

Soybeans



- Five Year Average of Fertility Programs (1999-2004)
- Two Year Average of Foliar Fertilized Soybeans (2001-02)
- No-Till Soybean Fertilization (2002)
- Effects of Fertilizer Placement on Soybeans (2000)
- Foliar Fertilizer Additives on Drilled Soybeans (2002)
- Effect of Potassium Fertilizer on Soybean Tissue K and Yield (2005)
- Late Foliar Fertilizer Applications on Soybeans (2005)
- Foliar Fertilization of Soybeans (Iowa -1999)
- Fertilization of Roundup Ready Drilled Soybeans (Iowa - 2002)
- Yield Response to Foliar Applications of Sure-K on Soybeans (Minnesota -2003)
- Soybean Foliar Fertilizer Programs (Illinois – 1998-1999)
- Seed Treated Soybeans (2006)
- Foliar Fertilizers plus Fungicide on Soybeans (2006)
- Fertilizer Applications in *Nutri-Till*_{TM} and No-Till Soybeans (2006)
- Sulfur Fertilization in Soybeans (2006)
- Soybean Fertilizer Programs (2006)
- Fertilizer Rate and Placement Effects and Seeding Depth Effects on Soybean Stand and Yield (2007)
- Sulfur Fertilizer Effects in Soybeans (2007)
- Carryover Effects of Potash Applications In Medium Testing K Soil (2007)
- Foliar Fertilizers plus Glyphosate for Soybeans (2007)
- Foliar Fertilizer and Glyphosate Applications on Soybeans (2008)
- Irrigation Timing Effects on Soybean Yield (2008)
- Glyphosate and Foliar Fertilizer Timing on Soybeans (2008)
- Soybean Seed Treatments (2008)
- Planting Timing and Response to Fertilizers by Soybeans (2008)

Continued onto the next page

- *Nutri-Till*TM Applications on Soybeans (2008)
- Fertilizer Program Comparisons in Dryland Soybeans (2008)
- Irrigation Timing on Soybeans (2009)
- Roundup Ready® and Liberty Link® Soybean Comparisons (2009)
- Foliar Fertilizer Applications with Roundup® (2009)
- Foliar Timing Comparison in 30" and Drilled Soybeans (2009)

Experiment: Five Year Average of Soybean Fertility Programs

Year: 1999-2004 (**-12)

Date of Planting/Harvest: Early June / Mid October

Plot Size: 10' x 100'

Soil Test Levels (ppm)

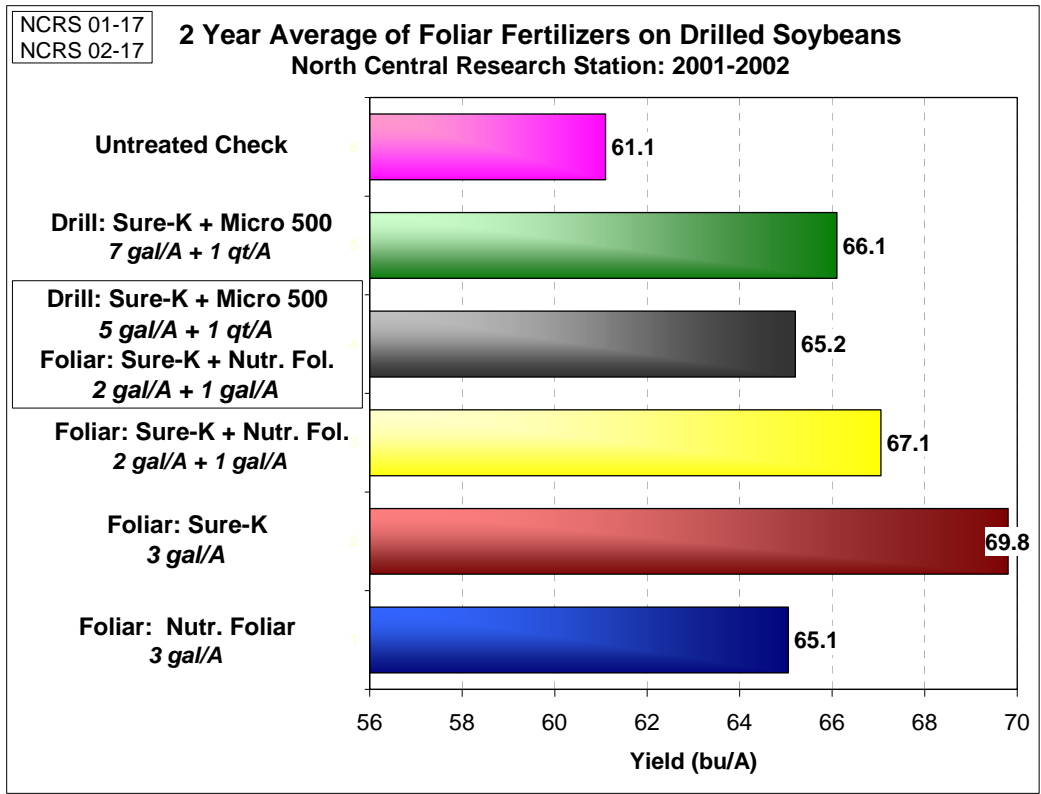
pH ~ 6.7 P1 ~ 51
CEC ~ 6.7 K ~ 165
OM ~ 2.1% (6.4% K)

Six-year yield averages of selected treatments North Central Research Station: 1999 - 2004.	
Fertilizer treatment	
1. Unfertilized check	40.7
2. 0-0-60 100 lb/A (pre-plant broadcast)	42.9
3. Sure-K + Micro 500 5 gal + 1 qt/A (planter)	44.2
4. Sure-K + Nutritional Foliar 2 gal + 1 gal/A (foliar)	45.9

- This long term study has compared two Agro-Culture Liquid Fertilizer programs to a conventional dry program and an untreated check. These plots are in a corn soybean rotation and have been placed in the same location for the past five years. In each year, either corn or soybeans, the untreated plot is always untreated and likewise for all other treatments. This is done so we can see the long term effects on a patricidal program.
- Planter applied liquid fertilizer was placed one inch to the side of the seed.
- Dry fertilizer was broadcast and incorporated before planting.
- Foliar fertilizer is usually applied when the soybeans are in the 4-6 trifoliolate stage. This application is timed around the first postemergence herbicide application.
- Use of the Agro-Culture Liquid Fertilizers' program saves time by reducing the broadcast and incorporation applications.
- The Liquid treatments had a higher 5 year average yield than the dry treatment (almost 2 bu/A higher with the planter applied fertilizer and 3 bu/A higher with the foliar application).
- Highest yield was with the foliar Sure-K treatment even with less total gallons than the planter-applied Sure-K
- The dry fertilizer treatment also receives the same rate of 0-0-60 (100 lbs/A) applied in the corn years, but has not benefited from the potassium build-up.

Experiment: Two Year Average of Foliar Fertilized Soybeans
Year: 2001-2002 (01,02-17)
Date of Planting/Harvest: Early May / Mid October
Plot Size: 10' x 125'

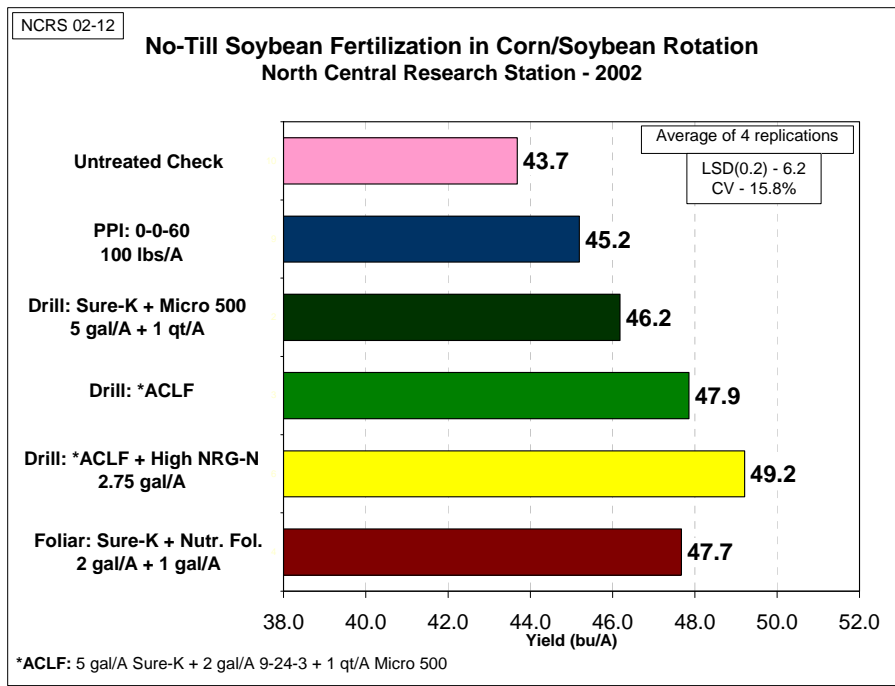
Soil Test Levels (ppm)	
pH ~ 6.8	P1 ~ 39
CEC ~ 7.5	K ~ 75
OM ~ 1.8%	(2.6% K)



- The ability to mix Agro-Culture Liquid Fertilizers with post-emergence pesticide applications has made foliar fertilization of soybeans a popular and beneficial practice.
- Due to low soil potassium levels at the North Central Research Station, 7 gal/A of Sure-K was recommended.
- All fertilizer programs increased soybeans yields over the untreated check.
- Tests were done comparing 7 gal/A Sure-K applied thru the drill vs. splitting the application between the drill and foliar. Near equal yields were achieved with either a single drill application or splitting the application into both drill and foliar applications.
- Foliar applications of Sure-K and Nutritional Foliar were compared both alone and in combination with one another. Highest yield was achieved with 3 gal/A Sure-K. Because of the low soil potassium levels and the high potassium demand of soybeans, there was a significant yield increase when applying more potassium.

Experiment: No-Till Soybean Fertilization
Year: 2002 (02-12)
Date of Planting/Harvest: May 20 / October 22
Plot Size: 10' x 100'

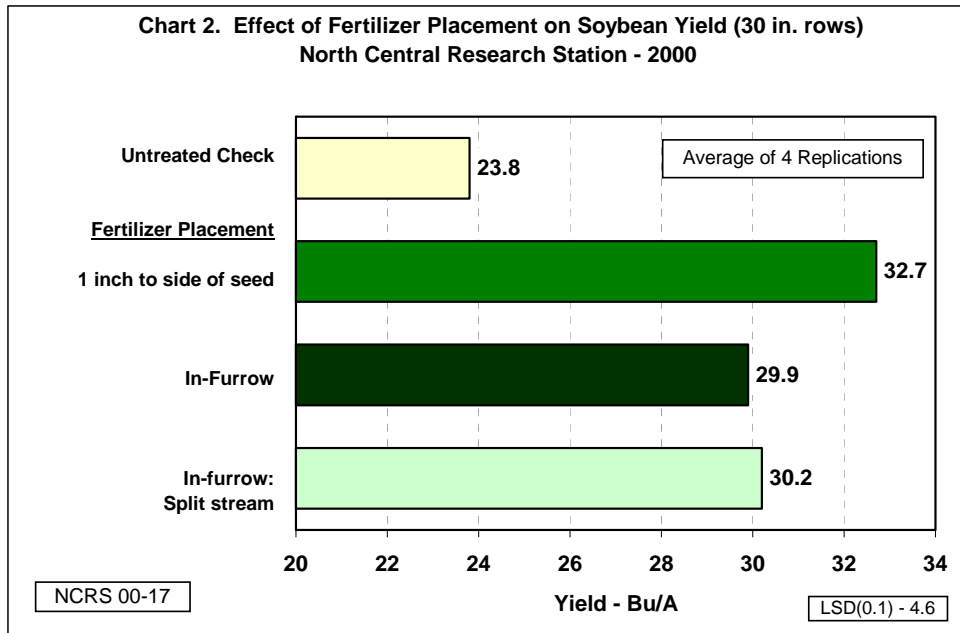
Soil Test Levels (ppm)	
pH ~ 6.7	P1 ~ 47
CEC ~ 7.6	K ~ 81
OM ~ 1.8%	(6.5% K)



- As recommended based off of a soil test, 5 gal/A of Sure-K was compared to a broadcast application of 0-0-60 to determine the best source of potassium in soils with low levels.
- These soils are also considered to be high in phosphorus (65 ppm P1) where no phosphorus fertilizer is recommended. Likewise, soybeans fix their own nitrogen so now addition nitrogen is recommended. Here a test was completed to determine the effects of the addition of 9-24-3 and High NRG-N to the planter fertilizer mix.
- Drill applied Sure-K yielded slightly higher than the pre-plant 0-0-60
- Yield increased to some extent with the addition of 9-24-3 added with the drill applied Sure-K and Micro 500.
- Addition of High NRG-N to the planter program showed the greatest yield increase of the untreated check. (5.5 bu/A)
- Foliar application of 2 gal/A Sure-K plus 1 gal/A Nutritional Foliar gave a positive yield increase.
- Similar to the past, near equal yields were achieved with Sure-K applied either foliar or through the drill.

Experiment: Effects of Fertilizer Placement on Soybeans
Year: 2000 (00-17)
Date of Planting/Harvest: May 25 / October 3
Plot Size: 10' x 130'

Soil Test Levels (ppm)	
pH ~ 6.6	P1 ~ 49
CEC ~ 7.3	K ~ 66
OM ~ 1.7%	(2.3% K)



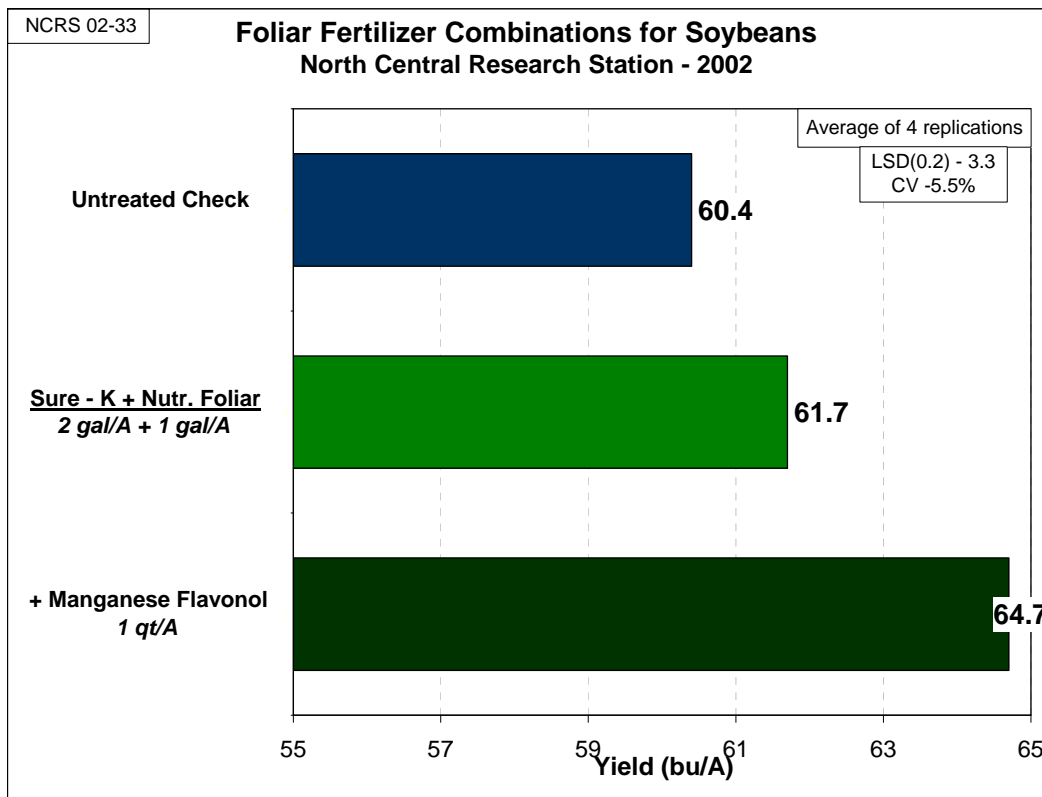
- Fertilizer placement is particularly important for soybeans compared to other crops due to the increased sensitivity to fertilizer contact.
- 6 gal/A Sure-K, 2 gal/A 9-24-3, and 1 qt/A Micro 500 was applied through the planter at 3 different placements: In-Furrow, In-Furrow with a split stream (said to keep 70% of the fertilizer off the seed), and 1 inch to the side of the seed.
- Stand counts were taken 30 days after planting to determine fertilizer effect on stand. Soil moisture was good immediately following planting however became dry as the season progressed.
- Stand counts were as followed:

Untreated check	123,000 plants/A
1 inch to the side	120,000 plants/A
In-furrow	115,000 plants/A
In-furrow	110,000 plants/A
- Dry growing conditions resulted in lower than normal yields as seen on the above chart. The plants were smaller than normal in stature and they soybean canopy did not close the rows.
- Fertilizer applications significantly increased soybean yield
- There was no significant different in yield between placement methods, in spite of difference in plant stand. The evidently shows the compensation capacity of soybeans.
- In-furrow application was not significantly lower in yield than placement to the side, although overall safety would suggest placement to the side to prevent possible damage.

Experiment: Foliar Fertilizer Additives on Drilled Soybeans
Year: 2002 (02-33)
Date of Planting/Harvest: May 10 / October 23
Plot Size: 10' x 125'

Soil Test Levels (ppm)	
pH ~ 6.5	K ~ 35
CEC ~ 8.3	(1.1% K)
OM ~ 2.6%	Mn ~ 14

The increase use in postemergence herbicides has increased the use of foliar fertilizer applications. Agro-Culture Liquid Fertilizers has been recommending a 3 gal/A foliar program, 2 gal/A Sure-K + 1 gal/A Nutritional Foliar, in the past. This program focused on the soybeans high demand for potassium. Due to varying soil conditions other yield limiting nutrients may be beneficial to soybean production. A study was initiated to determine the benefit of additional Agro-Culture Liquid Fertilizers to the current foliar program. Yields are shown on the following chart.

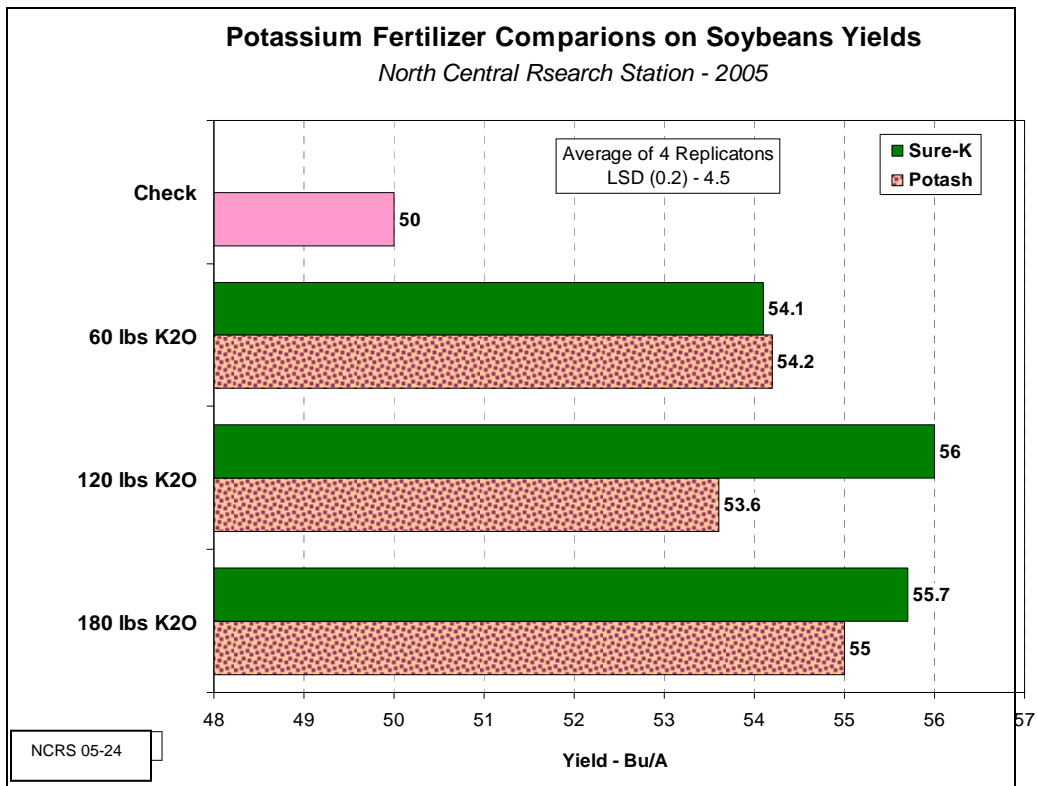


- The addition of Manganese Flavonol to the foliar program resulted in a significant yield increase over the untreated check.

