Sulfur Trials (2017-2019)

We know from past research that sulfur is essential in many plant functions such as nitrogen-fixing nodules on legumes, chlorophyll formation and the production of proteins, amino acids, enzymes, and vitamins. Sulfur also aids in disease resistance, plant growth, and seed formation. There has been a tremendous amount of discussion recently regarding the role that sulfur plays in grain corn production. With the reduction of sulfur emissions in the 1970s, it has become even more crucial that we utilize the use of reliable sulfur containing fertilizers in our crop fertility programs to avoid sulfur deficiency symptoms. The questions that often arise are: Exactly how much sulfur does corn need to reach its full yield potential? When does the plant need sulfur? Does it matter what form the sulfur is in?

Research studies have shown that the sulfur uptake for corn is in the range of 0.1-0.12 pounds per bushel of grain. So, if we harvest 175 bushels of corn grain, we should expect the corn plant to take up approximately 19 pounds of sulfur. 40-50% of that 19 pounds of sulfur is not taken up by the plant until flowering (VT/R1) which is between tasseling and silking. The fact that corn needs a season long supply of sulfur presents a challenge because sulfur has several forms and not all forms are readily available to the corn plant. Each form of sulfur has advantages and disadvantages. Elemental sulfur is not very mobile in the soil but unavailable to the corn plant without going through a mineralization process. Although elemental sulfur is not available to the plant, its low soil mobility provides greater protection from being leached from the soil profile. These properties make elemental sulfur (S) a better long-term source of sulfur to the corn plant. On the other hand, the mineralization process of elemental sulfur produces sulfate (SO_4^{2-}) that is readily available for plant uptake but is very mobile in the soil profile and can be easily leached. These properties make sulfate a better short-term source of sulfur to the corn plant. The use of Ammonium Sulfate (21-0-0-24s) is an excellent source of readily available sulfate in a dry fertilizer and Ammonium Thiosulfate (12-0-0-26s) is an excellent source of slowly available elemental sulfur and readily available sulfate in a liquid fertilizer. Both fertilizers are commonly used as elements of many corn starter fertilizer blends but can and should be considered as excellent sources of sulfur for side dress fertilizer applications to meet late-season sulfur requirements for grain corn.

This research prompted Carolina Eastern-Crocker to question whether the sulfur amount typically found in planter fertilizer was sufficient to provide the 19-22 units of sulfur per acre needed to produce 175-200 bushels of grain corn per acre. In May of 2017, Carolina Eastern-Crocker partnered with Joe Ryan of Ryan Estates in Spencerport, NY in conducting a replicated sulfur trial to explore the financial and yield advantages of adding additional sulfur to grain corn.

2017 Trial Plot

The entire plot was planted on May 17th 2017 using Pioneer P0157AMX (101CRM) hybrid corn seed at a seeding rate of 36,000 seeds per acre on 30-inch row spacing. The control for this trial was the farm's standard fertilizer program. The entire plot had 200 pounds per acre of 26-0-26 pre-plant broadcast fertilizer with a de-nitrification stabilizer (**N-Bound**) to provide the future grain corn crop with 52 units of nitrogen and potassium per acre. The surface applied fertilizer was incorporated within 24 hours of application. In addition, 200 pounds per acre of dry starter (10-20-20- 6.6sulfur with zinc and boron) was placed in a 2x2 band and 3 gallons of liquid pop up starter (7-20-4) was placed in furrow. This fertilizer combination provided 74.3 units of

nitrogen, 46.4 units of phosphorus, 93.3 units of potassium, and 13.2 units of sulfur. In addition to these upfront fertilizer applications, the entire plot received side dress fertilizer by injection on July 3rd 2017 at V6 growth stage. In this trial, 3 replicated treatments received 35 gallons of (32-0-0 UAN), providing an additional 124.3 units of nitrogen. The other 3 replicated treatments received 42 gallons of (27.2-0-0-1.8sulfur), providing an additional 124.5 units of nitrogen and 8.2 units of sulfur.

The corn was allowed to mature and harvested on December 1, 2017 at an average moisture 16.3% and an average test weight of 55.4 pounds per bushel. Each replicated treatment was harvested and weighed. All weights were averaged.

Based on the harvest reports, there were apparent financial and yield advantages to adding additional sulfur at side dressing time for grain corn. It appears that the addition of 8.2 pounds of sulfur per acre at side dress time yielded 5 more bushels of grain per acre with a return on investment of $16.73 per acre.

