

MHPEC Sulphur Research Report 2022

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Introduction: The Field Variability Study (FVS) was conducted from 2015 to 2019 with the overall goal of identifying and remediating factors responsible for variable processing potato yield. Approximately fifty-five soil, plant, and environmental factors were identified in 23 grower fields and each factor was ranked according to impact on potato yield in a new partial least squares model generated in 2020. Soil sulphur availability has been identified as the fourth most influential variable responsible for differences in total yield at row closure, which is approximately late June to Early July. Soil sulphur availability at the depths 0-30 cm throughout the growing season swept the top nine most influential variables responsible for variation in the 6 to 10 oz, 10 to 12 oz, and >12 oz yields. The assumed ideal soil sulphur test at preplant is 40 lb (based on 0-30 cm cores) in potato but not at row closure. This was shown to be an important variable in yield variability by improving size and value of tuber yield. This estimate is for each pound of sulphur which falls short of the row closure target could cost a grower \$0.86/ac.

Soil Sulphur in 0-30 cm	Estimated \$/ac lost	Estimated cost/field
0	\$34.40	\$4,472
10	\$25.80	\$3,354
20	\$17.20	\$2,236
30	\$8.60	\$1,118

Table 1 (above) – Estimates from the FVS on the amount of money lost per acre and per 130-acre field for each 10 pounds under the 40-pound goal for soil sulfur at row closure.

A small plot trial was created to field an appropriate rate and product that would reach the 40 lb goal at row closure. It was assumed the primary means of sulphur loss in the soil was by leaching. Different products that have varied amounts of solubility, due to sulphur being mobile in the soil, have varying propensities for leaching. These included magnesium sulphate, ammonium sulfate paired with ammonium thiosulphate fertigation (AMS), tiger combo and tiger XP (most to least soluble). These products were applied at the different rates of 20, 60 and 100 lb S to see fertilizer response and longevity in the soil to ultimately determine which products are most cost effective and environmentally friendly. It was determined that 60 lb rates of treatments such as Ammonium sulfate (AMS) and both of Tiger-Sul products (Combo and XP) were the most likely to reach the 40 lb goal. Additionally, some of these products hit the 40 lb goal in the soil with only 20 lb treatments. The rate of fertilizer needed by the potatoes has a lot of influencing variables such as past soil fertility, texture, and soil organic matter (SOM), making whole-field investigation a critical third and final step. After three years of small plot research, it was decided to extend this to a field sized trial to help focus on areas within fields that have the highest propensity to have sulphur deficiency and how to appropriately treat it.

Field Research Objectives:

1. Evaluate the results that were found in the small plot research on different soil types, SOM, and management styles to build an appropriate recommendation for MB potato growers
2. Use soil optix and drone technology to find areas where the field has the highest propensity to have sulphur deficiency
3. To validate the 40 lb Sulphur recommendation at row closure and how to reach that goal using previously tested products and their longevity through out the season

SS-1

Observations and questions related to research:

- Sulphur targets for the regular treatment of ammonium sulphate & ammonium thiosulphate (AMS) were at ~25 lb while the tiger combo and XP treatments were ~60 lb
- All preplant fertilizer except Tiger products were applied variable rate
- Whole field mapping will have a more complete picture than this few points model
- All treatments reached row closure target with the lower rate just reaching the goal
 - o Lower rate of S products on heavier soil and high SOM could be possible but risky of reaching goal
 - o Cost per lb S and the cost of application is the dictating factor for product choice
- Offsite study supports a difference in soil S with no difference in petiole S levels
- Offsite study showed the improvement for sulphur application was in the 10-12 oz yield and the total value.
- All nutrients were higher at row closure in the Tiger XP treatment
- Good SOM avg 5.3% likely decreasing fertilizer response
- High amount of S during late bulk but mostly used by end of season
- First irrigation wasn't until row closure time frame which could affect the leaching factor
- Lots of nightshade pressure throughout field but especially in the unplanted low areas
- Powdery scab nodules seen throughout the field
- Some phos acid burn seen throughout the field some areas were severe at harvest
- Early die, black dot, & vert seen throughout the field
- Manure application is a variable no other farm has application

Planting Date	Yield Collection Date
June 1	Sept 12

Table 1. Planting and yield collection dates.

Fertility

Treatment	Total nutrients applied (N-P-K lb/ac)	Lb Sulphur applied/ac	Estimated Cost of Sulphur applied/ac
Normal AMS app	166-40-164	19 Preplant 5 Fertigation 24 Total	\$7.03 \$3.05 Total: \$10.08
Tiger Combo	176-40-171	60	\$25.20
Tiger XP	169-40-171	60	\$15.60

Table 2. Fertility background of the each of the treatments. The cost of the sulphur fertilizer is approximate amounts as of December 2021. This cost does not include any extra application costs just the product.

