



2018 Research Journal for SUL4R-PLUS® Products

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Foreword

As a trained soil and plant scientist, I endeavor to do my research in a reputable and factual manner. Any ethical agronomist will admit that there are many factors involved in agricultural crop production. Some of these factors are uncontrollable such as temperature, and in most cases, proper moisture conditions. Fortunately, there are many controllable factors. Proper land selection for the appropriate crop can alleviate the moisture factor in many cases. Proper planning and planting timing, using historical data for temperature highs and lows, can also help with temperature problems.

Nutrition is a controllable factor, yet it is often treated as an unknown or an uncontrollable factor. It is easy to determine from various sources what the removal rate is for the crops; on a per bushel basis, or on a per ton basis, or whatever unit the crop is measured by or sold as. Nutrition supplied or that is stored in the soil is broken down as follows: primary, secondary, and micronutrients (micros). While primary and secondary nutrients are measured in pound per acre, micronutrients are measured in parts per million (ppm). Many individuals working in agriculture fail to recognize that nutrient uptake varies greatly between macronutrients (primary and secondary) and micronutrients. Each nutrient, macro or micro, is crucial to create balanced nutrient interactions to consequently improve plant growth and yield.

My goal as a soil and plant scientist is to educate dealers and farmers about the necessity of these vital nutrients that are often forgotten or neglected. I believe in the research that I am conducting with SUL4R-PLUS® products. There is a lot of misrepresentation of agricultural products, but science does not lie, and I believe SUL4R-PLUS® products are a big piece of the puzzle toward efficient and profitable agriculture. My research to date in 2017 and 2018 confirms that SUL4R-PLUS® products are needed by majority of today's agricultural crops and shows a trial response rate on the average up to 89%, whether compared to other sources of sulfur, boron, or zinc, or whatever the farmer standard is. As a plant scientist, I do not believe in "luxury feeding" of the plant, but that the plant only uses what nutrients it needs and when it needs them. If a nutrient is low or deficient or in an unavailable form, that plant will suffer somewhere in plant production.

We should not treat needed nutrition as an uncontrollable factor? It is a controllable one.

Research Locations

As with all agronomic studies, choosing the right location to conduct research is crucial in obtaining relative data. The chart below outlines the location, crop, time of application and the SUL4R-PLUS® product studied. The focus of this study was centered on SUL4R-PLUS® B+Z fertilizer in Kentucky and Indiana as applied to corn, soybeans and wheat with either spring or fall application timing. The strategy behind this study was to validate the need of adding secondary and micronutrients such as calcium, sulfur, boron and zinc as a homogeneous granule to nutrient blend as opposed to other single nutrient granules.

SUL4R-PLUS® products in this study were compared to the commonly used standard sulfur, magnesium and micronutrient products currently in marketplace including products like AMS, K-Mag and single micronutrient products, either granulated or in the foliar form. The farmer standard of N, P & K was applied, but the common nutrients were replaced with SUL4R-PLUS® products at the recommended rate of 100 pound per acre unless noted in the individual trial.

The locations selected were customer-driven in areas where potential product acceptance is occurring and ongoing. Trials at these locations are deemed necessary to educate the end-user of the benefits of SUL4R-PLUS® products including providing immediate availability and stabilization of nutrients that closely mimics the nutrient uptake curves of most crops.

LOCATION	CROP	APPLICATION TIMING	PRODUCT
HERNDON	WHEAT	FALL	SUL4R-PLUS® BZ
WALLONIA	SOYBEANS	FALL	SUL4R-PLUS® BZ
PEMBROKE	CORN	SPRING	SUL4R-PLUS® BZ
HENDERSON	CORN	FALL	SUL4R-PLUS® BZ
HENDERSON	CORN	SPRING	SUL4R-PLUS® BZ
OWENSBORO	SOYBEANS	FALL	SUL4R-PLUS® BZ
OWENSBORO	SOYBEANS	SPRING	SUL4R-PLUS® B + HUMIC
OWENSBORO	CORN	SPRING	SUL4R-PLUS®
OWENSBORO	SOYBEANS	SPRING	SUL4R-PLUS® BZ
STURGIS	SOYBEANS	SPRING	SUL4R-PLUS® BZ--200 #
STURGIS	SOYBEANS	SPRING	SUL4R-PLUS® BZ--100 #
HANCOCK CO	SOYBEANS	SPRING	SUL4R-PLUS® BZ
BRECKINRIDGE CO	TOBACCO	SPRING	SUL4R-PLUS® ZINC
HARDIN CO	CORN	SPRING	SUL4R-PLUS® BZ
MARION CO	TOBACCO	SPRING	SUL4R-PLUS® BZ
MARION CO	CORN	SPRING	SUL4R-PLUS® BZ
WAVERLY	CORN	SPRING 2017	SUL4R-PLUS® BZ
POSEY CO	CORN	SPRING	SUL4R-PLUS® BZ
POSEY CO	CORN	SPRING	SUL4R-PLUS® BZ
KITCHELL	CORN	SPRING	SUL4R-PLUS® BZ
KITCHELL	SOYBEANS	SPRING	SUL4R-PLUS® BZ
BROOKVILLE	CORN	SPRING	SUL4R-PLUS® BZ
WILLIAMSBURG	SOYBEANS	SPRING	SUL4R-PLUS® BZ
HODGENVILLE	SOYBEANS	SPRING	SUL4R-PLUS® BZ
GREENVILLE	CORN	SPRING	SUL4R-PLUS® BZ
GREENVILLE	SOYBEANS	SPRING	SUL4R-PLUS® BZ

Herndon, KY Wheat Plot

The Herndon wheat plot, conducted in Herndon, KY, was coordinated by CPS Pembroke. All nutrients for this trial were applied in the fall of 2017 with a blend of farmer standard P & K with 100 pound per acre of K-Mag, and a blend of farmer standard P & K with 100 pound per acre of SUL4R-PLUS® B+Z fertilizer on alternating 90 feet application passes.

Two tissue tests were completed with results as follows:

DATE	PLOT	CROP STAGE	N %	Ca %	S %	B ppm	Zn ppm
3/27/2018	CK	EARLY BOOT	4.32	0.47	0.37	6	17
3/27/2018	BZ	EARLY BOOT	4.39	0.88	0.4	6	24
5/3/2018	CK	FLAG LEAF	2.84	0.32	0.22	3	14
5/3/2018	BZ	FLAG LEAF	3.35	0.49	0.24	4	25

Figure 1: Herndon, KY Wheat Trial -- Tissue Analysis

N levels were included to show that the plant ran out of nitrogen before maturity. The yield of both SUL4R-PLUS® B+Z fertilizer and the K-Mag check (CK) were approximately 70 bushel per acre, but the low level of N in the plant was the limiting factor. SUL4R-PLUS® B+Z nutrient levels were all in a satisfactory range at flag leaf, which denotes what is truly going to the reproductive stage of the plant. However, more than 36 inches of rain fell on this crop between planting in the fall to early May testing, and N was lost in the process which limited the yield. The SUL4R-PLUS® B+Z nutrients, however, were not affected by unusual precipitation and were available during critical growth stages.

The picture below illustrates the health of the entire treated areas in March prior to rapid stem elongation, with no visual differences represented and no sign of nutrient deficiencies.

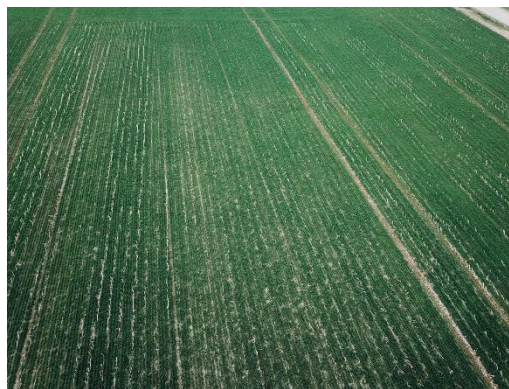


Figure 2: Herndon, KY Wheat Trial -- March 27, 2018

Wallonia, KY Soybean Plot

The Wallonia soybean plot, also conducted by CPS Pembroke, had SUL4R-PLUS® B+Z fertilizer applied in late October 2017, along with the farmer standard of P & K. Alternately each 90 feet pass, K-Mag was applied instead of SUL4R-PLUS® B+Z product. Both were applied in their respective passes at 100 pound per acre.

