

Corn: Sure-K



- Sure-K Rate Effect on Corn Yield (2002)
- Sure-K Rate Effect in Irrigated Corn (2003)
- Sure-K Rate Management in Irrigated Corn (2005)
- Potassium Fertilizer Carryover from Soybeans to corn (2006)
- Potash Application Effects in Soils with Very Low Potassium Levels (2006)
- Potassium Fertilizer Programs for Corn (2008)
- Potash Fertilizer Carryover Effects on Corn (2008)
- Sure-K Rate Comparison in Corn (2009)

Experiment: Sure-K Rate Effects on Corn Yield
Year: 2002 (02-07)
Date of Planting/Harvest: May 7 / October 14
Plot Size: 4 rows by 100 ft.

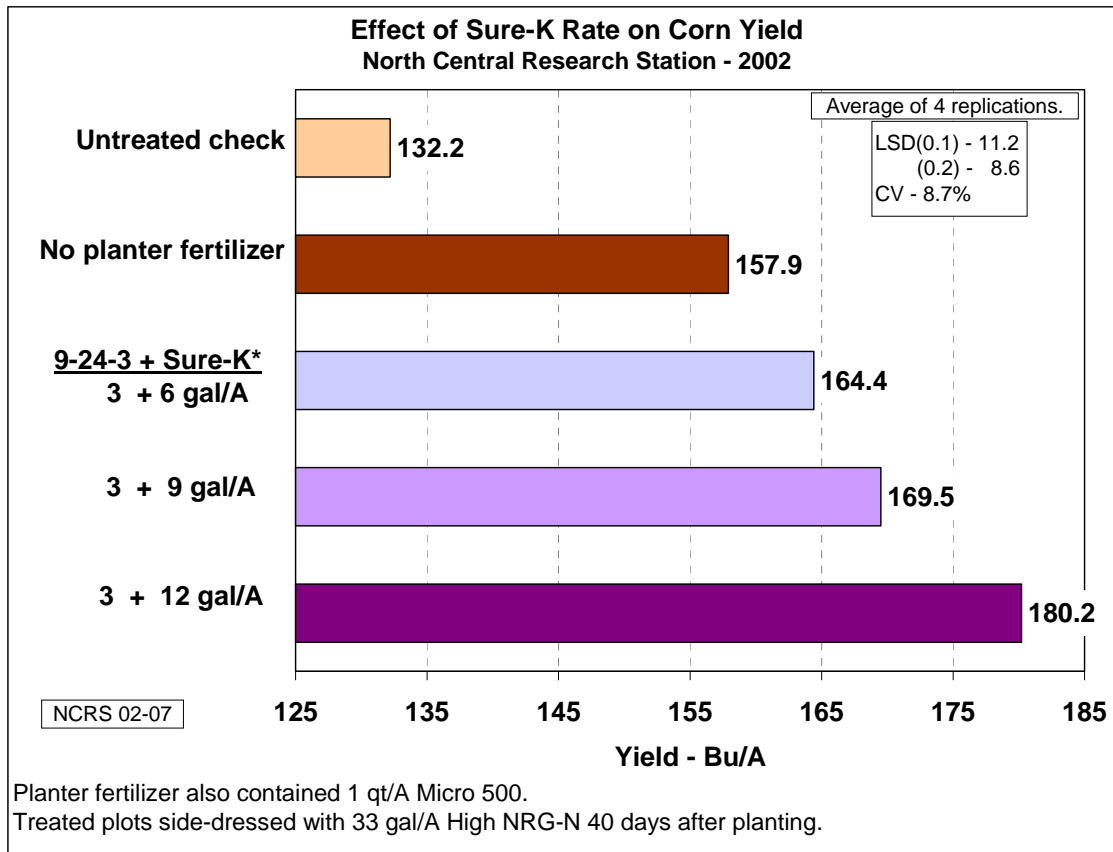
Soil Test Levels	
pH: 7.7	CEC: 11.6
OM: 3%	P1: 32 ppm
K: 66 ppm (1.5% base sat.)	

Sure-K has proven to be a very effective potassium source with the advantage of excellent compatibility with Pro-Germinator 9-24-3 and Micro 500. As with all crop nutrients, soil sampling provides the best guide for Sure-K rate recommendation.

Objective:

1. Determine best rate of planter-applied Sure-K for optimum yield in a low-K soil.

Based on the soil K level for 150 Bu/A yield goal, a rate of 7 gal/A Sure-K would be recommended. For higher yield goals, 9 gal/A would be the maximum rate. This is about the heaviest ground on the NCRS, and it holds moisture well. This experiment received water when supplemental irrigation with the traveling gun was applied to the rest of this farm. A total of 2.25 inches was applied in three applications on July 12, July 23, and August 9. This resulted in higher than expected yields under the dry conditions. Treatment yields appear in the following chart.



- There was a significant yield increase in yield when the Sure-K rate was increased from 9 to 12 gal/A.
- Under low soil potassium conditions, Sure-K rates higher than the previous maximum recommended rate of 9 gal/A may be warranted.