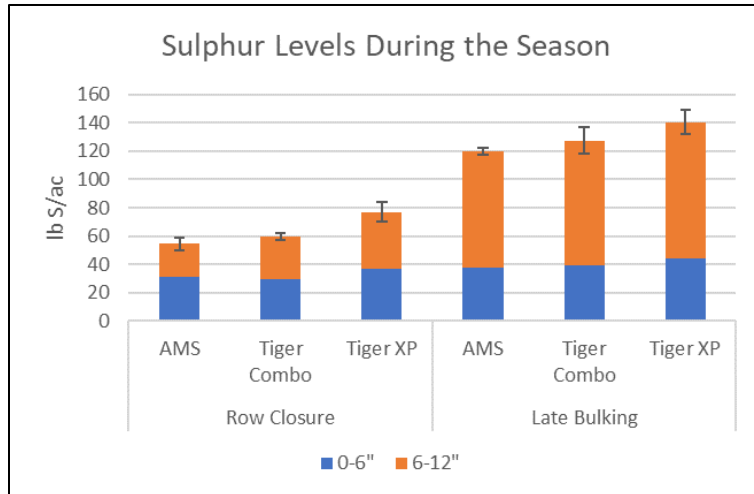


Figure 1. Sulphur levels during the season at row closure and late bulking. The goal is 40 lb S at row closure.

Yield

Treatment	Clean Weight cwt/ac	<3 oz cwt/ac	3-5.9 oz cwt/ac	6-9.9 oz cwt/ac	10-11.9 oz cwt/ac	>12 oz cwt/ac	Specific Gravity	Estimated Dollar Value \$/cwt
AMS	161	29	69	45	7	10	1.082	\$ 2,080.85
Tiger Combo	165	32	67	49	8	19	1.087	\$ 2,163.29
Tiger XP	149	28	63	46	4	6	1.080	\$ 1,936.00

Table 3. Yield, basic quality, and estimated value of each treatment.

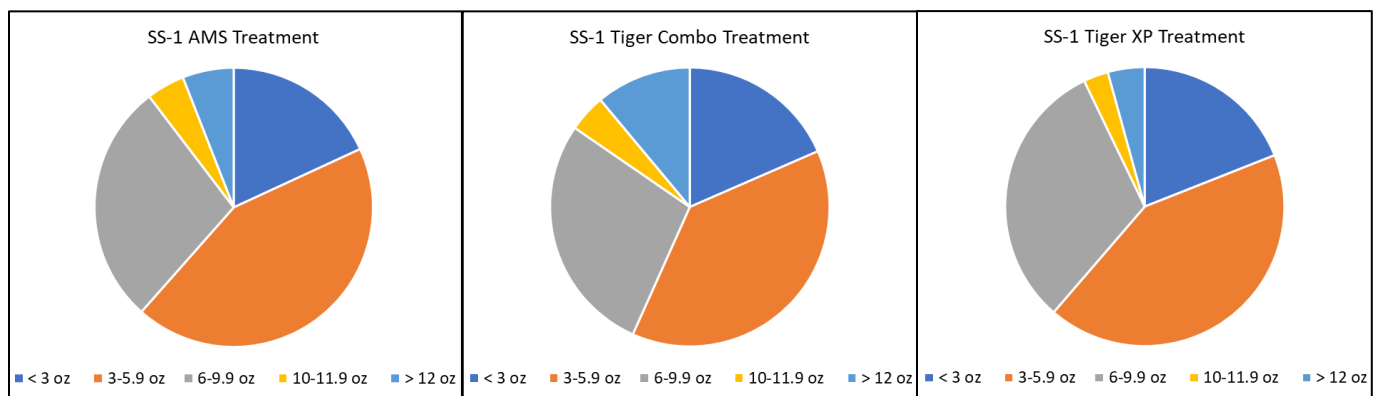


Figure 2. Size profile breakdown according to each size category of total yield.