The following were the results of tissue testing:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/19/2018	CK	R5	5.46	1.5	1.24	0.33	0.5	45	52
6/19/2018	BZ	R5	6.13	1.66	1.31	0.37	0.49	49	54
7/31/2018	CK	R5	5.92	1.39	1.69	0.37	0.48	39	47
7/31/2018	BZ	R5	6.7	1.47	1.38	0.39	0.36	45	38

Figure 3: Wallonia, KY Soybean Trial — Tissue Analysis

These results are from eight replications of each plot treatment, and well represent the features of this total field. At this testing, the soybeans were in the R5 stage, and thus far little if any pod drop had occurred. As noted by the tests, primary nutrient levels were good in the check and the SUL4R-PLUS® B+Z areas. Of interest was the magnesium uptake efficiency level which was the same or slightly elevated on the K-Mag check. K-Mag also added potassium, but the potassium with K-Mag was actually lower than the SUL4R-PLUS® B+Z plot.

By applying SUL4R-PLUS® B+Z fertilizer, secondary, and micronutrients, the proper ratio of nutrients was being utilized by the plant — thus improving overall plant nutrient uptake efficiency and health. As noted, there were no visual differences between the treatments. The noticeable differences occurred in the tissue analysis with one bushel increase in yield when SUL4R-PLUS® B+Z fertilizer was applied, and an economic difference. The cost of K-Mag per acre is considerably more expensive than the cost of SUL4R-PLUS® B+Z fertilizer per acre, and this cost difference in treatments will ultimately increase the gross dollar per acre revenue generated by utilizing the benefits of SUL4R-PLUS® B+Z fertilizer. For example, K-Mag average cost per acre for 100 pound per acre is \$33.75, whereas SUL4R-PLUS® B+Z fertilizer average per acre cost at 100 pound per acre is \$28.00. This equates to \$5.75 more gross dollars per acre combined with a one bushel yield increase.

PLOT	YIELD BU./AC	GROSS \$/AC @ \$9.00/BU	GROSS \$/AC DIFFERENCE
CK	62.57	\$ 563.13	
BZ	63.52	\$ 571.68	\$ 8.55

Figure 4: Wallonia, KY Soybean Trial -- Yield Results

Whitesville, KY Soybean Plot

One of the earliest planted soybean plots in this research and exceptional from day one, the field had been previously tilled at 40-foot spacing. After the fall application of SUL4R-PLUS® B+Z product, the field was tilled with 20-foot spacing, splitting the middle of existing tile with new tile. The extremely wet spring demonstrated that the 20-foot spacing did indeed help with getting rid of the water. However, in this case, the soil disturbance and fertility profile may have voided the relevance of the plot comparison data. Tissue comparisons and yield checks were still conducted. According to the tissue testing, these farmers do a good job on long-term fertility, and coupled with the tiling issue, there was little variation.

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/20/2018	CK	R2	5.49	2.05	1.64	0.36	0.38	50	45
6/20/2018	BZ	R2	6.38	2.16	1.11	0.38	0.3	46	43
7/5/2018	CK	R5	6.71	1.71	1.16	0.44	0.34	45	50
7/5/2018	BZ	R5	6.16	1.87	1.31	0.45	0.42	45	47

Figure 5: Whitesville, KY Soybean Trial -- Tissue Analysis

The plots were harvested on 10/19/18 but unfortunately overlooked the fact that this field had multiple studies being conducted in conjunction with the SUL4R-PLUS® B+Z study, such as multiple varieties, plant population differences and planting dates. According to the grower, when revisiting the data, there may have been an improvement of approximately one bushel with the SUL4R-PLUS® B+Z product, but areas were not exact as the results were intertwined with other test criteria including variety and population studies and planting dates. The grower also acknowledged that the tiling after the SUL4R-PLUS® B+Z application probably skewed the test results. As observed in the tissue analysis, there was no notable difference in nutrient levels between the check and SUL4R-PLUS® B+Z product and most of the test field averaged 80 bushels. As depicted in the photo below, the field was uniform in stand and visual plant health observations, thus enforcing the data collected.



Figure 6: Whitesville, KY Soybean Trial -- June 20, 2018

Henderson County, KY Corn Plots

The first Henderson County corn plot was a difficult plot to try to separate the variables. It had a CEC of around 8 with less than 1.5% organic matter on average. The fertility ranged from very low on phosphorus and potassium to medium high. The ranges were not unique to specific areas of the field but randomly appeared throughout. Our goal was to conduct a 20-acre fall application of SUL4R-PLUS® B+Z fertilizer with the farmer's P & K, and to conduct the equivalent P & K on the remainder of the field. We conducted a check area in the fall and then applied the SUL4R-PLUS® B+Z fertilizer on another 20-acre area in the spring when the corn was planted. The only variables were the SUL4R-PLUS® B+Z application in the fall and the spring and a check with no SUL4R-PLUS® B+Z product.

With no magnesium added, the magnesium in the plant highlighted the variability of the soil. As determined in the winter after the application of the SUL4R-PLUS® B+Z product in the fall, this variability was typical of the soil tests of all nutrients as well as the pH, but testing continued as planned.

The tissue test results were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/7/2018	CK	VT	4.1	1.74	0.37	0.27	0.26	3	31
6/7/2018	BZ-FALL	VT	3.63	3.19	0.33	0.22	0.11	3	20
6/7/2018	BZ-SPRING	VT	3.54	3.72	0.3	0.27	0.09	8	59
7/12/2018	CK	R3	3.01	2.54	0.56	0.23	0.16	10	21
7/12/2018	BZ-FALL	R3	2.72	1.83	0.78	0.23	0.27	25	30
7/12/2018	BZ-SPRING	R3	2.85	1.81	0.88	0.23	0.29	15	27

Figure 7: Henderson, KY Corn Trial -- Tissue Analysis

As the 6/7/18 spring testing results show, the need for zinc emerged earlier in the plant as needed and emerged as needed in the ear leaf sample with both the 7/12/18 fall and spring samples showing a response. Calcium and boron were both needed later in the plant's life cycle. Calcium was needed not only as a cell wall component, but as a major nutrient in the ear. Boron responded in the ear leaf sample as well as a bump compared to the check at the flowering and reproductive stages. The sulfur testing was consistent throughout the plots indicating that sulfur was not deficient nutrient in this crop.

Plots were harvested on 9/21/18 with the following yield results:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$3.00/BU	GROSS \$/AC DIFFERENCE	TEST WEIGHT LBS./BU	MOISTURE
CK	205.1	\$ 615.30		57	17.5
BZ-FALL	208.1	\$ 624.30	\$ 9.00	58.5	17
BZ-SPRING	210.3	\$ 630.90	\$ 15.60	59	17.7

Figure 8: Henderson, KY Corn Trial -- Yield Results

This trial was conducted to demonstrate the need to apply secondary and micros, in addition to the primary nutrients (N, P & K), which are often overlooked but play a critical role in yield and plant quality. The trial also sought to verify that an application of SUL4R-PLUS® B+Z fertilizer in the fall would provide the same or near the same result as applying SUL4R-PLUS® B+Z fertilizer in the spring. As demonstrated in the yield results above, combined with the tissue analysis previously noted, an application of secondary and micros by using SUL4R-PLUS® B+Z product either in the fall or spring played a factor in improving yield and overall plant health.

Union County, KY Corn Plot

Included in the fall applied crop results, the SUL4R-PLUS® B+Z product was applied actually in March 2017 as a wheat top dress. It had a 91 bushel per acre average of wheat harvested in June 2017, and then nearly a 90 bushel per acre of double crop soybeans harvested in the fall of 2017.

Tissue tests were pulled from the plot areas that had wheat/soybeans in the previous year to determine if residual nutrients from the SUL4R-PLUS® B+Z product would appear over an extended time period in the next year's crop.

No sulfur, calcium, boron, or zinc was applied on this 2018 crop, so if there was an increase in tissue tests of these four nutrients, it would be carryover from the 2017 application. Even though only 100 pound per acre of SUL4R-PLUS® B+Z product was applied and even though it was intended to apply needed nutrients for annual requirements, a moderate increase in each nutrient was present in the 2018 corn crop. This residual could be because of the severe drought that the area had in 2017, even though 90+ bushel per acre of wheat was harvested and nearly 90 bushel per acre of double crop soybeans was harvested.

The photo below, captured on 5/10/18, is representative of the plot area and its uniformity reflecting plant stand and overall plant health. This measure of uniformity is crucial in doing research, eliminating variables that that could possibly invalidate data obtained.



Figure 9: Union County, KY Corn Trial -- May 10, 2018

Tissue analysis results were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/11/2018	CK	VT	3.24	2.34	0.39	0.22	0.12	2	12
6/11/2018	BZ	VT	3.55	2.24	0.49	0.25	0.15	3	13

Figure 10: Union County, KY Corn Trial -- Tissue Analysis

Even though minimal, the SUL4R-PLUS® B+Z plot still shows some residual today even after one year since application. This field has little variation, making it such a good plot for wheat. The residual nutrient availability demonstrates the stability of SUL4R-PLUS® B+Z in the soil.

For this trial, there were no yield results because of the follow up work completed from the previous year's plots to see nutrient values in the plant.