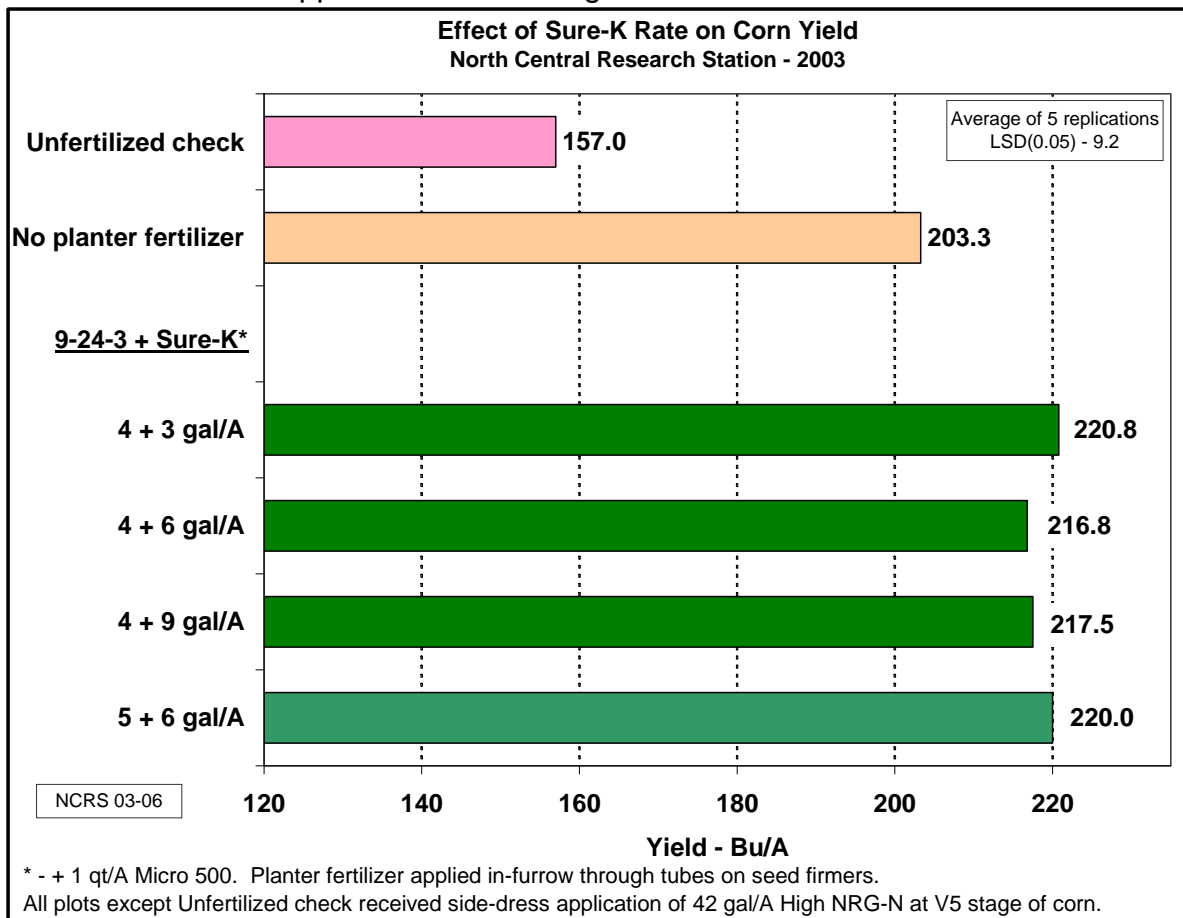
Experiment: Sure-K Rate Effect in Irrigated Corn
Year: 2003 (03-06)
High-Performance Proof 95-08

Soil Test Levels	
pH: 6.8	CEC: 5
OM: 1.4%	P1: 38 ppm
K: 62 ppm (3.4% base sat.)	

Date of Planting/Harvest: April 30 / November 11
Plot Size: 4 row x 210 ft.

Planter-applied fertilizer can be beneficial in supplying needed crop nutrition with the advantage of placement in the root zone for best efficiency. Determining best rate for yield and cost based on soil nutrient levels can be a challenge. Agro-Culture Liquid Fertilizers have been shown to produce economic yield responses in a variety of conditions, including Pro-Germinator 9-24-3 application in soils with high phosphorus levels. In 2002 an experiment showed increased yield with increased Sure-K rate up to 12 gal/A in a soil with low potassium levels (87 ppm/1.5% base saturation). The soil in this experiment was coarser with a lower CEC. It had a lower soil potassium level but a higher % base saturation for potassium.

Sure-K was applied in-furrow at rates of 3, 6 and 9 gal/A with 4 gal/A of 9-24-3 and 1 qt/A Micro 500. Application was made through *Sideshooter* model Flo-Rite Drop Tubes from Farmer Fabrications or Hicksville, OH. This applies the fertilizer in an inverted “V” around the seed. Yield results appear in the following chart.



- All fertilizer treatments significantly increased yield over the check.
- All planter-applied treatments resulted in a significant yield increase compared to the no planter fertilizer. The no planter fertilizer treatment plots were noticeably shorter and purple early in the season compared to the planter-applied fertilizer treatments. Also it was observed that the ear silks of the planter fertilizer treatments were fully dried while the silks of the no planter fertilizer treatment were still green. (See following pictures.)
- In this experiment with higher relative soil potassium levels, there was not a response to increased Sure-K rate like in the previous experiment as may have been expected. With a soil base saturation of 3.4%, the 3 gal/A rate of Sure-K evidently was effective.
- Doesn't this make you want to scratch your head or something?
- The 4 gal/A rate of Pro-Germinator 9-24-3 was sufficient as increasing the rate to 5 gal/A did not significantly increase yield.

In-season plot pictures:



No planter fertilizer

4 gal/A 9-24-3 + 3 gal/A
Sure-K + 1 qt/A Micro 500



- Planter fertilizer enables faster crop development and higher yield.

Experiment: Sure-K Rate Management in Irrigated Corn

Year (Experiment Number): 2005 (05-09)