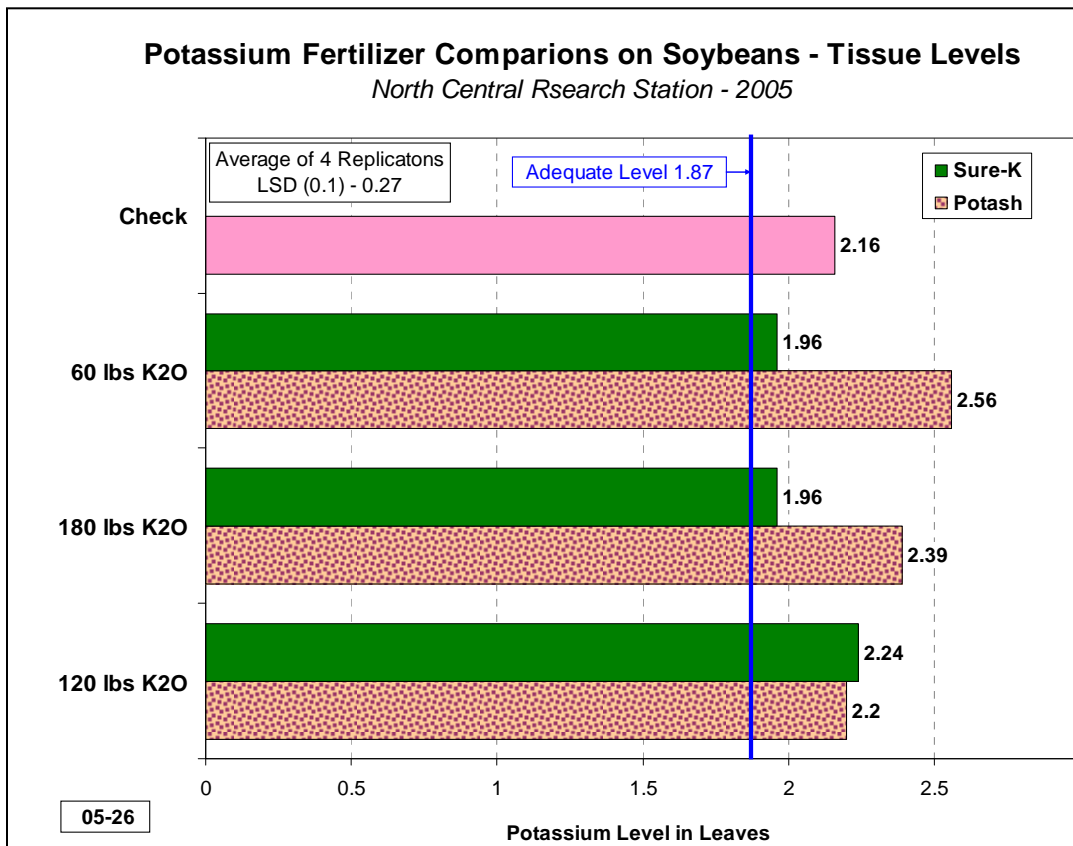
Experiment: Effect of Potassium Fertilizer on Soybean Tissue K and Yield (05-24)
Year: 2005
Date of Planting/Harvest: May 17 / October 4
Variety: Pioneer 92B38
Plot Size: 10' x 130'

Soil Test Levels	
pH: 7.0	C.E.C.: 8.0
OM: 1.9%	P1: 57 ppm
K: 75 ppm	(2.5% BS)

- Two potassium fertilizers were compared in this study to determine the best source of potassium for plant uptake and yield.
 - Dry potash was broadcast incorporated prior to planting
 - Agro-Culture Liquid Fertilizers Sure-K was applied one inch to the side at planting.
- Three rates of each potassium fertilizer applied at 60, 120, and 180 lbs/A of K₂O were evaluated to determine the best rate for soils with low potassium soils.
- The Sure-K rates are based on equivalent pounds per acre of K₂O, where 4.5 gal/A is equivalent to 60 lb/A of K₂O in performance.



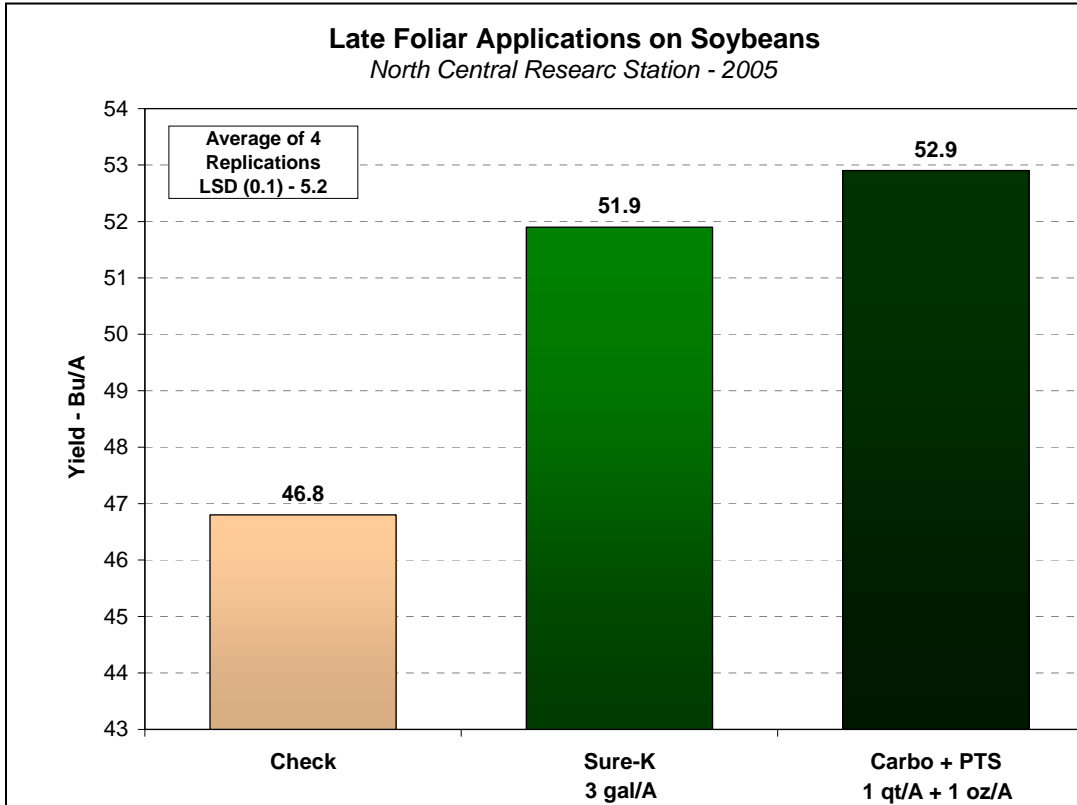
- All fertilizers and rates yielded higher than the unfertilized check.
- At each fertilizer rate Sure-K provided equal to or better yields than potash.
- The best rate of Sure-K was the 120 lbs/A (9 gal/A) rate. There was no yield increase by increasing the rate to 180 lbs/A.



- Tissue samples were taken on June 14th; soybeans were 18" tall and flowering (R2).
- Samples were sent to Midwest Laboratories and analyzed for potassium content. An adequate potassium level for soybeans tissue at R2 is 1.87.
- All treatments including the check came back with adequate levels of potassium.

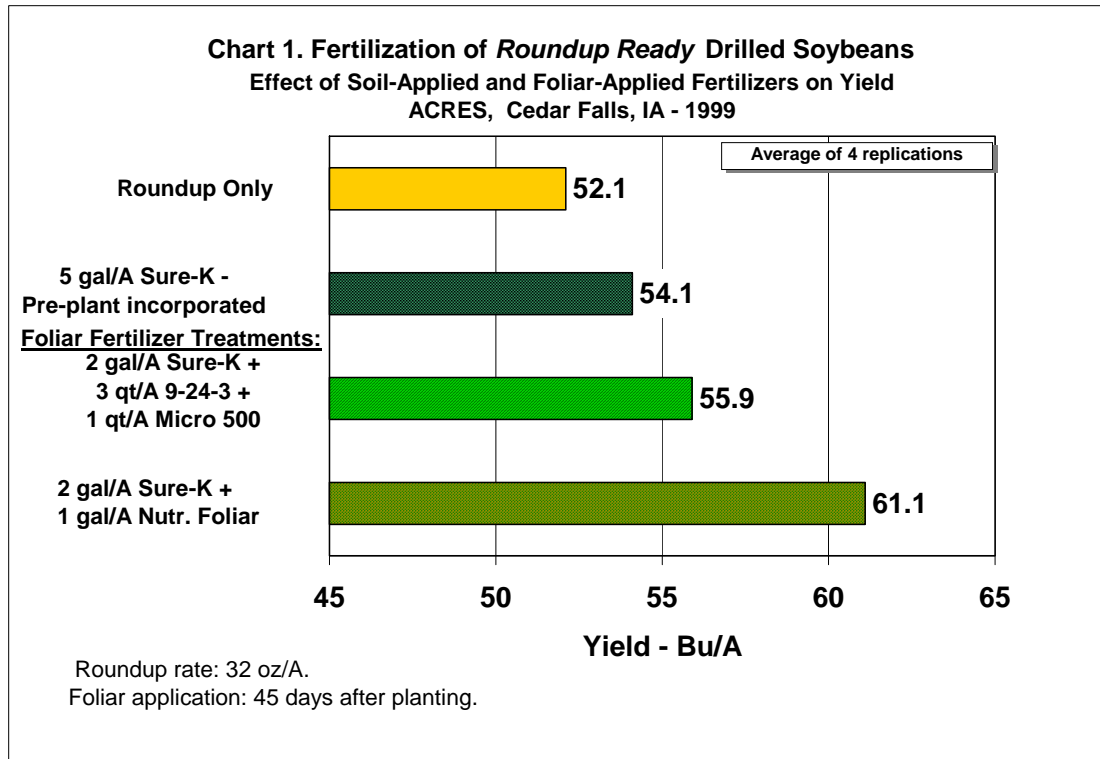
Experiment: Late Foliar Fertilizer Applications on Soybeans (05-30)
Year: 2005 (05-30)
Date of Planting/Harvest: May 18 / Sept 27
Variety: Pioneer 91B64
Plot Size: 10' x 210'

Soil Test Levels	
pH: 7.3	C.E.C.: 6.3
OM: 1.8%	P1: 61 ppm
K: 87 ppm	(3.5% BS)



- Foliar applications were made on August 1st. Soybeans were 36" tall and at podding (R4). The late foliar application was to see if there was any advantage to foliar application during pod fill.
- Fertilizers were applied at a total rate of 15 gal/A and were applied with a high boy sprayer.
- The addition of late fertilizers increased soybeans yields
- Highest yield was achieved with the addition of Carbo and PTS.
- Similar yields were seen with Sure-K and Carbo + PTS foliar.

Experiment: Fertilization of Roundup Ready Drilled Soybeans. ACRES Research. Cedar Falls, Iowa
Year: 1999

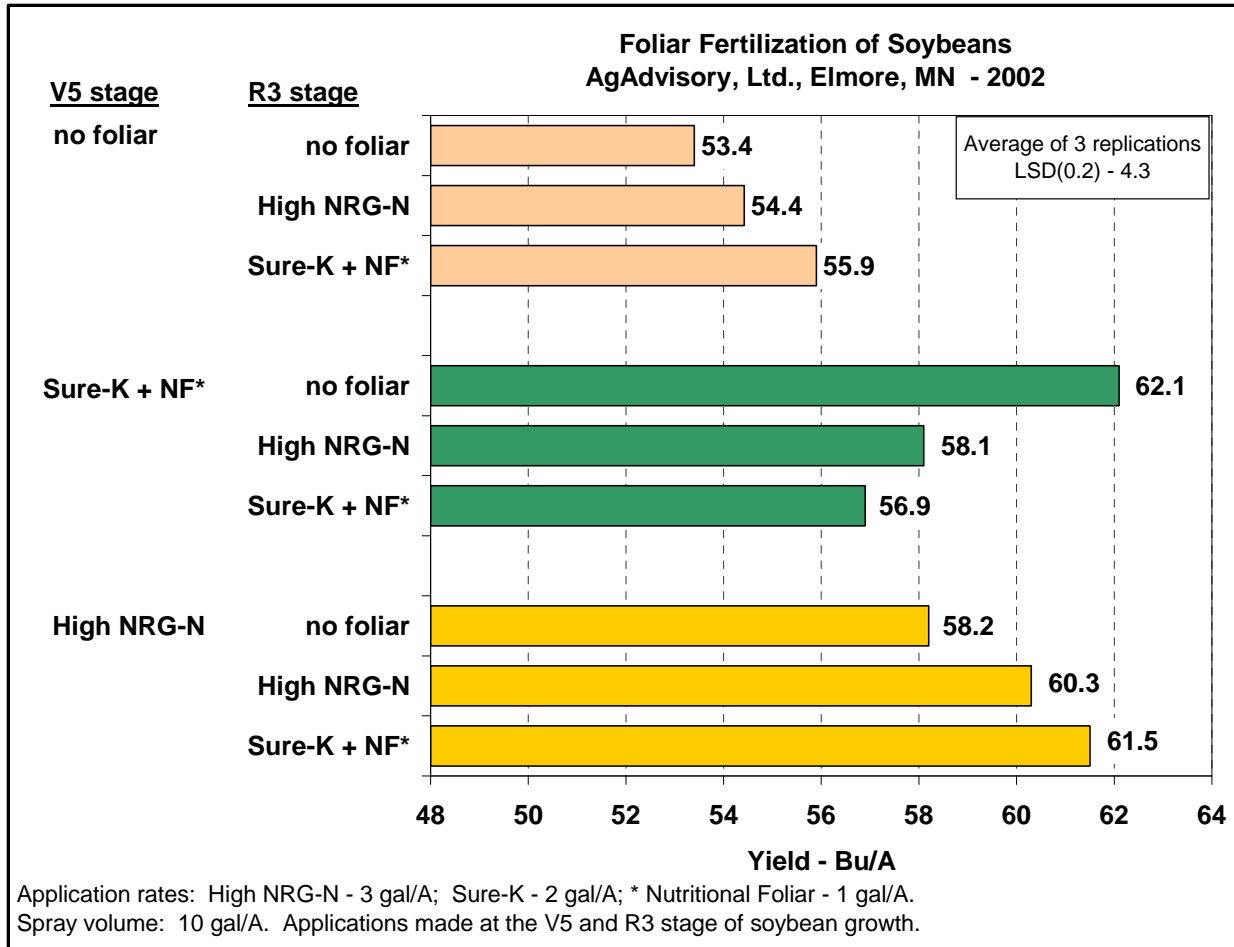


In this experiment, the effects of foliar fertilization on drilled soybeans were evaluated. It is hoped that with drilled soybeans that only one Roundup application is sufficient, due to earlier canopy closure than 30 inch row soybeans. The treatment comparisons here were not fertilizer, Sure-K applied broadcast and pre-plant incorporated, and foliar applications with Roundup herbicide. The standard Midwestern foliar treatment of 2 gal/A of Sure-K + 1 gal/A of Nutritional Foliar was used. Additionally, another foliar treatment was evaluated. This treatment was 2 gal/A Sure-K + 3 qt/A 9-24-3 + 1 qt/A Micro 500. It was hypothesized that perhaps the addition of some phosphorus through the foliar would be beneficial. Foliar applications were made on July 6th, 45 days after planting. Plots not receiving foliar fertilizer with Roundup, received an application of Roundup only. Soybeans were in the V6 stage of development. There was a heavy infestation of giant foxtail, 13 inches tall, and moderated infestation of cocklebur, 14 inches tall, at the time of application. Roundup gave complete control of these weeds. Treatment yields appear on the above chart.

There was a yield increase with both the pre-plant Sure-K and the foliar application of the Sure-K + 9-24-3 + Micro 500 treatment, although it was not statistically significant. However the standard treatment of Sure-K + Nutritional Foliar did result in a statistically significant yield increase.

Experiment: Foliar Fertilization of Soybeans. Ag Advisory Inc. Algona, IA (2002)

The objective of this experiment was to evaluate two different foliar fertilizer treatments applied at 2 different soybean growth stages. This was a large field experiment located in Elmore, MN, near the Iowa border, with a plot width of 8-30 inch rows by half-mile row length. Each treatment was replicated 3 times. Foliar applications were made based on soybean growth stage: V5 and R3. Applications were made in a total spray volume of 10 gallons per acre. Treatment yield results appear in the following chart.

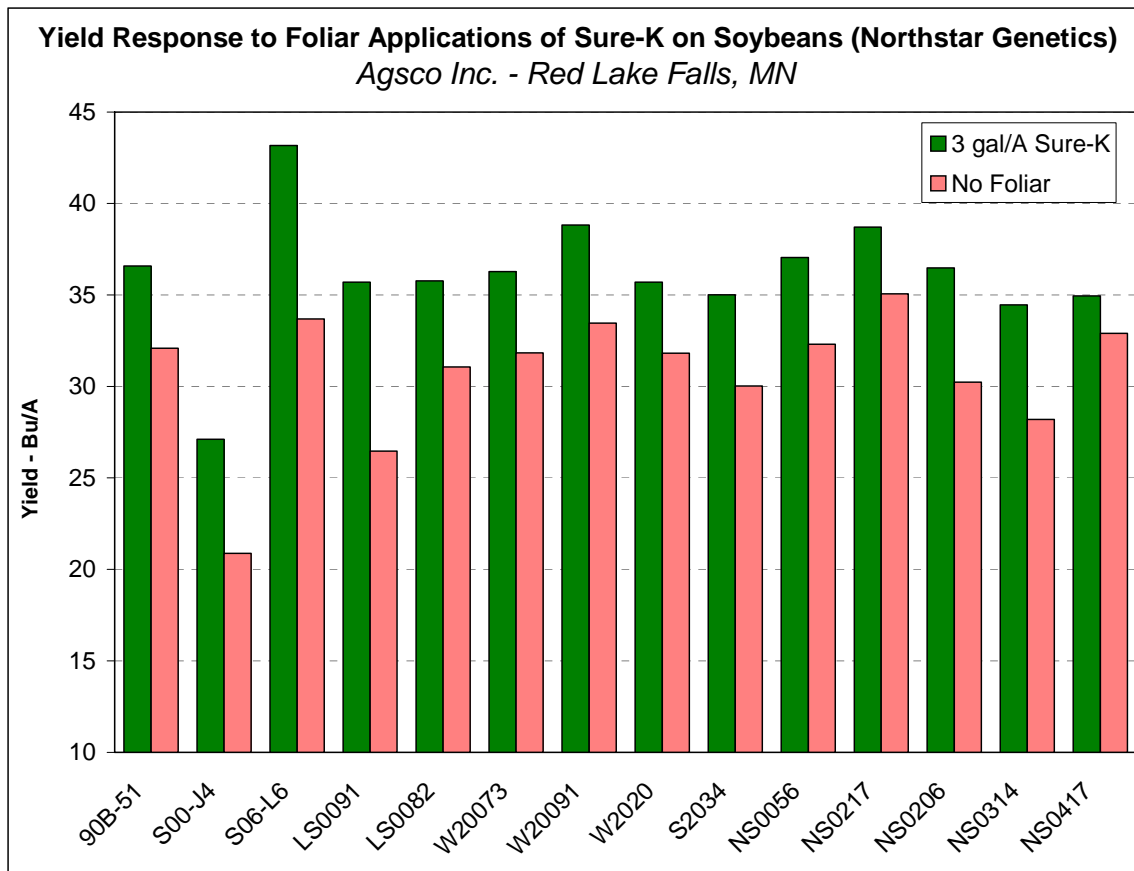


- Foliar fertilization did result in yield increase.
- Having fertilizer applied at the V5 stage seemed to be more effective than waiting until the R3 stage.
- As a single application at the V5 stage, the Sure-K + Nutritional Foliar resulted in higher yield than did the High NRG-N.
- Of the applications at both stages, highest yield was with the High NRG-N followed by Sure-K + Nutritional Foliar.
- Unfortunately there was no solid predictable pattern of foliar response on yield, but the benefit of foliar application is apparent.

Experiment: Yield Response to Foliar Applications of Sure-K on Soybeans. Agsco Inc. Red Lake Falls, MN.

Year: 2003

A single foliar application of 3 gal/A Sure-K was applied to 14 varieties of Northstar Genetics soybeans in northern Minnesota. The foliar applied strip was compared to a side-by-side strip without a foliar fertilizer application. The Sure-K was applied to *Roundup Ready* soybeans with Mad Dog (glyphosate) herbicide at the 5th trifoliolate on solid seeded beans. The following table and chart display the yield results for each of the 14 varieties of soybeans.