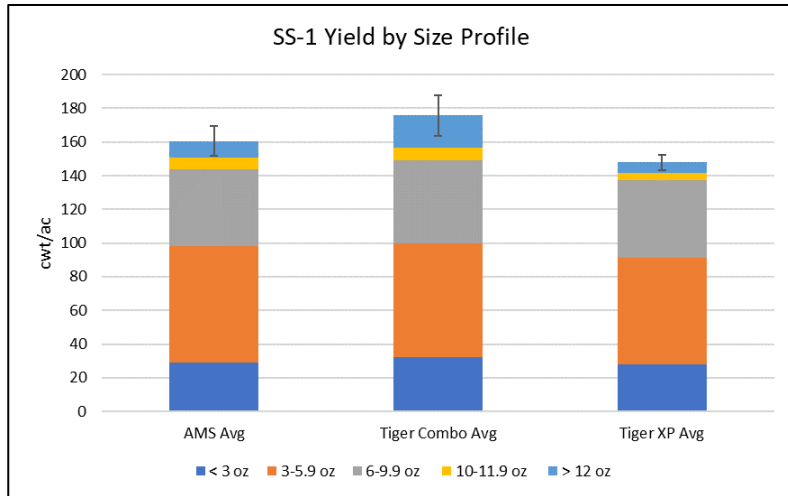


Figure 3. The total yield of both treatments broken up by the size profiles

Plot 4: Normal AMS

SOM: 6.6%
RC NO₃: 109 lb/ac outlier
RC Sulphur: 56 lb/ac
Yield: 145 cwt/ac

Plot 3: Normal AMS

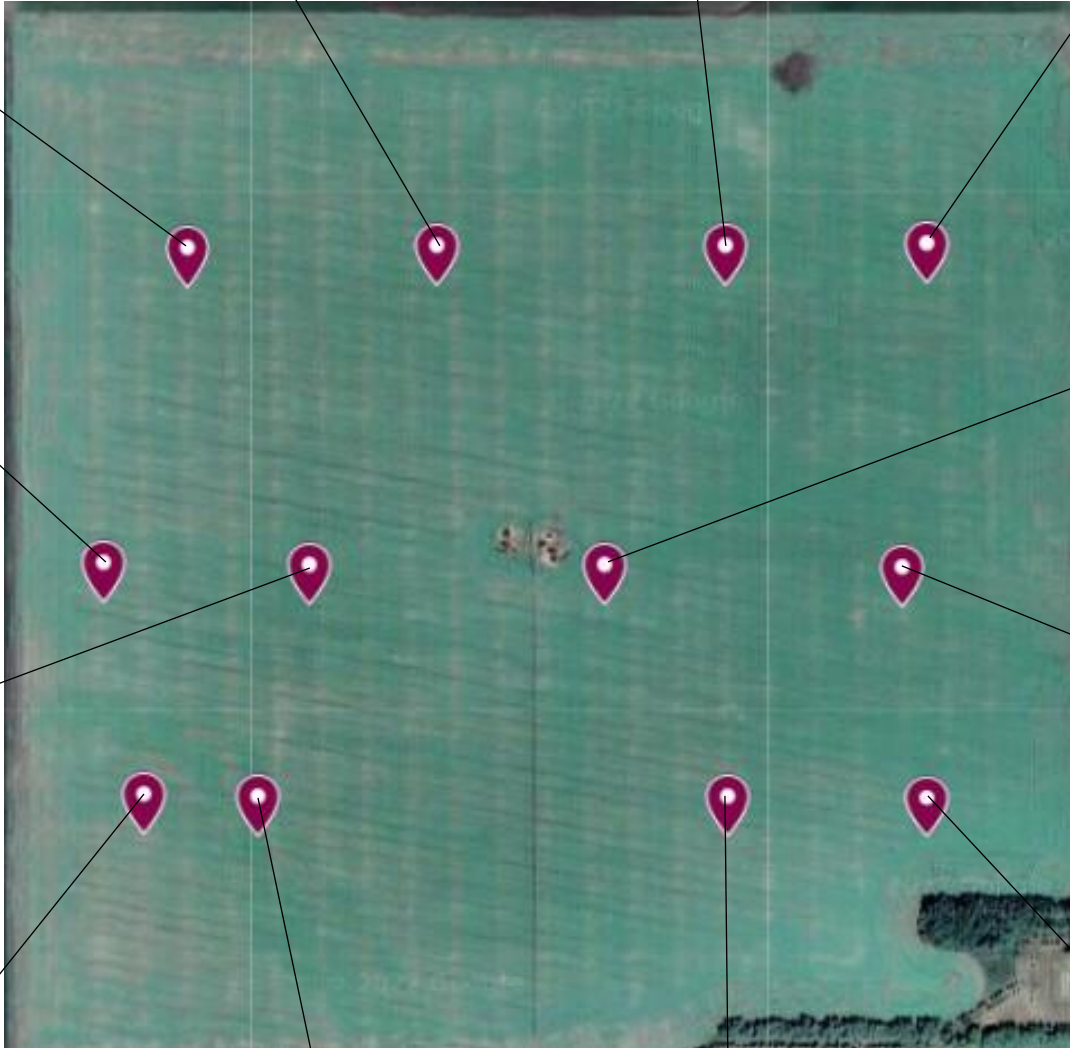
SOM: 5.9%
RC NO₃: 32 lb/ac outlier
RC Sulphur: 44 lb/ac
Yield: 183 cwt/ac outlier
Powdery Scab

Plot 2: Normal AMS

SOM: 4.7%
RC NO₃: 79 lb/ac
RC Sulphur: 52 lb/ac
Yield: 149 cwt/ac
Powdery Scab

Plot 1: Normal AMS

SOM: 4.3%
RC NO₃: 54 lb/ac
RC Sulphur: 66 lb/ac
Yield: 169 cwt



Plot 5: Tiger Combo

SOM: 4.1%
RC NO₃: 64 lb/ac
RC Sulphur: 58 lb/ac
Yield: 185 cwt/ac

Plot 7: Tiger Combo

SOM: 5.2%
RC NO₃: 55 lb/ac
RC Sulphur: 54 lb/ac
Yield: 170 cwt/ac

Plot 6: Tiger Combo

SOM: 6.8%
RC NO₃: 73 lb/ac
RC Sulphur: 66 lb/ac
Yield: 176 cwt/ac

Plot 8: Tiger Combo

SOM: 6.2%
RC NO₃: 88 lb/ac
RC Sulphur: 60 lb/ac
Yield: 131 cwt/ac outlier

Plot 12: Tiger XP

SOM: 3.2%
RC NO₃: 36 lb/ac outlier
RC Sulphur: 64 lb/ac
Yield: 156 cwt/ac
Roots and stolons malformed