Date of Planting/Harvest: May 5 / Oct. 19

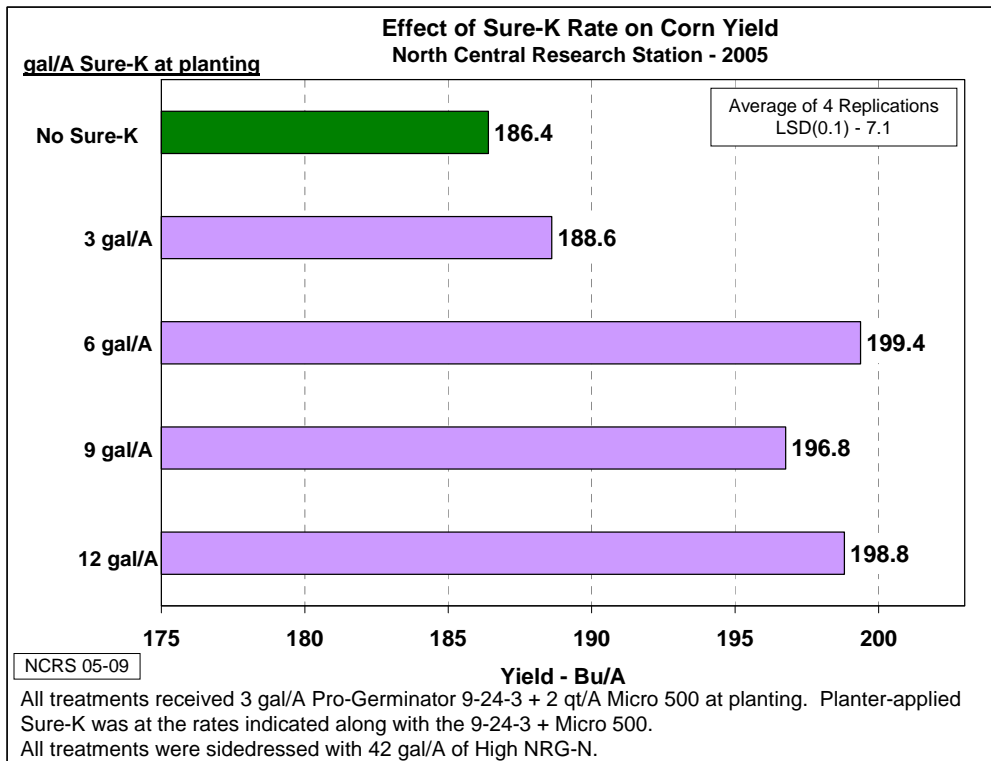
Hybrid: Pioneer 37R71

Plot Size (replications): 4 row x 240 ft. (4)

Soil Test Levels	
pH: 6.9	C.E.C.: 7.3
OM: 2.4%	P1: 43 ppm
K: 80 ppm	(2.8% BS)

Potassium nutrient management is critical to high-yielding corn production. In spite of its comparatively low nutrient analysis (2-1-6), Sure-K has long been proven an effective K source for growing crops, including corn. The objective of this experiment was to determine the most effective Sure-K rate in a soil low in potassium (80 ppm and 2.8% base saturation). In a soil like this, a rate response to potassium application would be expected. Rates of 0, 3, 6, 9, and 12 gal/A were applied at planting in combination with Pro-Germinator 9-24-3 and Micro 500, it being thought that higher yield would correlate with higher rate of application. Fertilizer was placed one inch to the side of the seed at planting. Additionally, with a base rate of 6 gal/A of Sure-K applied at planting, an additional 6 gal/A was applied in two methods of application: (1) 2 applications of 3 gal/A applied as a foliar (June 21, 20 in. tall and July 6, 58 in. tall/V10), and (2) 6 gal/A at sidedress in combination with the normal 42 gal/A of High NRG-N on June 10 (36 days after planting to 14 in. tall/V5 corn). Because of the low analysis of Sure-K, it may be thought by some that application of additional dry fertilizer like muriate of potash, 0-0-60, is necessary for maximum yield. So a treatment was included which had a pre-plant incorporated application of 100 lb/A of 0-0-60, and then 6 gal/A of Sure-K in the planter fertilizer.

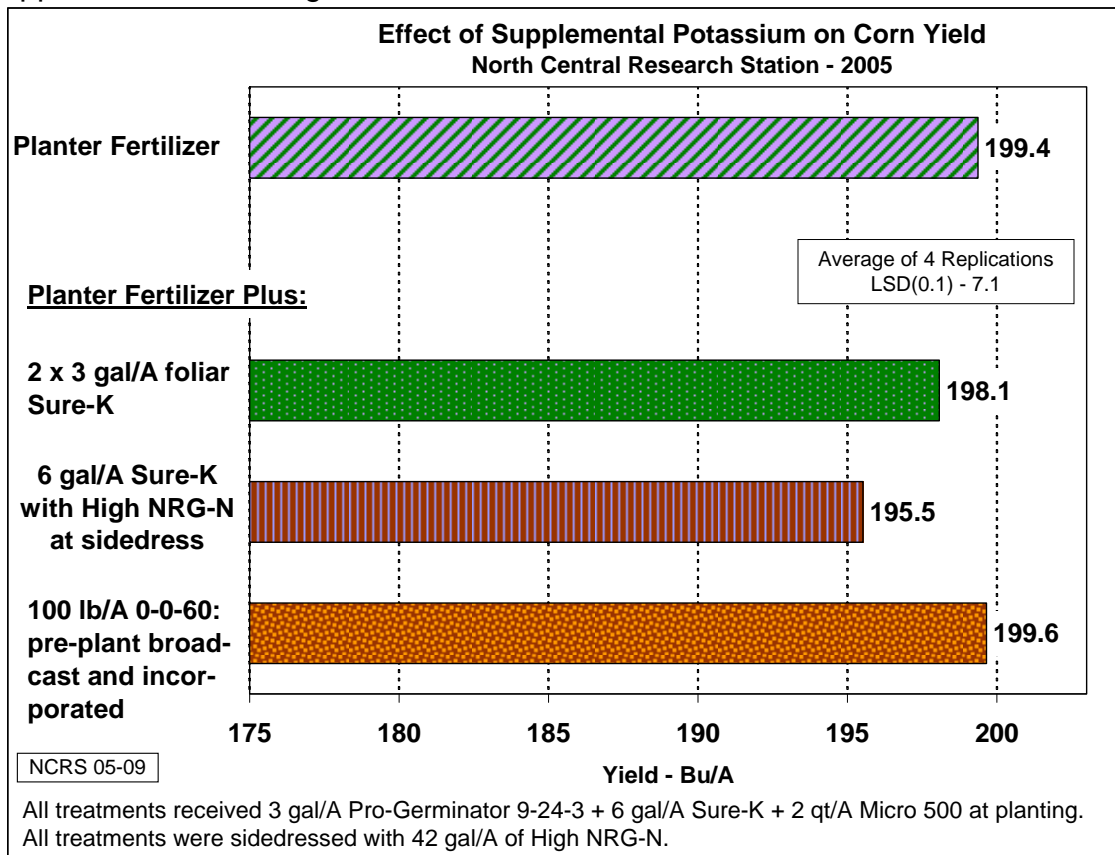
The results of the planter rate portion appear in the following chart.