Spring Trials

Pembroke, KY Corn Plot

Every agronomist has the “perfect test plot field” with the least variables, proper layout, shows a cosmetic response early in the growing season, and tissue tests which support the product being tested, in this case SUL4R-PLUS® B+Z fertilizer. This field at Pembroke was that perfect test plot as depicted in the photo below. The visual of the improved health displayed after the application of SUL4R-PLUS® B+Z fertilizer. The darker green stripes represent a much healthier plant within two weeks of application. This visual difference was displayed throughout the growing season.



Figure 11: Pembroke, KY Corn Trial

The Pembroke field was laid out with the corn rows and pre-plant fertilizer spread west to east, and the SUL4R-PLUS® B+Z product alone was spread north to south on every other 80-foot pass.

Having followed this field from early on after planting and fertilization, its results were remarkable. First, as the photo illustrates, cosmetics showed each pass clear and well defined with a remarkable contrast between the corn plants in the SUL4R-PLUS® B+Z passes and the check areas. Tissue tests confirmed that nutrient levels coincided with the treatment or non-treatment areas, with visible ear size and ear fill changes between the two treatment areas.

The tissue results were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/7/2018	CK	VT	3.57	3.37	0.36	0.24	0.08	4	17
6/7/2018	BZ	VT	4.05	2.4	0.5	0.31	0.17	6	29
6/28/2018	CK	R3	3.2	2.35	0.75	0.22	0.18	5	21
6/28/2018	BZ	R3	3.21	2.67	0.57	0.22	0.13	7	27

Figure 12: Pembroke, KY Corn Trial -- Tissue Analysis

An interesting note was that when tested against K-Mag, the SUL4R-PLUS® B+Z product adds no magnesium to the crop but the SUL4R-PLUS® B+Z product tested .17 on the 6/7/18 test, and the check area tested .08. Even the 6/28/18 testing demonstrated a minor difference in magnesium as the SUL4R-PLUS® B+Z product tested .13 and the check tested .18.

Another interesting visual is demonstrated in the photographs below showing the differences between the check and SUL4R-PLUS® B+Z treated plants. The photographs of the ears also tell a story with the tip-back on the check as opposed to the SUL4R-PLUS® B+Z treated product. This amount of tip-back leads to the question “How many bushels are lost?” - knowing that three kernels lost per ear with 30,000 plant population per acre equals one bushel lost.

As the photos below reiterate, adding secondary and micronutrient fertilizer such as SUL4R-PLUS® B+Z product to the nutrient program has clear advantages.



June 07, 2018-Pembroke, KY Corn Trial—UNTREATED

- DIFFERENCES:**
- COLOR
 - HEIGHT
 - MATURITY STAGE
 - CANOPY

Which looks better?



June 07, 2018-Pembroke, KY Corn Trial—TREATED



CHECK-FS

SUL4R-PLUS® BZ

Figure 13: Pembroke, KY Corn Trial

A visual look at the yield map below demonstrates the increase in yield where 100 pounds per acre of SUL4R-PLUS® B+Z product was applied versus the applications of K-Mag. Interesting to note, the yield map shows the trial area (treated and bleed over) was overwhelmingly in the blue, denoting an increase in yield in area above the red line. The area below the red line was treated with farmer standard plus K-Mag, the same treatment that was applied as the check in the trial area. A more in-depth review of the yield map illustrates the SUL4R-PLUS® B+Z treated area distinctly improved yield over the field average of 218 bushels per acre, where most of the acres in the trial area yielded 227 to 262 bushels to acre based on the darker blue areas. An exact side-by-side comparison is hard to distinguish yield values due to the bleed over of the two separate blends that were applied in the trial area. Although, reviewing the entire field a conclusion could be made; the area below the red line averaged 188 bushels to the acre, not an apple to apple comparison, but enough evidence to warrant the addition of 100 pounds per acre SUL4R-PLUS® B+Z fertilizer did improve yield by a minimal 10 bushels per acre over the field average of 218 bushels. A comparison of the cost of K-Mag per acre and cost of SUL4R-PLUS® B+Z fertilizer per acre, where K-Mag is ~\$10.00 more per acre than the cost of SUL4R-PLUS® B+Z fertilizer per acre the potential for more gross margin per acre is evident.

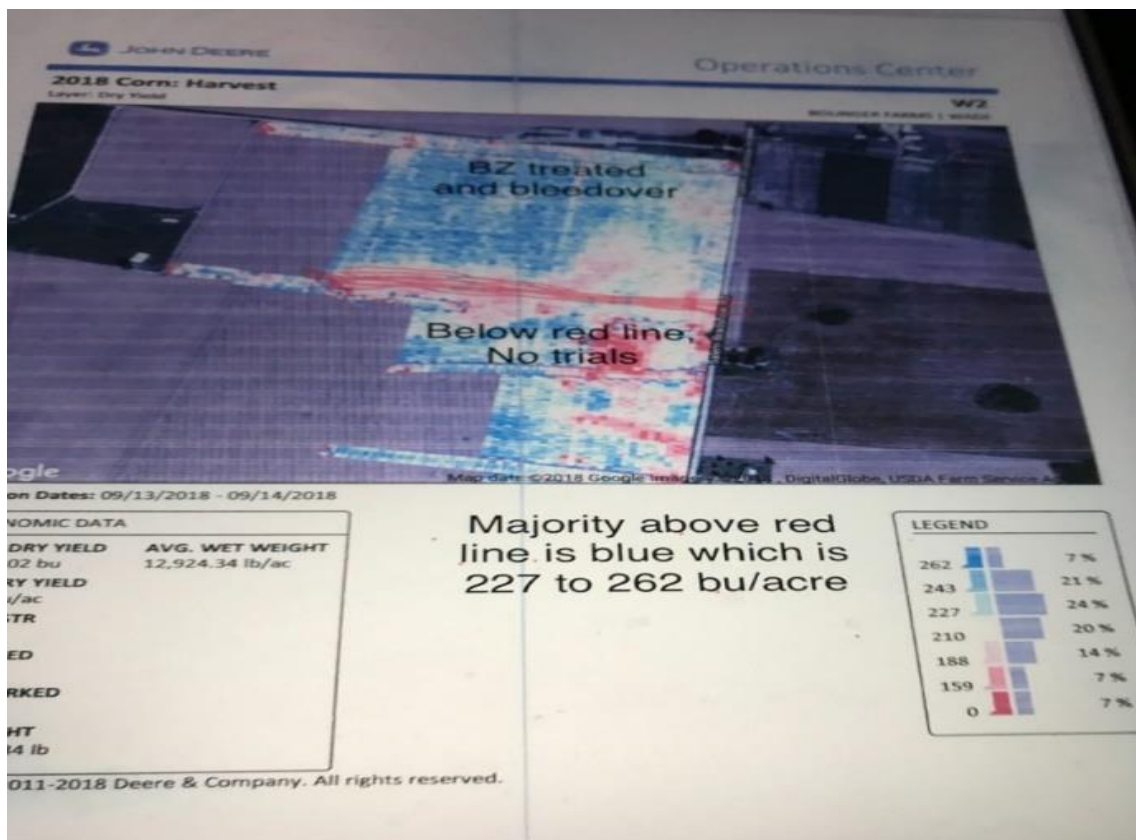


Figure 14: Pembroke, KY Corn Trial – Yield Map

Hardin County, KY Corn Plot

In Hardin County, KY, the farmer standard has always believed that AMS was the practical and efficient way to apply sulfur to corn. In certain years, a “green up” effect has been achieved immediately after top dressing with it. While this effect is common, AMS has nitrogen in it that can cause a cosmetic burst in some years. In dry years, however, the sulfur in sulfate form may linger around for a few weeks, but since it is an immobile nutrient within the plant, it still must enter the soil and make its way up through the roots in order for the plant to utilize it. Through this process it is very apt to leach with very little rainfall while on the surface of the soil.

The photo below represents a misapplication of pre-plant nutrients. This misapplication of nutrients causes nutrient deficiencies for the plant, thus robbing plant of crucial nutrients to grow and reiterating the need for proper nutrient application to ensure uniform feeding. This misapplication is most likely due to improper settings on the application equipment. These visual differences were noted at this time to ensure proper caution was taken in collecting tissue analysis during growing season.