Plot 11: Tiger XP

SOM: 4.7%
RC NO₃: 83 lb/ac
RC Sulphur: 72 lb/ac
Yield: 150 cwt/ac
Black Dot observed

Plot 10: Tiger XP

SOM: 6.1%
RC NO₃: 99 lb/ac
RC Sulphur: 76 lb/ac
Yield: 154 cwt/ac

Plot 9: Tiger XP

SOM: 6.1%
RC NO₃: 81 lb/ac
RC Sulphur: 96 lb/ac outlier
Yield: 136 cwt/ac outlier

SS-2

Observations and questions related to research:

- Sulphur targets for the regular treatment of ammonium sulphate & ammonium thiosulphate (AMS) were at ~50 lb while the tiger combo and XP treatments were ~60 lb
- All fertilizers except the Tiger Combo and fertigated ATS was variable rate applied
 - o Would the variable rate applied combo compensate for the ATS that can't be variable rate applied?
- Whole field mapping will have a more complete picture than this few points model
- Both treatments reached row closure target so the cost per lb S is a dictating factor for product choice
 - o Cost per lb S and the cost of application is the dictating factor for product choice
- Offsite study supports a difference in soil S with no difference in petiole S levels
- Offsite study showed the improvement for sulphur application was in the 10-12 oz yield and the total value.
- Both treatment yields would be very comparable with out point 1 yield as it was significantly lower than any other point in the field at ~155 cwt/ac
 - o The dollar figure came out ahead due to the higher amount of yield above 6 oz
- Small amounts of powdery scab nodules seen
- Large healthy plants in in the Northwest quadrant
- Canopy was healthy when harvesting
- Less agronomic issues than some other fields such as disease and weed pressures

Planting Date³	Yield Collection Date
June 1	Sept 12

Table 1. Planting and yield collection dates.

Fertility

Treatment	Total nutrients applied (N-P-K lb/ac)	Lb Sulphur applied/ac	Estimated Cost of Sulphur applied/ac
Normal AMS app	200-80-225	26 Preplant	\$9.62
		20 Fertigation	\$12.20
		46 Total	\$21.82
Tiger Combo	191-80-225	60	\$25.20

Table 2. Fertility background of the each of the treatments. The cost of the sulphur fertilizer is approximate amounts as of December 2021 this cost does not include any extra application costs just the product.

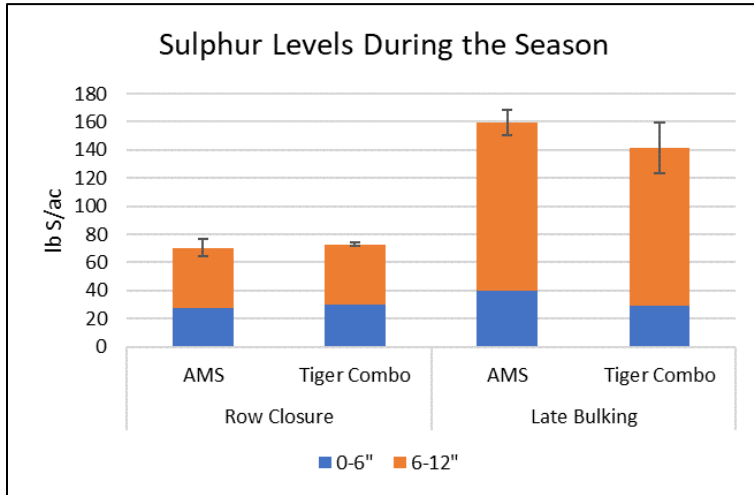


Figure 1. Sulphur levels during the season at row closure and late bulking. The goal is 40 lb S at row closure.

Yield

Treatment	Clean Weight cwt/ac	<3 oz cwt/ac	3-5.9 oz cwt/ac	6-9.9 oz cwt/ac	10-11.9 oz cwt/ac	>12 oz cwt/ac	Specific Gravity	Estimated Dollar Value \$/cwt
Normal AMS app	233	21	81	75	18	22	1.085	\$ 3,009.17
Tiger Combo	209	20	81	70	13	7	1.080	\$ 2,663.53

Table 3. Yield, basic quality, and estimated value of each treatment.

