ground or surface water supply available for irrigation), then the nitrogen fertilizer that is applied will not be used as efficiently by the plant to produce yield.

Program 9C-2

Effectiveness Of Variable Rate Fertilizer Applications On Cotton Fields

Presented by Matthew Rhine
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From 1996 to 2004, we conducted cotton field experiments at the Delta Center and on growers' fields to evaluate the effectiveness of variable rate lime and fertilizer. Results showed trends towards higher yields with variable rate technology (VRT) compared to uniform applications, but often the differences were not dramatic or statistically significant. The most important information that we determined was that less fertilizer was applied with VRT in most fields. Variable rate applications generally rely on Veris electro conductivity technology to identify differences in soil texture. This can be helpful when nutrient deficiencies may be attributed to soil type. However, VRT may not accurately identify differences that may be man-made. In many cases, grid sampling may be better suited to identify man-made problems. Fertilizer dealers usually charge farmers $10 to $15 per acre for grid soil sampling and $1 to $3 per acre for variable rate applications. Soil test results are good for 3 to 4 years, but the variable rate charge is an annual expense. In the past, with relatively cheap fertilizer prices, many farmers were not willing to pay the extra costs for variable rate applications. However, over the years, fertilizer costs have dramatically increased, causing the need to reevaluate the cost effectiveness of variable rate technology.

The objective of this research was to evaluate the soil test results of cotton fields on Missouri farms that have had variable rate applications in the past. Fields were chosen that had received variable rate phosphorus (P) and potassium (K) fertilizer applications for several years, as well as fields that had been uniformly applied for comparison. Soils samples were taken on 0.25 acre grids and analyzed for P and K levels at the University of Missouri's Soil Testing Lab in Portageville, MO. Soil P and K levels were evaluated based on whether or not they surpassed critical levels. Critical P and K levels were determined for each field based on cotton production and cation exchange capacity. Different fields were used in both years.

In 2009, many fields under variable rate applications of P and K were found to be below critical nutrient levels compared to uniformly applied fields. The general trend found in most of these fields was that P and K variability appeared to be man-made rather than due to soil type. Our research concurred with previous published studies showing nutrient variability was highest across rows and lowest within rows. Fertility tended to be highest in rows closest to the field entrance and decline in rows farther away. This suggests that spreader trucks in the past may have adjusted the gates down or the chain drives delivered less as they had less fertilizer in the trucks at the far side of the fields. Another pattern that we found was "streaks" of high P or K in rows surrounded by lower P and K in rows to the right and left. This pattern may have been caused by improper swath width spacing and not enough overlap in the spreaders. Since P and K is residual in the soil, application uniformity mistakes may have occurred many years in the past with obsolete spreader technology but being observed in the cotton fields today.

In 2010, soil samples taken from fields under variable rate P and K applications were found to be above soil critical levels in most situations. Only minor problems of one to eight samples per field were recorded if there were any problems at all. In total, cotton fields with variable rate applications averaged 0.4 % of samples low in P and 1.0% of samples low in K. In all but one of the uniformly applied fields, however, widespread areas were found to be below critical levels for P, K, or both nutrients. Uniformly applied fields averaged 10.5% of samples low in P and 36.5% of samples low in K. As recorded in our research in 2009, several fields showed man-made P and K variability rather than soil type variability. Streaks of low P and K levels were found in both variable rate and uniformly applied fields, signifying improper application techniques or spreader malfunction.

Many of the uniformly applied fields showed widespread cases of low P and K levels. This could be caused by either producers not applying enough P and K to cover soil deficits, or by some natural soil causes. Soil K can be leached due to low cation exchange capacities as well as absorbed by particles such as illite clays, while soil P may be lost in runoff water from the field. Other uniformly applied fields were found to be excessively high in P and K, signaling that too much fertilizer had been applied over the years. This could be avoided if these soils were sampled on a regular basis.

Although VRT can be used to reduce fertilizer costs, special care must be taken that applications are done according to soil analysis. Many of the nutrient deficiencies found in these VRT fields appeared to be man-made problems, which can be identified easier with grid sampling. However, soil sampling in such a small grid is not economically feasible for growers. Using VRT that utilizes Veris technology is a suitable option when problems could be due to soil type. When applied correctly, fields under VRT generally corrected soil deficits of P and K, while using less fertilizer than uniformly applied fields. Adhering to regularly scheduled soil sampling every few years is key to addressing whether or not field problems have been corrected. This is also important in uniformly applied fields, where either too much fertilizer could be applied or nutrient deficiencies may not properly be addressed.

Program 13C-2

▸ Development Of Nematode Resistant Cotton Breeding Lines

Presented by Dr. Ted Wallace

Cotton Breeder, Mississippi State University

Cotton losses attributed to reniform nematodes have increased over recent years, especially in the southeastern states. Unfortunately, the entire species of upland cotton (Gossypium hirsutum) is considered susceptible to the reniform nematode. Although cotton is considered to be somewhat tolerant to root-knot nematodes, few varieties are considered resistant. Management options are available to help alleviate some of the losses associated with nematodes, however, some of these such as crop rotation, are not always a viable option. Options for chemical control are also limited now that Temik® is no longer available, and conventional nematicides can be cost prohibitive. Genetic resistance would provide an economical alternative to traditional nematode control measures with the potential for significant reductions in yield loss and use of chemicals. A major development in the realm of nematode resistance was announced in 2004 when researchers at Texas A&M acknowledged success in transferring reniform nematode resistance from a wild species of cotton (Gossypium longicalyx) into upland cotton. The successful transfer of resistance into upland cotton, for the first time, made development of reniform resistant upland varieties a real possibility. Reports of stunting and other agronomic shortfalls associated with the original reniform resistant breeding line, designated "Lonren", have prevented the immediate use of resistance in commercial varieties. A poor choice for use in commercial variety development, breeders have been working to improve the agronomic performance (yield, fiber quality, maturity, etc.) associated with new source of reniform resistance. In 2007, breeders with the Mississippi Agricultural & Forestry Experiment Station (MAFES) began a program aimed at developing nematode resistant breeding lines adapted to the Mid-south utilizing the Lonren source of resistant in addition to root-knot resistant breeding lines. The primary objective of the breeding program is to transfer reniform resistance from Lonren into competitive breeding lines suitable for use in commercial variety development. Another objective is to combine both reniform and root-knot resistance into a single breeding line. Unique breeding challenges are encountered when selecting plants for nematode resistance compared to selection for agronomic traits such as yield and fiber quality. Yield and fiber quality traits, for example, are relatively easy to quantify and can be measured under a wide range environments. Nematodes on the other hand, may or may not be present in the soil, nematode populations