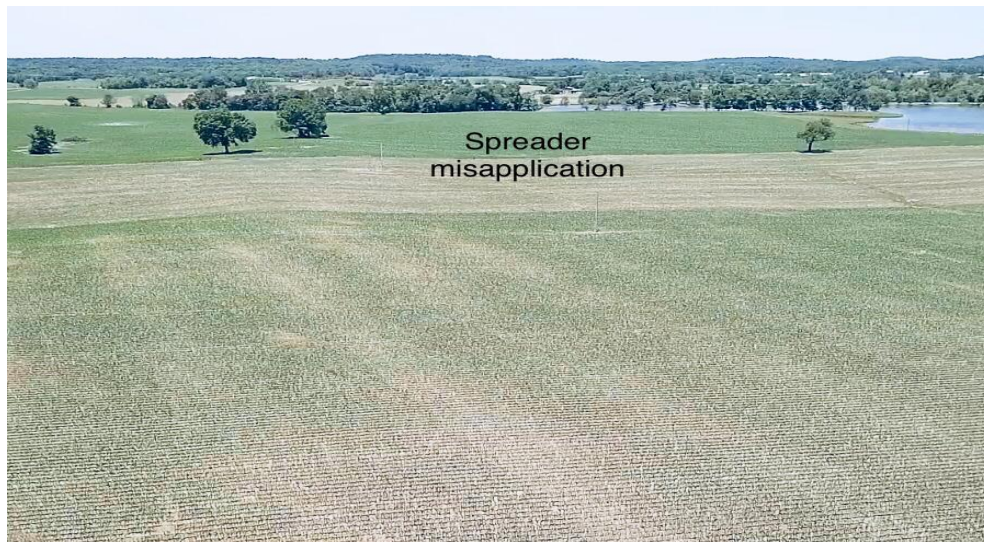


Figure 15: Hardin County, KY Corn Trial -- Poor Pre-Plant Fertilizer Application

The problem of poor pre-plant corn fertilizer application was visible opposite of the planted corn and opposite of the applied SUL4R-PLUS® B+Z product and AMS that was applied post emergence with the rows of planted corn. As seen in the photograph, pre-plant fertilizer was applied opposite the planted rows, as seen by the striping. This misapplication of pre-plant fertilizer made it difficult in pulling tissue samples, and difficult to match the passes of the pre-plant fertilizer in order to get apples to apples representation. Using aerial photos and pinning the darker areas of the passes, the checks and the treated areas were able to match up as to pre-plant applied fertilizer.

How did the AMS fare as compared to the SUL4R-PLUS® B+Z product? The tissue analysis is below taken from different growth stages.

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/5/2018	CK	VT	4.24	3.34	0.37	0.28	0.13	3	25
6/5/2018	BZ	VT	4.05	3.12	0.39	0.36	0.15	6	28
7/5/2018	CK	R3	3.5	2.77	0.63	0.22	0.16	6	28
7/5/2018	BZ	R3	3.39	2.36	0.69	0.25	0.17	7	37

Figure 16: Hardin County, KY Corn Trial -- Tissue Analysis

As demonstrated in the tissue analysis, the evidence of nitrogen from the AMS is elevated above the SUL4R-PLUS® B+Z treatment; although the sulfur (sulfate) from SUL4R-PLUS® B+Z fertilizer was less than the sulfur (sulfate) from the AMS-product. When 100 pound per acre was applied with both AMS and SUL4R-PLUS® B+Z fertilizer, AMS had 24 units of sulfate per 100 pound, whereas SUL4R-PLUS® B+Z product had 16 units of sulfate per 100 pound. According to tissue analysis, the 16 units of sulfate provided more available sulfur to the plant to aid nitrogen in producing proteins. Again this proves the stability of SUL4R-PLUS® B+Z fertilizer in the soil, hence it being available when the plant is in need of such nutrients.

The next question to be answered is “Did the additional available nutrients supplied by SUL4R-PLUS® B+Z fertilizer, as compared to AMS, produce a higher yield?” The plots were harvested on 11/30/18 and yield was likely reduced some due to lodged corn, both in the SUL4R-PLUS® B+Z plot and in the AMS check. However, yield was considered good if not excellent. With SUL4R-PLUS® B+Z product’s increase of 11.3 bushels per acre over the AMS treated area equating to more gross dollars per acre revenue, the value of SUL4R-PLUS® B+Z fertilizer is clear.

PLOT	YIELD BU./AC	GROSS \$/AC @ \$3.00/BU	GROSS \$/AC DIFFERENCE
CK-AMS	182.4	\$ 547.20	
BZ	193.7	\$ 581.10	\$ 33.90

Figure 17: Hardin County, KY Corn Trial -- Yield Results

The grower said that there was noted ear difference with the check plot not filling out to the end as well as the SUL4R-PLUS® B+Z plot. Again, this is the same notation that was obvious in the Pembroke plot. The grower said he felt the plots were valid since he laid out the plots as every other five acres with the SUL4R-PLUS® B+Z product having four plot areas and the check in between each treated area. The plots were laid out opposite of the direction as the pre-plant fertilizer application, thus this variable was removed. This field yielded very well considering the poor job of pre-plant fertilizer application that no doubt cost some yield.

Posey County, IN Corn Plot

This field had a tough go at it from day one. Water stood on it for weeks due to early season rainfalls. When a window opened to apply fertilizer and plant, they probably “mudded in” the crop, causing compaction and a multitude of problems during the growing season. Then after an uneven stand was established, more heavy rains came, and some areas never fully recovered.

SUL4R-PLUS® B+Z fertilizer was compared to K-Mag as a sulfur source, as is practiced quite extensively in the area. The sulfate in K-Mag, which has no stabilizer to keep the sulfur from leaching, was not a very good fit for the sandy and wet soils early on such as this year. Magnesium perhaps was needed for the area but as a spring applied, K-Mag had elemental magnesium as its source and that year’s crop probably did not receive any benefits. So how did SUL4R-PLUS® B+Z fertilizer and K-Mag products compare in this plot? And what about that magnesium that was applied with K-Mag?



Figure 18: Posey County, IN Corn Trial

As displayed in the photo above representing the magnitude of this trial, no visual differences were observed between treatments. The difference was not visual, nor was the difference in the uptake and efficiency of the nutrients being supplied to create balanced nutrient interactions. A review of this tissue analysis at different growth stages will determine the difference.

It is important to review the tissue analysis from different growth stages to determine. The sulfur content was higher each testing in the SUL4R-PLUS® B+Z plot but even without the SUL4R-PLUS® B+Z product having any magnesium as a nutrient, the magnesium content in the tissue samples of the plants treated with SUL4R-PLUS® B+Z product were significantly higher than the

check. SUL4R-PLUS® B+Z product tested higher in nitrogen at 2.52% which is low, but the check tested 1.87% which is deficient, as demonstrated by the 7/5/18 test date.

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/5/2018	CK	VT	2.51	2.08	0.29	0.2	0.11	2	24
6/5/2018	BZ	VT	3.45	2.28	0.41	0.26	0.16	5	27
7/5/2018	CK	R3	1.87	1.91	0.52	0.14	0.15	6	16
7/5/2018	BZ	R3	2.52	1.88	0.74	0.18	0.2	5	18

Figure 19: Posey County, IN Corn Trial -- Tissue Analysis

In review of the tissue analysis, it is obvious the nutrient levels in the plant are elevated when SUL4R-PLUS® B+Z fertilizer was applied. This demonstrates the stability of SUL4R-PLUS® B+Z product in the soil, regardless of soil type and excess soil moisture. The plot was harvested on 9/14/18 and being an extremely flat field, it had some areas that had early issues with too much water. However, as far as plot comparisons, there were some general areas that could still get good comparisons.

PLOT	YIELD BU./AC	GROSS \$/AC @ \$3.00/BU	GROSS \$/AC DIFFERENCE
K-MAG (side by side BZ)	228	\$ 684.00	
BZ (side by side K-MAG)	234	\$ 702.00	\$ 18.00
K-MAG AVERAGE	232	\$ 696.00	\$ 6.00

Figure 20: Posey County, IN Corn Trial -- Yield Results

The side-by-side comparison had the most credibility, with tissue tests pulled and visual comparisons available. The K-Mag yield in another area was real, but no side-by-side comparison was available. Even averaging the two K-Mag together gave it 232 bushel per acre, and with the cost of 100 pound of K-Mag compared to the cost of the SUL4R-PLUS® B+Z fertilizer, return on investment is better with SUL4R-PLUS® B+Z product.