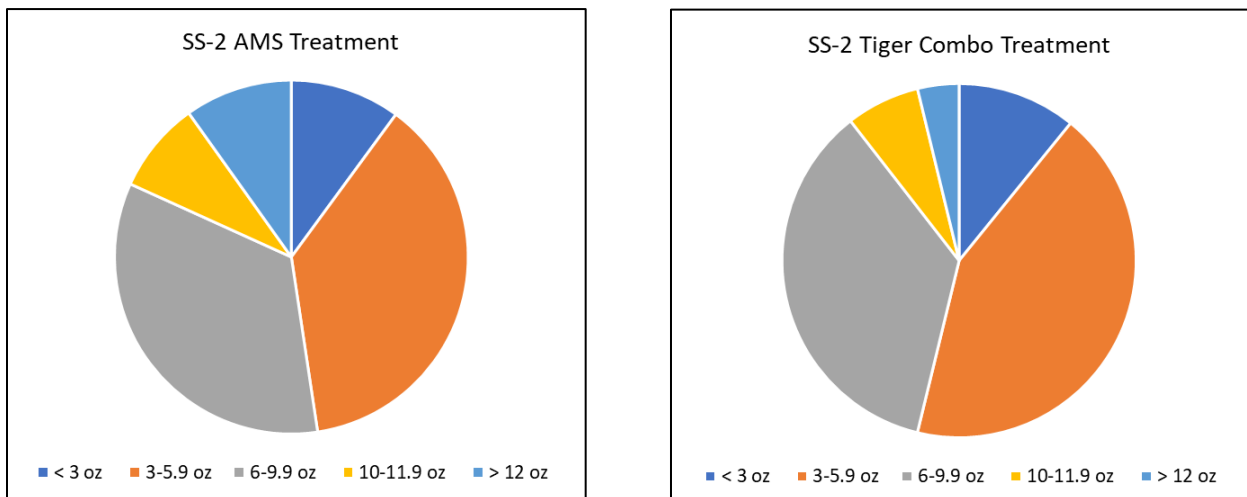


Figure 2. Size profile breakdown according to each size category of total yield.

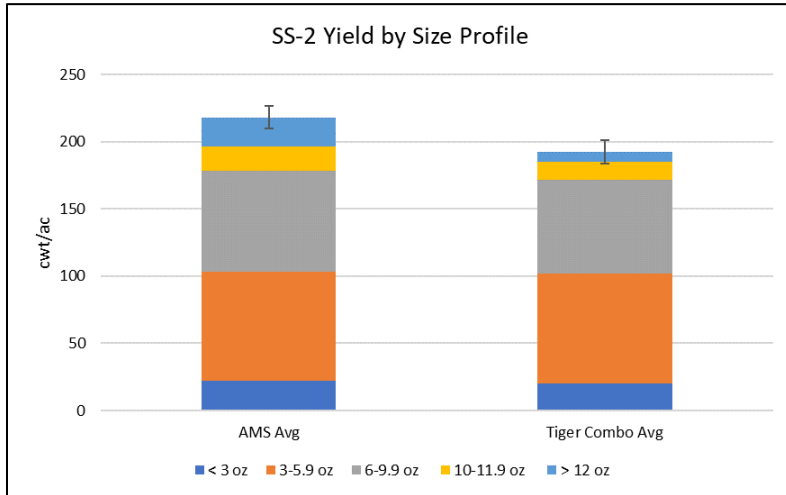


Figure 3. The total yield of both treatments broken up by the size profiles.

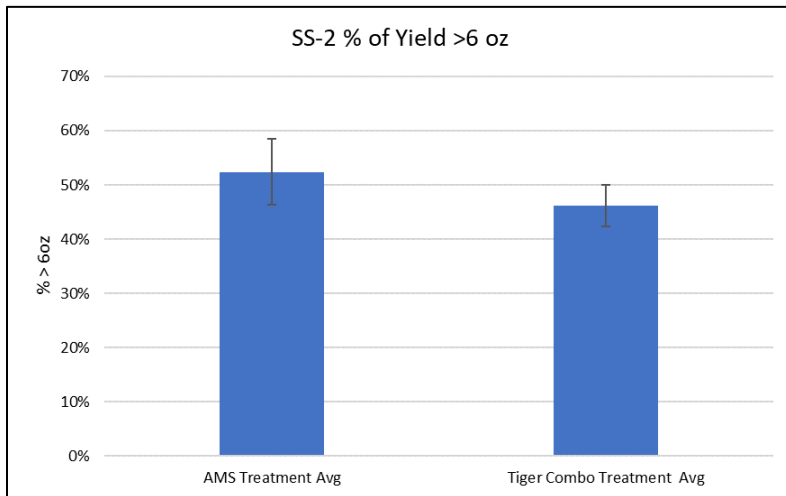


Figure 4. The percent of yield over the size category of 6 oz.

