— Soil Fertility Note 16 —

Gearing up for Conservation Tillage

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Conservation tillage describes a wide range of management practices that share two basic components: 1) minimal disturbance of the soil surface during planting and 2) minimal clearing of crop residues during harvest and seedbed preparation. Across North Carolina, more and more growers are employing conservation-tillage practices like ridge-tillage, no-tillageand mulch-tillage. More than 25 percent of the state's cropland is now managed under one of these systems.

Growers convert to conservation tillage for three main reasons.

1) It can reduce soil erosion up to 90 percent more than conventional practices can, and it is an effective way to preserve land's long-term productive capacity.

2) Under many circumstances, it can increase farm profits by reducing labor and tillage costs without reducing yields.

3) The 1985 farm bill has specified that all growers on highly erodible land must implement a conservation plan by 1995 if they wish to receive federal program benefits. Conservation tillage is frequently an important component of such plans.

Although not all forms of conservation tillage work equally well under all conditions, many growers recognize that these systems can offer an economically efficient way to maintain production and protect the environment. Developing site-specific management strategies that enable growers to implement such systems is one of the state's most important agricultural challenges. By reducing farm runoff and the siltation of waterways, conservation tillage can not only protect the land base upon which individual growers depend, but it can also safeguard the environmental resources vital to all state residents—now and in generations to come.

Taking a Soil Sample

Successful conservation-tillage programs all start with a soil test. Why? Conservation-tillage systems require even more careful fertility management than conventional systems. The reason is clear—because fertilizer and lime are not plowed into the soil, they take longer to reach the root zone than they do under traditional practices. As a result, nutrient and pH imbalances tend to cause more prolonged damage under conservation tillage than they do under conventional tillage.

Growers can overcome this constraint by optimizing nutrient and acidity levels before they convert to conservation tillage. Soil testing is the most efficient and reliable way to achieve this optimization.

Once a conservation-tillage system is well-established, changes in soil structure and soil organisms will enhance the movement of surface-applied amendments. By monitoring fertility and pH levels with frequent soil tests, growers can calibrate amendment levels so that surface applications provide plants with an optimal pH level and all of their required nutrients.

Proper soil sample depth depends on whether 1) you are converting from conventionally tilled fields and plan to plow in your amendments or 2) you are managing an established conservation-tillage system with surface applications. When establishing new minimum tillage areas, growers should collect soil cores 6- to 8-inches deep just like on conventionally tilled fields. For established minimum tillage areas, growers should collect 4-inch soil cores because the shallower sample provides a more reliable estimate of nutrient availability in the root zone.

Growers should avoid sampling from bands where fertilizer has been applied. Samples taken from such spots can distort evaluations of a field's nutrient-supplying capacity.

Growers submitting samples to the Agronomic Division's soil testing service should obtain standardized soil-sample boxes and information sheets. These are available from the Division's Raleigh office, as well as from regional agronomists, Cooperative Extension, and other agricultural advisors. Test results and recommendations will be mailed as soon as they are complete. The service is provided free of charge.

Managing Nitrogen (N)

Nitrogen reacts differently under conservation tillage than under conventional tillage. Surface-applied N is often immobilized by the increased amount of crop residue. Since the residue will not be mixed with the soil, much of this N is mineralized at a slower rate.

Losses frequently occur with surface-applied urea, a popular source of N in conventional tillage. In the cooler, moister soils under conservation tillage, urea is often converted to N gas and lost through volatilization. Increased residue levels can also increase soil microbe levels, which can temporarily immobilize N.

Growers should choose N sources and application methods carefully. Both ammonium nitrate and ammonium sulfate are less prone to volatilization than urea is. To be used effectively, urea must be injected below the soil surface or rainfall must occur soon after application. Below-surface applications reduce immobilization and volatilization losses. Surface banding is preferable to broadcasting if subsurface applications are not possible.

Subsurface injections of anhydrous ammonia or liquid nitrogen are perhaps the best ways to supply N. Specialized equipment is available for these injections. Timing and N quantities are similar to those used for conventional tillage.

Managing Phosphorus (P) and Potassium(K)

Initially, phosphorus tends to move very slowly through the soil, sometimes at rates of less than an inch per year. In contrast, potassium is quite mobile on sandy soils and thus can be subject to leaching.

Growers should test their soils and correct P deficiencies before they convert to conservation tillage. Once soil P levels are optimized, surface applications can provide all of the P plants require. Phosphorus tends to move more rapidly to the root zone after a conservation-tillage system has been in place for several years. Research has shown that plants grown under conservation tillage can absorb nutrients located fairly near the soil surface.

P and K can generally be applied in the fall. However, on sandy soils with a history of K leaching, spring applications may be preferable.

Managing Soil pH

Across the state, low soil pH continues to be the most significant fertility problem. Acidic soils can damage plant roots, immobilize nutrients, and reduce yields.

Applying agricultural limestone is the best remedy for soil acidity problems. Like phosphorus, however, lime tends to move very slowly through the soil profile. As a result, growers should test their soils and optimize pH levels before they convert to conservation tillage. Once pH levels have been optimized, surface applications of lime are sufficient to maintain pH within the desired range—provided that growers monitor changes with regular soil tests.

Managing Starter Fertilizer

Growers who employ a conservation-tillage system need to be mindful of two early-season problems: 1) dry weather sometimes fails to move broadcast fertilizer down into the soil solution where seedlings can use it; 2) even when the soil contains adequate nutrients, the cooler, wetter surface conditions caused by reduced tillage and increased residue can sometimes retard seedling growth. In both cases, seedlings can experience early-season nutrient deficiencies.

To avoid these problems, growers may wish to place small amounts of fertilizer near developing seedlings. This starter fertilizer provides a readily available source of nutrients during the crucial early stages of plant growth. Not only do these applications reduce stunting and hasten plant maturity, but they can also increase a plant's tolerance to certain pests.

Starter fertilizer must be carefully placed. Nutrients must be readily available to seedlings but not so close as to cause injury. A common goal is to place fertilizer about two inches from the seed.

Starter fertilizer should contain N and P. Potash and micronutrients can be applied if deficiencies have been detected by soil or tissue analyses. When soil tests reveal medium P levels, 30–50 lb of phosphate should be adequate; growers can generally apply 2/3 the recommended P broadcast rate as starter fertilizer. For N, 8–10 lb/acre has generally proven safe and effective.

For dry fertilizer, a 50/50 blend of diammonium phosphate (DAP) (18-46-0) and ammonium sulfate (21-0-0-24S) is an excellent source of nutrients. These materials have low salt levels and should pose no threat to seedling health. This balanced blend will promote seedling vigor in almost any environmental condition. Depending on the crop, a rate of 50–100 lb/acre should prove adequate.

For liquid fertilizer, a blend of monoammonium phosphate (10-34-0) with an added sulfur source should be adequate. Application rates will vary depending on the formulation and the crop.

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Questions or comments should be directed to the Soil Testing Section of the NCDA&CS Agronomic Division.
Information on field services, nematode assay and plant/waste/solution/media analyses
is also available from the division.

Steve Troxler, Commissioner of Agriculture