- There was a significant yield response to application of Sure-K at a minimum of 6 gal/A.

- Interestingly, there was no further increase in yield above the 6 gal/A rate, indicating that the potassium demand was met with this rate.

The results of the method of application of supplemental potassium portion of the experiment appear in the following chart.



- Additions of Sure-K or 0-0-60 beyond the 6 gal/A rate of Sure-K applied at planting did not increase yield.
- The planter-applied rate of Sure-K must be meeting the K demand even in this relatively low-potassium soil. Even adding 60 extra lb/A of K₂O from the muriate of potash did not affect yield. This shows addition of supplemental dry fertilizer is not necessary unless there is the desire to waste money.

Experiment: Potassium Fertilizer Carryover from Soybeans to Corn

Year (Experiment Number): 2006 (06-505)

Date of Planting/Harvest: 4-28-06 / 10-25-06

Hybrid: NK 45A6

Plot Size (replications): 6 rows x 130 ft (4)

Soil Test Levels (ppm)

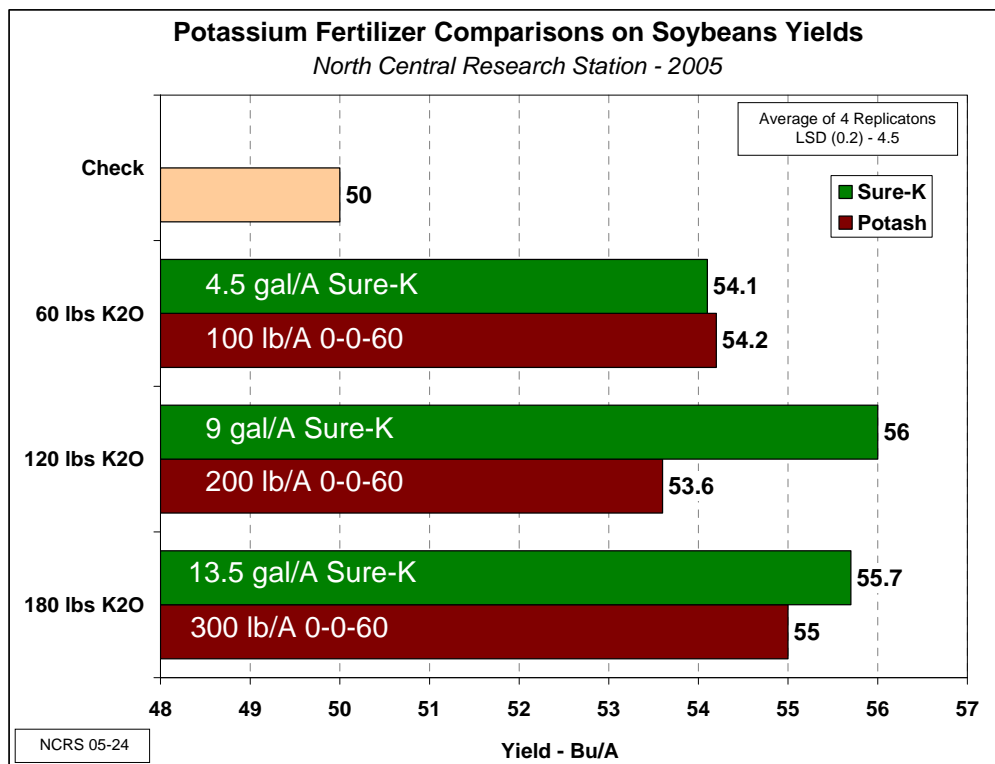
pH: 7.0 C.E.C.: 8.0

OM: 1.9% P1: 57 ppm

K: 75 ppm (2.5% BS)

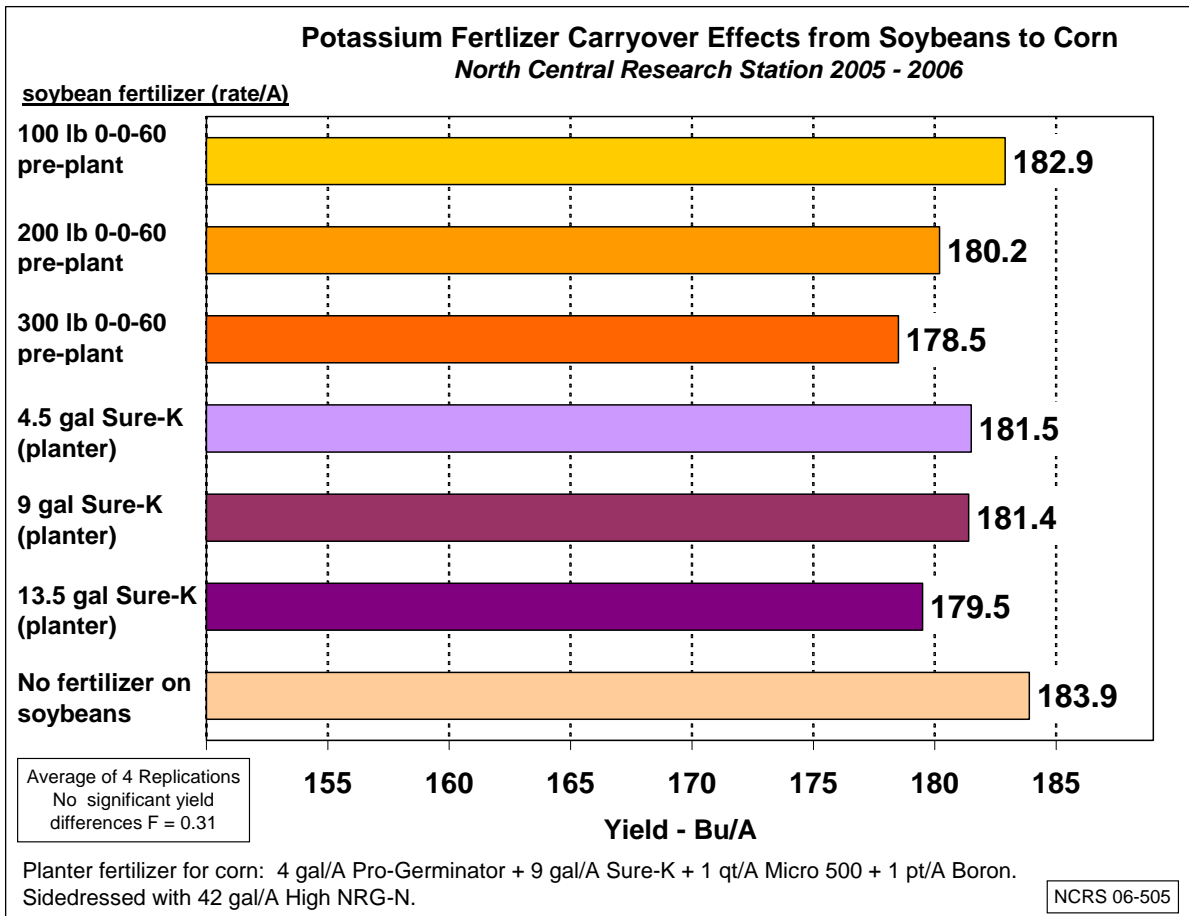
Objective: Determine if muriate of potash application is necessary.

