k-state extension Agronomy e-Updates

Number 16
January 20, 2006

1. Strip-till research in Kansas, Part 2: Central Kansas

Strip-till is a possible alternative to no-till for corn and grain sorghum under irrigated or dryland production in central Kansas. Why would producers consider an alternative to no-till for dryland production? Because no-till has both advantages and disadvantages, and strip-till may be a better solution for some.

The benefits of no-till include reduced soil erosion, better soil water use efficiency, improved soil quality, and time and labor savings. But no-till also leaves considerable residue on the soil surface, which can reduce early-season growth and vigor, and reduce early-season nutrient uptake. It's also difficult to apply anhydrous ammonia in no-till systems, which means more expensive forms of nitrogen must usually be used.

Strip-till is one way to maintain the advantages of a high-residue cropping system such as no-till while eliminating the early-season growth and nutrient uptake problems. Strip-till can provide an environment that conserves soil and water while establishing a seedbed that is similar to conventional tillage. It's also possible to apply anhydrous ammonia in a strip-till system, if desired.

At the North Central Experiment Field, we have tested strip-till on dryland corn in 2003 and dryland grain sorghum in 2004-2005 on a heavy clay loam soil. Treatments included: (1) strip-tilling and applying fertilizer about 6 inches deep in the fall, (2) strip-tilling in the fall and applying fertilizer at planting time, and (3) no-till, with fertilizer applied at planting time. Various rates of fertilizer were also tested: none, 40-30-5-5 (N, P_2O_5, K_2O, S), 80-30-5-5, 120-30-5-5, and a split application of 80-15-2.5-2.5 in the fall and 40-15-2.5-2.5 in the spring. The strip-till operation was conducted in late October or early November each year.

Yields were compared, along with early-season soil temperatures at planting depth and early-season nutrient uptake.

In 2003, rainfall during the growing season totaled only 6 inches. Corn was either strip-tilled or no-tilled into wheat residue. Strip-till corn averaged 61 bu/acre, while no-till corn averaged 48 bu/acre. With both strip-till and no-till, the 120-30-5-5 fertilizer rate resulted in the highest yields. On the strip-till fields, fertilizer timing had no effect on yields.

In 2003, the soil temperature at planting depth was about 2-6 degrees higher every day from April 25 until May 25. This resulted in much greater early-season growth of corn on the strip-till plots, compared to the no-till plots. Strip-till reduced the number of days to mid-silk by about 10 days and moisture at harvest by about 2 percentage points compared to no-till.

In 2004 and 2005, grain sorghum was strip-tilled or no-tilled into wheat residue. The sorghum was planted in mid-May. Over the two-year period, grain sorghum yielded 123 bu/acre with strip-till and 111 bu/acre with no-till. Yields peaked with the 80-30-5-5 fertilizer rate for both strip-till and no-till. As with corn, fertilizer timing had no effect on yields.

In 2004-2005, soil temperatures at planting depth were again about 2-6 degrees higher every day from April 25 until May 25. In addition, strip-till sorghum had nearly twice as much growth as no-till sorghum at the V-6 (early vegetative) growth stage. Strip-till also reduced the number of days to half-bloom in sorghum, by about 5 days.

Both dryland corn and grain sorghum yields were higher with strip-till than no-till in these tests. In tests conducted in northwest Kansas (see the Dec. 13, 2005 issue, e-Update No. 12), corn and sunflower yields were higher with strip-till, but grain sorghum yields were similar in both tillage systems. One possible explanation for this is planting dates. Strip-till has the greatest advantage over no-till with early planting dates. With later planting dates, no-till soils will have warmed up more and there would be less advantage to strip-till for yields and early-season growth and nutrient uptake.

-- Barney Gordon, agronomist-in-charge, North Central Kansas Experiment Field
wgordon@ksu.edu

(Editor's Note: There has also been research on strip-till in eastern Kansas. Results from the eastern Kansas research will be summarized in an upcoming issue of Agronomy e-Update. – Steve Watson)

2. Soil pH analysis: Fundamental principles and complicating factors

One of the first factors most soil fertility scientists look at when evaluating a producer's soil is its pH. What is pH and what is its role in soil fertility?