Posey County, IN Corn Plot

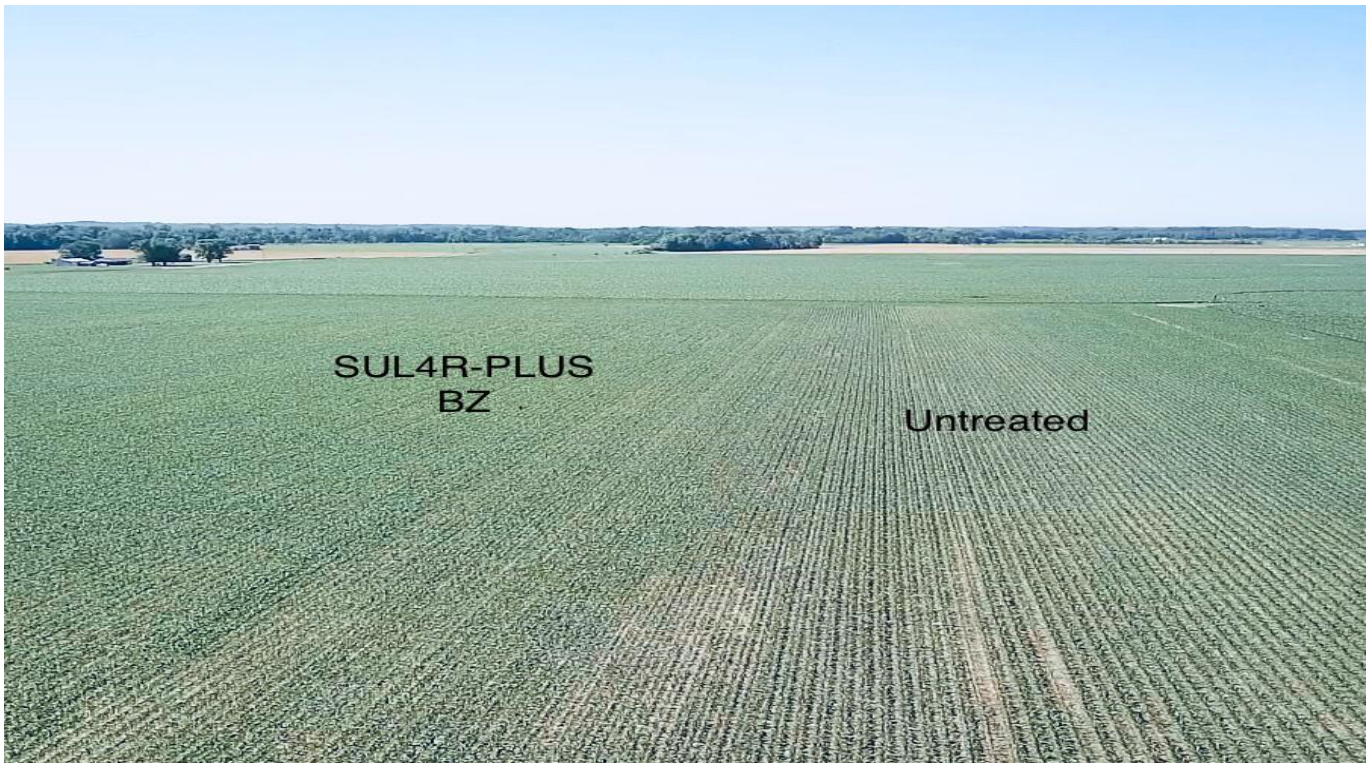


Figure 21: Posey County, IN Corn Trial

The above photo is early representation of the visual difference associated with adding SUL4R-PLUS® B+Z fertilizer to the farmer standard blend of N, P & K. As mentioned before, like the early heavy rains and early water damage on the other Posey County, Indiana corn plot less than a mile away, this plot also suffered from rain damage. With its extremely sandy soil and flat topography, its visible irrigation pivot clearly indicates that it could be drought prone with water being a “feast to famine” situation most years. While this plot would not be a good candidate for un-stabilized sulfate, it as well would test other negative charged nutrients.

The first tissue testing results came back as expected with the calcium, sulfur, boron, and zinc elevated in the plant when it had finally taken off with its early growth through V-10. But when hotter temperatures and drier conditions hit, the plants were suffering terribly until the farmer cranked up the pivot. While research tried to represent the plots uniformly, whether it was soil, or whether it was the early water damage, or both, something was negatively impacting the uniformity of areas in the plots. Grey leaf spot was emerging sporadically in some areas which may account for the later testing results.

A review of the tissue analysis determined the availability of nutrients observed at different growth stages.

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/5/2018	CK	VT	3.3	2.93	0.43	0.28	0.12	4	22
6/5/2018	BZ	VT	4.01	3.77	0.26	0.27	0.12	5	33
7/6/2018	CK	R3	3.21	2.19	0.68	0.22	0.13	6	25
7/6/2018	BZ	R3	2.91	2.44	0.62	0.19	0.18	8	20

Figure 22: Posey County, IN Corn Trial -- Tissue Analysis

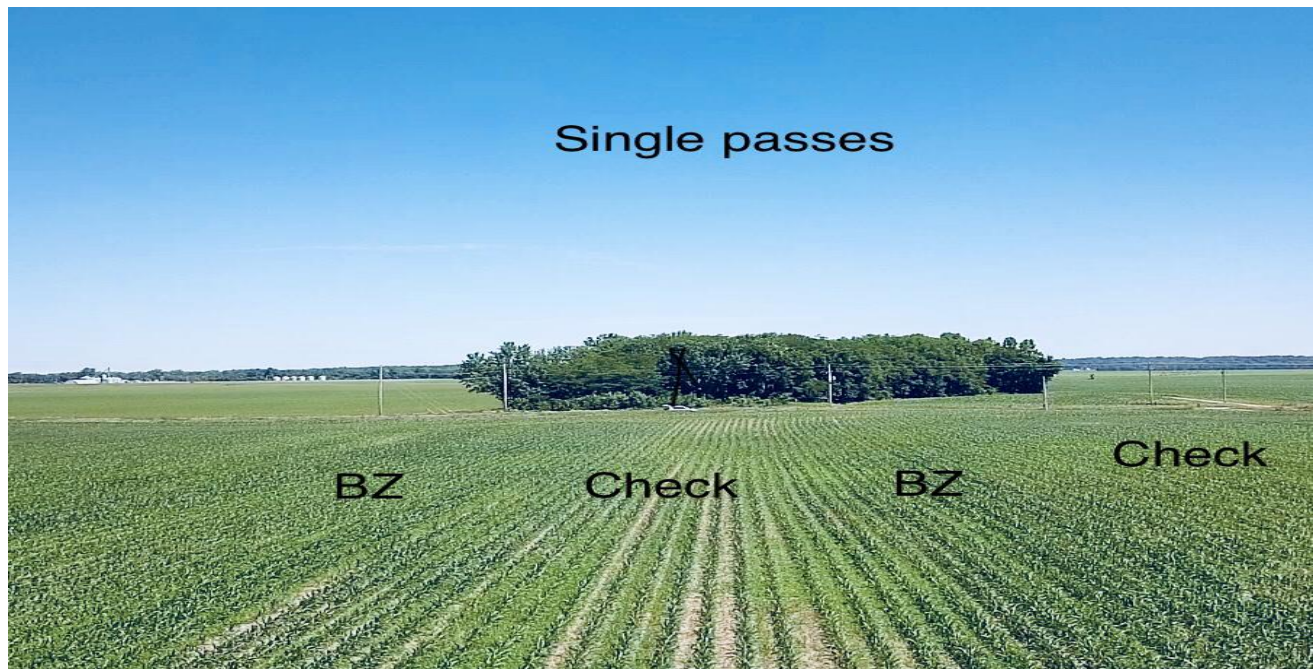


Figure 23: Posey County, IN Corn Trial

As noted earlier, visual differences were observed throughout growing season as depicted in the above photo taken after post emergence application of nitrogen. Although visual differences and tissue analysis revealed a much healthier plant, which should lead to improve yields, this field suffered from multiple challenges, resulting in an invalid trial. The plot had too much water damage early on and yield data was invalid.

Hodgenville, KY Soybean Plot

Tissue samples on this plot were conducted on 8/23/18 as the soybeans were going into R6 so this was a very important testing as the crop was in full reproductive stage. Evidently, the farmer has done a great job of fertility, not just in the primaries, but some of the secondary and micronutrients as well. The farmer standard treatment of P & K coupled with foliar micronutrients and secondary nutrients as the check, compared to the farmer standard P & K and 100 pound per acre of SUL4R-PLUS® B+Z fertilizer. The results were as following:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
8/23/2018	CK	R6	4.38	0.72	2.33	0.27	0.56	57	39
8/23/2018	BZ	R6	4.46	0.81	2.29	0.29	0.42	62	40

Figure 24: Hodgenville, KY Soybean Trial -- Tissue Analysis

While there was a response in sulfur, boron, and zinc, the response was minor and both the check and the SUL4R-PLUS® B+Z plot were in a good range. However, some of the levels could have been distorted by an extremely high magnesium level in the plant and the soil. In addition, the potassium level was extremely low at .72 and .81, yet the soil test showed that K tested at a high medium. The extension agent recommended only 30 pound of K looking at the soil test, but did not take into account that the high level of magnesium would restrict the uptake of the K. The plot will yield very well despite this, if harvested early but this plot will be prone for lodging, and was already showing signs of “squatting.” The plots were harvested on 11/ 30/18 and the entire field yielded in the upper sixties. The harvested yield was as follows:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$9.00/BU	GROSS \$/AC DIFFERENCE
CK	67.7	\$ 609.30	
BZ	70.5	\$ 634.50	\$ 25.20

Figure 25: Hodgenville, KY Soybean Trial -- Yield Results

While not a drastic yield increase, 2.8 bushels more per acre on a field with excellent fertility and well maintained by the grower utilizing best management practices still warrants the addition of nutrients supplied by SUL4R-PLUS® B+Z fertilizer, thus enforcing the need to consider calcium, sulfur, boron and zinc. The additional revenue generated will more than pay for the cost of additional nutrients.