Dry fertilizer is often spread with the intention of providing nutrition for a crop in the year of application (if applied in the spring) as well as carryover nutrition for a crop the following year. Agro-Culture Liquid Fertilizers on the other hand, are primarily applied for feeding a crop in the year of application. In 2005, a soybean experiment was conducted to evaluate effect of three different pre-plant incorporated rates of 0-0-60 and three different planter-applied rates of Sure-K. The soil in this experiment tested low in potassium (75 ppm), with a base saturation of 2.5%. We would consider this to be a moderate base saturations level for potassium. That is low enough to expect a yield response to applied potassium, but not so low where excessive soil adjustment is warranted. The results of potassium fertilizer applications to soybeans from 2005 appear in the following chart.



It was found that high rates of applied potassium fertilizer did not result in corresponding high yields. But what about the effects of fertilizer applied in soybeans on the following corn crop? To answer this, the entire plot area was planted to corn in 2006. The entire experiment received the same rate of applied fertilizer: 4 gal/A Pro-Germinator + 9 gal/A Sure-K + 1 qt/A

Micro 500 + 1 pt/A Boron at planting and 42 gal/A High NRG-N at sidedress. Plots were harvested for evaluation of potassium carryover effects on



corn. Corn yields from these carryover plots appear in the following chart.

- There was no effect from the soybean potassium treatments on corn yield the following year, even at high rates as 300 lb/A 0-0-60.
- Evidently the soil K and in-season corn fertilizer application of Sure-K was sufficient at the current K levels.

Corn leaf samples were collected prior to tasseling to determine previous-season potassium applications effects on tissue K levels. Results appear in the following table.

Corn leaf tissue potassium levels	
Soybean fertilizer	leaf tissue % K
100 lb/A 0-0-60	1.81
200 lb/A 0-0-60	1.85
300 lb/A 0-0-60	2.12
4.5 gal/A Sure-K	1.72
9 gal/A Sure-K	1.40
13 gal/A Sure-K	1.36
no fertilizer	1.62
LSD(0.05):	0.27
LSD(0.10):	0.22

Corn leaf tissue K was higher following application of potash to soybeans in the previous year. But as seen in the previous chart, higher tissue K did not result in corn yield increases.

Conclusion: At moderate (2.5% or higher) levels of potassium expressed as % Base Saturation, application of muriate of potash is not necessary. Sure-K in either soybeans or corn is sufficient for optimum yield.

Experiment: Potash Application Effects in Soil with Very Low Potassium Levels

Year (Experiment Number): 2006 (06-507)

Date of Planting/Harvest: April 28 / 10-24-06

Hybrid: NK45A6

Plot Size: 100 ft x 500 ft

Soil Test Levels (ppm)

pH: 7.4 C.E.C.: 11.1

OM: 2.8% P1: 42 ppm

K: 55 ppm (1.3% BS)

Objective: Determine corn yield effects of potash application in very low potassium soil.

A previously reported experiment showed that addition of 0-0-60 muriate of potash to soils with a moderate %K base saturation of 2.5% did not result in higher soybean or corn yields. What about soils with very low soil K levels and low %K base saturations? One field at the North Central Research Station has such a soil where the soil K level was 55 ppm and 1.3% base saturation in a sample collected in the summer of 2005. At that time, soybeans were exhibiting potassium deficiency symptoms of leaf chlorosis along the leaf margins, in spite of application of Sure-K at planting. Following soybean harvest, 300 lb/A of 0-0-60 muriate of potash was applied to a 1 acre section of the field. The entire field was ripped following this application, and worked with a field cultivator the next spring.

The next spring the entire field received a planter application of 4 gal/A of Pro-Germinator + 9 gal/A Sure-K + 1 qt/A Micro 500 + 1 pt/A Boron. A sidedress application of 42 gal/A of High



NRG-N was also applied to the entire field. There was no observable potassium deficiency seen on the corn leaves during the season. No corn leaf samples were collected, although that would have been a good thing to do. At harvest, two strips from each portion of the field were harvested for yield comparison between the potash and no-potash treatments. Following harvest, soil samples were collected to evaluate potash application effects on soil K level. Results appear in the adjacent table.

