SELECTION OF FOLIAR-APPLIED POTASSIUM FERTILIZER SOURCES AND RATES OF APPLICATION TO OPTIMIZE SOYBEAN RESPONSE AND WEED CONTROL WITH GLYPHOSATE IN A "WEED AND FEED" MANAGEMENT SYSTEM

Peter Motavalli
Assistant Professor
Gene Stevens
Extension Associate Professor
Manjula Nathan
Extension Assistant Professor
Kelly Nelson
Research Agronomist
Andy Kendig
Extension Associate Professor
David Dunn
Supervisor Soil Test Lab

Soybeans were produced on over 5 million acres in Missouri and 83% of the soybean varieties were Roundup Ready® or contained another form of transgenic herbicide resistance in 2003 (MASS, 2003). Roundup Ready® varieties allow farmers to apply Roundup® and other glyphosate-based products for broad spectrum post-emergence weed control. The incidence of K deficiency has increased in recent years due to reduced K availability under drought and areas with soil compaction, reduced applications for soybean due to low commodity prices, and higher corn grain yields and increased soybean acreage in rotation with corn increasing K fertilizer requirements (Reetz and Murrell, 1998; Fixen, 2000). Soil test K data from the University of Missouri Soil and Plant Testing Lab indicates that over 50% of the soil samples tested in the low to medium range for K (Fixen, 2002). This situation indicates that nearly 2.5 million soybean acres in Missouri could be at risk or are currently experiencing yield loss due to inadequate K soil test levels.

Several studies have evaluated response of soybean to foliar fertilizer mixtures (Garcia and Hanway, 1976; Haq and Mallarino, 1998; Parker and Boswell, 1980); however, no research has evaluated the interaction between macronutrient foliar fertilizers and weed control with postemergence herbicides. Potassium is an essential nutrient that increases drought tolerance, stem strength, and improves plant growth. Uptake of K is primarily by diffusion through roots and under drought conditions limited uptake may occur (Sardi and Fulop, 1994). Previous research on a farm field in Northeast Missouri by Nelson and Motavalli in 2001 and 2002 on crop response to a foliar application of K sulfate at the V4, R1-R2, or R3-R4 stages of development demonstrated that soybean grain yield increased over 10 bu/acre when compared to a non-treated or $MgSO_4$ control (Nelson and Motavalli, unpublished). The calculated increase in profit due to this yield increase from foliar K applications was approximately $50/acre. However, possible limitations for the use of K sulfate combined with a post-emergence herbicide application are the large carrier volume required for an optimum foliar K application and the possible incompatibility that the K fertilizer source may have when mixed with a glyphosate-based herbicide. In addition, the K source/herbicide mix must result in minimal crop injury and not affect weed control.

This study was designed to 1) determine soybean yield response and salt injury from different foliar-applied potassium (K) fertilizer sources and rates of application; 2) determine the impact of K fertilizer source and rate of application on weed control when mixed with a glyphosate-

based herbicide (e.g. Roundup WeatherMAX®); and 3) evaluate the cost-effectiveness of applying K fertilization with glyphosate-based herbicides for no-till glyphosate-resistant soybean production.

Field trials were established at the MU Greenley Center in Northeast Missouri and at the MU Delta Center in Southeast Missouri. Roundup-Ready® soybeans were no-till planted at 180,000 seeds/acre in 15 inch rows. The study was arranged as a randomized complete block design with four replications. Treatments consisted of four rates (0, 2, 8, and 16 lb K/acre) of foliar K fertilizer sources (potassium chloride, potassium thiosulfate, potassium phosphate, Trisert K+) and diammonium sulfate (2.6 lb/acre) either sprayed separately on plots maintained weed-free or sprayed as a mixture with a glyphosate-based herbicide (i.e. Roundup Original® plus nonionic surfactant) on plots with weeds. The foliar K application rates that will be utilized in this research (8 to 16 lb K/acre) are based on previous research that demonstrated a consistent positive soybean yield response to foliar-applied potassium sulfate at several growth stages on a claypan soil near the MU Greenley Research Center with medium to low soil test K (Nelson and Motavalli, 2003). The spray mixture pH was determined prior to the "weed and feed" application. All treatments were applied at a standard postemergence timing for weed control at a 15 gallons/acre carrier volume. Changes in soil test K in the plow layer due to treatment application were determined. Foliar salt injury was rated 3, 7, 14, 21, and 28 days after application. Weed control for individual weed species was recorded 14, 28, and 56 days after application. A biomass harvest of weeds 28 days after treatment was utilized to evaluate weed control. Leaf samples taken at initial bloom were used to determine crop K status in treated and non-treated plants. Soybeans will be harvested and data analyzed to determine the influence of foliar K fertilizer source on crop response, weed control, and grain yield. The authors would like to extend a special thanks to the Fertilizer and Ag Lime Board for their support of this research.

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