Hudson, KY Tobacco Plot

This tobacco plot was somewhat late, yet it had good potential for high yield and quality. Tissue tests confirmed magnesium deficiency symptoms on the upper leaves. A recommendation of ½ gallon of magnesium chelate per acre helped overcome the symptoms and the plot has the appearance of an excellent crop now.

This farmer used SUL4R-PLUS® products on tobacco at 200 pound per acre as he had such good yields and quality from past use. The check used was 160 pound per acre of SUL4R-PLUS® ZINC fertilizer.

The results were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
7/26/2018	SUL4R-PLUS®	Stage 5	6.14	3.97	1.59	0.38	0.28	17	53
7/26/2018	SUL4R-PLUS® Zn	Stage 5	6.23	3.8	2.13	0.43	0.28	18	50

Figure 26: Breckinridge, Co, KY Tobacco Trial -- Tissue Analysis

Even with the 200 pound of SUL4R-PLUS® fertilizer, there was a response in calcium and sulfur with SUL4R-PLUS® ZINC fertilizer. There is no response to the zinc at this point, but the zinc will no doubt appear later toward maturity as that is its function in the plant.

The farmer had the capability to separate the results out for weight and quality difference at sale. The yield data and quality data will be forthcoming, and the tobacco is still being stripped and baled in preparation for market. It is unique to have this opportunity to get these statistics in burley tobacco.

Union County, KY Nutrient Soybean Plot

This plot has provided a unique opportunity to explore different rates of the SUL4R-PLUS® B+Z product compared to the check, with the check being farmer standard P & K without any additional secondary and/or micros applied, to determine if it would be cost effective to use a higher rate than recommended. It also checks out the theory of “luxury” feeding, that is, if the plant has ample fertility of certain nutrients, will it respond in yield with additional nutrients?

The results were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/11/2018	CK	R1	5.39	2.33	1.61	0.38	0.47	41	40
6/11/2018	100 # SUL4R-PLUS® BZ	R1	5.79	2.24	1.5	0.38	0.53	59	44
6/11/2018	200 # SUL4R-PLUS® BZ	R1	5.73	2.32	1.81	0.42	0.64	68	58
7/12/2018	CK	R5	6.38	1.95	1.41	0.41	0.55	82	50
7/12/2018	100 # SUL4R-PLUS® BZ	R5	6.84	1.72	1.06	0.43	0.49	90	47
7/12/2018	200 # SUL4R-PLUS® BZ	R5	6.84	1.86	1.03	0.42	0.41	94	47

Figure 27: Union County, KY Soybean Trial -- Tissue Analysis

This plot had good fertility and was not low in sulfur, boron, or zinc, but for maintenance, 100 pound per acre of SUL4R-PLUS® B+Z fertilizer was recommended. As can be seen on the 7/12/18 testing, there was no significant advantage with the extra 100 pound per acre of SUL4R-PLUS® B+Z fertilizer yet the 6/11/18 testing showed a drastic increase in boron and zinc on 6/20/18, so why did the plant demand it earlier on? The plant only pulls what it needs at the time it needs it, so there was some function of necessity at this time for the increased uptake of boron and zinc. Yield will determine if this increase at that time was of necessity.

The yield results were as follows:

PLOT	YIELD BU./AC
AVERAGE	74
100 # SUL4R-PLUS® BZ	70
200 # SUL4R-PLUS® BZ	71

Figure 28: Union County, KY Soybean Trial -- Yield Results

A look at the overall Union County yield map below tells several stories. This plot was extremely flat, was tilled, and was rare to flood. However, through tillage and some past history of perhaps compaction, or rutting when harvesting wet, the map shows distinct patterns in both treated and untreated plots through the yield monitor. Good fertility in this field showed that overall nutrition was strong through soil tests. So much so, a 3 to 4 bushel yield difference would not be the consequence of fertility, as far as N, P & K, nor macro or micro nutrients. If the SUL4R-PLUS® B+Z fertilizer and the farmer standard locations had been reversed, the yield likely would have been reversed as well.

Testing for compaction showed exactly what the yield map exhibited. The corners and end rows showed penetration easily until the 5-6 inch soil depth. This band of compaction was severe down to the 12-14 inch soil depth before it broke through.

The red yield stripe in the blue block showed compaction started at 4-6 inches and continued until the 15-16 inch depth before breaking through. These areas also appear 3-5 inches lower which indicates rutting perhaps from fall 2017 harvest. Compaction appeared in several locations throughout the field.



Figure 29: Union Co, KY Soybean Trial -- Yield Map

This Union County, KY yield map shows the patterns of past compaction or low areas that affected the yield. The blue enclosed area shows the 100 pound per acre rate of SUL4R-PLUS® B+Z fertilizer which averaged 70 bushels per acre. Distinct patterns of something affected the yield; (see areas of red) which denoted lower yields of approximately 50 bushels per acre. To the right of the enclosed blue area, is the 200 pound per acre rate of SUL4R-PLUS® B+Z fertilizer, and again, areas of yellow and red show inconsistent patterns not related to fertility but compaction or lower levels of the field affected by standing water early on in the season which averaged 71 bushels per acre. To left of the enclosed blue area is the rest of the field that averaged 74 bushels per acre, but note that even it had a lot of yellow and some red which shows that even it had areas of some kind of stress. Fertility was not the factor that affected yield but inconsistencies of geographical difference made a difference in yield determination. Even though this field looked uniform, and the soil test was probably uniform across the 55 acres, this map shows that something in the past made inconsistent yield across this field.

This is a great example of how hard it is to compare apples to apples without looking at the total picture. Small areas of this field could have shown a 30 bushel difference either way. Only with a yield map such as this can problem areas be seen, both in the treated and untreated areas.

Union County, KY Nematode Soybean Plot

In exploring a theory that has not been heavily researched in the U.S., testing explored if the **ammonium lignosulfonate** ('ALS': 8-10% by weight) used as the binder for the SUL4R-PLUS® products has any effect on nematode numbers in our cropping fields. There has been research in Canada using ALS in potatoes and the data shows a reduction in nematode pressure as a result of treating the soil with ALS. The Union County area of Kentucky was the first known existence of nematode damage in soybeans, as well as the first known case of Sudden Death Syndrome (SDS) in Kentucky, the assumption was that there was the presence of nematodes here at the Union County plot, and since the only way of combating damage are nematode resistance soybeans and crop rotation. Resistance soybean varieties does not mean that they are exempt from damage, and to demonstrate this, nematodes are one of the precursors to Sudden Death Syndrome, therefore if there was NO damage from nematodes, there would be no SDS. Yet SDS still exists and nematodes indeed are still doing damage.

Trial results from these plots testing nematode presence were as follows:

DATE	PLOT	PREVIOUS CROP	SPIRAL NEMATODE	JUVENILE NEMATODE
8/27/2018	CK	CORN	79	0
8/27/2018	100 # SUL4R-PLUS® BZ	CORN	4	13
8/27/2018	200 # SUL4R-PLUS® BZ	CORN	9	0

Figure 30: Union County, KY Soybean Trial -- Nematode Analysis

From the analysis, there is reduction in spiral nematodes when an application of ALS via SUL4R-PLUS® B+Z fertilizer is used. This is not a complete study, as more work will need to be done to prove the theory, but this is a start in the right direction.

The plot was harvested on 9/ 27/18 and yield data has not been supplied by grower. An interesting phenomenon that was an extremely rare find -. a 5 bean soybean pod found on the 200 pound per acre SUL4R-PLUS® B+Z plot!



Figure 31: Union County, KY Soybean Trial -- 5 Bean Pod

Owensboro, KY Soybean Plot

It is hard to improve on good fertility, and this plot, with exception of magnesium, was good across the board according to the soil test. However, some things on a soil test can be somewhat deceiving such as calcium and sulfur. While these nutrients may show good or high in the soil, that does not mean that they are in an available form to the plant. Calcium may be in a calcium carbonate form or be tied up with other nutrients. Sulfur may be in an elemental form and may not be available to this or even next year's crop.