Carryover effects of muriate of potash application in low K soil*			
Soybean leaves showing potassium deficiency.	Yield Bu/A	Soil K ppm	Base saturation %K
300 lb/A 0-0-60	174.2	77	1.8
No potash	163.9	54	1.2

* - Muriate of potash 0-0-60 applied after 2005 soybean harvest

- Application of potash under these very low soil K levels did result in increased corn yield.

Soil K levels did increase with application of muriate of potash. The portion of the field not receiving muriate of potash showed a soil K level nearly identical to that collected the previous summer. So the application of Sure-K did maintain the K level. But when the level is this low at the start, application of a K may prove beneficial to corn.

Conclusion: Under very low soil potassium conditions where soybeans show deficiency, an application of muriate of potash is recommended to raise soil K to manageable levels.

Experiment: Potassium Fertilizer Programs for Corn
Year (Experiment Number): 2008 (08-502)
Date of Planting/Harvest: May 5 / October 16
Variety: DeKalb 4660
Plot Size (replications): 15 ft x 90 ft (4 replications)

Soil Test Levels (ppm)

pH: 7.0 C.E.C.: 11.1
OM: 3.1% P1: 18 ppm
K: 52 ppm (1.2% BS)

Objective: Evaluate single and multi-year applications of muriate of potash (0-0-62), no potash and Sure-K liquid fertilizer for effects on corn yield and soil nutrient levels.

Sure-K fertilizer has proven to be an excellent source of potassium nutrition for crops for many years both in test plots and in grower's fields. However, in some studies where soil K level is in the very low range, it was shown that supplemental potassium in the form of muriate of potash may be a benefit. This is when base saturation levels are down to 1% or lower. But at higher levels, research has shown no benefit to application of potassium fertilizer other than Sure-K. In this particular field, soil potassium is in the Very Low (VL) range. This field was planted to a corn experiment in 2006, and by August of that year, severe potassium deficiency was seen on the corn leaves, as characterized by the yellowing of the leaf margins. These symptoms were seen on leaves nearly up to the ear. However, in that experiment, the total Agro-Culture Liquid Fertilizer program with Sure-K out-performed a comparable conventional program with muriate of potash. (Results are in the *High Performance Proof* section of the Research CD, under Corn – Strip-Till). The field was in sugarbeets in 2007, and was designated for corn again in 2008. Recalling the potassium deficiency symptoms on corn in 2006, it was thought that there may be a benefit to a broadcast application of potash. Now here is where it gets a little complicated.

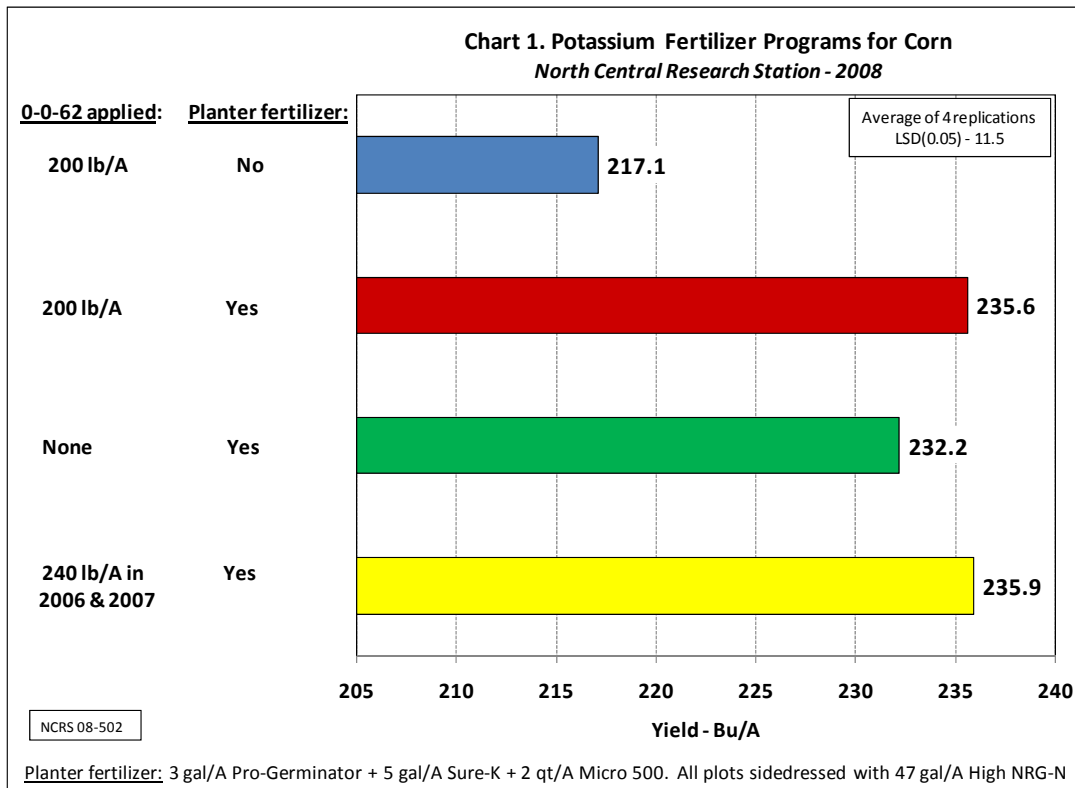
Soil test levels from the previous year suggested an application of 260-33-172 lb/A of N-P₂O₅- K₂O, plus 6 lb/A manganese, 2 lb/A zinc, and 1 lb/A boron for a yield goal of 210 Bu/A. This recommendation is from the *Tri-State Fertilizer Recommendations*. Now recall that this field was in corn in 2006 and sugarbeets in 2007. At the North Central Research Station, care is taken to follow plot treatment applications from previous years. In the conventional treatment plots, there was an application of 240 lb/A of 0-0-62 each year. There was no dry potash applied in any of the other plots, only Sure-K or no potassium. Thus, the following treatments were designed to compare potash applications on corn yield this year.

