Flowable formulations of pesticides were occasionally antagonistic to glyphosate; most notable was the fungicide azoxystrobin.

Spray water quality did not affect glyphosate (Roundup Custom) efficacy for various adjuvant-fertilizer blends, indicating that all contained a sufficient amount of AMS to overcome the antagonistic salts (1550 ppm $CaCO_3$) in the hard water source. The adjuvant-fertilizer blends were applied at a rate to provide 8.5 lb AMS per 100 gal water. Glyphosate (Roundup Custom), which does not include a surfactant, was most effective when applied with adjuvants that contained surfactant, which included L-283 (NDSU experimental adjuvant blend), Surfate, Class Act Next Generation, Bronc Plus, and One-Ap XL. The drift retardant-AMS blends of Corral AMS, Surf Plus, and Gardian Plus, which do not contain a surfactant, were generally the least effective. However, glyphosate with Placement Pro-Pak or Array was generally more effective than with the other drift retardant-AMS blends, except with One-Ap XL which also contains surfactant. Thus, with glyphosate (Roundup Custom), which does not contain a surfactant, adjuvant-fertilizer blends that contained surfactant were the most effective adjuvants for glyphosate.

All treatments in the glyphosate surfactant experiment were applied with a hard water carrier (1550 ppm $CaCO_3$). Glyphosate efficacy was best when applied with surfactants plus AMS at 1% w/v or surfactant-AMS blends. Glyphosate efficacy, when applied without AMS, tended to be greater when

applied with Liberate, Atplus GTM-10, Purity 100, and LI-700 than other surfactants. However, results varied across location, evaluation date, and species.