**Yield Response to Foliar Applications
of Sure-K on Soybeans (Northstart Genetics)**

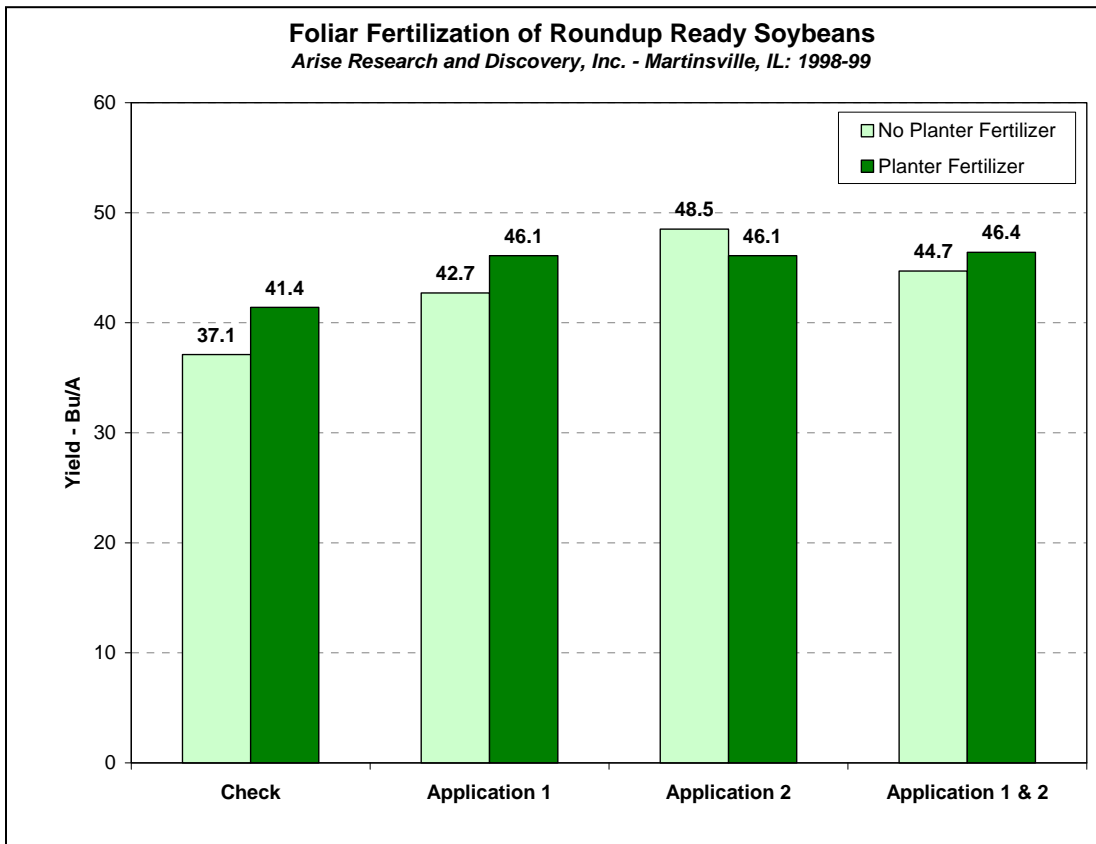
Agsco Inc. - Red Lake Falls, MN

Soybean Variety	Yield - Bu/A 3 gal/A Sure-K	Yield - Bu/A No Foliar	Yield Advantage
90B-51	36.6	32.1	+ 4.5
S00-J4	27.1	20.9	+ 6.2
S06-L6	43.2	33.7	+ 9.5
LS0091	35.7	26.5	+ 9.2
LS0082	35.8	31.1	+ 4.7
W20073	36.3	31.8	+ 4.4
W20091	38.8	33.5	+ 5.4
W2020	35.7	31.8	+ 3.9
S2034	35.0	30.0	+ 5.0
NS0056	37.1	32.3	+ 4.7
NS0217	38.7	35.1	+ 3.6
NS0206	36.5	30.2	+ 6.3
NS0314	34.5	28.2	+ 6.3
NS0417	35.0	32.9	+ 2.1
Average:	36.1	30.7	+ 5.4

- Foliar fertilizers increased yield of **ALL** 14-soybean varieties.

Experiment: Soybean Foliar Fertilizer Programs
Year: 1998-99

This test was conducted by Arise Research and Discovery in East Central Illinois. A comparison of foliar fertilizer programs was evaluated with Roundup applications on Roundup Ready Soybeans. Applications of 2 gal/A Sure-K + 1 gal/A Nutritional Foliar were made at two timings: **Application 1** - 2 trifoliolate and **Application 2** – 5 trifoliolate. A treatment at both timings along with a Roundup only check were also tested. Roundup was applied at 24 oz/A and made at a spray volume of 10 gal/A. All treatments provided near 100% control of weeds present. Foliar treatments were made to either soybeans with a planter application of 5 gal/A Sure-K or soybeans planted with no planter fertilizer.



Results

- All treatments with foliar fertilizers provided significantly higher yields than the untreated check (Roundup only)
- Two year averages show a strong response to foliar fertilization.
- There was little difference between planter fertilizer and no planter fertilizer treatments.
- There was no advantage to a second foliar application.
- There are many environmental factors that influence soybean response to foliar fertilizer applications including temperature and moisture.

Experiment: Seed Treated Soybeans
Year (Experiment Number): 2006 (06-106)
Date of Planting/Harvest: 6-2-06 / 10-10-06
Hybrid: Stine 1916
Plot Size (replications): 5 ft x 250 ft (3 reps)

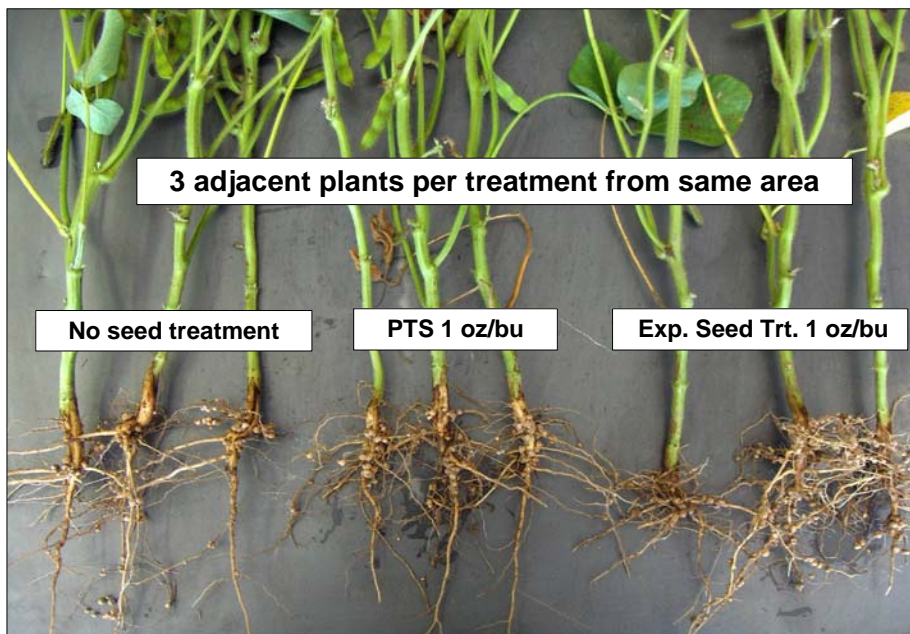
Soil Test Levels (ppm)	
pH: 5.9	C.E.C.: 7.2
OM: 2.2%	P1:60 ppm
K: 127 ppm	(4.5% BS)

Objective: Determine if a nutritional seed treatment can influence soybean yield.

Seed treatments are commonly used to combat things as disease and insect pests. But can a seed treatment enhance the nutritional status of a crop? The volume of a seed treatment on a per acre basis is very small, in the ounces per acre range. Thus the direct application of any nutrient would be very small and likely not effective. But what if the seed treatment could enhance soil microbes as the *Rhizobia* bacteria that form soybeans nodules? Two experiments were conducted to evaluate soybean seed treatments: one at the North Central Research Station and one in South Central Kansas.

At the North Central Research Station as experiment was established to evaluate two different seed treatments: Protrastim (PTS) and an Experimental Seed Treatment (EST). Protrastim is a fermentation product consisting of a protein source and a tri-alcohol with the purpose of increasing plant metabolism. It is not generally viewed as a microbe stimulant. These materials were mixed with soybean seed at a rate of 1 fluid ounce per bushel of seed. This was done the day before planting. All soybean seed was inoculated before planting. At planting with a six row planter, 2 boxes were filled with untreated seed, 2 boxes with PTS treated seed and 2 boxes with EST. Then three passes were made with the planter for the three replications of 2 rows with each treatment, including the check. A planter fertilizer application of 7 gal/A Sure-K + 1 qt/A Micro 500 was placed an inch to the side of each seed row.

In early September, adjacent soybeans from each treatment were pulled for nodule evaluation, as shown in the following picture.



- The soybeans with the Experimental Seed Treatment had the most and largest nodules, followed by the PTS.

At maturity, the two soybean rows per treatment were harvested for yield determination.

Effect of Soybean Seed Treatment on Soybean Yield <i>North Central Research Station - 2006</i>			
Seed trt.	Yield		Test wt.
	Bu/A	% moisture	lb/Bu
none	48.3	12.7	48.3
PTS 1 oz/Bu	49.8	12.8	49.8
EST 1 oz/Bu	51.0	12.9	51.0
<i>LSD(0.2)</i>	2	<i>nsd</i>	<i>nsd</i>

there

yield increase with the Experimental Seed Treatment over the no seed treatment.

- Although small, was a significant

In Kansas, a field was planted to soybeans on June 13 following winter wheat harvest. There were three strips of soybeans planted with Experimental Seed Treatment at a rate of 2 fluid ounces per acre, and three strips with no seed treatment. The seed was inoculated with Cell Tech. Soybeans were harvested on October 4.

Effect of Soybean Seed Treatment on Soybean Yield <i>South Central Kansas - 2006</i>			
Seed trt.	Yield		Test wt.
	Bu/A	% moisture	lb/Bu
none	58.6	10	56.0
EST 2 oz/Bu	64.2	9.3	56.7

- The Experimental Seed Treatment had a more dramatic effect on soybeans in Kansas than at the NCRS with a much higher yield, drier harvest moisture and higher average test weight. Field tests will be expanded in 2007 for further evaluations for future market introduction.
- Thanks to Area Manager Jerry Cordell and Sales Account Manager Brian Waugh for their work in the establishment and follow through of this test in Kansas.



Conclusion:

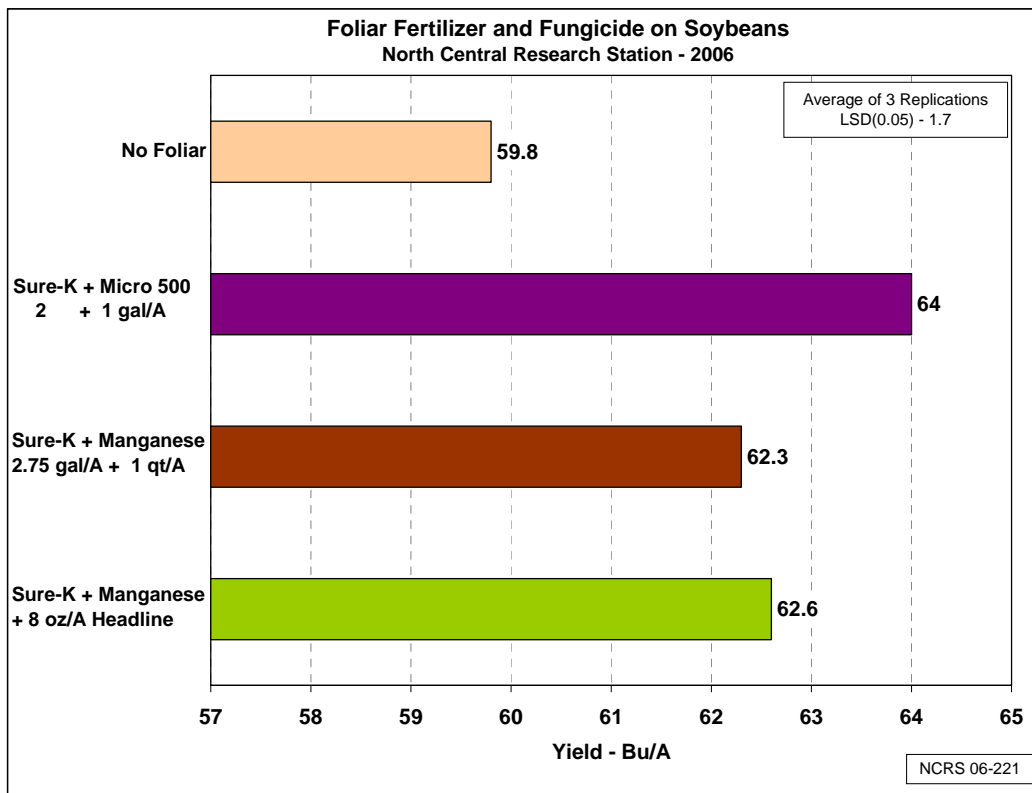
Seed treatments can influence soybeans by their effect on microbes like *Rhizobia*.

Experiment: Foliar Fertilizer Plus Fungicide on Soybeans
Year (Experiment Number): 2006 (06-221)
Date of Planting/Harvest: 6-12-06 / 10-16-06
Hybrid: Pioneer 92B38
Plot Size (replications): 15 ft x 345 ft (3 reps)

Soil Test Levels (ppm)	
pH: 7.2	C.E.C.: 6.6
OM: 2.2 %	P1:34 ppm
K: 92 ppm (3.6% BS)	

With the threat of soybean rust, there is increased awareness of foliar fungicide application in areas prone to attack. Fortunately, the affected areas have been confined to the Southern States, even though late season infestation has occurred as far North as Indiana in 2006. But this late –season infection did not affect yield. None the less, there is interest in foliar fungicides anyway as perhaps a way to increase overall plant health. An experiment was conducted to evaluate several foliar applications including the fungicide Headline.

All soybeans received a planter-time application of 1 gal/A Pro-Germinator + 7 gal/A of Sure-K and 1 qt/A of Micro 500. Soybeans were planted in 15 inch rows. Foliar application was on July 7 when the soybeans were in the R1 stage, and 12 inches tall. Total spray volume was 15 gal/A with flat fan nozzles (Turbojet 11002) at 45 psi. Treatments included the standard 3 gal/A of Sure-K, 2.75 gal/A Sure-K + 1 qt/A Manganese, and 2 gal/A Sure-K + 1 gal/A Micro 500, all of which maintained the fertilizer volume at 3 gal/A. Headline fungicide was added at a rate of 8 oz/A to the Sure-K plus Manganese rate for an additional treatment. Yield results appear in the following chart.



- Yields were very consistent across replications as indicated by the low LSD value.
- All foliar treatments resulted in a statistically significant yield increase, with the highest yield from the application of the Sure-K + Micro 500, although the cost of the Micro 500 is a consideration.
- The application of the Headline did not increase yield over application without it. It was observed that the Headline-treated soybeans remained green longer at senescence than the soybeans in the other treatments which turned yellow sooner. However, this did not affect moisture as all treatments averaged 13.4% moisture at harvest.
- Future testing should evaluate foliar only applications, with no fertilizer applied at planting.

Conclusion: Application of Headline fungicide with foliar fertilizers did not increase or decrease soybean yield in the absence of disease.

Experiment: Fertilizer Applications in Nutri-Till™ and No-Till Soybeans

Year (Experiment Number): 2006 (06-510)

Date of Planting/Harvest: 6-2-06 / 10-26-06

Hybrid: Stine 1918

Plot Size (replications): 15 ft (6-30 in rows) x 300 ft (2 reps)

Soil Test Levels (ppm)

pH: 7.6 C.E.C.: 7.9

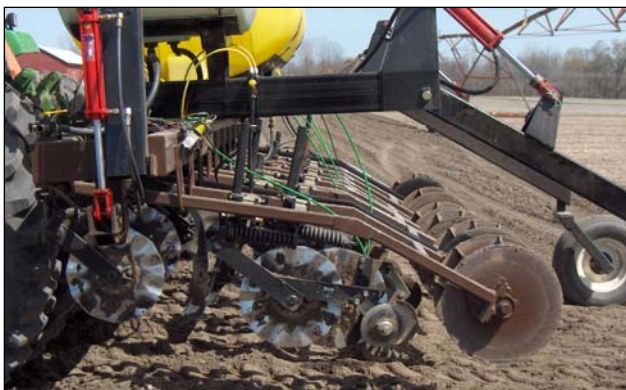
OM: 2.6 % P1: 47 ppm

K: 120 ppm (3.9% BS)

Objective: Determine best fertilizer applications for two reduced tillage options.

In recent years, *strip-till* or *zone-till* equipment has been developed to combine tillage strips in the seed zone with no-till between the rows for residue and moisture conservation. This has also presented an opportunity for nutrient application to reduce the need for extra application trips or application at planting. The *Nutri-Till™* applicator was custom-built by North Central Research Station supervisor Doug Summer. What makes *Nutri-Till™* different is the ability for dual placement of liquid nutrition in the seed zone or below the seed. The deep shank is actually an anhydrous knife which would place the liquid fertilizer approximately 8 inches below the surface. The seed zone placement is through a stream nozzle applied to the soil surface, and then covered by small hilling disks. Three coulters do the tillage and a rolling basket firms the tilled strip.

An experiment was conducted to evaluate fertilizer applications in both *Nutri-Till™* and no-till soybeans. The experimental area was in high-yielding corn in 2005 and there was heavy residue. Half of each replication was conducted in *Nutri-Till™* and half in no-till. Both were planted in 30 inch rows. The *Nutri-Till™* treatments were applied on May 10. Persistent rainfall the rest of May delayed planting until June 2. There were three methods of application: 1) shallow fertilizer placement in the seed zone, 2) below the seed placement and 3) no fertilizer placement in the strips. The fertilizer rate used was 10 gal/A Sure-K + 1 qt/A eNhance + 1 qt/A Micro 500. (The eNhance was used in response to the low soil test for sulfur.) When this fertilizer rate was applied through the planter, it was placed one inch to the side of the seed.

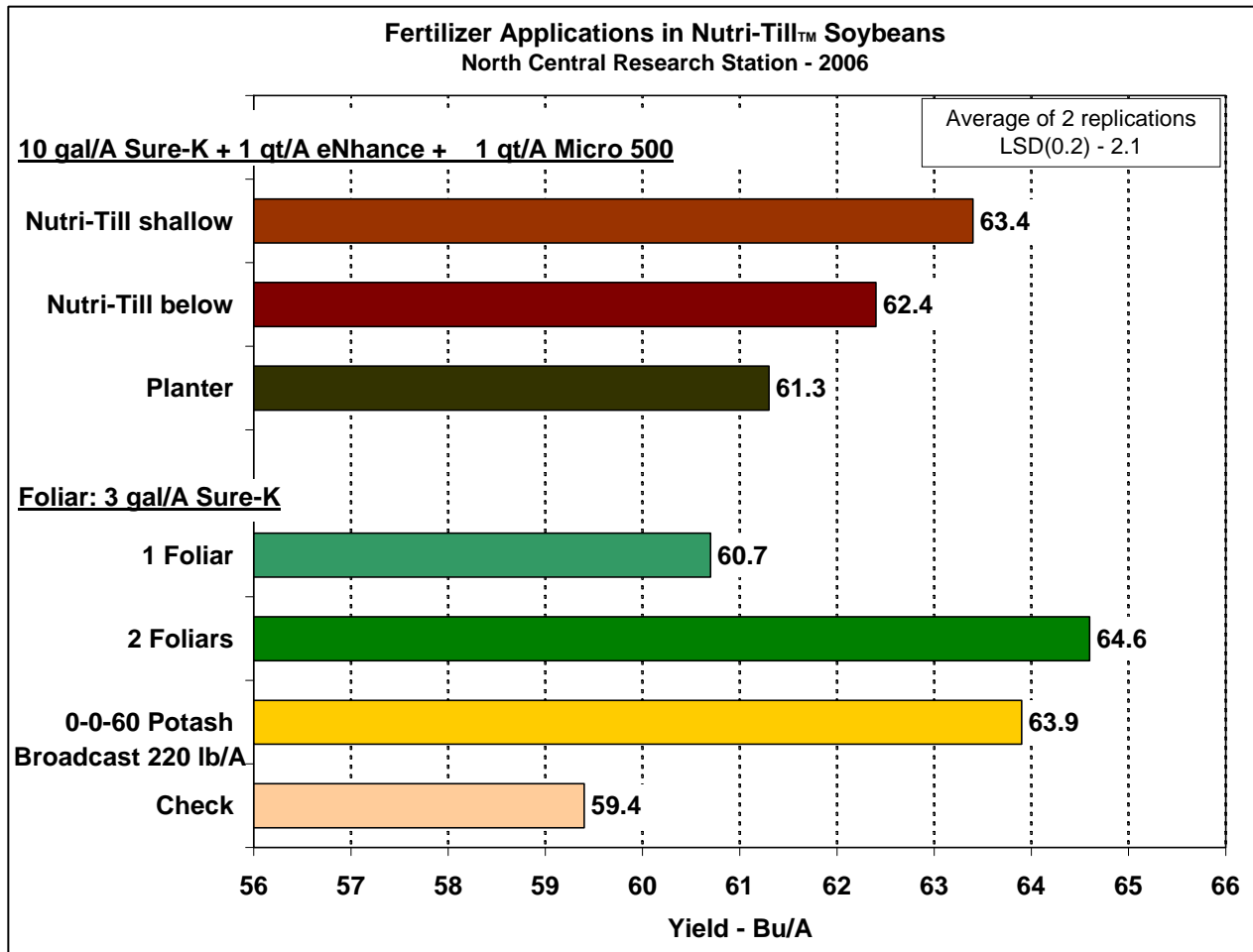


Nutri-Till™ implement in the raised position.

