Fluid Fertilizers Improve Fertilizer Use Efficiency

Product shines in drip irrigation, banded starter, and in-season research studies

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Summary

Our trials indicate that in-season applications of low-salt fluid fertilizer similar to 3-18-18 can positively impact yield and economic returns. Because of cooperation between our Simplot Agronomic Services Group and the Simplot Land and Livestock Group, this case study allowed a concept of fluids to be used within a commercial production practice. We are expanding similar treatments of these fluids to two 120-acre irrigated fields for 2013 in hopes of continuing to show greater economic improvements for yield and alfalfa quality as well as a demonstrated benefit via improved fertilizer use efficiency.

Introduction

The world is acknowledging the limitations of productive land, clean water, and available fertilizer with the challenge to balance production requirements, environmental stewardship, and economic sustainability. World populations continue to increase almost with no abatement and with predictions of 9 to 10 billion people on the earth within the next two generations. However, population alone is not the only concern. As diets change with more disposable income there will be a change from vegetarian diets to the consumption of meat. And who can blame people for wanting to have better nutrition? Nevertheless, because of these changes there will be a corresponding change from a simple cereal diet to higher protein and meat consumption. Already this change is being reflected in an increase in cereal crop production that is now being fed to livestock. It has been estimated that these demands on cereal production will continue in direct proportion to growing world population.

It has been estimated by the Food and Agriculture Organization of the UN (FAO) that one-sixth of the world's population suffers from chronic hunger. The FAO further predicts that the world will need to produce 50% to 70% more food by 2050. Such staggering statistics create a two-fold challenge:

- An awareness of what is lacking in the world around us. We who live in privileged parts of the world have ample amounts of food and the economics to purchase it. However, for anyone traveling to a developing country there will be regions where this is not the case. Availability of nutritious food and the production of nutritious food can be difficult and often very limited.
- It is becoming increasingly apparent that this scarcity of food in some regions of the world is driving governmental policy and humanitarian efforts to resolve the differences between those with adequate food and those in need. Such concerns of inadequate food supply can drive populations from one geographical region to another, depending on the winds of stability within a country where shifting environments can produce either radical thinking or allow ideas that are more tolerated.

Respected role

Fluid fertilizers have played a great and respected role in the area of food production. Their significance has been documented with long-term field trials in both England and North America. With many, many years of research and observations it has been estimated that the overall contribution of fertilizers (fluids) to yield is between 50% and 60%. Therefore, as cereal production increases, approaching more and more its attainable yields, fluid fertilizer consumption should also increase (FAO and International Fertilizer Organization). This has become apparent with world consumption of nitrogen, phosphorus, and potassium (NPK) during the last 50 years, moving from 30 Mt/year in 1960 to about 180 Mt/year in 2012. However, the increase is not necessarily coming from "industrial" nations, but rather from developing regions such as East and South Asia, Southern Africa, as well as Latin America. In addition to increasing the amount of fertilizer where it is needed, improved management is also needed to get the most benefit from these inputs.

The key to future nutrient use in North America and Europe involves a better understanding of how to achieve greater efficiency. Fertilizer efficiency is sometimes defined as the difference between yield (or quality) with a given rate of fertilizer minus the yield without the fertilizer. This is divided by the amount of

fertilizer applied. Our pursuit of greater nutrient efficiency will require a careful reexamination of our current practices, such as:

- The choice of nutrient sources; growers should consider the many advantages that fluid fertilizers can offer. The Fluid Fertilizer Foundation (FFF) needs to continue to educate growers about why fluid fertilizer can be beneficial. The availability of new fertilizer products and additives can also boost efficiency in many circumstances.
- Selecting the appropriate rate of nutrient application requires knowledge of nutrient availability and plant demand. This decision should be adjusted to meet site-specific conditions and goals of the individual farmer.
- Applying the nutrients at the right time is key to achieving efficiency goals. Matching nutrient availability with plant demands requires consideration of all nutrient sources and any potential losses. The logistics of field operations is also a key factor in this decision.
- Nutrients need to be strategically delivered so that the plants can access them. Proper placement allows the plant to acquire as much of the nutrient as possible to reach its potential. Understanding the rooting characteristics of your target crop will allow better nutrient placement. Fluid fertilizers offer many advantages in getting nutrients applied in the right place—in the soil or on the foliage.

Looking ahead

Improvements in fertilizer use and efficiencies have been studied in-depth during the last century. There have been noticeable improvements in manufacturing and processing as well as agronomic use of those fertilizers. In many crop production systems, combinations of fertilizer forms and placement have increased fertilizer use efficiency (FUE). For example, fluid fertilizers are being used within a specific cropping system where in the past only dry fertilizers were being offered. It is becoming more common for fluid starter bands or in-furrow "low salt" NPK blends to be used where historically only dry fertilizer had been used. These combinations are becoming a part of the fertilizer industry's offering to emphasize the 4-R Nutrient Management Stewardship program.

