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Foliar K Applications Safe With Glyphosate

Expect minimal soybean injury and reduction in weed control, depending on product selection and application rate.

Soybeans were produced on over five million acres in Missouri in 2003 and 83 percent of the soybean varieties were Roundup Ready® or contained another form of transgenic herbicide resistance. Roundup Ready varieties allow farmers to apply glyphosate-based products for broad-spectrum post-emergence weed control. The incidence of K deficiency has increased in recent years due to 1) reduced K availability under drought conditions, 2) soil compaction, 3) reduced applications of K for soybeans due to low commodity prices, 4) higher corn grain yields, and 5) increased soybean acreage in rotation with corn, increasing K fertilizer requirements. Soil test K data from the University of Missouri Soil and Plant Testing Lab indicate that over 50 percent of the soil samples tested in the low-to-medium range for K. This situation indicates that nearly 2.5 million soybean acres in Missouri and large acreages in adjacent states could be at risk or are currently experiencing yield loss due to inadequate soil K test levels.

Several studies have evaluated response of soybeans to foliar fertilizer mixtures. However, no research has evaluated the interaction between macronutrient foliar fertilizer and weed control with post-emergent herbicides. Potassium is an essential nutrient that increases drought tolerance, stem strength, and improves plant growth. Movement of K to plant roots and subsequent uptake of K is primarily controlled by diffusion. Drought and other stress conditions such as soil compaction and low soil temperature may limit K uptake.

Previous research on a farm field in northeast Missouri 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/A when compared to a non-treated or $MgSO_4$ control. The calculated increase in profit due to this yield increase from foliar K applications was approximately \$50/A. However, possible limitations for the use of K sulfate combined with a post-emergent herbicide application are: 1) the large carrier volume required for an optimum foliar K application and 2) the possible incompatibility of the K fertilizer source with a glyphosate-based herbicide. In addition, the K source and herbicide mixture must result in minimal crop injury and not affect weed control.

SUMMARY

Soybean injury resulting from foliar applications of up to 19.2 lbs/A of K_2O from several potassium (K) fertilizer sources (i.e., potassium chloride, potassium thiosulfate, and 3-18-18) was generally less than 10 percent. K fertilizer sources tank-mixed with glyphosate, such as 3-18-18 at 2.4 and 9.6 lbs K_2O/A, 5-0-20-13 (KTS + urea-triazone) at 2.4 lbs K_2O/A, and 0-0-62 at 9.6 and 19.2 lbs K_2O/A, controlled more than 90% of weeds and produced grain yields similar to herbicide applications with diammonium sulfate (DAS), while providing additional K fertilizer to the soybean plant in a single-pass weed management system in northern Missouri. However, two-pass weed management in southern Missouri provided excellent weed control for all additives, and grain yields were greater than or similar to glyphosate plus DAS. The results of the study indicate that foliar K applications can be mixed with glyphosate with minimal crop injury and reduction in weed control, depending on product selection and application rate.

The objectives of this research were to:

• Determine soybean yield response and salt injury from different foliar-applied K fertilizer sources and rates of application

• Determine the impact of K fertilizer source and rate of application on weed control when mixed with a glyphosate-based herbicide.

Methodology

Soil. Research was conducted in 2003 and 2004 at the University of Missouri Greenley Center near Novelty on a Putnam silt loam with a high soil test K, and at the Delta Center near Portageville on a Portageville sandy loam in locations with a high and a low soil test K.

Plots. Plots were 7.5 by 25 feet and 10 by 35 feet. Soybeans were planted in 15-inch rows at Novelty and in 30-inch rows at Portageville.

Treatments. All treatments were applied with a CO_2 propelled hand sprayer calibrated to deliver 15 and 20 GPA at Novelty and Portageville, respectively. Treatments were applied at four rates (K_20 at 2.4, 9.6, and 19.2 lbs/A) of foliar K sources (potassium chloride, potassium thiosulfate, potassium phosphate, and Trisert K+) and diammonium sulfate (2.6 lbs/A) either sprayed separately on plots maintained weed-free or sprayed as a mixture with a glyphosate at 0.75 lb/A on plots with weeds.

Grain yield

Novelty. No significant grain yield increase over the weed-free control was observed in 2004 or 2005 (Table 1). Glyphosate plus 0-0-62 at 19.2 lbs K_2O/A reduced grain yield 5 bu/A when compared to 0-0-62 applied in the weed-free

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Table 1. The effect of fertilizer additive on grain yield applied alone as a weed-free treatment and tank mixed with glyphosate, Novelty, 2004 and 2005.