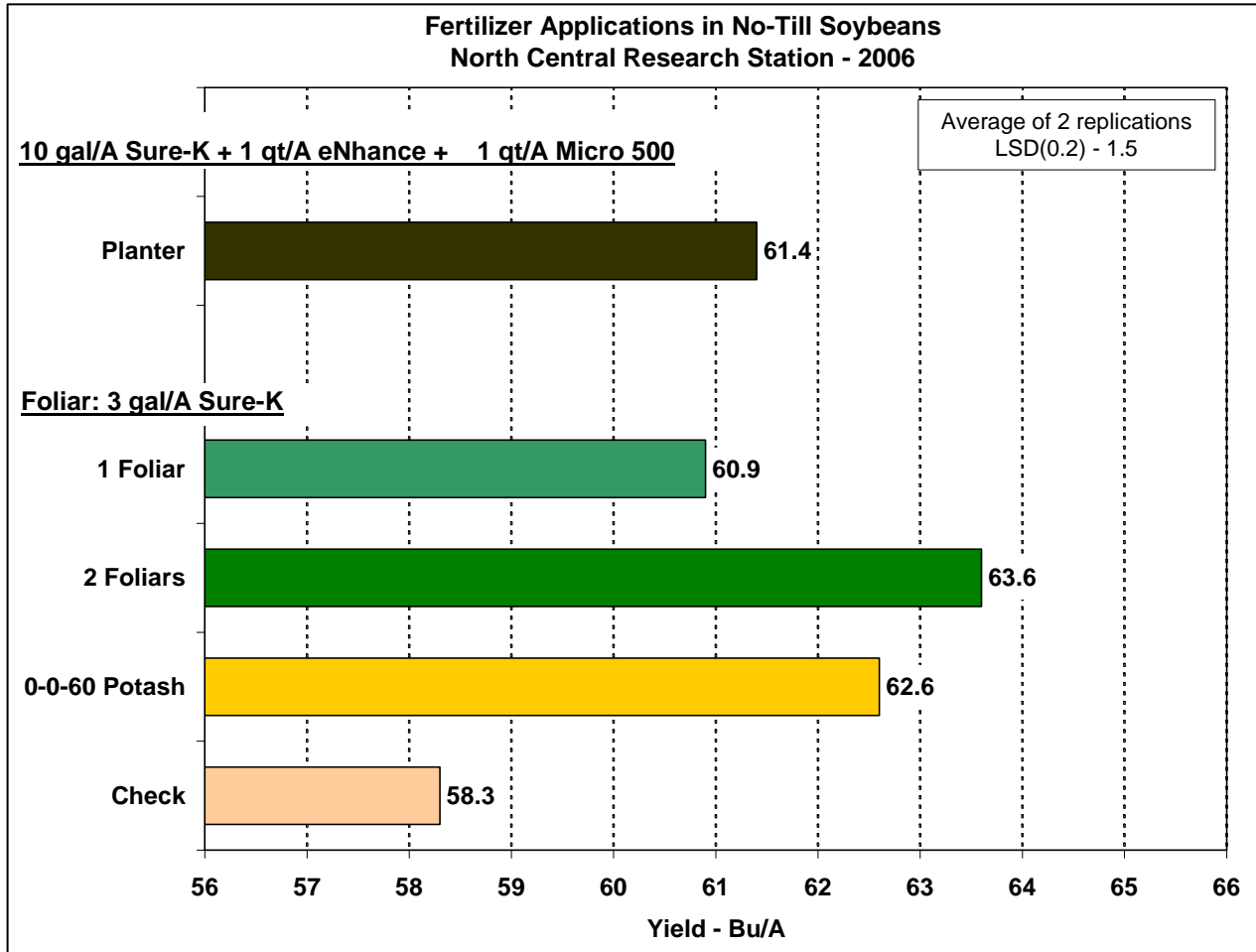


No-Till plot after planting in heavy residue.

In addition to the fertilizer placement comparisons, foliar fertilizer treatments were also applied. One or two foliar applications of 3 gal/A of Sure-K were applied. Foliar applications were applied on July 5 when soybeans were in the V3 (3 trifoliolate) stage and on July 17 when the soybeans were in the R1 stage (first flower). No other fertilizer was applied to the plots receiving foliar treatments. Additionally, broadcast applications of muriate of potash (0-0-60) were applied to both systems. Application was prior to *Nutri-Till_{TM}* and planting. Treatment yields appear in the following charts.



- Yield response to fertilizer was lower than expected likely due to late planting.
- Shallow placement of fertilizer with *Nutri-Till_{TM}* was slightly better than deeper placement below the seed zone. But *Nutri-Till_{TM}* was better in yield than planter applications.
- Two foliar applications resulted in the highest overall yield. This continues to show the efficiency of foliar applications of Sure-K on soybeans.
- The action of the *Nutri-Till_{TM}* and the planter evidently provided some incorporation of the potash. However, this same plot also received 200 lb/a of 0-0-60 in *Nutri-Till_{TM}* corn in 2005.



- As it was with the *Nutri-Till_{TM}*, the two foliar applications of 3 gal/A of Sure-K provided the highest yield.
- *Nutri-Till_{TM}* yields were slightly higher than the no-till yields.

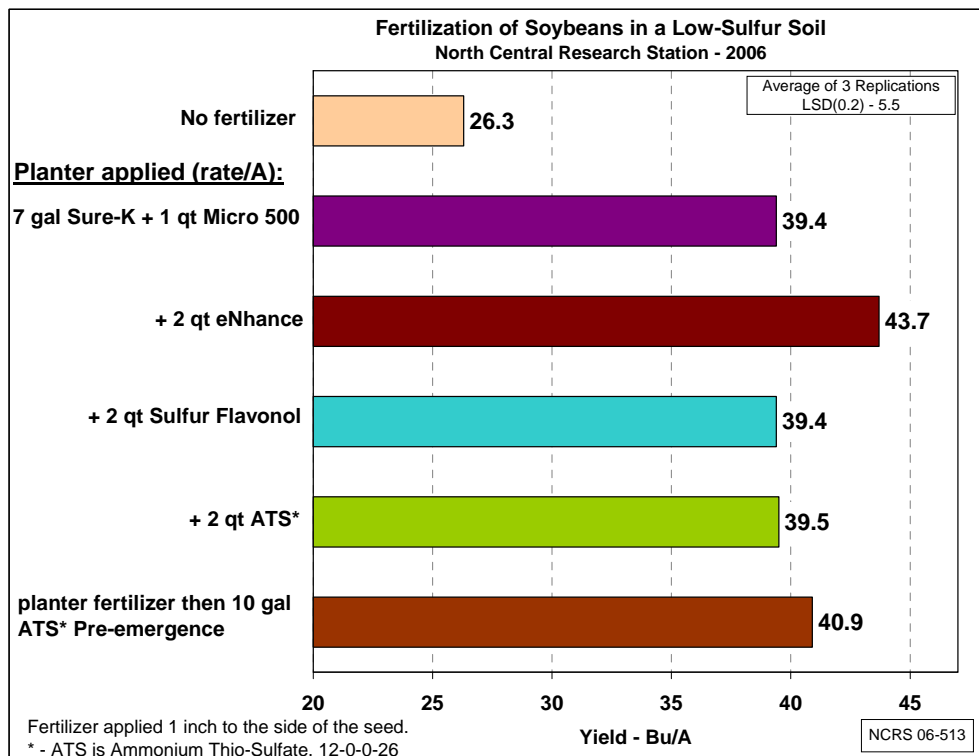
Conclusion: *Nutri-Till_{TM}* fertilizer application before planting was better than planter application of fertilizer. But in both systems, the foliar application of Sure-K resulted in the best yield.

Experiment: Sulfur Fertilization in Soybeans
Year (Experiment Number): 2006 (06-513)
Date of Planting/Harvest: 6-6-06 / 10-10-06
Hybrid: Pioneer 92B38
Plot Size (replications): 15 ft (6-30 in rows) x 130 ft (3 reps)

Soil Test Levels (ppm)	
pH: 7.5	C.E.C.: 9.2
OM: 2.3%	P1:35 ppm
K: 88 ppm (2.5% BS)	
Sulfur: 10 ppm (Low)	

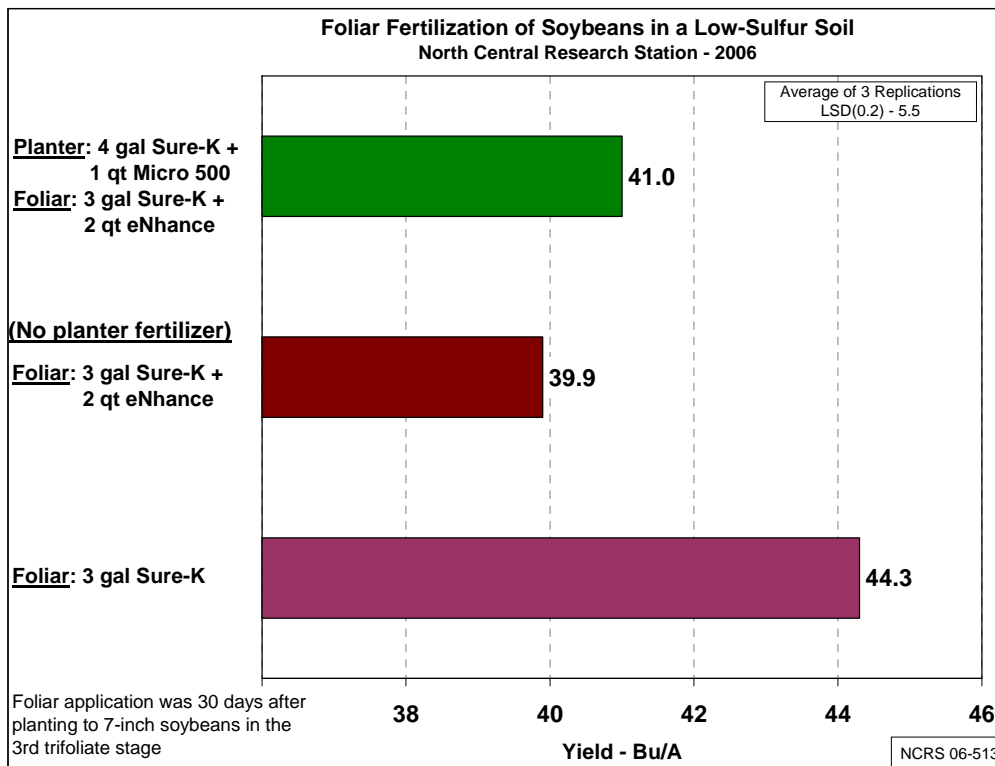
Objective: Determine which of several sulfur fertilizer additives has the greatest influence on soybean yield.

If a soil test indicates low sulfur, should sulfur fertilizer be applied for soybeans? An experiment was conducted to find out. With a soil test sulfur level of 10 ppm (rated Low), several different sulfur applications were applied in conjunction with a standard planter applied treatment of 7 gal/A Sure-K + 1 qt/A Micro 500, placed 1 inch to the side of the seed. These included 2 qt/A each of 6% Sulfur Flavonol, eNhance (8.7% sulfur) and ammonium thio-sulfate (ATS, 12-0-0-26S). Additionally, a surface broadcast application of ATS was applied immediately after planting at a rate of 10 gal/A. (Due to excessive rainfall in May, planting was delayed until June 6 which is some three weeks later than normal. Delayed planting may have affected final yield.) Treatment yields from planter treatments appear in the following chart.



- Although there was a strong response to addition of planter fertilizer, the application of sulfur did not result in a significant yield response.
- Highest numerical yield was with the addition of eNhance to the planter fertilizer. The eNhance also contains manganese and zinc which may have an effect, although the planter fertilizer did include Micro 500.
- The addition of 28.7 lb of sulfur/A with the broadcast application of ATS also did not affect yield. This would indicate that 10 ppm of soil sulfur is not limiting soybean yield.

Foliar applications. Three foliar treatments were included in this experiment. Foliar applications were made 30 days after planting to soybeans in the V3 stage and 7 inches tall. Applications were made at a total spray volume of 10 gal/A with water. One of the treatments had 4 gal/A of Sure-K + 1 qt/A Micro 500 at planting, and then a foliar application of 3 gal/A Sure-K + 2 qt/A eNhance, to keep the total volume of Sure-K at 7 gal/A as in the planter treatments. The next foliar treatment had the same foliar volume, but with no planter treatment. The third foliar treatment was simply the standard foliar application of 3 gal/A Sure-K. Foliar yields appear in the following chart.



- Results are confusing in that the foliar applications of only 3 gal/A of Sure-K, with or without eNhance, were as high as the full 7 gal/A rate of Sure-K with the planter.
- The application of Sure-K alone was the highest numerical yield in the experiment which confirms the effectiveness of this foliar application. The inclusion of eNhance to Sure-K resulted in a lower yield, although not statistically so. However, it suggests some potential for antagonism which should be investigated. But again, the soil sulfur level must not have been a limiting factor to warrant inclusion of sulfur fertilizer.

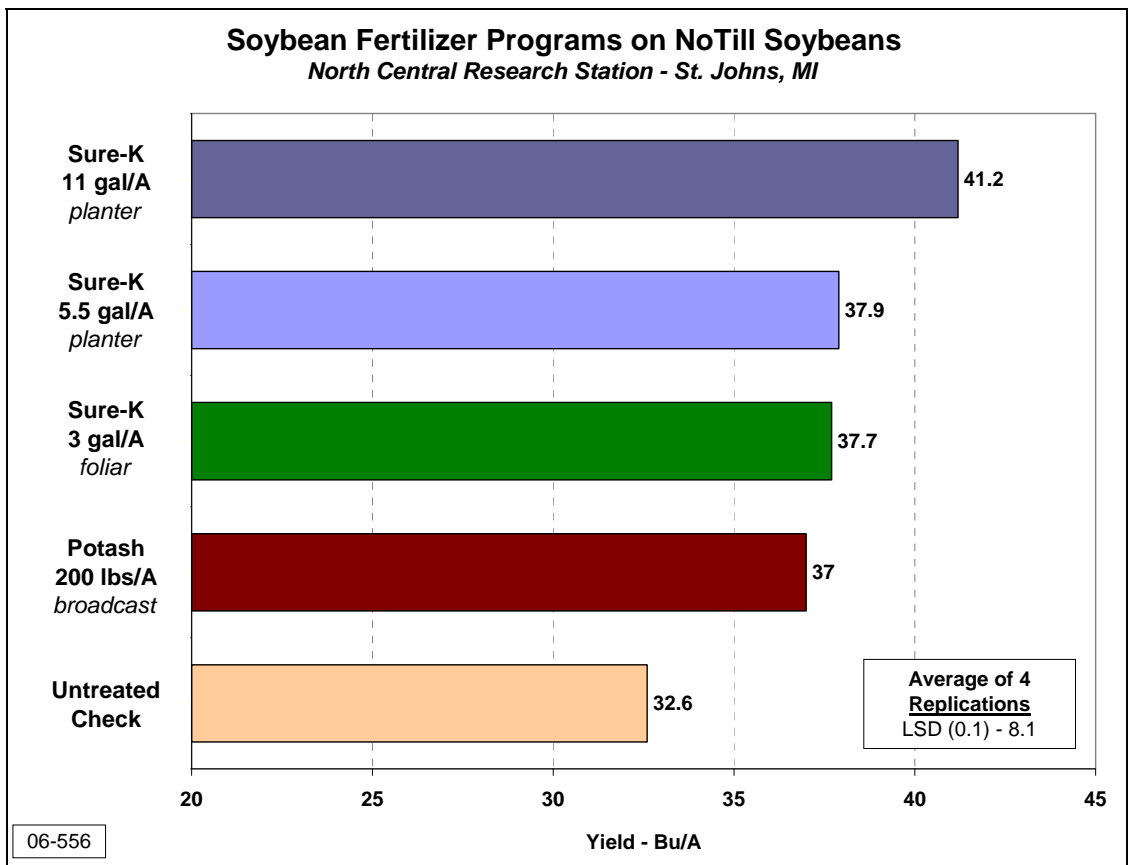
Conclusion: Despite the low soil sulfur according to the soil test, application of supplemental sulfur did not increase soybean yield. Under these conditions, emphasis should be placed on potassium fertilization only.

Experiment: Soybean Fertilizer Programs
Year (Experiment Number): 2006 (06-556)
Date of Planting/Harvest: 6-2-06 / 10-16-06
Hybrid: Pioneer 92B38
Plot Size (replications): 15 ft x 100 ft (4 reps)

Soil Test Levels (ppm)	
pH: 7.9	C.E.C.: 15
OM: 2.3%	P1: 18 ppm
K: 100 ppm	(1.7% BS)

Objective: Determine if high rates of Sure-K are needed in a low potassium soil.

A soybean experiment was established to evaluate several different soybean fertility programs. Soybeans were planted in 30" rows with a no-till planter on June 2. Sure-K was applied in a band one inch to the side of the seed or foliar applied in mid-July when the soybeans were in the R1 stage. Potash was broadcasted prior to planting. In this study we compared a standard rate of planter-applied Sure-K (5.5 gal/A) to a standard foliar application of 3 gal/A. Previous studies have shown that a foliar application works as well as a band application even though less material is being applied. Also compared was a high rate of Sure-K, 11 gal/A, to evaluate the effect of a higher rate in this low potassium soil. An application of 200 lbs of 0-0-60 muriate of potash was included as a conventional fertilizer comparison. Yield results are shown in the chart below.



Results:

- All fertilizer increased soybean yield over the untreated check.
- As seen in past research, similar yield response was seen with the standard 5.5 gal/A band application of Sure-K (37.8 bu) to the 3 gal/A foliar application of Sure-K (37.7 bu). At this low soil K level, two foliar applications should have been tested.
- Comparable results were seen with the standard Sure-K application (37.8 bu) compared to the conventional potash application (37 bu), even though more actual potassium was applied with the potash. (Sure-K provides 71.5 equivalent pounds of K₂O where potash provided 120 lbs of K₂O.)
- With the low soil potassium level and, correspondingly, low percent base saturation, highest overall yield was achieved with the increased rate of Sure-K (11 gal/A).

Conclusion: Higher planter-applied rates as 11 gal/A of Sure-K significantly increased soybean yield when soil K level is low with only 1.7% base saturation.

Experiment: Fertilizer Rate and Placement Effects and Seeding Depth Effects on Soybean Stand and Yield
Year (Experiment Number): 2007 (07-103)
Date of Planting/Harvest: 5-30-07 / 10-8-07
Variety: Asgrow 2107
Plot Size: 6 rows x 155 ft.

Soil Test Levels (ppm)	
pH: 7.0	C.E.C.: 6.8
OM: 1.2%	P1: 89 ppm
K: 80 ppm (3.0% BS)	

Poor stand or injury to a stand of soybeans may be caused by a number of different factors. It is often forgotten that planting depth can pay a huge effect on the germination and stand of a crop. Likewise, fertilizer rate and placement is also very important when it comes to a complete crop stand. In the demonstration area of the North Central Research Station, a soybean experiment was established to determine the effects of planting depth and fertilizer rate and placement on the overall stand and yield of the crop.

Two different fertilizer rates were tested in this experiment:

1. 4 gal Pro-Germinator + 4 gal Sure-K + 2 qt Micro 500 (high)
2. 2 gal Pro-Germinator + 2 gal Sure-K + 1 qt Micro 500 (low)

Each rate was applied per plot (6 rows). Within each of the plots there was a subplot, with 3 rows having the fertilizer placed in-furrow and 3 rows placed 2 x 2.

The second part of this experiment was planting depth; there were two different depths tested:

1. 1 inch deep (normal)
2. 2 ¼ inches deep (deep)

In addition to the above there were two plots that did not receive any planter applied fertilizer, but instead received either one or two foliar applications of 2.75 gal of Sure-K + 1 qt of Manganese Flavonol.

Various combinations of the planter rates and planting depths were made to develop the plots. Stand counts and pictures (see figures 1-4 below) for evaluation were taken in June, 23 days after planting. Percent stand reduction was calculated using the average of the foliar treatments as the complete stand. These plots were planted at the correct depth and without planter applied fertilizer.