Plot 2: Tiger Combo

SOM: 3.2%
RC NO₃: 85 lb/ac
RC Sulphur: 62 lb/ac
Yield: 237 cwt/ac

Plot 1: Tiger Combo

SOM: 3.7%
RC NO₃: 75 lb/ac
RC Sulphur: 62 lb/ac
Yield: 155 cwt/ac outlier

Plot 3: Tiger Combo

SOM: 3.2%
RC NO₃: 46 lb/ac outlier
RC Sulphur: 70 lb/ac
Yield: 200 cwt/ac

Plot 4: Tiger Combo

SOM: 3.2%
RC NO₃: 99 lb/ac
RC Sulphur: 88 lb/ac outlier
Yield: 242 cwt/ac

Plot 6: Normal AMS

SOM: 4.4%
RC NO₃: 85 lb/ac
RC Sulphur: 72 lb/ac
Yield: 210 cwt/ac

Plot 7: Normal AMS

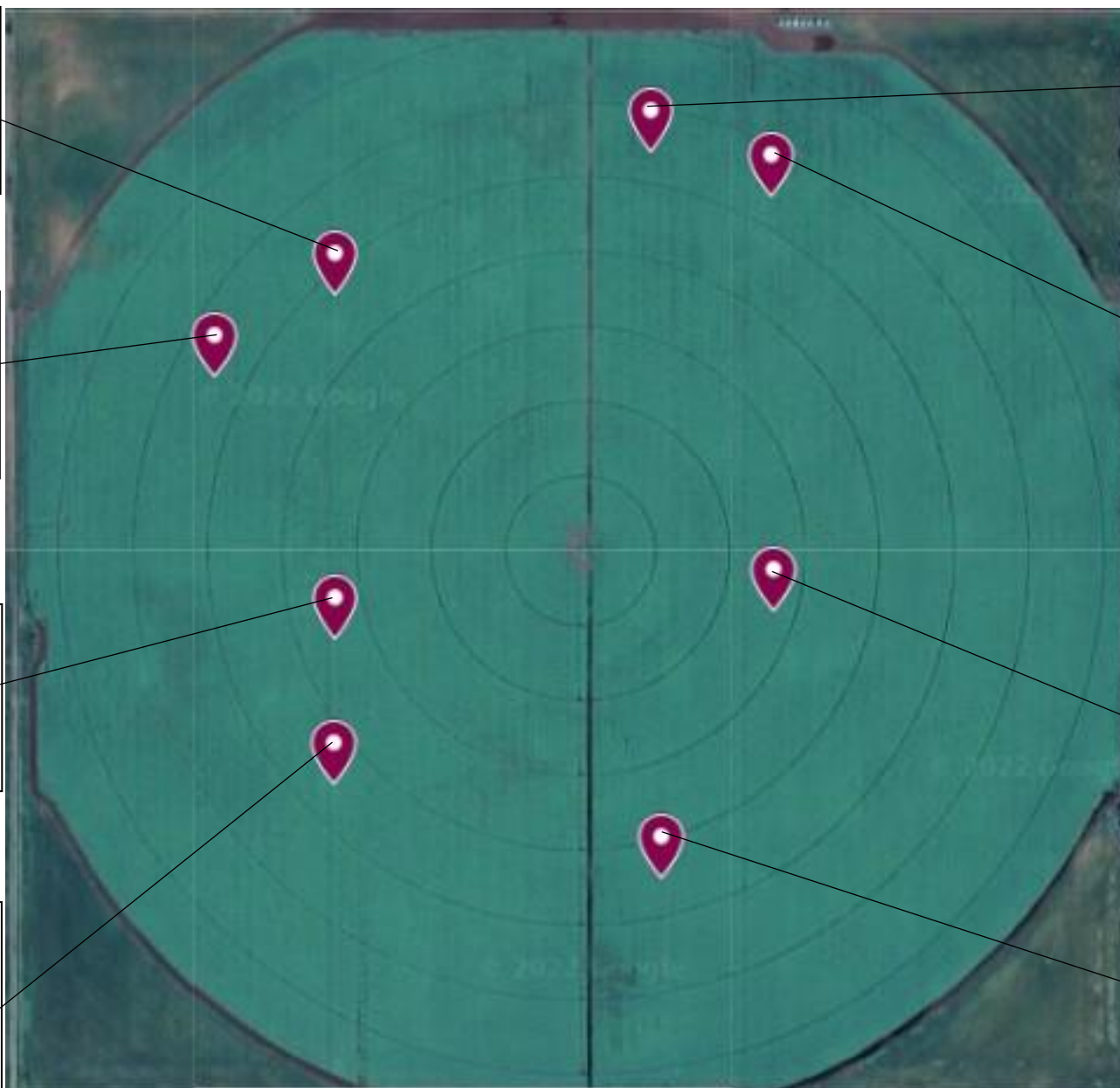
SOM: 2.1%
RC NO₃: 81 lb/ac
RC Sulphur: 76 lb/ac
Yield: 249 cwt/ac
Harvest: Huge plants & root system. V. healthy

Plot 8: Normal AMS

SOM: 4.5%
RC NO₃: 80 lb/ac
RC Sulphur: 70 lb/ac
Yield: 243 cwt/ac

Plot 5: Normal AMS

SOM: 1.5%
RC NO₃: 39 lb/ac outlier
RC Sulphur: 74 lb/ac
Yield: 231 cwt/ac



SS-3

Observations and questions related to research:

- Sulphur targets for the regular treatment of ammonium sulphate (AMS) were at ~50 lb while the tiger combo treatment was ~60 lb
- All fertilizers except the Tiger Combo was variable rate applied
- Whole field mapping will have a more complete picture than this few points model
 - o Drone wasn't run over this field only Soil Optix
- Row Closure targets weren't reached with either treatment, but tiger combo treatment was over 20 lb S
 - o Regardless of the soil sulphur being sufficient the petiole was still low in point 7
 - o Cost per lb S and the cost of application could be a dictating factor for product choice
- High amounts of soil sulphur seen at late bulking
- AMS treatment on the north side had a higher yield but smaller tubers
 - o Verticillium and low row closure nitrogen could be a limiting factor
- Offsite study supports a difference in soil S with no difference in petiole S levels
- Offsite study showed the improvement for sulphur application was in the 10-12 oz yield and the total value.
- Large rain event in early to mid June (~4" rainfall)
- Verticillium seen on the North side specifically especially on the sand ridges
- High amounts of leaching potential due to low SOM
 - o Tiger Combo showed less potential leaching loss
- Plot 1 didn't get harvested due to the extreme moisture in the area
- Powdery Scab nodules seen throughout the field

Planting Date	Yield Collection Date
June 6	Sept 14

Table 1. Planting and yield collection dates.

Fertility

Treatment	Total nutrients applied (N-P-K lb/ac)	Lb Sulphur applied/ac	Estimated Cost of Sulphur applied/ac
AMS	185-95-206	51	\$18.87
Tiger Combo	185-95-206	60	\$25.20

Table 2. Fertility background of the each of the treatments. The cost of the sulphur fertilizer is approximate amounts as of December 2021 this cost does not include any extra application costs just the product.

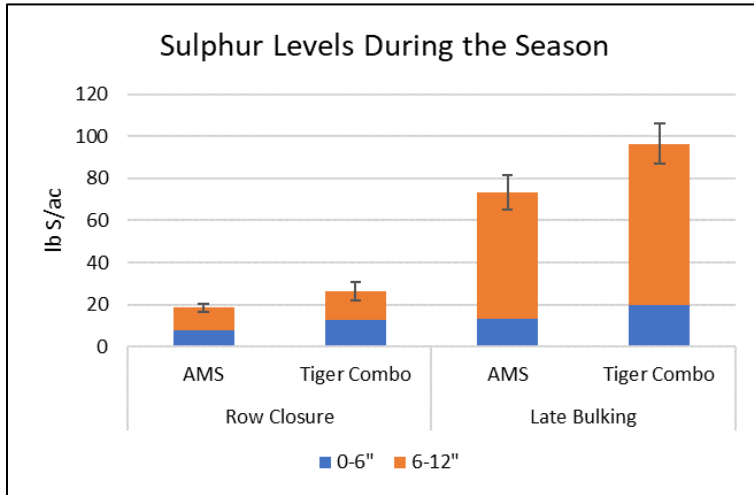


Figure 1. Sulphur levels during the season at row closure and late bulking. The goal is 40 lb S at row closure.

Yield

Treatment	Clean Weight cwt/ac	<3 oz cwt/ac	3-5.9 oz cwt/ac	6-9.9 oz cwt/ac	10-11.9 oz cwt/ac	>12 oz cwt/ac	Specific Gravity	Estimated Dollar Value \$/cwt
AMS	195	33	100	40	6	0	1.090	\$ 2,541.63
Tiger Combo	181	19	79	55	8	6	1.085	\$2,375.28

Table 3. Yield, basic quality, and estimated value of each treatment.

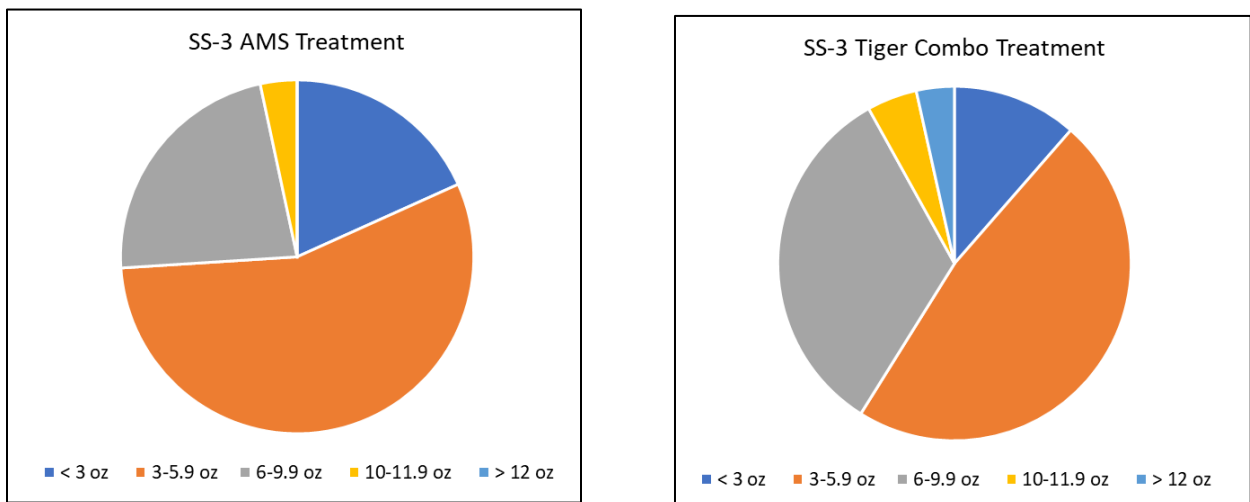


Figure 2. Size profile breakdown according to each size category of total yield.