2018 Trial Plot

The entire plot was planted on May 18th 2018 using Pioneer P0157AMX (101CRM) hybrid corn seed at a seeding rate of 36,000 seeds per acre on 30-inch row spacing. The control for this trial was the farm's standard fertilizer program. The entire plot had 200 pounds per acre of 26-0-26 pre-plant broadcast fertilizer with a de-nitrification stabilizer (**N-Bound**) to provide the future grain corn crop with 52 units of nitrogen and potassium per acre. The surface applied fertilizer was incorporated within 24 hours of application. In addition, 200 pounds per acre of dry starter (10-20-20-6.6sulfur with zinc and boron) was placed in a 2x2 band and 3 gallons of liquid pop up starter (7-20-4) was placed in furrow. This fertilizer combination provided 74.3 units of nitrogen, 46.4 units of phosphorus, 93.3 units of potassium, and 13.2 units of sulfur.
In addition to these upfront fertilizer applications, the entire plot received side dress fertilizer by injection on July 4th 2018 at the V6 growth stage. In this trial, 4 replicated treatments received 35 gallons of (32-0-0 UAN), providing an additional 124.3 units of nitro-gen; 4 replicated treatments received 39 gallons of (30.3-0-0-2s), providing 131.2 units of nitrogen and 8.7 units of sulfur; 4 replicated treatments received 45 gallons of (28-0-0-4.6s), providing 139.9 units of nitro-gen and 23.0 units of sulfur; 4 replicated treatments received 45 gallons of (25.8-0-0-6.4s), providing 127.7 units of nitrogen and 31.7 units of sulfur; and 4 replicated treatments received 55 gallons of (23.9-0-0-7.7s), providing 142 units of nitrogen and 45.7 units of sulfur.
The corn was allowed to mature and har-vested on December 1, 2018 at an average moisture of 19.9% and an average test weight of 55.4 pounds per bushel. Each replicated treatment was harvested and weighed. All the weights were averaged. Lower return on investment figures in 2018 were influenced by higher fertilizer prices and lower corn prices in 2018.

Based on the harvest reports, there were apparent financial and yield advantages to adding very similar amounts of additional sulfur at side dressing time for a 2nd year in a row. It appears that the addition of 8.7 units of sulfur per acre at side dress time to the 13.2 units of sulfur per acre provided in the planter fertilizer yielded 4.2 more bushels of grain per acre with a return on investment of $8.54 per acre. The other three higher rates of additional sulfur applied did not yield a positive return on investment.

2019 Trial Plot

The entire plot was planted on June 18th 2019 using Pioneer P9840AM (98CRM) hybrid corn seed at a seeding rate of 36,000 seeds per acre on 30-inch row spacing. The control for this trial was the farm's standard fertilizer program. The entire plot had 200 pounds per acre of 26-0-26 pre-plant broadcast fertilizer with a de-nitrification stabilizer (**N-Bound**) to provide the future grain corn crop with 52 units of nitrogen and potassium per acre. The surface applied fertilizer was incorporated within 24 hours of application. In addition, 200 pounds per acre of dry starter (10-20-20-6.6sulfur with zinc and boron) was placed in a 2x2 band. This fertilizer combination provided 72 units of nitrogen, 40 units of phosphorus, 92 units of potassium, and 13.2 units of sulfur.

In addition to these upfront fertilizer applications, the entire plot received side dress fertilizer by injection on July 8th 2019 at the V6 growth stage. In this trial, 4 replicated treatments received 35 gallons of (31.9-0-0 UAN), providing an additional 124.4 units of nitrogen; 4 replicated treatments received 37 gallons of (30.3-0-0-2s), providing 124.8 units of nitrogen and 8.2 units of sulfur; 4 replicated treatments received 38 gallons of (29.5-0-0-1.9s), providing 124.4 units of nitrogen and 8.0 units of sulfur; 4 replicated treatments received 40 gallons of (28-0-0-4.6s), providing 124.2 units of nitrogen and 20.4 units of sulfur; and 4 replicated treatments received 44 gallons of (25.8-0-0-6.4s), providing 124.4 units of nitrogen and 30.7 units of sulfur.
The corn was allowed to mature and harvested on November 22, 2019 at an average moisture of 24.6% and an average test weight of 51.6 pounds per bushel. Each replicated treatment was harvested and weighed. All the weights were averaged.

Based on the harvest reports, there were apparent financial and yield advantages to adding very similar amounts of additional sulfur at side dressing time for a 3rd year in a row. It appears that the addition of 8.2 units of sulfur per acre at side dress to the 13.2 units of sulfur per acre provided in the planter fertilizer yielded 4.3 more bushels of grain per acre with a $8.78 per acre return on investment. The other three higher rates of additional sulfur applied did not yield a positive return on investment.