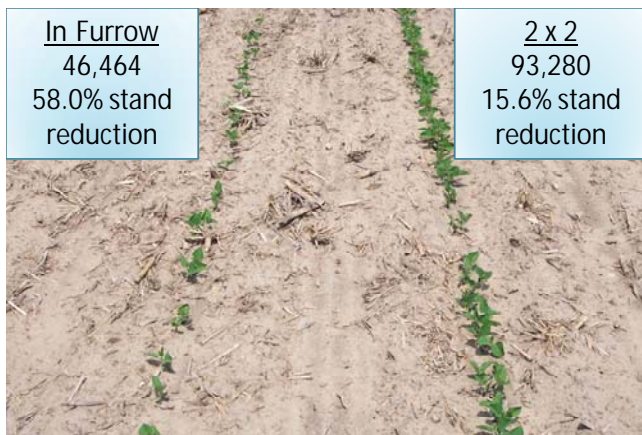


Figure 1. deep – low fertilizer rate

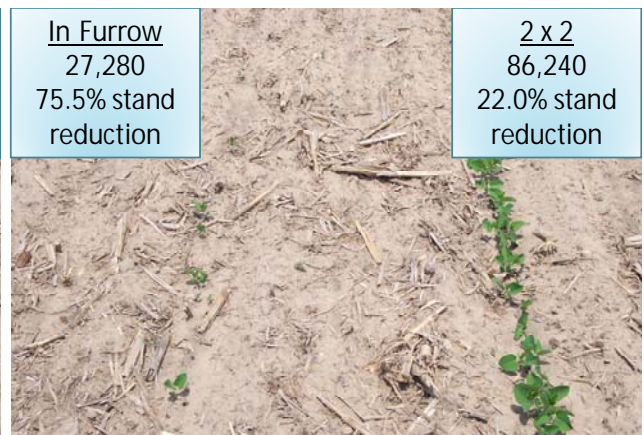


Figure 2. deep – high fertilizer rate

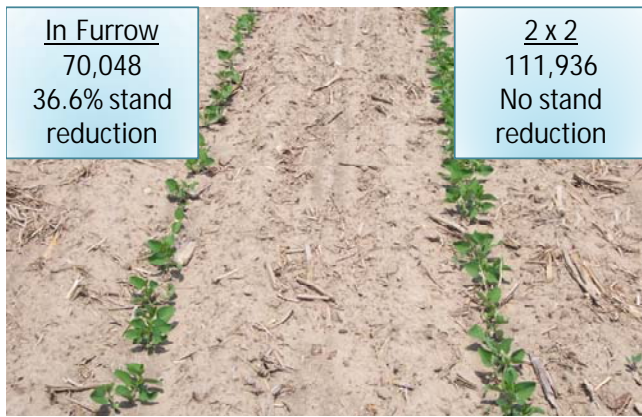


Figure 3. normal – low fertilizer rate



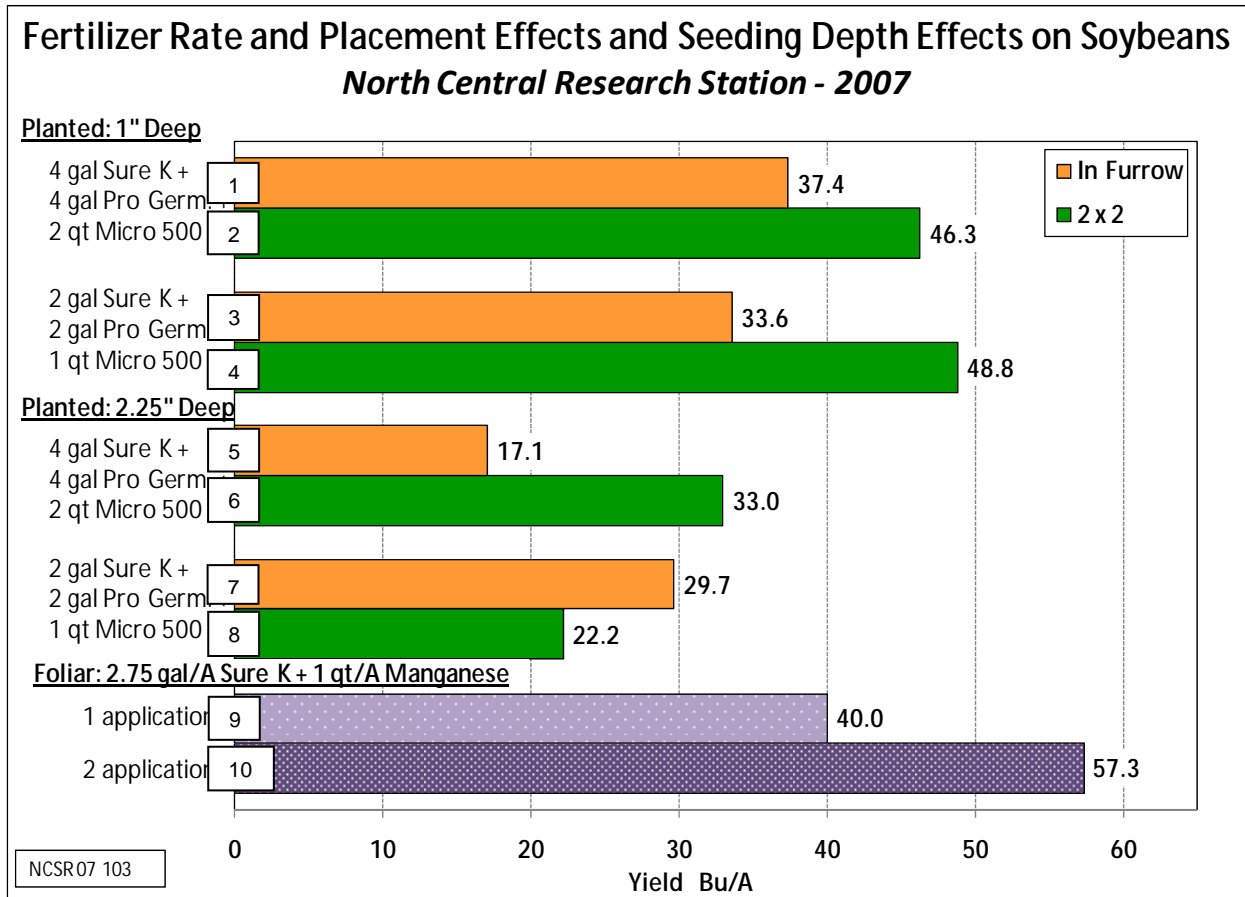
Figure 4. normal – high fertilizer rate

The above figures show pictures taken 23 days after planting. In each figure the left row has the fertilizer placed in-furrow and the right 2 x 2. Population based on stand counts and percent stand reduction for each row is in the corresponding box in each corner.

Conclusions:

- It is **NOT** recommended to place fertilizer in-furrow for soybeans as shown in Figures 1-4. Even lower rates can still injure stands, Figure 2 and 3.
- Planting depth is just as important as fertilizer placement.
- The combination of deep planting and high fertilizer rates caused the most damage on soybean stand (Figure 2).
- Soybean stands were not reduced with 2 x 2 placement of the higher fertilizer rate (Figures 3 and 4).

Although these plots were done as demonstration, harvest for yield comparisons was done. Yields appear on the chart below.



Conclusions:

- In almost all cases, yields were higher where fertilizer was placed 2x2 compared to in-furrow.
- The low fertilizer rate in-furrow, deep planted did not produce the lowest yield as predicated by the lowest stand counts; however, this could be due to the low stand allowing each plant extra sunlight, moisture and nutrients to produce higher than normal yield. Essentially, for the plants that did survive, all competition was removed providing ideal growing conditions.
- Having the correct planting depth greatly increased soybean yields.
- A single foliar application produced nearly as well as the planter applied treatments.
- Highest yield was achieved with two foliar applications, nearly 10 bushels higher than the next closest treatment.

Another way of evaluating yield is comparing the yield increase per nutrient applied. This is done by dividing the actual pounds of nutrients applied by the yield increase. In this soybean experiment, highest yield per nutrient applied was seen with the single foliar application, although highest yield was with two foliar applications more nutrients were applied lowering the yield per nutrient applied. Table 1 below shows increases.

**Table 1. Yield Per Pound of Nutrient Applied
07-103 Demo Soys**

	Fertilizer Treatment	Pounds of Nutrients Applied	Yield Increase Per Nutrient Applied
1	Deep - Low (IF)	10	3.7 bu
2	Deep - Low (2 x 2)	10	4.6 bu
3	Deep - High (IF)	20	1.7 bu
4	Deep - High (2 x 2)	20	2.4 bu
5	Normal - Low (IF)	10	1.7 bu
6	Normal - Low (2 x 2)	10	3.3 bu
7	Normal - High (IF)	20	1.5 bu
8	Normal - High (2 x 2)	20	1.1 bu
9	1 Foliar Apps.	2	20.0 bu
10	2 Foliar Apps.	4	14.3 bu

Conclusions:

- Highest increase per pound of nutrient applied was seen with the single foliar application (trt 9), although higher yield was seen with 2 applications (trt 10), more nutrients were applied lowering the increase per nutrient applied.
- The lowest yield increase per nutrient applied was seen with the normal planting depth with the high rate of fertilizer placed 2 x 2 (trt 8), because of its low yield and high fertilizer rate.

Experiment: Sulfur Fertilizer Effects in Soybeans
Year (Experiment Number): 2007 (07-513)
Date of Planting/Harvest: May 18 / September 28
Variety: Asgrow 2107
Plot Size (replications): 9-15 in rows x 130 ft (3 reps)

Soil Test Levels (ppm)	
pH:	7.1
C.E.C.:	8.2
OM:	2.5%
Bicarb P:	24 ppm (Very High)
K:	93 ppm (Med)
2.9% Base Sat.)	S: 8 ppm (Low)

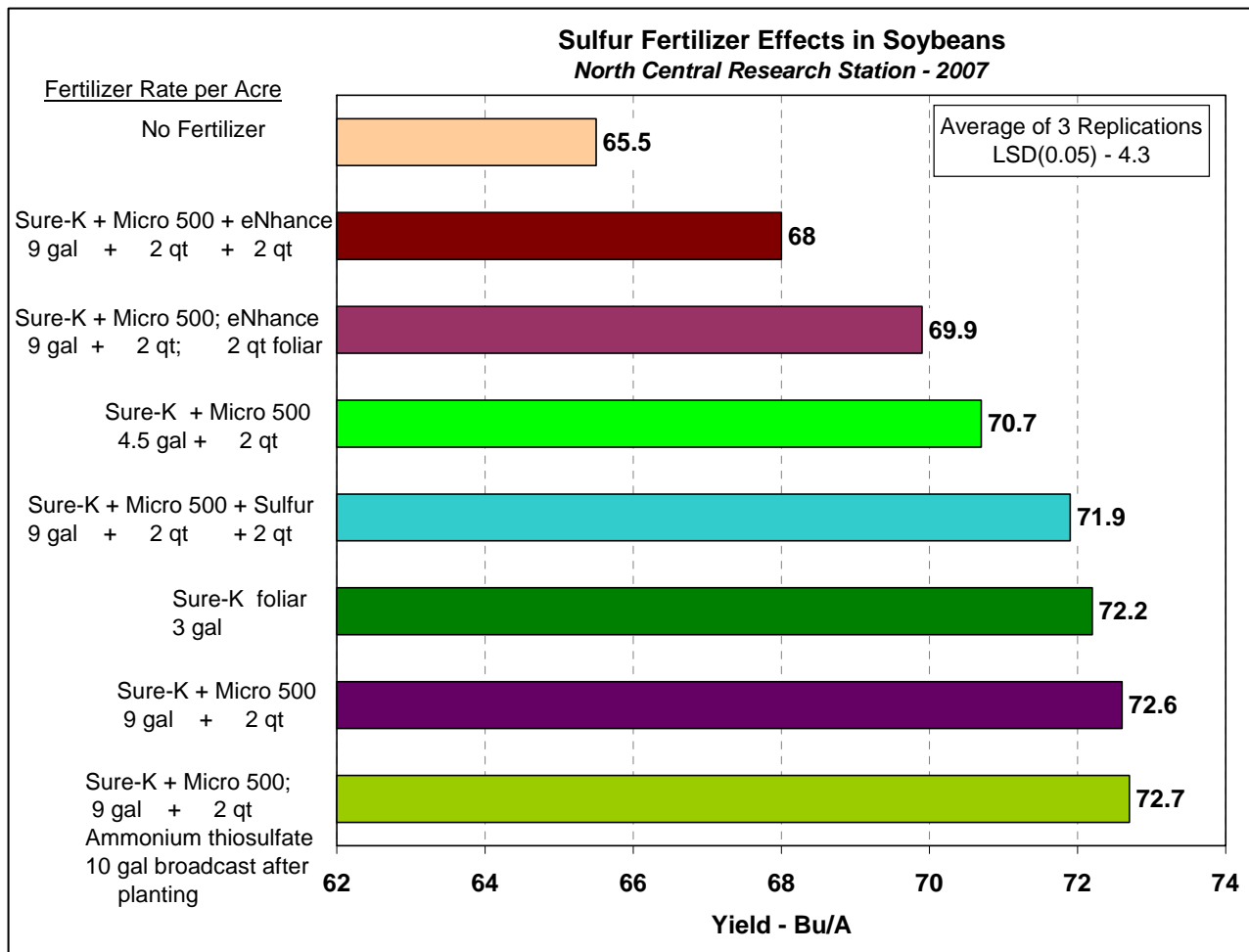
With most nutrients, application according to soil test levels and yield goal is recommended for best results. However, in recent years, testing at the North Central Research Station has not been able to demonstrate a positive yield response to sulfur applications in either corn or soybeans using low rates of Liquid sulfur nutrition. Perhaps these low rates were below the threshold levels to enable a yield response.

Objective: Measure effect of added Liquid sulfur fertilizer to planter-applied or foliar-applied treatments in soybeans.

This experiment was established in a low-sulfur soil and followed corn the previous year. The fertilizer recommendation (from Midwest Labs) for a 60 Bu/A yield goal was 19 lb/A of sulfur and 160 lb/A of K₂O potash. This seemed a little high for the potassium based on previous experience, and so a standard rate of 9 gal/A of Sure-K was used. Planter-applied treatments were made in the seed furrow with seed firmers in the 15 inch rows. Application of 2qt/A of either **6% Sulfur** or **eNhance**, which contains 8.7% sulfur (plus 0.07% manganese and 0.07% zinc) were the Liquid sulfur fertilizers used. While these applications do not approach the 19 lb/A of recommended sulfur, it was hoped that there would be an economic response. Foliar fertilizer applications were made on July 2 when the soybeans were in the fifth trifoliate stage. Application was in a total spray volume of 10 gallons per acre using broadcast nozzles (Turbojet 02) at a pressure of 35 psi. (Temperature was 72 degrees at 4:00 pm with calm wind conditions and partly cloudy skies.)

As a conventional standard, one treatment included a surface broadcast application of 10 gal/A of ammonium thiosulfate (12-0-0-26) after planting. This application provided 28.7 lb/A of sulfur, which is more than the recommended rate. So if a response to sulfur is to be obtained, this should be the treatment to provide it.

Yield results of treatments appear in the following chart. Treatments are arranged according to yield result.



- Soybean yield was good, and all fertilizer treatments resulted in yields significantly greater than the check, and exceeded yield goal.
- There were no significant yield differences between most of the fertilizer treatments. Addition of eNhance to the standard planter-applied treatment of Sure-K did have a lower yield than the same treatment without eNhance. The foliar application of eNhance was also lower than the same treatment without the foliar application. The reason is not understood, as this low rate of eNhance would not be expected to cause injury. However, this is consistent with earlier findings.
- Application of ammonium thiosulfate on top of the standard Sure-K treatment did not result in a yield increase, even though the standard treatment did not have any sulfur. But this was a 11% increase over the check treatment.
- There was no significant yield drop by halving the standard application rate of planter-applied Sure-K from 9 gal/A to 4.5 gal/A.
- The most economical response came from the foliar application of 3 gal/A of Sure-K, which is the standard foliar treatment determined in many years of prior testing. In fact, in previous testing of sulfur application to soybeans, this treatment also yielded the highest.
- Accurate prediction of yield based upon nutrient application and soil tests continues to be challenging, especially with sulfur. But it is gratifying to see that the standard foliar application will provide an economic response.

Experiment: Carryover Effects of Potash Applications
In Medium Testing K Soil

Year (Experiment Number): 2005 (05-24); 2006 (06-505);
2007 (07-512)

Date of Planting/Harvest: May 18 / Sept 28

Variety: Stine 1832

Plot Size (replications): 10 ft (drilled 7 in rows) x 130 ft (4 reps)

Soil Test Levels (ppm)

pH: 7.2 CEC.: 8.2 OM: 2.1%
Bicarb P: 26 ppm (VH)
K: see text.

Objective: Measure the effects of muriate of potash fertilizer two years after application on soil, soybean tissue levels and soybean yield.

Is dry muriate of potash fertilizer necessary when soil test potassium levels are in the medium levels? Agro-Culture Liquid Fertilizers believes that application of Sure-K alone is sufficient for meeting crop potassium demand in soils testing medium for potassium, where per cent base saturation is greater than 2%. In 2005, an experiment was established where three different rates of muriate of potash (100-, 200-, and 300 lb/A) were applied pre-plant broadcast and incorporated prior to planting of soybeans. This was compared to three different rates of planter-applied Sure-K (4.5-, 9-, and 13.5 gal/A). Placement was in the seed furrow with seed firmers. The soil test level for potassium in a composite sample for the entire test area was 80 ppm and 2.5% base saturation. Soil test lab recommendations for K₂O for a 60 Bu/A yield goal was 170 lb/A, or 283 lb/A of muriate of potash. This is a fairly high amount of potash, so it was anticipated that there would be a fertilizer response as this rate falls within the rates of potash applied.

Tissue tests were collected at the R2 growth stage. Soybeans were harvested for yield at maturity. The following year, corn was planted in these same plots. All corn received a planter application of 4 gal/A Pro-Germinator + 9 gal/A Sure-K + 1 qt/A Micro 500 + 1 pt/A Boron, and was sidedressed with 42 gal/A of High NRG-N. Corn leaf samples were collected at the pre-tassel stage for tissue K analysis. At maturity, plots were harvested for yield. The results from 2005 and 2006 were reported in their respective research reports. Data from each year appear in Table 1.

Table 1. Results of three seasons of testing effects of potash applications on crop growth and soil levels.							
2005 application	2005 soybeans		2006 corn		2007 soybeans		fall 2007
	% leaf K	Bu/A	% leaf K	Bu/A	% leaf K	Bu/A	soil K (ppm)
No fertilizer check	2.16	50	1.62	183.9	2.56	70.2	67
100 lb/A 0-0-60	2.56	54.2	1.81	182.9	2.43	72.3	70.5
4.5 gal/A Sure-K	1.96	54.1	1.72	177.6	2.5	67.7	75
200 lb/A 0-0-60	2.39	53.6	1.85	180.2	2.44	69.5	82
9 gal/A Sure-K	1.96	56	1.4	181.4	--	66.4	--
300 lb/A 0-0-60	2.2	55	2.12	178.5	2.99	70.2	84.5
13.5 gal/A Sure-K	2.24	55.7	1.34	179.5	--	65.5	
Adequate level:	1.87		1.8		1.87		
LSD(0.05):	0.32	<i>nsd</i> *	0.26	<i>nsd</i> *	<i>nsd</i> *	<i>nsd</i> *	16.3
Fertilizer applications: <u>2005</u> : as written in table; <u>2006</u> : all received planter application 4 gal/A of Pro-Germinator + 9 gal/A Sure-K + 1 qt/A Micro-500 + 1 pt/A Boron, and sidedressed with 42 gal/A High NRG-N; <u>2007</u> : no fertilizer applied to plots that received 0-0-60 in 2005 and the check. The plots that received Sure-K in 2005 received 4.5 gal/A of Sure-K at planting.							
* - <i>nsd</i> : no statistically significant differences between treatment averages.							

- In the first year of 2005, dry potash at the 100 and 200 lb/A

application rates did increase tissue K levels higher than that of the 4.5 and 9 gal/A rates of Sure-K, although tissue K levels for all treatments, including the check, were higher than the adequate level of 1.87%.

- Application of the high rates of dry potash did not result in significant soybean yield increase over the Sure-K. The check had the lowest yield, but it was not statistically significantly lower than the fertilized plots.
- The corn grown in 2006 generally showed higher tissue K levels with the dry fertilizer from 2005 levels compared to the Sure-K. However, the residual potassium from the previous year's application did not result in higher yield, as there was no significant difference in corn yield from any treatment when all were treated with Pro-Germinator and Sure-K.
- The soybeans grown in 2007, which was two years following potash application, did not show residual effects of high rates of applied potassium in tissue levels. All treatments, including the check, showed soybean leaf tissue levels for potassium in excess of the adequate level. (Note: only one treatment of Sure-K was collected as there is no reason to expect any residual effects from higher rates of Sure-K applied two years previous.)
- Soybean yields for all treatments in 2007 were all good, and there were no apparent fertilizer application effects on yield. Other experiments showed yield increases with both potash and Sure-K in even higher K soils, but not here for some reason. Mother Nature is a mad scientist.
- Soil samples collected after soybean harvest in 2007 showed that the dry potash at the 200 and 300 lb/A application rates in 2005 did result in a significantly higher soil potassium level compared to the check. The Sure-K plot and the 100 lb/A rate of muriate of potash were not significantly higher. But these soil potassium level increases did not result in higher yields.
- Fine tuning of the Liquid application more towards soil test recommendations may have resulted in soybean yield increases significantly higher than the check, as has been shown elsewhere. But the objective of this experiment was to evaluate the carryover effects of rates of muriate of potash in medium potassium testing soils, which was no apparent effect for three crops following application.