Fertilizer additive	Rate K_2O lbs/A	Yield 2004		Yield 2005	
		Weed-free	Glyphosate tank mixture	Weed-free	Glyphosate tank mixture
		bu/A			
Non-treated		9.6		15.9	
Weed-free		66.3		47.6	
NIS			68.1		42.5
NIS + DAS			69.9		40.9
3-18-18	2.4	66.7	67.1	47.5	41.5
3-18-18	9.6	70.4	66.8	46.5	40.1
3-18-18	19.2	66.8	68.9	46.7	38.5
0-0-25-17-KTS	2.4	68.6	65.1	48.1	39.1
0-0-25-17-KTS	9.6	68.2	65.1	48.7	35.1
0-0-25-17-KTS	19.2	66.6	66.0	47.5	36.6
5-0-20-13	2.4	67.7	66.4	47.2	40.5
5-0-20-13	9.6	70.2	66.6	46.9	40.7
5-0-20-13	19.2	65.1	67.3	46.8	36.9
0-0-62	2.4	70.3	67.1	46.3	41.2
0-0-62	9.6	67.5	67.7	47.5	40.3
0-0-62	19.2	69.4	64.1	49.4	38.9
LSD		4.9		4.7	

NIS = non-ionic surfactant; DAS = diammonium sulfate; KTS = potassium thiosulfate; LSD = least significant difference.

check in 2004. K fertilizer additives applied alone to weed-free checks produced soybean yields 5 to 14 bu/A greater than a single application of glyphosate plus the fertilizer additive in 2005, primarily due to reduced weed control at some of the highest K_2O rates. Soybean yield was reduced 6 bu/A when glyphosate was tank-mixed with 5-0-20-13 at 19.2 lbs K_2O/A when compared to glyphosate plus a non-ionic surfactant (NIS) in 2005. Similarly, 0-0-25-17 at 9.6 and 19.2 lbs K_2O/A reduced grain yields 7 and 6 bu/A, respectively.

Portageville. All weed-free treatments had grain yields similar to tank mixtures with glyphosate (Table 2). All K additives increased soybean grain yield compared to glyphosate plus DAS except 5-0-20-13 at 9.6 and 19.2 lbs/A, and KTS at 19.2 lbs/A. This was probably due to increased soybean injury caused by these treatments. At the low-soil-test-K site, no significant grain yield differences were detected (Table 3).

Soybean injury

Novelty. Soybean injury from the foliar K or foliar K plus glyphosate was less than 10 percent three days after treatment for all treatments.

Portageville. Similarly, all treatments except 5-0-20-13 at 19.2 lbs K_2O/A produced less than 10 percent injury to soybeans 22 days after treatment.

K concentration

Novelty. Leaf K concentrations at R-1 were not dramatically affected by foliar K applications but trended higher in the weed free plots without glyphosate.

Portageville. Leaf K concentrations 14 days after application were similar among K treatments at the low-soil-test-K site.

Weed control

Novelty. Glyphosate plus 3-18-18 at 2.4 and 9.6 lbs K_2O/A, 5-0-20-13 at 2.4 lbs K_2O/A, and 0-0-62 at 9.6 and 19.2 lbs K_2O/A provided greater than 90 percent weed control 28 days after treatment.

Portageville. All treatments, except glyphosate plus DAS, controlled more than 90% of Palmer amaranth, morning glory, and large crabgrass 21 days after treatment.

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Table 2. Soybean yield at Portageville, 2004-05.

Fertilizer additive	Rate K_2O lbs/A	Yield: Weed-free (bu/A)	Yield: Glyphosate tank mixture (bu/A)
Non-treated		17.2	
NIS			43.8
NIS + DAS			31.4
0-0-62	2.4	39.3	45.3
0-0-62	9.6	38.2	48.8
0-0-62	19.2	38.6	41.6
5-0-20-13	2.4	37.1	44.8
5-0-20-13	9.6	38.1	40.0
5-0-20-13	19.2	35.0	37.6
3-18-18	2.4	44.4	41.9
3-18-18	9.6	41.5	41.3
3-18-18	19.2	38.8	45.6
0-0-25-17 KTS	2.4	40.8	46.2
0-0-25-17 KTS	9.6	38.8	43.0
0-0-25-17 KTS	19.2	42.7	40.6
LSD		10	

NIS = non-ionic surfactant; DAS = diammonium sulfate;
KTS = potassium thiosulfate; LSD = least significant difference.

Table 3. Soybean grain yield with a low-soil-test K, Portageville, 2004-05.

Fertilizer additive	Rate K_2O lbs/A	Yield: Weed-free (bu/A)	Yield: Glyphosate tank mixture (bu/A)
Non-treated		48.0	
Weed-free		54.4	
NIS			49.9
NIS + DAS			53.1
3-18-18	2.4	44.5	52.1
3-18-18	9.6	53.3	57.5
3-18-18	19.2	54.4	54.9
0-0-25-17-KTS	2.4	51.2	51.1
0-0-25-17-KTS	9.6	50.3	53.5
0-0-25-17-KTS	19.2	52.7	55.8
5-0-20-13	2.4	51.8	52.1
5-0-20-13	9.6	54.3	47.9
5-0-20-13	19.2	53.4	53.0
0-0-62	2.4	53.7	55.8
0-0-62	9.6	59.7	52.1
0-0-62	19.2	51.8	53.9
LSD		NS	

NIS = non-ionic surfactant; DAS = diammonium sulfate;
KTS = potassium thiosulfate; LSD = least significant difference;
NS = not significant.