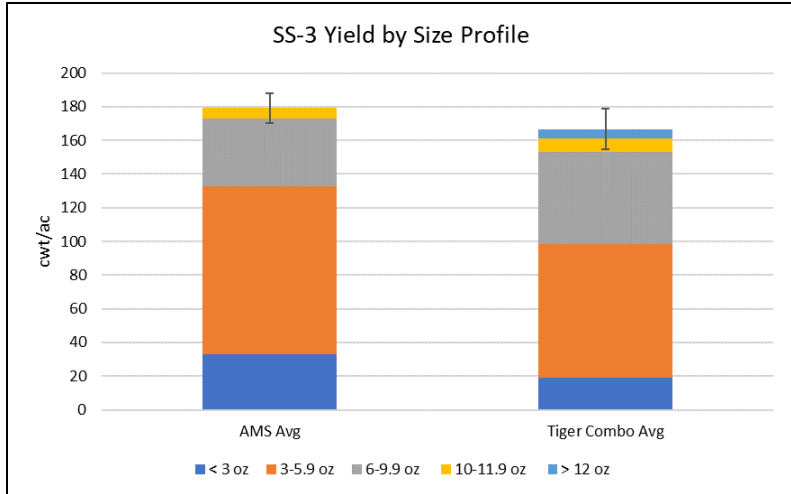


Figure 3. The total yield of both treatments broken up by the size profiles

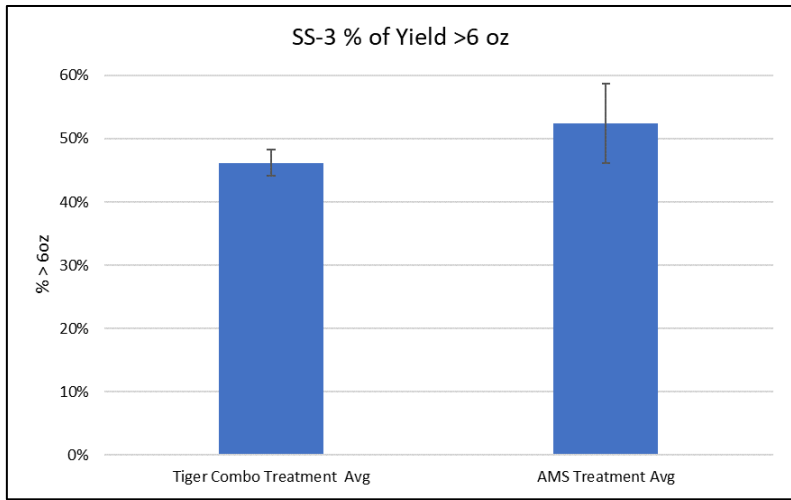


Figure 4. The percent of yield that is over 6 oz

Red outline indicates areas that were subject to season long standing water.

Plot 2: Normal AMS
SOM: 0.9%
RC NO₃: 13 lb/ac outlier
RC Sulphur: 14 lb/ac
Yield: 187 cwt/ac
Verticillium and powdery scab nodules

Plot 1: Normal AMS
SOM: 0.9%
RC NO₃: 26 lb/ac
RC Sulphur: 20 lb/ac
Yield: Not harvested

Plot 5: Tiger Combo
SOM: 1.1%
RC NO₃: 30 lb/ac
RC Sulphur: 22 lb/ac
Yield: 188 cwt/ac

Plot 6: Tiger Combo
SOM: 1%
RC NO₃: 29 lb/ac
RC Sulphur: 22 lb/ac
Yield: 161cwt/ac
Powdery Scab and vines went vegetative



Plot 3: Normal AMS
SOM: 0.9%
RC NO₃: 52 lb/ac
RC Sulphur: 22 lb/ac
Yield: 185 cwt/ac

Plot 4: Normal AMS
SOM: 0.6%
RC NO₃: 27 lb/ac
RC Sulphur: 18 lb/ac
Yield: 213 cwt/ac

Plot 7: Tiger Combo
SOM: 0.9%
RC NO₃: 23 lb/ac
RC Sulphur: 40 lb/ac outlier
Yield: 213 cwt/ac
The canopy had a dark green colour

Plot 8: Tiger Combo
SOM: 1.3%
RC NO₃: 25 lb/ac
RC Sulphur: 22 lb/ac
Yield: 165 cwt/ac