Experiment: Foliar Fertilizers plus Glyphosate for Soybeans

Year (Experiment Number): 2007

Location: ACRES Research, Waterloo, IA

Date of Planting/Harvest: May 16 / September 24

Variety: Kruger 235 RR/SCN

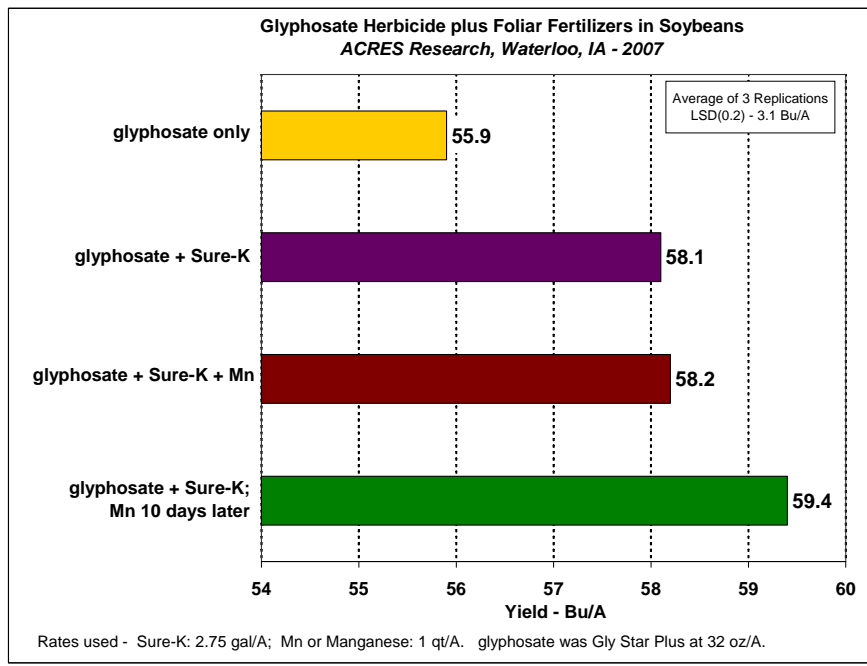
Plot Size (replications): 6-30 in rows x 40 ft

Soil Test Levels	
pH: 6.1	C.E.C.: 15.4
OM: 4.7%	P1: 45 ppm
K: 254 ppm (4.2% base sat)	

An experiment was conducted in Northeastern Iowa by ACRES Research to evaluate the effects of application of foliar fertilizers with glyphosate on soybean yield. Recently it has been reported that application of glyphosate to soybeans causes reduction of manganese uptake (due to oxidation of the manganese in the soil by root exudates) as well as reduction of manganese translocation in the plant itself. Application of manganese with the glyphosate has not been sufficient to overcome this effect, but application nine days after glyphosate was effective.

For many years Agro-Culture Liquid Fertilizers has shown positive yield effects from foliar applications of **Sure-K**. Additionally, application of **4% Manganese** has shown positive results, particularly in soils testing low in manganese. In Mid-Michigan and other areas, a common foliar fertility application consists of 2.75 gal/A of Sure-K plus 1 qt/A of 4% Manganese. This is often applied in combination with glyphosate herbicides with no reported adverse effects. Thus, this study was undertaken to test this rate of fertilizer along with glyphosate, and the recommendation for making a separate manganese application. Unfortunately, the soil test manganese level at this location is not available.

The glyphosate herbicide formulation used was Gly Star Plus, which contains 3 pounds (acid equivalent) of glyphosate per gallon. Application rate was 32 fluid ounces per acre. Foliar applications were made on June 29 when the soybeans were in the V5 stage and 12 inches tall, and the later manganese treatment was ten days later on July 9, when the soybeans were in the R2 stage and 19 inches tall. Spray volume was a total of 10 gallons per acre at 30 psi using 8002 flat fan nozzles. Yield results appear in the following chart.



- All fertilizers resulted in modest yield increases, although the treatment with the separate manganese application was the only treatment that yielded significantly higher than the glyphosate only treatment at the level indicated.
- There was little weed pressure present at time of application, but there was no herbicide antagonism observed.
- Foliar fertilization can be a good tool for increasing soybean yields with glyphosate application, and there was no significant effect on timing of manganese application.

Experiment: Foliar Fertilizer and Glyphosate Applications on Soybeans

Year (Experiment Number): 2008 (Demonstration Soybeans)

Date of Planting/Harvest: May 28 / October 14

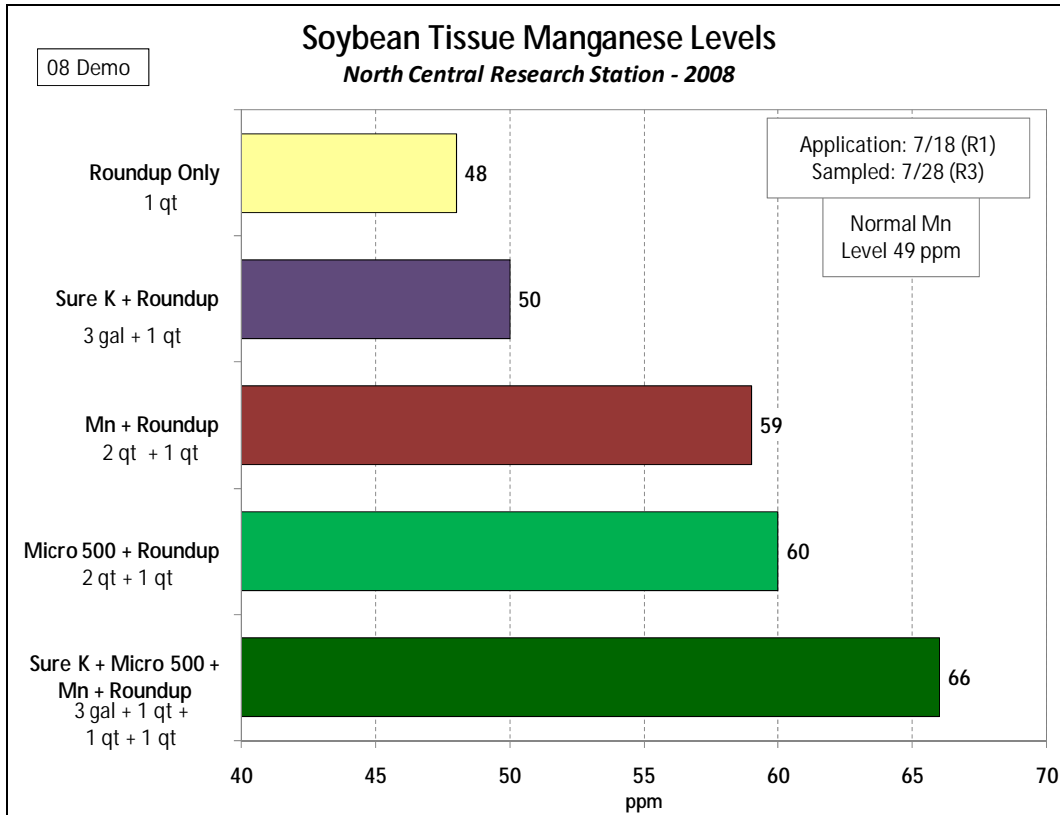
Variety: Stine 2062

Plot Size: 15 ft. x 220 ft. (2 reps)

Soil Test Levels (ppm)

pH: 7.2 C.E.C.: 4.3
OM: 1.2% P1: 56 ppm
K: 54 ppm (3.2% BS)

Objective: To compare the response to micronutrients when applied with glyphosate herbicide on soybean tissue and yield.



In areas with low micronutrient levels, combining fertility with a postemergence glyphosate application saves time along with costs of additional applications. However, recent recommendations from universities and other industry professionals is to separate fertilizers, especially manganese from the glyphosate applications due to reduced uptake of the fertilizer. This field demonstration was set up to look at fertilizer program combinations with glyphosate herbicide. All treatments were applied with 1 qt/A Roundup Original and were compared to Roundup alone.

Treatments are as followed:

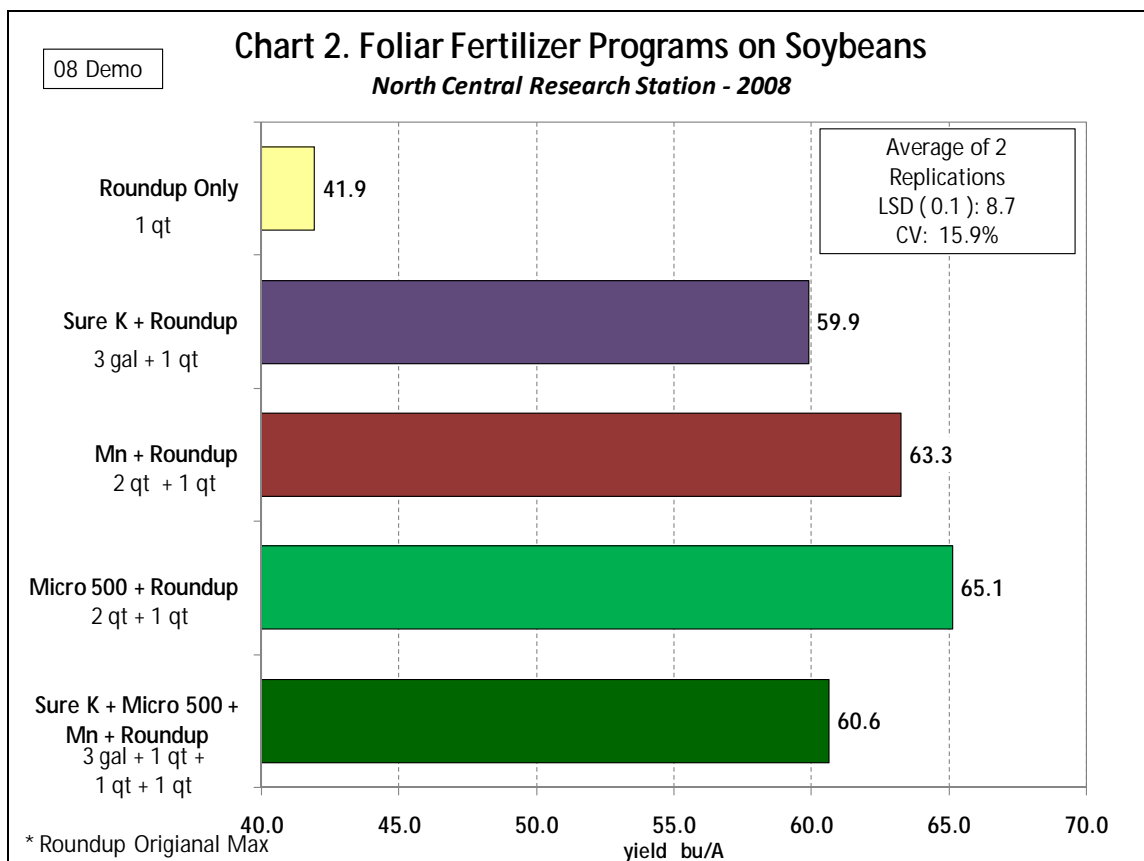
1. Roundup
2. Roundup + 3 gal Sure-K
3. Roundup + 2 qt Manganese
4. Roundup + 2 qt Micro 500
5. Roundup + 3 gal Sure-K + 1 qt Micro 500 + 1 qt Manganese

Applications were made with a pressurized backpack sprayer at a rate of 10 gal/A at 40 psi. Treatments were made on July 18th when the soybeans were in the R1 (early flowering) growth stage. Tissue samples were taken 10 days after application on July 28 and sent to Midwest Laboratory for analysis. Manganese levels are reported on *Chart 1* above.

Tissue Level Results:

- The 1 qt application of Roundup alone (trt 1) had a tissue level of 48 ppm, just below the normal level of 49 ppm.
- The addition of Sure-K slightly increased the tissue level to 50 ppm. Although there are no micronutrients on the Sure-K label, a healthier plant should increase the uptake of other nutrients.
- Applications of 2 qt of Manganese and Micro 500 increased the tissue levels to 59 and 60 ppm respectively. However, the most significant increase in tissue levels was the combination of all products at 66 ppm.
- All foliar fertilizer applications did increase the tissue levels of manganese found in the plant compared to the glyphosate only. This proves that Agro-Culture Liquid Fertilizers formulations of nutrients are not affected by the combination with glyphosate.
- No antagonism on weed control was noticed with any of the product combinations.

Above it was shown that Agro-Culture Liquid Fertilizers have been efficiently absorbed into the plant. Effects on yield are shown in *Chart 2* below.



Yield Results:

- The addition of foliar fertilizers significantly increased yield over the Roundup alone application.
- Foliar applications with Sure-K, Manganese, or Micro 500 greatly increased yield over the Roundup alone, however, no further significant yield increase was seen when all products were combined in a complete foliar application. It was however, nearly 18 bu/A higher than the Roundup alone (60.6 bu/A compared to 41.9 bu/A).

Experiment: Irrigation Timing Effects on Soybean Yield
Year (Experiment Number): 2008 (08-201)
Date of Planting/Harvest: May 23 / October 13
Variety: Stine 2402
Plot Size: 15 ft. x 145 ft. (2 reps)

Soil Test Levels (ppm)	
pH: 6.8	C.E.C.: 5.9
OM: 1.5%	P1: 23 ppm
K: 62 ppm (2.7% BS)	

Objective: Evaluation of irrigation timing and fertilizer response on soybean yields.

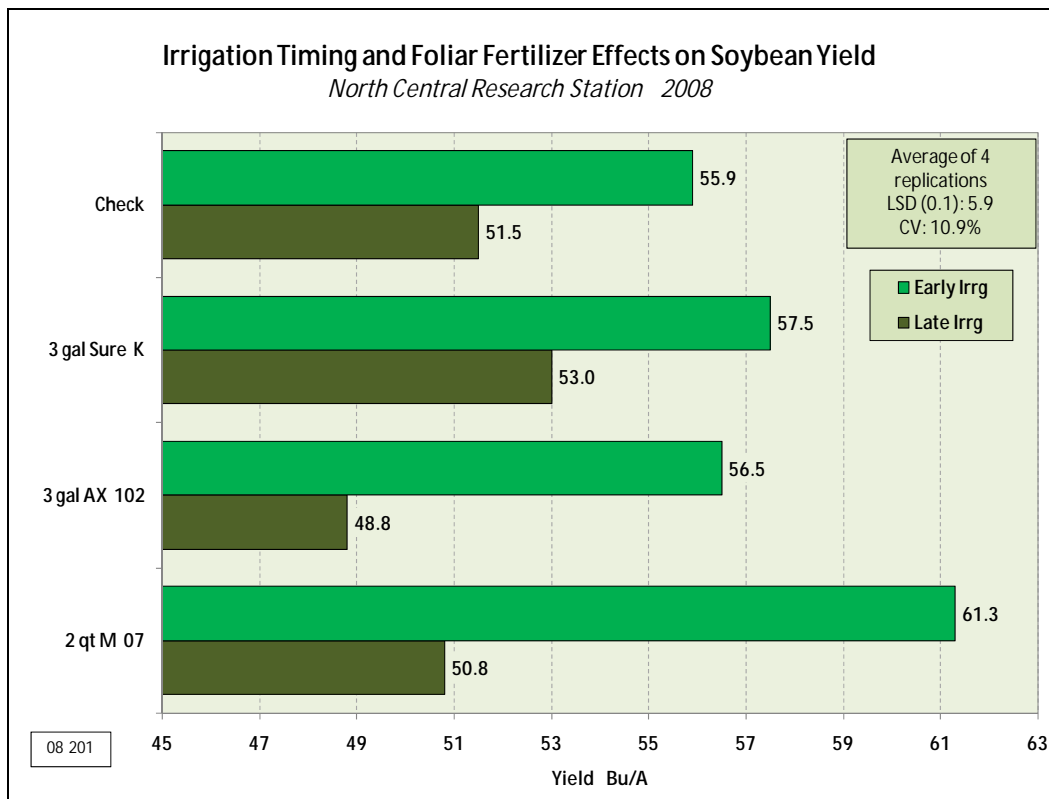
Recent industry recommendations promote that soybeans do not need additional irrigation water until after flowering (R1). This experiment was established to test the effects on three foliar fertilizer programs and a check using two different irrigation timings, early and late. Irrigation was applied through drip tape and was either started immediately after planting (early) or at flowering, approximately mid July (late).

Soybeans were planted on May 23rd, in a relatively dry season thus far. Just under 2 inches of rainfall occurred in May, most of which was in the second week. June was a near normal month with 2.7 inches of rainfall throughout. The first early irrigation treatment was applied on July 1st, with a total of 0.83 inches added. Flowering occurred in mid July, however over 6 inches of rainfall occurred during the month; therefore the first late irrigation application was on July 31st, with a total of 0.72 inches added.

The early irrigated soybeans received a total 6 irrigation applications totally 4.55 inches was additional water. The late irrigated soybeans were watered 3 times totally 2.27 inches of water.

Three foliar treatments were compared in both irrigation timings: 3 gal Sure-K, 3 gal AX-102, and 2 qt M-07. Treatments were made on July 2nd when the soybeans were in the V3 stage of growth and were approximately 8 inches tall. Each treatment was mixed with water and sprayed at 10 gal/A at 40 psi with a Self-propelled plot sprayer.

Yields appear on the chart to the below.



Results:

- Foliar fertilization did not increase yield in either irrigation timing. This is likely due to applications being applied too early (V3). Research has shown a better likelihood of response when soybeans are in the R1 growth stage.
- Within each foliar program there was a yield advantage to applying irrigation early, immediately after planting. This response could be due to the dry soil conditions at planting and may not be seen in ideal soil conditions. A repeat of the experiment will be done to better determine irrigation timing effects for soybeans.

Experiment: Glyphosate and Foliar Fertilizer Timing on Soybeans
Year (Experiment Number): 2008 (08-514)
Date of Planting/Harvest: May 23 / September 26
Variety: Stine 2062
Plot Size: 15 ft. x 240 ft. (4 reps)

Soil Test Levels (ppm)

pH: 7.2 C.E.C.: 10.0
OM: 2.4% P1: 22 ppm
K: 90 ppm (2.3% BS)

Objective: To determine the effects of tank mixing Sure-K and Manganese with glyphosate on soybean yield.

Recent work across the United States and other soybean growing countries has been done on the interaction between manganese fertilizers and glyphosate herbicides. Work over 15 years done by Dr. Don Huber of Purdue University was summarized in the article What About Glyphosate-Induced Manganese Deficiency?, Fall 2007. He stated in this writing, that “genetically modified corn and soybeans reduced the efficiency of manganese uptake 10-15%.” Therefore, “require the application of almost 50 percent more manganese to meet their physiological sufficiency than conventional soybean varieties.” This is due to the fact that “glyphosate in root exudates of weeds and GM tolerant plots change the rhizosphere biology to reduce the availability of Fe, Mn and other essential mineral nutrients for crop uptake.” Initial research work was done, using manganese fertilizers as a carrier of the glyphosate herbicide to reduce time and expense of two trips across the field. Much work has been done to show that various forms of manganese either reduce the effects of the glyphosate herbicides or show no yield response. “Ammonium sulfate and different glyphosate formulations can reduce the antagonism and immobilizations of Mn to improve weed control. Normal uptake and translocation of foliar applied Mn was not observed until at least eight days after glyphosate was applied.” Because of this work the recommendation of making a glyphosate application and waiting 9 days before a manganese application was made. By doing this, the plant should recover from the glyphosate application and begin uptake of foliar applied manganese.