Fluid fertilizers can be especially effective in improving nutrient use efficiency (NUE) for a diverse number of cropping systems. Because of the flexibility of fluids, they can be applied either as the only portion of the fertilizer requirement or as a specially directed application to improve upon a crop's yield/quality potential.

As examples of these flexible fluid uses, three recent studies are provided:

Drip irrigation. Dr. Scott Staggenborg (Kansas State University) was able to develop a fluid fertilizer delivery system combining a buried drip system and the injection of low salt NPK fluid materials into corn. The grower standard practice (GSP) was a 30-30-0 applied as an in-furrow application with the planter across all starter treatments. Soil test potassium (K) was high enough that no additional K was recommended. A series of in-season fluid treatments were injected and three out of the seven treatments indicated significant yields above the GSP where starter alone was applied. Where no starter was applied, the responses were not nearly as dramatic. His conclusions were to apply a fluid starter band in combination with in-season injections of fluid phosphorus (P) fertilizers.

Banded starter. J.R. Simplot Company conducted a commercial-size fluid starter demonstration in 2012. Corn was planted in a commercial furrow-irrigated field where the background level of P was considered high. Various dry fertilizer formulations, including new formulations, were broadcast into established beds with incorporation being made at planting. Each treatment included a fluid starter (low-salt NPK 6-24-6 with AVAIL®) banded at a rate of 10 gallons/ac with a placement 2 inches to the side and 1 inch above the seed. These soils are typically cold and damp early in the developmental

stages of the crop and this year was no different. Growth and development were monitored throughout the year and differences were observed with stalk diameter, plant height, and ear fill. Each treatment was harvested with a commercial John Deere 12-row combine and weighed using a weigh wagon. Each treatment was adjusted to 15 percent moisture and yield determinations made. The fluid starters substantially improved yield of the grower standard practice by more then 20 bushels. This improvement of yield potential lends them to be used across similar growing conditions even at times where the soil test P levels are high.

In-season NPK. Where established forage crops (in this case irrigated alfalfa) are managed for higher and higher yields, in-season applications of an NPK low-salt foliar fertilizer may be warranted. A commercial alfalfa field was selected that was uniform, irrigated by wheel-lines, and of the size and shape that allowed for both foliar fertilizer application to be made and individual treatments to be harvested with commercial equipment and weighed separately. Each plot was the width of the commercial applicator (approximately 70 feet wide) and 900 feet long and replicated two times. Treatments of 3-18-18 were applied at 1.25, 2.5, and 5.0 gallons/ac with an Ag Chem Rogator. Applications were timed between one and two cuttings when the alfalfa had about 10 inches of regrowth. Treatments were allowed to dry for 24 hours prior to irrigation water being resumed. Each treatment border was marked using GPS prior to treatment and these boundaries were used to accommodate the commercial harvesting. Harvesting was accomplished, maximizing both yield and feed quality. The field was allowed to dry and a custom harvesting crew, which included five alfalfa combines, worked the field at one time, cutting and windrowing alfalfa in each treatment. These were followed by five choppers that lifted each windrow, chopped the alfalfa where it was blown into marked trucks. Each truck was weighed and total yield for each treatment determined. When the weights of each truck were measured, the chopped alfalfa was placed in a pit for ensilage and eventually fed as a part of the Simplot Livestock feed lot operation.

A similar application and harvest procedure was followed for the third cutting. Tissue samples were also collected in-season as well as at the point of harvest from each truck and subsequent treatment. Yields were calculated for each treatment and each cutting and summarized in tables. This large robust field evaluation was the exact procedure being recommended by University Extensions to determine treatment responses on a grower's field.

Conclusion

Our trial indicated that in-season applications of a low-salt fluid similar to 3-18-18 can positively impact yield and economic returns. Although the highest yields as summarized for both cuttings were 5 gallon/ac, the most economical was at the rate of 2.5 gallons/ac. Because of the cooperation between our agronomic services, land, and livestock groups, this case study allowed a concept of fluids to be used within a commercial production practice. We are expanding similar treatments of these fluids to two 80-acre irrigated fields for 2013 in hopes of continuing to show greater economic improvements for yield and alfalfa quality, as well as a demonstrated benefit for improved fertilizer use efficiency.

This is an exciting time to be involved in the fertilizer industry. There has never been a greater need for plant nutrients to meet human needs. However, we have a responsibility to expand global food production in an advanced way that protects our precious global resources. For much of these expansions, fluid fertilizers will continue to play an expanded role in meeting these critical production goals.

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