1. 200 lb/A of 0-0-62 (124 lb/A K₂O) pre-plant broadcast and incorporated. Then no fertilizer other than nitrogen.
2. 200 lb/A of 0-0-62 pre-plant broadcast and incorporated. Then planter-applied Pro-Germinator + Sure-K + micros.
3. No preplant potash. Then planter-applied Pro-Germinator + Sure-K + micros.
4. No preplant potash, but 240 lb/A of 0-0-62 was applied in 2006 and 2007. Then planter-applied Pro-Germinator + Sure-K + micros.

The muriate of potash was broadcast applied with the custom-built air spreader for plots. The broadcast application of potash supplied most of the recommended K₂O. Planter-applied Sure-K would supply the rest. The planter applied fertilizer was an if-furrow application of 3 gal/A Pro-Germinator + 5 gal/A of Sure-K + 2 qt/A Micro 500. (Note: this experiment was part of the experiment: Micronutrient Programs on Corn (experiment number 08-502). So with these applications it was felt that yields would reflect the effects of potash either from a single application in the spring, from previous years of application, or from no application.

By mid-season a key observation came to light as there was no symptoms of potassium deficiency seen in any of the plots, even the plot that had never had any potash applied (Trt. 3 above.) Now corn hybrids do react differently to different things, including soil potassium levels. Evidently, the hybrid used in 2006 was more sensitive to lower K levels than the DeKalb hybrid used here. The crop was

monitored throughout the season and no potassium-deficiency signs were ever seen in this experiment. Treatment yields appear in the following chart.



- In this experiment, the muriate of potash applications did not have an effect on corn yield whether applied in the spring before planting, or in the two previous seasons, all fertilized treatments yielded virtually the same regardless of potash application.
- The application of planter fertilizer resulted in a significant increase in yield, and clearly had a greater impact on yield than did the potash application.

Following harvest, soil samples were collected for evaluation of treatment effects on soil potassium levels. Ten soil cores were collected from each plot (two directly from the row and 8 from between the rows) and combined into a composite sample by treatment. (The no planter fertilizer treatment was not sampled). Results appear in the following table.

trt.	0-0-62 applied	Planter fertilizer	post harvest soil K
1.	200 lb/A	No	--
2.	200 lb/A	Yes	51 ppm
3.	None	Yes	42 ppm
4.	240 lb/A in 2006 and 2007	Yes	42 ppm

Planter Fertilizer: 3 gal/A Pro-Germinator + 5 gal/A Sure-K + 2 qt/A Micro 500.

- The spring 2008 application of muriate of potash did raise the soil K level, although it was still classified as "Very Low". But it did not affect yield.
- The previous years' applications of potash (Trt 4) did not affect soil test K level. This was not expected, and begs the question: *"What happened to my potash?"*

Experiment: Potash Fertilizer Carryover Effects on Corn
Year (Experiment Number): 2008 (08-506)
Date of Planting/Harvest: May 1 / October 17
Variety: DeKalb 4660
Plot Size (replications): 15 ft x 487 ft (3 replications)

Soil Test Levels (ppm)	
pH: 7.1	C.E.C.: 11.4
OM: 3.1%	Bicarb P:13 ppm
K: see text	

Objective: To further evaluate effects of previous years applications of muriate of potash on corn yield and soil test levels of potassium.

An experiment was established in 2006 to evaluate effects of application of 300 lb/A of muriate of potash (0-0-60) the previous fall after soybean harvest. The full report is in the *High Performance Proof* section of this CD: “*Potash Application Effects in Soil With Very Low Potassium Levels*”. Then, the entire test received a planter application of 9 gal/A of Sure-K, along with Pro-Germinator and micros. It was found that the ground receiving the potash yielded an average of 174.2 Bu/A where the no-potash ground averaged 163.9 Bu/A. Soil test found that the ground receiving potash had a soil potassium level of 77 ppm while the no-potash ground had 54 ppm soil potassium. These are very low soil K levels. Other NCRS tests showed that potash application did not affect yield where Sure-K was used as long as the soil test K level was in the range of near 2% base saturation or higher. In this test, the soil K level was 1.3% base saturation. The field was in soybeans in 2007. Following soybean harvest, further potash applications were applied. The applicator was a pull type spinner spreader set for 150 lb/A. Portions of the field received either none, 150 lb/A or 300 lb/A of potash. Complete treatment description is in Table 1. Following application, the field was worked with a disk chisel plow. The next spring, again the entire field 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 a 42 gal/A sidedress application of High NRG-N. Each of the treatments consisted of three six-row planter passes.

No potassium deficiency symptoms were seen on the leaves of any of the corn in this experiment. This is unlike the test in 2006 where a different hybrid was used. Following corn harvest, soil samples were collected to determine effect of potash applications on soil test potassium level. A map of the field layout, average yield and soil K level appear in the following table.

Trt:	1	2	3	4	5	6
potash fall 2005:	0	0	0	300 lb	300 lb	300 lb
potash fall 2007	0	150 lb	300 lb	300 lb	150 lb	0
avg. yield (Bu/A):	207.5	220.1	226	233.5	230.1	219.3
soil test K (ppm):	47	40	43	49	51	47

- Potash applications appear to have increased yield in this low-K field.
- The low soil K levels even where potash was previously applied was surprising. In 2006, the soil where 300 lb/A of potash applied the previous fall had a post-harvest soil test K level 23 ppm higher than where no potash was applied. However, yields were some 55 Bu/A lower that year, so there must have been higher crop removal this year.
- These low soil K levels were around 1.2% base saturation, a level where potash application may be warranted.
- In the previous experiment (08-502), spring potash applications weren't effective even in very low soil test K soils. So timing is also a factor.