The soil pH reading is a measure of a soil's acidity or alkalinity. The expression of acidity or alkalinity on the pH scale ranges from 0 to 14, a scale that was adopted by chemists many years ago for ease of expressing the ratio of hydrogen to hydroxide ion concentration in a substance.

The pH scale is logarithmic, so that each unit change in pH represents a 10-fold change in acidity or alkalinity. For example, a soil with a pH of 5.0 is 10 times more acidic than a soil with a pH of 6.0, and 100 times more acidic than a soil with a pH of 7.0. As a result, a small numeric change in soil pH reflects a major change in acidity or alkalinity of a soil.

In basic terms, a soil with a pH of 7.0 is neutral. Less than 7.0 is acidic and higher than 7.0 is alkaline. The ideal range for most crops in Kansas is 6.0 to 7.0 or slightly higher. However, excellent yields can be obtained on soils with a pH level above or below this range with good overall management.

In practice, soil pH analysis and interpretation is a little more complicated. There are different methods of analyzing pH, which result in different readings. There is the added complication of toxic aluminum concentration. There is the problem of how to deal with high pH soils. And there are questions about how lime recommendations are made.

1. Method of analysis. Most soil test labs, including K-State, analyze for soil pH using a soil/water slurry as part of their routine test package. This is referred to as "water pH." However, there are some labs that determine soil pH using a soil-weak salt solution slurry to minimize the effect of soluble salts in the soil on pH readings. This is referred to as "salt pH." Salt pH readings will generally be about a half-unit lower than water pH readings. The University of Missouri Soil Test Lab uses the salt pH method.

2. Aluminum concentration. A soil pH of 5 or less (using the water pH method) suggests the likelihood of soluble aluminum, which is extremely toxic to plant roots. However, a test for exchangeable aluminum would be needed to confirm this. Soluble aluminum concentrations depend to some extent not only on pH level, but on the clay mineralogy of the soil. Soluble aluminum levels have been found to be quite high in the low pH soils of central Kansas, causing significant wheat yield losses, especially among sensitive varieties.

3. High pH readings. Soils with very high pH levels are not as easily corrected as acidic soils. High pH can be due to either excessive levels of lime or excessive levels of exchangeable sodium. A soil pH of 7.5 or above would suggest excess lime could be present in the soil, although a soil test for excess lime would be needed to confirm this. Elemental sulfur can be used to lower the pH of a soil that has excess lime. If the pH reading is 8.5 or above, it is probably due to excessive amounts of exchangeable sodium, gypsum can be used to correct the condition.

4. Lime recommendations. Soils with a low pH level can be limed to raise the pH. There are several philosophies being used by different labs in making lime recommendations. This will be discussed in next week’s issue of Agronomy e-Update.

Soil pH has an impact on availability of P, Ca, Mg, and many micronutrients. It also affects microbe activity, which in turn affects the ability of a soil to mineralize nitrogen from organic matter. Maintaining the soil pH in the ideal range for optimum plant growth will maximize availability of nutrients in most cases.

Soil pH also has an impact on plant root growth. Root growth will be slow at either very low or very high pH levels. Soil pH also is important for herbicide selection and rate. The activity or residual life of some herbicides, such as atrazine, is different depending on soil pH levels. This topic will be explored further in a future edition of Agronomy e-Updates.

To summarize, knowing the soil pH is an important step in assessing the productivity of the soil. Routine soil tests should be taken to monitor soil pH. Relatively inexpensive pocket pH meters are available at most farm and garden supply outlets, with good accuracy when used properly. They are fairly simple to use, but should be calibrated with soil test lab results, at least initially.

-- David Whitney, Soil fertility specialist
785-532-5776

These e-Updates are a regular weekly item from K-State Extension Agronomy. All of the Research and Extension faculty in Agronomy will be involved as sources from time to time. If you have any questions or suggestions for topics you'd like to have us address in this weekly update, contact Jim Shroyer, Research and Extension Crop Production Specialist and State Extension Agronomy Leader
785-532-0397 jshroyer@ksu.edu