The results of the tissue tests were as follows comparing farmer standard P & K with 100 pound per acre SUL4R-PLUS® B+Z fertilizer to the check farmer standard P & K with AMS and Solu-Bor:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/20/2018	CK	R1	5.56	2.26	1.02	0.34	0.36	42	49
6/20/2018	BZ	R1	5.65	2.07	1.09	0.35	0.29	43	43

Figure 32: Owensboro, KY Soybean Trial -- Tissue Analysis

This farmer has amazing fertility levels on all of his cropping fields, and he constantly monitors his crops both by soil tests and tissue testing. Knowing this, little yield variation was expected.

The soybean plots were harvested on 10/25/18 with the following yield results:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$9.00/BU	GROSS \$/AC DIFFERENCE
CK	83.8	\$ 754.20	
BZ	84.6	\$ 761.40	\$ 7.20

Figure 33: Owensboro, KY Soybean Trial -- Yield Results

These are excellent yields, and unlike some of his neighbors, the grower suffered little to no quality issues with his soybeans. He was amazed that there even was an increase in the SUL4R-PLUS® B+Z plot because of his fertility levels and his program that he has in place, which includes AMS and Solu-bor. While this is a minimal increase, and could be due to a little variability elsewhere, it did match or slightly exceed his program, and was less costly per acre and the ease of application coupled with a dust free uniform application of micronutrients. The ease of application of dust free homogeneous granules of SUL4R-PLUS® B+Z product provides even distribution across the acre which in turn provides even feeding of nutrients as compared to applying small amounts of inconsistent micronutrient granules to achieve uniform coverage across the acre.

Owensboro, KY Corn Plot

This plot had outstanding soil test nutrient levels other than magnesium and was under an irrigation pivot, with nutrients supplied in the past through the pivot. Only SUL4R-PLUS® product blended with Urea was used on this plot because the soil test did not show the need for the boron or zinc, with the check being two applications of AMS blended with Urea.

The results were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/20/2018	CK	V10	3.42	2.33	0.4	0.24	0.11	20	32
6/20/2018	SUL4R-PLUS®	V10	3.2	1.93	0.48	0.22	0.14	21	25

Figure 34: Owensboro, KY Corn Trial -- Tissue Analysis

The magnesium level was included in these results even though none was added. Like other test results, the trial actually showed an increase in magnesium due to the increased health of the plant and the increase of calcium which makes a better relationship with magnesium uptake.

Yield was measured on 9/13/18 and was very impressive. Check was conducted with two applications of AMS (one at planting and the other post at V9 stage) but only one application of SUL4R-PLUS® product at the V9 growth stage. Yield results were as follows:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$3.00/BU
CK-AMS	331	\$ 993.00
SUL4R-PLUS®	331	\$ 993.00

Figure 35: Owensboro, KY Corn Trial -- Yield Results

What is most impressive about this yield is the fact that two applications of AMS was applied to reach this impressive yield, whereas one application of SUL4R-PLUS® product was applied. The added product and labor costs of the second application of AMS reduces the gross margin per acre to the grower.

Hancock County, KY Soybean Plot

This plot was located at a river bottom that usually floods 1-2 times yearly, and nutrients get deposited there as the water leaves. The plot never requires lime for pH correction, and never requires phosphate. It was very sandy, and water through the growing season can be the limiting factor. This would be an excellent piece of ground for a pivot, but it is rented so the investment for a pivot has not been made. This plot studied the effect associated with applying 100 pound per acre SUL4R-PLUS® B+Z fertilizer along with the farmer standard P & K against the farmer standard P & K to validate the need of applying secondary and micronutrients.

The results of the tissue test were as follows:

DATE	PLOT	CROP STAGE	N %	K %	Ca %	S %	Mg %	B ppm	Zn ppm
6/20/2018	CK	R1	5.16	2.19	1.34	0.34	0.52	49	75
6/20/2018	BZ	R1	5.43	2.36	1.2	0.35	0.45	55	77
7/6/2018	CK	R3	6.32	1.85	1.36	0.41	0.49	60	69
7/6/2018	BZ	R3	7.11	1.9	1.13	0.42	0.45	61	65

Figure 36: Hancock Co, KY Soybean Trial -- Tissue Analysis

The soybeans were harvested on 10/29/18 and due to the monitor getting erased from the time of fertilizer application to harvest, exact areas of the plot are unknown. To complicate this error, a different variety of soybeans was planted near where the check plot began.

The approximate area of the SUL4R-PLUS® B+Z plot yielded 60 bushels per acre, and the soybeans in the check area and remaining part of the field yielded approximately 50 bushels per acre. We are unable to determine what drove the 10 bushels per acre yield difference; the use of SUL4R-PLUS® B+Z fertilizer, or the soybean variety. The soybeans were not only a different brand name, but they were quite different maturity, with the ones in the SUL4R-PLUS® B+Z area being 4.2 and the ones in the check being 3.8.

The sulfur and the boron were higher in the SUL4R-PLUS® B+Z plot on both tissue tests, but testing cannot confirm that it was responsible for the yield boost. The farmer did not learn anything from this plot on what to duplicate for the next year, and valuable data was lost due to error and poor communications.

Brookville, IN Corn Plot

This corn plot had excellent potential but must be harvested early in the fall because lodging is a huge potential. Often seen in certain areas that have a high magnesium content in their Ag lime, it translates to high magnesium levels in the soil and thus represses potassium uptake in the plant. This field had a high medium level of K on the soil test, but it was very low on the tissue analysis. To compound this, the corn grew excessively fast due to good growing conditions and thus left the immobile nutrients such as potassium behind in the stalk development. This study was conducted to determine the value of adding SUL4R-PLUS® B+Z fertilizer to the farmer standard fertility program, with farmer standard being N, P & K.

The tissue tests were as follows:

DATE	PLOT	CROP STAGE	Ca %	S %	B ppm	Zn ppm
6/11/2018	CK	V5	0.48	0.19	2	22
6/11/2018	BZ	V5	0.54	0.31	4	36
8/20/2018	CK	R1	0.5	0.23	44	33
8/20/2018	BZ	R1	0.58	0.24	48	43

Figure 37: Brookville, IN Corn Trial -- Tissue Analysis

For some unknown reason other than increases in plant health with the SUL4R-PLUS® B+Z product, the N level in the untreated was very low at 2.7%, while the treated was sufficient at 4.33%. It is very possible that boron was the vital link in this equation since it was extremely low in the plant on the untreated side. Visual differences were noted on 8/20/18 as to ear size when getting out of the lapped area between the check and the treated.

The plot was harvested on 9/30/18 and the farmer was pleased with not only the quality of spreading the uniform material of both ESN and SUL4R-PLUS® B+Z fertilizer, but the way both products release as the plant needs it.

As of 12/24/18, yield data was not available.

Kitchell, IN Soybean Plot



Figure 38: Kitchell, IN Soybean Trial

The Kitchell, IN soybean plant population appeared to be a little thin on the ground, as displayed in the photo above, but the plant population count averaged 110,000 which was sufficient, especially if a semi-bush or bush soybean was planted. According to the tissue analysis conducted on 8/20/18, the testing results indicated the soybeans were in good shape. This farmer has a good reputation among not just the retailer but others as someone who does a good job of fertility. This study was conducted to verify the addition of 100 pound per acre of SUL4R-PLUS® B+Z product to the farmer standard P & K blend, where the check is farmer standard P & K blend.

The tissue results were as follows:

DATE	PLOT	CROP STAGE	Ca %	S %	B ppm	Zn ppm
6/11/2018	CK	R1	1.11	0.38	35	66
6/11/2018	BZ	R1	1.39	0.35	34	79
8/20/2018	CK	R3	1.35	0.29	31	26
8/20/2018	BZ	R3	1.5	0.32	39	34

Figure 39: Kitchell, IN Soybean Trial -- Tissue Analysis

The field was harvested on 9/19/18 with the yield as follows:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$9.00/BU	GROSS \$/AC DIFFERENCE
CK	82.4	\$ 741.60	
BZ	94.8	\$ 853.20	\$ 111.60

Figure 40: Kitchell, IN Soybean Trial -- Yield Results

This 155-acre field was an exceptional field of soybeans, averaging 85.6 bushels per acre. By adding SUL4R-PLUS® B+Z fertilizer providing the addition of secondary and micronutrients, the result was increased yield, improved plant health and increased in gross revenue per acre.

Kitchell, IN Corn Plot



Figure 41: Kitchell, IN Corn Trial

As depicted in the photo above, the field involved in this study is very uniform and displays a picturesque view of a well fertilized corn field. The photo is evidence of the amazing job of fertilizing and maintaining fertility through best management practices performed by this grower and verified by the retailer. The uniformity of nutrient distribution in this field is displayed in the first tissue tests conducted on 6/11/18. The grower's corn looked extremely good except for some kind of pattern in the field which could have been split varieties or an application problem. With a little research, it was discovered that he had an ammonia "bleeding" problem when he applied his nitrogen. This study was conducted to validate the use of 100 pound per acre of SUL4R-PLUS® B+Z fertilizer versus the farmer standard of using AMS as the sulfur source in corn production.