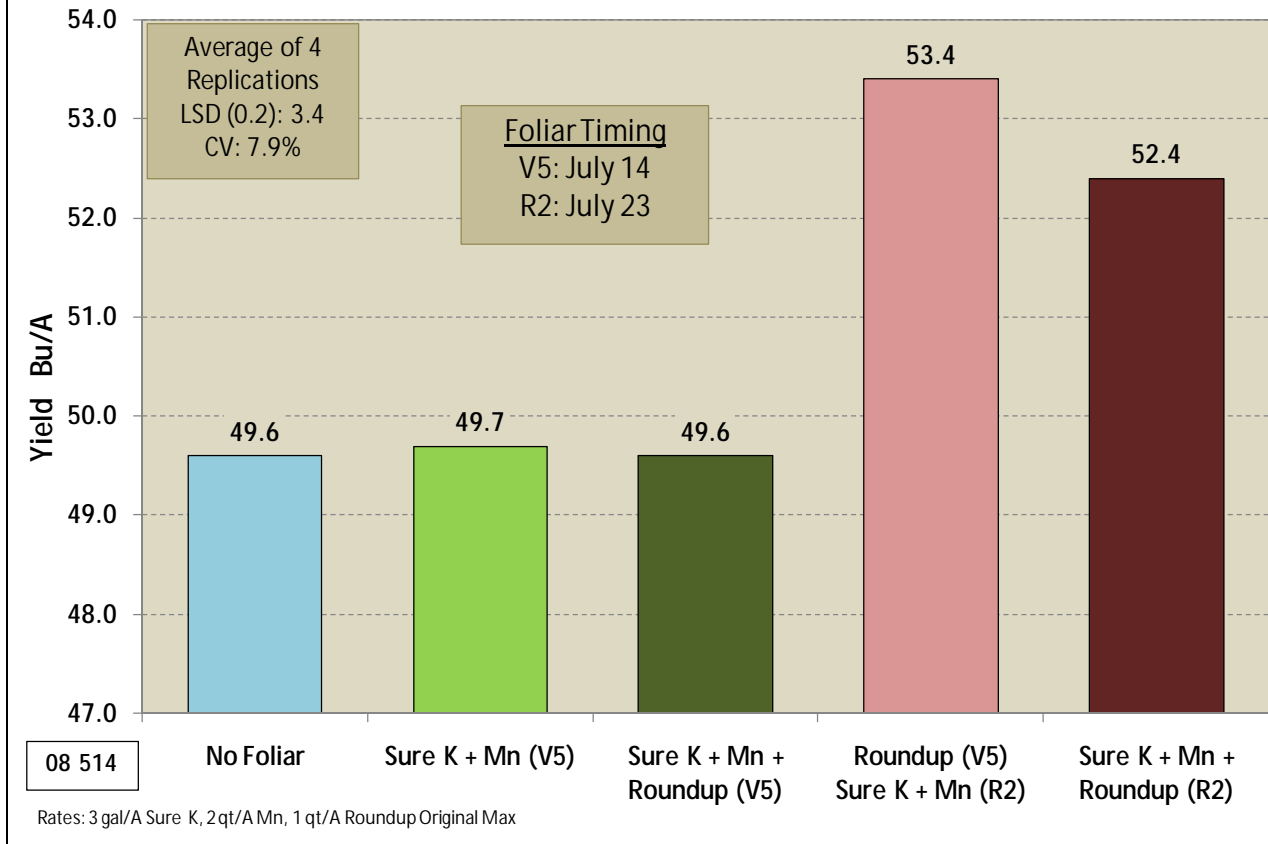
For many years now, Agro-Culture Liquid Fertilizers Sure-K and Manganese foliar program has been tank mixed with various formulations of glyphosate with much success. Research at the North Central Research Station along with contract sites and grower’s fields has shown the benefits of foliar fertilizers, including manganese, with glyphosate applications without negative effects talked about above. Results from past work can be found in the Research Compilation disk.

In 2008 an experiment was established to test the above recommendation of applying foliar manganese applications 9 days after the glyphosate application. Roundup Original at 1 qt/A was used as the glyphosate source; Outfitter AMS was used at 2 pt/100 gal. Treatments were mixed with water and sprayed at a total spray volume of 10 gal/A at 40 psi with a self-propelled plot sprayer. The first application was made on July 14th, when the soybeans were in the V5 stage of growth and approximately 9 inches tall. The second application was made 9 days later when the soybeans were in the R2 stage of growth and 15 inches tall. Treatments evaluated were:

1. Untreated check
2. Sure-K + Manganese (V5 growth stage)
3. Sure-K + Manganese + Roundup (V5 growth stage)
4. Roundup (V5 growth stage); Sure-K + Manganese (R2 growth stage) **Industry Recommendation**
5. Roundup + Sure-K + Manganese (R2 growth stage)

Yield results appear on the chart below.

Glyphosate and Foliar Manganese Timing on Soybeans North Central Reserach Station - 2008



Results:

- No yield difference was seen with the early applications at the V5 growth stage compared to the untreated check. This may be due to the small plants in little tissue surface area that is being covered in the 30" rowed soybeans. There may not have been enough tissue uptake at this early time to get benefit from the foliar application.
- A significant yield increase was seen when the foliar application was made at the R2 stage of growth. (Nearly 3 bu/A)
- No significant yield loss was seen when Roundup was applied at the same time as the foliar fertilizers at both the V5 and R2 growth stage. This proves that Agro-Culture Liquid Fertilizers are formulated differently than convention fertilizer sources and that combining applications will save time and trips across the field without jeopardizing yield.

Experiment: Soybean Seed Treatments
Year (Experiment Number): 2008 (08-518)
Date of Planting/Harvest: May 23 / October 14
Variety: Stine 2062
Plot Size: 15 ft. x 130 ft. (4 reps)

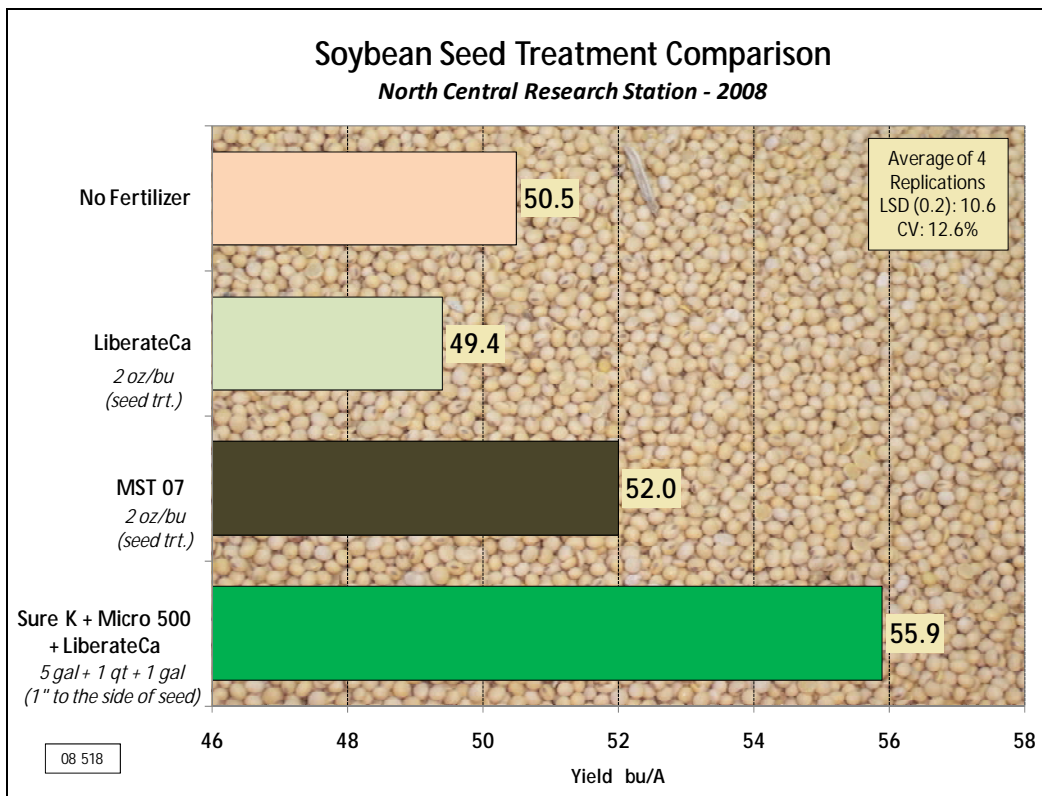
Soil Test Levels (ppm)	
pH: 7.2	C.E.C.: 7.9
OM: 1.5%	P1: 27 ppm
K: 53 ppm (1.7% BS)	

Objective: To determine yield response to fertilizer seed treated soybeans.

There are many seed treatments being applied to soybean seeds to help promote early growth and increase soybean yield. Agro-Culture Liquid Fertilizers have been working on a few products to be used as a seed treatment. LiberateCa is a 3% high quality calcium product that can be mixed with other fertilizers with improved compatibility. The other seed treatment is MST-07, an experimental product designed specifically as a seed treatment. Both of these products were applied at 2 oz per bushel of soybeans. Seed treatments were measured with a syringe and mixed into the soybean seed the day before planting. No other fertilizer was applied.

These seed treatments were compared to a planter applied program which included 5 gal Sure-K + 1qt Micro 500 + 1 gal of LiberateCa placed 1 inch to the side of the seed.

Yield results appear on the chart below.



Results:

- LiberateCa as seed treatment did not increase soybean yield over the untreated check.
- The experimental seed treatment, MST-07 increased yield 1.5 bu/A over the untreated check, however, this was not statically significant.
- Highest yield was achieved with the planter applied program of Sure-K, Micro 500 and LiberateCa, increasing yield over 5 bu/A.

Experiment: Planting Timing and Response to Fertilizers by Soybeans

Year (Experiment Number): 2008 (08-520)

Date of Planting/Harvest: May 15 / October 14

Variety: Stine 1832

Plot Size: 10 ft. x 95 ft. (4 reps)

Soil Test Levels (ppm)

pH: 7.2 C.E.C.: 11.6

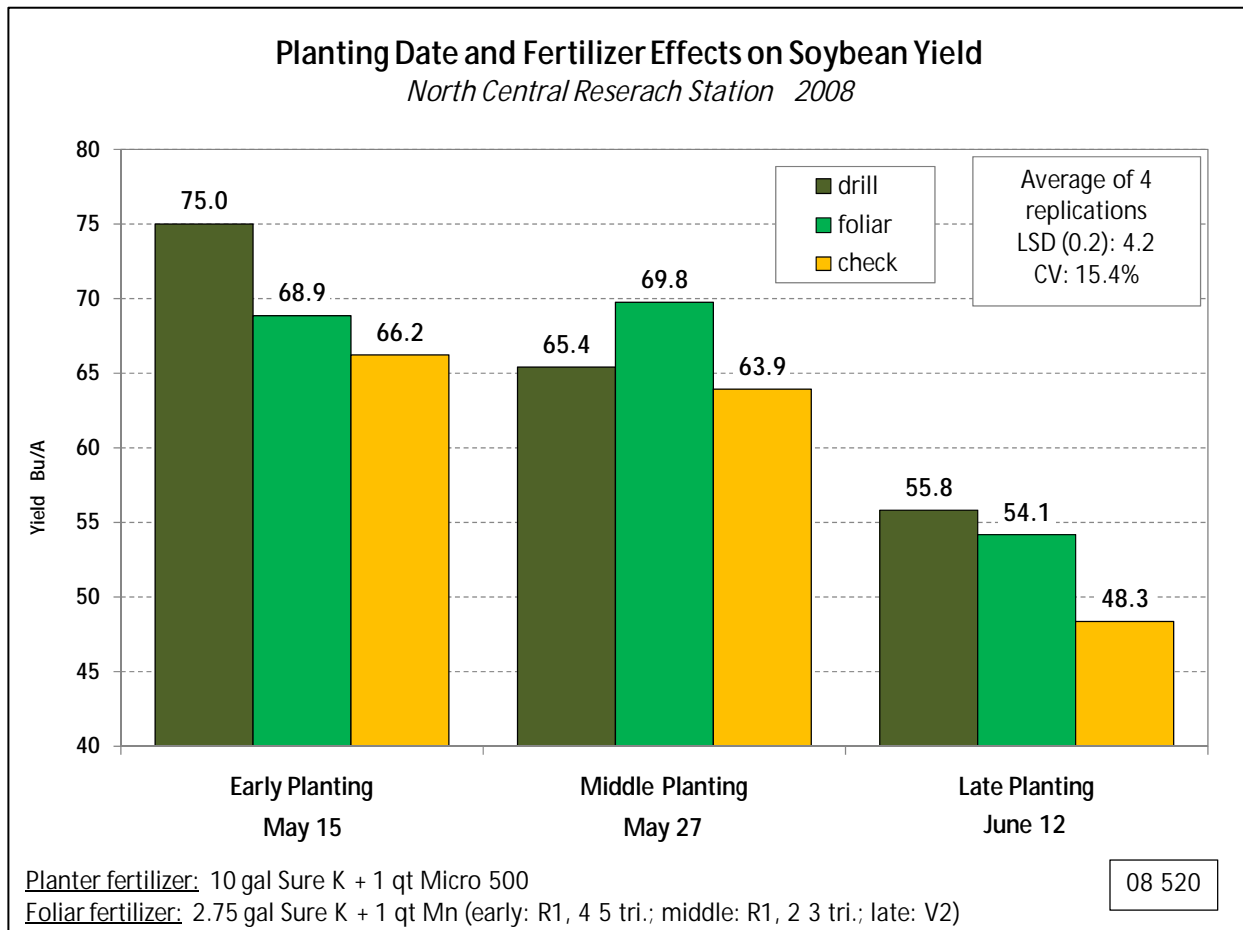
OM: 3.1% P1: 26 ppm

K: 100 ppm (2.2% BS)

Objective: To determine if fertilizer programs and planting date can affect soybean yield.

This experiment compared three different soybean planter timings; an early planting of May 15th, middle planting date May 27th and a late date of June 12th. Within each planting date three fertilizer programs were applied:

1. 10 gal Sure-K + 1 qt Micro 500 (drill)
2. 2.75 gal Sure-K + 1 qt Manganese (foliar)
3. Unfertilized Check



Soybeans were planted with a Great Plains drill and fertilizer was applied in-furrow with Rebounders with Y-knot Split-it seed covers from Schaffert Manufacturing. Foliar applications were made on July 10th. The early planting was in the R1 growth stage and 3-4 trifoliolate, the middle planting was also in the R1 growth stage with 2-3 trifoliolate, and the late planting was in the V2 growth stage. Fertilizers were mixed with water and applied at a total spray volume of 10 gal/A at 40 psi. Results appear on the chart above.

Results:

- Overall, the earlier the planting, the higher the soybean yield, no matter which fertilizer treatment was applied.
- All fertilizer treatments out yielded the untreated at each planting time.
- In the early planting on May 15th, the drill applied fertilizer was significantly higher than the foliar program and the check, increasing yield nearly 9 bu/A. In the colder soils, the soybeans could be taking advantage of the fertilizer placed close to the seed.
- The foliar program was significantly the highest yielding treatment in the second, May 27th planting. Many soybeans in Michigan are planted in late May, and as shown in the past, a foliar application works as well and often times better than a higher fertilizer rate drill applied.
- The foliar application of these second planting yielded as well as the same treatment of the first planting.
- The last planting has the lowest yields overall and none of the treatments produced yields equal to those of earlier plantings, though both fertilizer applications did result in a significant yield increase.

Experiment: *Nutri-Till*TM Applications on Soybeans
Year (Experiment Number): 2008 (08-306)
Date of Planting/Harvest: May 21 / October 13
Variety: Asgrow 2107
Plot Size (replications): 15 ft (6 rows) x 210 ft (4 replications)

Soil Test Levels (ppm)	
pH: 7.2	C.E.C.: 5.8
OM: 1.2%	Bicarb P: 12
K: 53 ppm (2.3% BS)	

Objective: Compare fertilizer applied through dual placement of *Nutri-Till* to planter and foliar applications for soybeans.

Nutri-Till is a form of strip tillage developed by Agro-Culture Liquid Fertilizers. *Nutri-Till* is unlike other forms of strip tillage in that it allows for different liquid fertilizers to be placed in two different zones. The upper zone is in the seed zone from the planter, and the lower zone is eight inches below the soil surface. One area of research in this experiment is to test the hypothesis that soybeans will respond to applications of nitrogen placed down in the root zone. Certainly soybeans obtain sufficient nitrogen from the nodulation process, but perhaps placing a hi-quality nitrogen source as High NRG-N would be a supplement. Additional comparisons were planter fertilizer compared to *Nutri-Till*, and the effect of foliar application of 3 gal/A of Sure-K on July 2.



*Nutri-Till*TM in the raised position showing dual placement of liquid fertilizers.



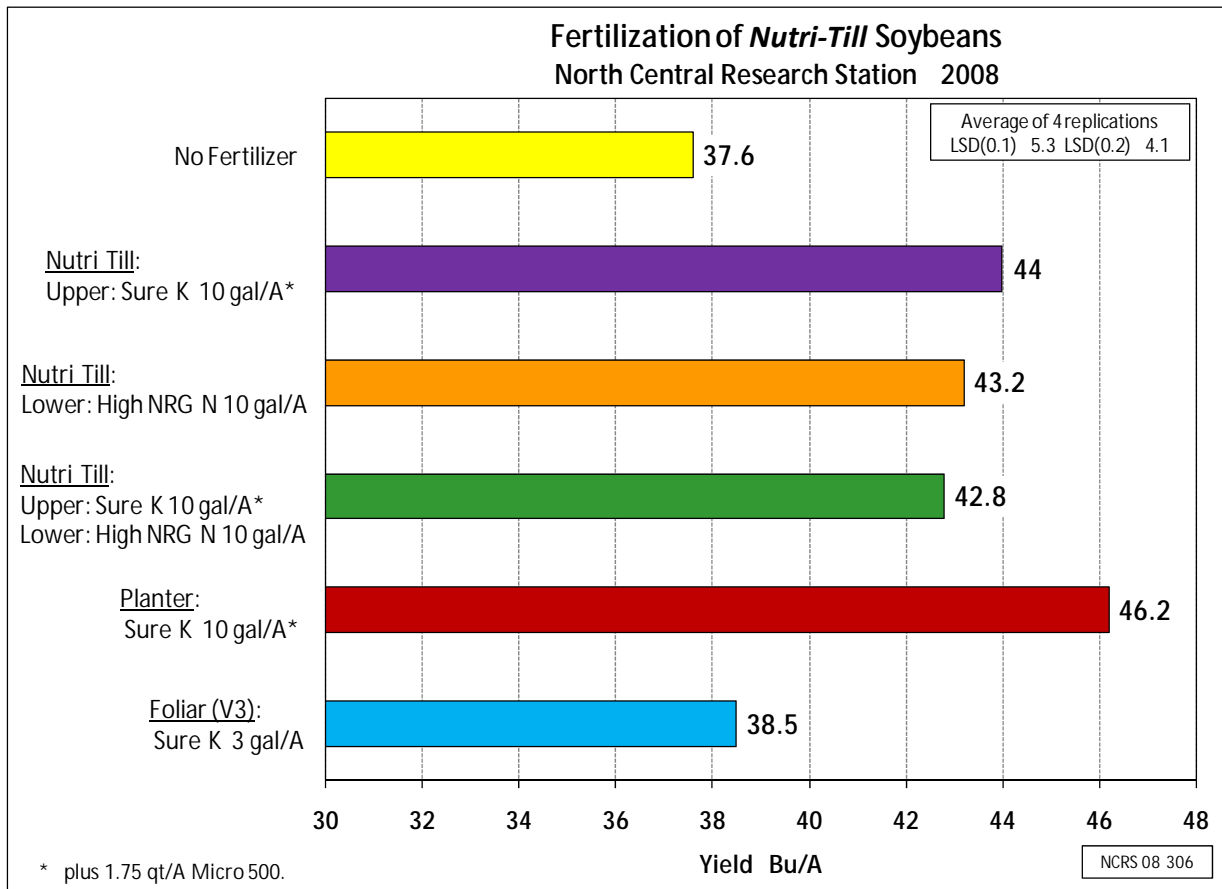
*Nutri-Till*TM application to test plot.



*Nutri-Till*TM plot ready for the planter.



Making a foliar application with the plot sprayer to soybeans in the V3 stage.



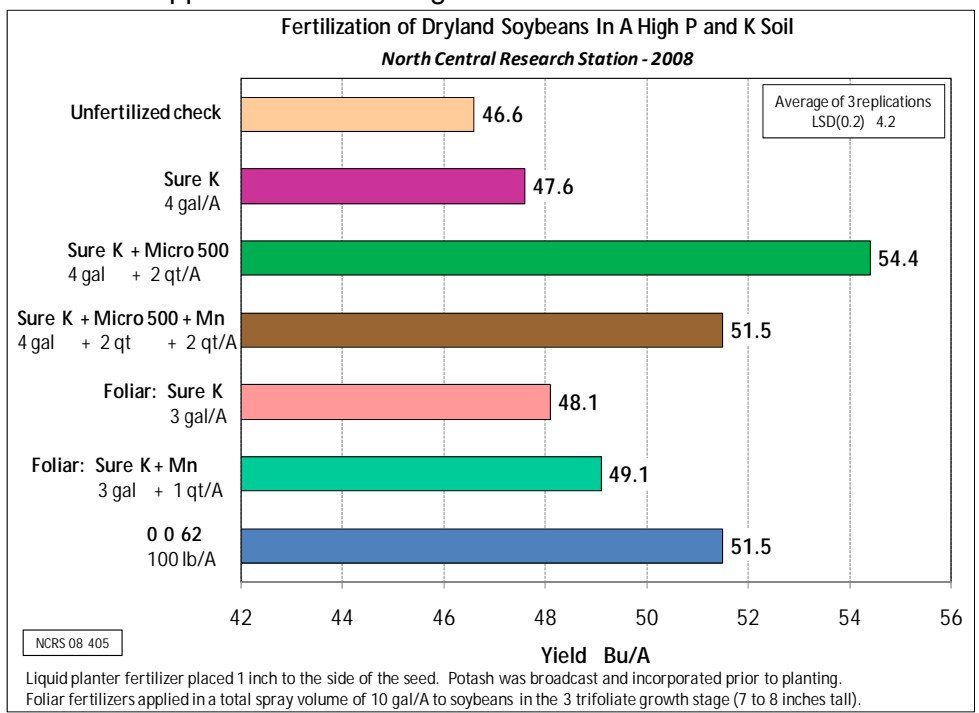
- All of the soil-applied treatments resulted in a significant yield increase vs no fertilizer.
- It was interesting to see that the soybeans responded similarly to the Nutri-Till application of either Sure-K or High NRG-N. But there was no yield difference when both were applied compared to either one alone.
- Highest yield was with the planter application of Sure-K placed an inch to the side of the seed, although this yield was not statistically different from the Nutri-Till application.
- The foliar application of Sure-K did not result in a yield increase. We have found this in other tests this year. We have concluded that applications in the V3 growth stage will result in a yield increase when the soybeans are drilled in narrow (i.e. 7.5 in) rows. But soybeans in the V3 stage in 30 inch rows are still small and most of the application goes on the ground. The soybeans may not recover all that is sprayed on the ground. We have changed the recommendation that soybeans planted in 30 inch rows should be in the R1 stage of growth when sprayed with Sure-K to enable enough foliage for interception of the nutrition.