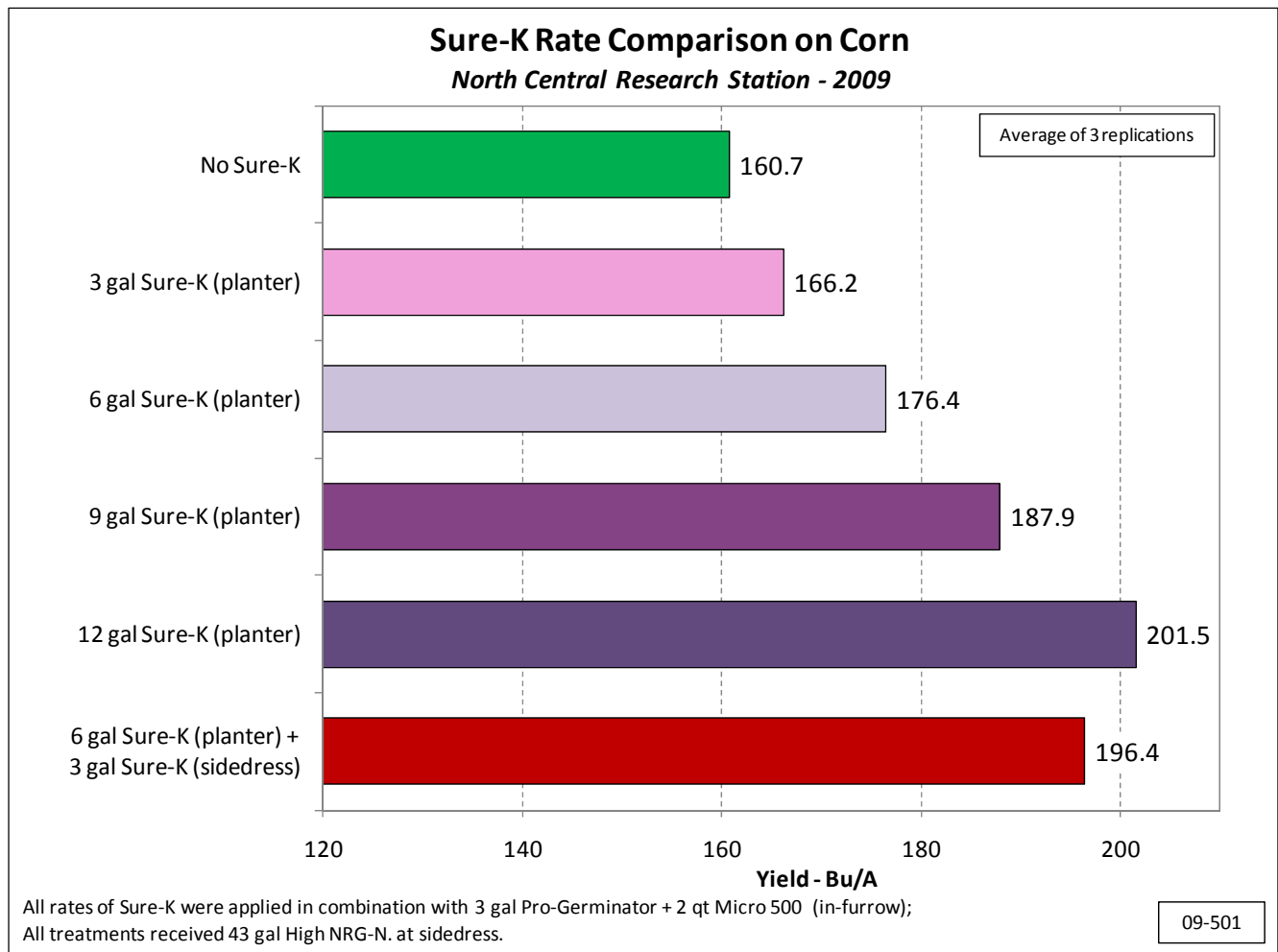
Experiment: Sure-K Rate Comparison in Corn (09-501)

Planted: 5/5/09	Hybrid: DK46-60	Population: 33,000
Plot Size: 15' x 285'	Replications: 3	Harvested: 10/29/09
Sidedress: 6/2/09		

Soil Test Values (ppm):													
pH	CEC	% OM	Bicarb	K	S	% K	% Mg	% Ca	% H	% Na	Zn	Mn	B
7.2	10.5	2.3	23	71	7	1.7	24.3	73.5	0	0.5	1.3	4	0.6

Objectives: Evaluate a range of planter-applied Sure-K rates for effect on corn yield in a soil testing low in potassium. Previous testing at the NCRS found that maximum yield response was at 6 gal/A, but those soils had similar K levels, but was higher in % base saturation. We at Agro-Culture Liquid Fertilizers feel that the base saturation is a good indicator of relative amounts of plant usable potassium, and can be used as a recommendation guideline. The base saturation in this experiment is low at only 1.7%. In this test, Sure-K at the rates indicated were applied in-furrow in combination with 3 gal/A of Pro-Germinator plus 2 qt/A Micro 500. One treatment applied 6 gal/A of Sure-K (plus Pro-Germinator and Micro 500) with the planter, and another 3 gal/A with High NRG-N at sidedress, to compare to 9 gal/A at planting.

Results:



LSD(0.5): 10.4; (0.1): 8.2. CV: 9.0%

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

Conclusions:

- There was a direct yield response to increased rate of applied Sure-K. This was the first time such a response was seen all the way up to 12 gal/A. This is due to the lower K level compared to previous tests as indicated in the Objectives. So at % base saturations lower than 2%, higher rates are warranted.
- The split application of Sure-K totaling 9 gal/A yielded significantly higher than the single application of 9 gal/A at planting. We did not see such a response in soils with higher K levels. This may be desirable in order to use fewer gallons at planting when time is at a premium. But it does show that corn is responsive to Sure-K in low-K soils at sidedress since the extra 3 gal/A raised yield by 20 Bu/A.

The following pictures were taken on June 12 which was 38 days after planting and 10 days after sidedress.



No Sure-K in the planer fertilizer and the early signs of potassium deficiency.



Sure-K in the planer fertilizer: 3 gal/A on the left and 6 gal/A on the right.



9 gal/A of Sure-K in the planer fertilizer.



12 gal/A of Sure-K in the planer fertilizer.

These pictures show the increasing visible plant health with increasing rates of Sure-K in this very-low potassium soil. The yields correlated with the increasing rates as well.

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