Tissue results were as follows on the corn plot:

DATE	PLOT	CROP STAGE	Ca %	S %	B ppm	Zn ppm
6/11/2018	CK	V5	0.37	0.3	6	65
6/11/2018	BZ	V5	0.24	0.29	7	64
8/20/2018	CK	R1	0.63	0.17	10	21
8/20/2018	BZ	R1	0.65	0.23	8	28

Figure 42: Kitchell, IN Corn Trial -- Tissue Analysis

The farmer's sulfur source (AMS) started playing out at ear fill whereas the SUL4R-PLUS® B+Z sulfur was still in the sufficient level. As noted before with the Nitrogen (N) to Sulfur (S) ratio and making the Nitrogen more efficient, the N in the 08/20/18 check was deficient at 2.18% while the 08/20/18 SUL4R-PLUS® B+Z plot showed 2.81% which was sufficient at ear fill.

The plot was harvested on 10/16/18 with yield as follows:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$3.00/BU	GROSS \$/AC DIFFERENCE
CK-AMS	257.4	\$ 772.20	
SUL4R-PLUS® BZ	268.7	\$ 806.10	\$ 33.90

Figure 43: Kitchell, IN Orr Corn Trial -- Yield Results

While there is a considerable difference in yield between the SUL4R-PLUS® B+Z application and the check, this field averaged 260.2 bushel per acre on 154 total field acreage. There was some low-lying water damage, and the loss of yield on the stripes of nitrogen loss, but the lowest yield recorded on the yield monitor was 237 bushels, while the highest recorded was 288 bushels. Overall, this field had little variation prior to planting. This plot made a good test for the SUL4R-PLUS® B+Z product as compared to farmer standard. SUL4R-PLUS® B+Z fertilizer proved its worth as providing much needed secondary and micronutrients at the right time and right place; improving yield by 11.3 bushels more per acre, thus increasing gross revenue per acre.

Williamsburg, IN Soybean Plot

This field had great potential for yield but tissue test showed it was deficient in potassium (K) yet the soil tests showed it is in good shape on K. Two things were going on to suppress the K; magnesium was elevated on the soil test and the tissue test, and the soil was similar in quality and consistency to a peat bed and was saturated, especially during this growing season. It was extremely flat and not tilled, but even if tilled, percolation would be a challenge in this soil type. The study was conducted to validate the need of 100 pound per acre of SUL4R-PLUS® B+Z fertilizer as a needed nutrient source to provide secondary and micronutrients for production of soybeans as opposed to the farmer standard P & K blend, which is the check SUL4R-PLUS® B+Z fertilizer is being compared to.

Tissue tests for the Williamsburg plots were as follows:

DATE	PLOT	CROP STAGE	Ca %	S %	B ppm	Zn ppm
6/25/2018	CK	R1	0.99	0.27	36	25
6/25/2018	BZ	R1	1.05	0.3	43	31
8/20/2018	CK	R3	2.5	0.23	44	33
8/20/2018	BZ	R3	2.81	0.24	43	43

Figure 44: Williamsburg, IN Soybean Trial -- Tissue Analysis

The plot was harvested on 10/1/18 and yield was as follow:

PLOT	YIELD BU./AC	GROSS \$/AC @ \$9.00/BU	GROSS \$/AC DIFFERENCE
CK	66.8	\$ 601.20	
BZ	71.2	\$ 640.80	\$ 39.60

Figure 45: Williamsburg, IN Soybean Trial -- Yield Results

SUL4R-PLUS® B+Z fertilizer proved its worth, by adding value to the acre. As stated, this study was conducted to prove the need of adding secondary and micronutrients to the standard P & K blend to improve production of soybeans. An increase of 4.4 bushels per acre demonstrated the importance of providing a balance of plant available nutrition to plant consisting of calcium, sulfur, boron and zinc. The addition of homogeneous dust free SUL4R-PLUS® B+Z granular fertilizer to the nutrient blend provided said plant available nutrients with ease of application to evenly distribute plant available nutrients across the acre for even feeding. The increase in yield most certainly resulted in more gross dollars per acre, which will offset the additional cost of adding secondary and micronutrients.

Owensboro, KY Nematode Soybean Plot

As stated earlier concerning the nematode research on the Union County trial and seeing the effects of ALS (ammonium lignosulfonate) on nematode numbers, a soybean plot was conducted in Owensboro, KY. There was no check within the field because a mistake occurred and the entire plot was spread with SUL4R-PLUS® BORON fertilizer, but there was an adjacent soybean field immediately across the road in the same rotation and therefore we would expect it to have similar nematode pressure. Neither field had been treated for nematodes with a nematocide. The treated field was a special formulation of SUL4R-PLUS® BORON fertilizer. Since there was no check to compare apples to apples on nutrients, nematode testing was conducted to see if pressure was diminished by the SUL4R-PLUS® BORON product. The check presented 48 juvenile cyst nematodes, whereas the SUL4R-PLUS® BORON treated field presented 18 juvenile cyst nematodes and 15 spiral nematodes.

As stated earlier, this is the beginning of this research to determine whether or not ALS will aid in the reduction of nematodes in the soil. Preliminary results indicated a reduction, as noted by results, but a material amount work still needs to be completed. Research will be continuing.

DATE	PLOT	PREVIOUS CROP	SPIRAL NEMATODE	JUVENILE NEMATODE
8/27/2018	CK	CORN	0	48
8/27/2018	SUL4R-PLUS® Boron	CORN	15	18

Figure 46: Owensboro, KY Soybean Nematode Trial -- Test Results

Lebanon, KY Corn Plot

This plot cannot be considered a valid test as one field was treated with SUL4R-PLUS® B+Z fertilizer and a field about ¼ mile away was going to be used as a check.

Lebanon, KY Tobacco Plot

None of the results from this test were valid as 160 pound per acre of SUL4R-PLUS® ZINC fertilizer was applied on one field, and 200 pound per acre of SUL4R-PLUS® ZINC fertilizer was applied on another field to compare.

Greenville, IL Corn/Soybean Plot

As of 12/24/18, yield data had not been received.

2018 Summary of Trials

I have enjoyed the process of learning about the capability of the SUL4R-PLUS® products and their need in the agricultural industry. The products have shown that they can give tremendous return on investment which is needed in today's farming economy. I have been disappointed in several dealers as to their involvement of their customer's wellbeing. They seem to only do no more than they have to do, and mimic only what their competitors are doing. They do not seem to get involved with the success or failure of the farmer, and most will say that there is no loyalty but everything is based on price. While price is important to the farmer, he needs the dealer to help show him the truth from the fiction, and there is a lot of fiction out there. Science does not lie, and that is where the SUL4R-PLUS® products excel in the industry. The nutrients are needed, and the relationship of nutrients are needed to be fulfilled in the plant. If the nutrients are in the environment of the plant and are in an available form that the plant needs at the time the plant needs it, it will take it up at the right time and as it needs it.

Some farmers do not realize the expense nor the time it takes to get meaningful research data. They either destroy a yearlong study by not following out with the yield, or fail to see first-hand how they can learn from the research and make themselves more profitable.

I believe my terminology of this research should be changed from "trials" to "study." Because of the broad area of this research, and because of variations of fertility, weather, soil type, and farming practices, this has truly been a study of a lot of unknown factors. Science still prevailed as we would think, but relationships of nutrients varied greatly due to planting dates, past cropping practice, and weather phenomena.

All factors considered, SUL4R-PLUS® B+Z fertilizer showed its stability and season-long feeding ability. Even in situations that would limit or negate the potential of the SUL4R-PLUS® B+Z product, it still had an impact on most every plot; whether it improved plant health enough that it actually improved other nutrient uptake, or whether the plant found one or more of the four nutrients supplied was needed at a certain time/and or situation.

The impact of ammonium lignosulfonate on nematodes requires further study. The indications of the two trials noted herein are compelling. I will be incorporating this study along with some of my trials in 2019.

I myself am impressed with the results of 2018 and I believe that the SUL4R-PLUS® products are needed on 90% of the acres I've been exposed to. I am glad to be a part of this education process, and I hope we find the ways to do just that.

I want to thank the coordinators of these studies in 2018, and I wish to thank the SUL4R-PLUS® team for allowing me to study these trials, and to work with such products that have shown the

potential to impact the vast majority of those in agriculture. These products show that they could make a difference in profit or loss in today's agricultural economy.

One final thing: being able to study the science of these products and studying the crops response throughout the year has confirmed time and time again how the process of fertility to plant nutrition could not happen by accident. It confirms to me that a design requires a designer.....God is still at work!

Ralph E. Hart

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