Experiment: Fertilizer Program Comparisons in Dryland Soybeans
Year (Experiment Number): 2008 (08-405)
Date of Planting/Harvest: May 27 / October 7
Variety: Stine 2062
Plot Size (replications): 15 ft x 100 ft (3 replications)

Soil Test Levels (ppm)
 pH: 6.6 C.E.C.: 8
 OM: 2.5% P1: 22 ppm
 K: 127 ppm (4.1% B.S.)
 Zinc: 0.6 ppm Mn: 8 ppm
 Fe: 64 ppm Cu: 0.7 ppm
 B: 0.5 ppm

Objective: Compare several different fertilizer programs for effects on soybean yield in a field testing high in both phosphorus and potassium, but low in micronutrients.

Research at the North Central Research Station has consistently shown a yield response in corn to planter-applied fertilizers in high phosphorus soils. This is because phosphorus is not in a plant-usable form in cool soils typical for when corn is planted. This has not been the case with soybeans, since they are planted later when soils are warmer and soil phosphorus is in a usable form. However, soybeans are large users of potassium, and they will sometimes respond to potassium applications even in soils testing high in potassium. The field where this particular experiment is located tests high in both phosphorus and potassium, but low in all micronutrients except iron (Fe). Planter fertilizer applications of Sure-K and Sure-K plus micronutrients were compared to foliar applications of Sure-K and Sure-K plus Manganese. Additionally, there was an unfertilized check and a conventional standard of 100 lb/A of muriate of potash (0-0-62) which was broadcast applied and incorporated prior to planting. Yield results appear in the following chart.



- Highest yield was obtained with a planter application of Sure-K plus Micro 500. This yield was significantly higher than the same treatment without Micro 500, which follows the soil test indicating low levels of most micronutrients.
- Additional Manganese did not increase yield of treatment with Micro 500 alone.
- Foliar applications did not result in significantly increased soybean yields over the check, although applications either had no micronutrients or only manganese. The applications were made to soybeans in the 3-trifoliolate stage, which may have been too early
- The potash application did have a significant yield increase, although it took 62 lb/A of K₂O to do it, and it was still lower than the Liquid application of Sure-K + Micro 500.

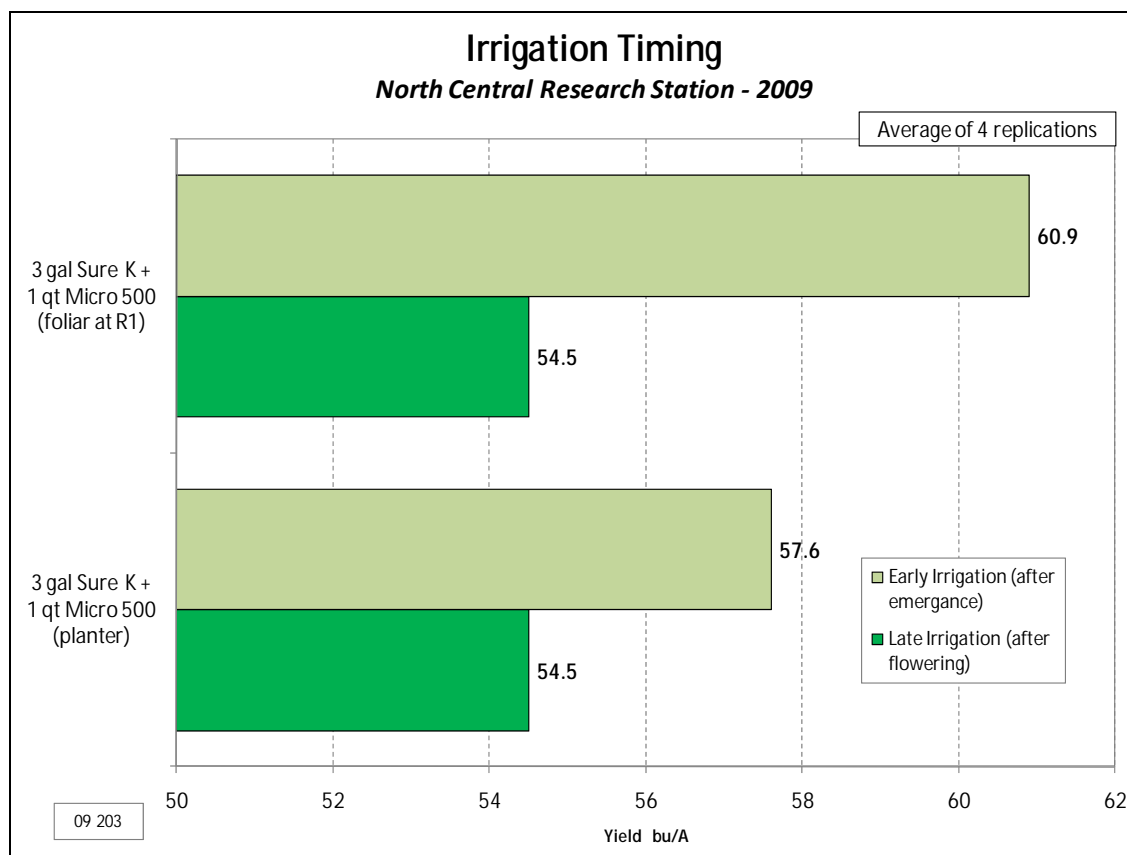


Experiment: Irrigation Timing on Soybeans (09 203)

Planted: 5/13	Variety: Stine 2420	Population: 140,000
Plot Size: 15' x 200'	Replications: 4	Harvested: 10/16/09
Foliar: 7/13/09		

Soil Test Values (ppm):													
pH	CEC	% OM	P1	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
7.0	6.1	1.7	37	102	10	4.3	19.5	75.8	0	0.4	0.7	10	0.5

Objectives: A repeat of a study done in 2008, looking at the effects of irrigation timing on soybean yield. Some researchers promote that irrigation is not necessary until after flowering. In this experiment irrigation was applied with drip tape. The first early irrigation application was made on June 11th and a second application was made on June 28th, totaling 2 inches applied before flowering. After flowering a total of 2.75" inches was applied in three applications in July though early August. August began timely rain events, eliminating the need for irrigation.



Conclusions:

- No yield difference was seen between the fertility programs.
- There was a significant increase in yield where irrigation was applied after emergence. This contradicts the theory that soybeans do not benefit from supplemental water until flowering.

*See *Product Descriptions* in the introduction for more information on ACLF products used.

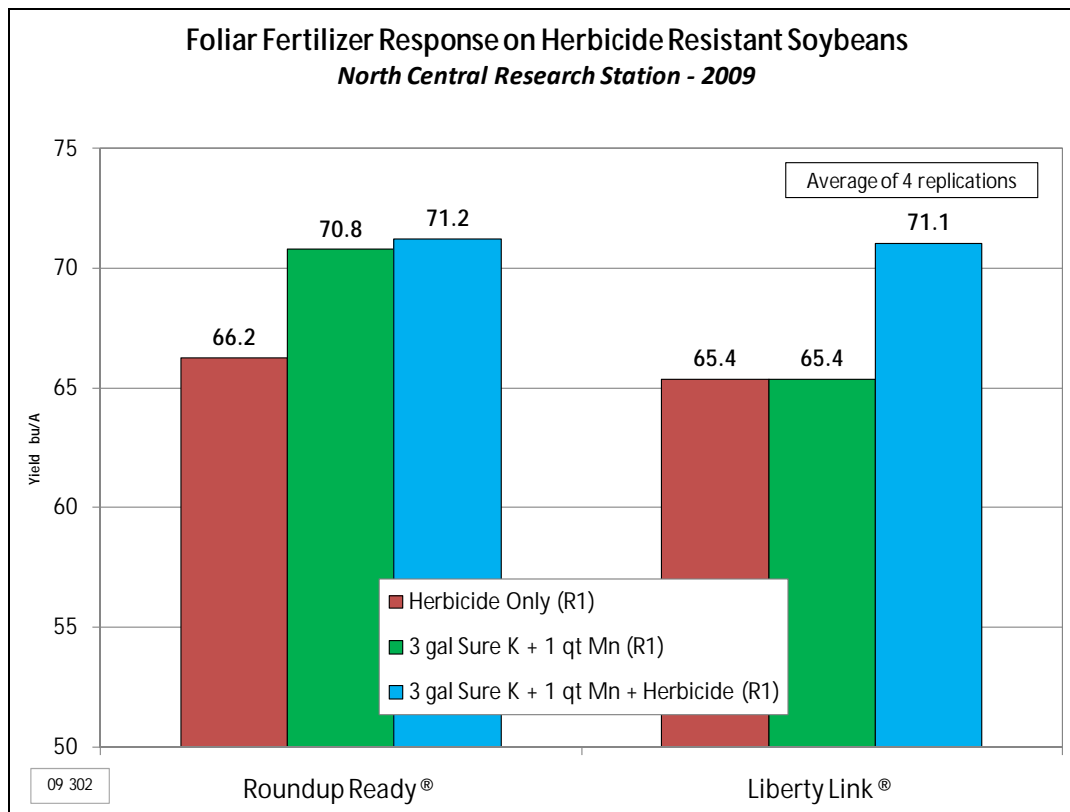


Experiment: Roundup Ready® and Liberty Link® soybean comparison (09 302)

Planted: 5/15/09	Variety: Stine 2420RR Stine 23LA08	Population: 140,000
Plot Size: 15' x 85'	Replications: 4	Harvested: 10/16/09
Foliar: 7/8/9		

Soil Test Values (ppm):													
pH	CEC	% OM	Bicarb	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
7.2	5.9	1.3	10	74	7	3.2	14.1	81.8	0	0.9	1.0	5	0.1

Objectives: New technology in soybeans for the 2009 growing season was the use of LibertyLink® soybeans. Similar to the Roundup Ready® soybeans already used, LibertyLink soybeans allow a grower to spray a postemergence application of Ignite® for weed control without injury to the soybeans. With the new technology, a test was established to compare both Roundup Ready and LibertyLink soybeans with and without foliar application of 3 gal Sure K and 1 qt Mn.



LSD(0.1): 3.8, CV: 8.5%

Conclusions:

- There was over a 4 bu/A yield increase with the addition of Sure K and Mn to the Roundup Ready soybeans with no difference if herbicide was used. This confirms past results that showed there is no antagonism with Sure K and Roundup combinations.
- The LibertyLink soybeans only had a yield increase when the foliar fertilizer was mixed with the Ignite. In the first year of testing this show no antagonism, however, further testing is warranted.

*See Product Descriptions in the introduction for more information on ACLF products used.

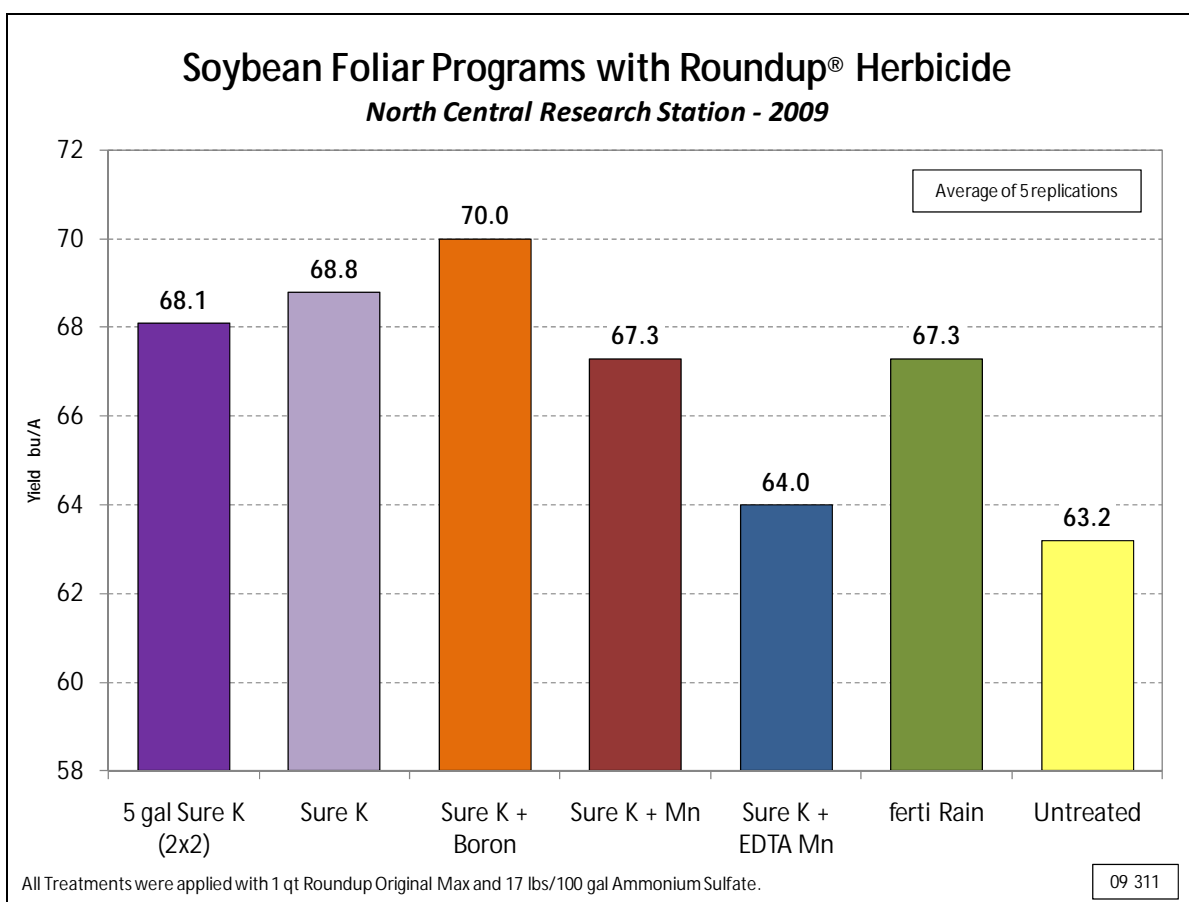


Experiment: Foliar Fertilizer Applications with Roundup® (09 311)

Planted: 5/15/09	Variety: Pioneer 92Y29	Population: 40,000
Plot Size: 15' x 210'/130'	Replications: 5	Harvested: 10/20/09
Foliar: 7/8/09		

Soil Test Values (ppm):													
pH	CEC	% OM	Bicarb	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
7.5	8.3	1.6	7	70	12	2.2	15.5	81.7	0	0.6	1.2	3	0.6

Objectives: This experiment compares different micronutrient additives applied at 1 qt/A to the standard foliar program of 3 gal/A of Sure K. Treatments were applied at R1 soybeans with Roundup® Original Max and AMS and sprayed at 10 gal/A. Foliar treatments were also compared to 5 gal/A Sure K applied 2x2 at planting.



LSD(0.2): 4.1, CV: 8.9%

Conclusion:

- The conventional manganese source, 6% EDTA Mn, was the only treatment that did not significantly increase yield over the untreated check.
- As shown in past research, planter applied Sure K yielded equal to foliar applied Sure K (68.1 and 68.8 bu respectively).
- The addition of Boron was the only micronutrient to result in a further increase in soybean yield.

*See Product Descriptions in the introduction for more information on ACLF products used.

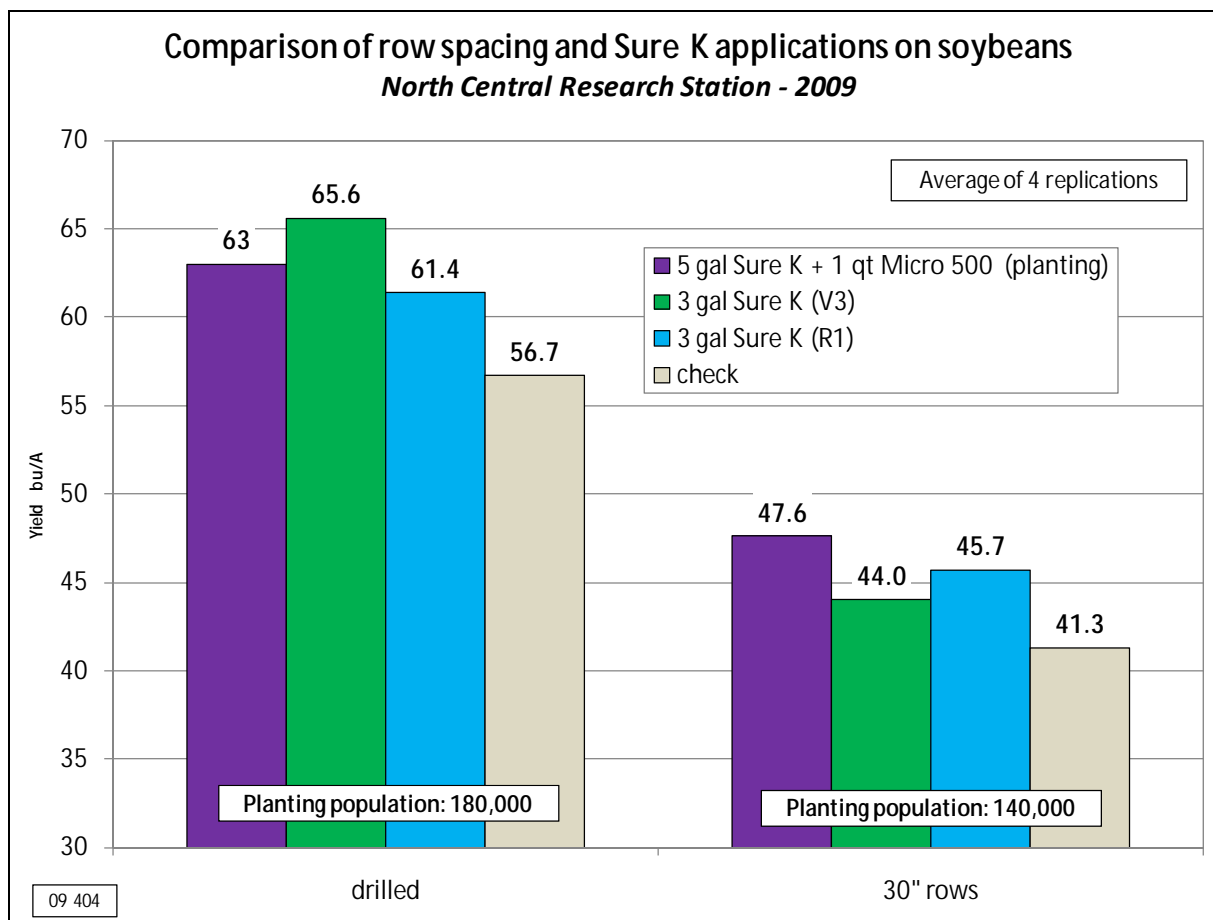


Experiment: Foliar Timing Comparison in 30" and Drilled Soybeans (09 404)

Planted: 6/16/09	Variety: Stine 2420	Population: 140,000/180,000
Plot Size: 15' x 100'	Replications: 4	Harvested: 10/13/09
Foliar (V3): 7/16/09	Foliar (R1): 7/30/09	

Soil Test Values (ppm):													
pH	CEC	% OM	P1	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
6.2	6.9	1.5	37	99	13	3.7	13.8	70.4	11.5	0.6	0.8	8	0.5

Objectives: Previous work at the North Central Research Station has shown a consistent response in drilled soybeans to a foliar application at the V3 growth stage. In more recent years and a switch to 30" row soybeans, less of a response was seen from foliar applications at that stage. This raised the question, should there be different timings of foliar applications dependent on the soybean planting widths? This made sense when thinking about plant coverage in different planting widths (see pictures below). Because of this, an experiment was developed to evaluate timing on two different row widths: 30" and 7.5" (drilled). Foliar applications were made at both V3 and R1 stage of growth.



LSD(0.1):4.7, CV: 20.1%

*See *Product Descriptions* in the introduction for more information on ACLF products used.

