Crop rotations are as important, or may even be more important, in conservation tillage systems than in conventional till systems. Crop rotations are especially important for cropping systems with soybeans, wheat and sweet potatoes – crops that quickly lose yield and quality potential with continuous cropping practices, because of disease, insect and weed problems. In addition to the yield benefits, other benefits are derived from crop rotation in conservation tillage systems are described below.

Rotational sequences

Farmers’ experience and many years of agronomic and economic research in the LSU AgCenter have convincingly demonstrated that crop rotations increase yields of the included crops. Even without the presence of definable and identifiable causes of yield limitations, such as diseases and nematodes, yield increases from rotations usually are in the range of 20 percent. When specific problems that adversely affect crop health can be identified, the yield increases from rotations will be larger.

For example, in a 25-year rotation study at the LSU AgCenter’s Northeast Research Station, continuous cotton produced 1,051 pounds of lint per acre, and cotton rotated in two-year cycles with corn or grain sorghum produced 1,241 pounds per acre, an 18 percent increase. Continuous soybeans, however, that were affected by disease (charcoal rot) and nematodes produced only 32 bushels per acre, whereas rotated soybeans produced 48 bushels per acre, a 50 percent increase (Figure 1-1). Crops such as sweet potatoes cannot be grown successfully without regular use of crop rotation to control insects, diseases and nematodes. Rotational crops for sweet potatoes must be nonhost crops for nematodes.

Figure 1-1. Soybean on the right was rotated with grain sorghum; soybean on the left was grown continuously without rotation. The continuous soybean had low yields because of the buildup of nematode and disease organisms over several years.
Most agronomic benefits of no-tillage systems are the result of crop or cover crop residue on or near the soil surface. Properly used, residue from cash crops and from cover/green manure crops will minimize soil and nutrient loss from cropland and maintain soil organic matter. Residue management is therefore the key to improving soil quality in conservation systems and also for protecting surface water quality (Figures 1-3, 1-4).

If a soil is severely degraded because of many years of intensive tillage, it may take a few years to accrue noticeable benefits from crop rotation and conservation tillage systems (Figure 1-5). Intensively tilled soils have greatly reduced organic matter and microbial populations, and these will be restored by conservation practices, but it will take time.

In conservation systems, soil cover should be 50 percent or more at all times. Some crops, however, leave too little residue, leading to insufficient ground cover. Both soybeans and cotton are low-residue crops. Corn, grain sorghum, winter grains and rice are examples of crops that produce large amounts of residue for long-lasting ground cover. Rotating high-residue and low-residue crops helps to maintain sufficient cover because residue from the high-residue crop will carry over into the low-residue crop. After a low-residue-producing crop, it is beneficial to plant a winter grain or cover crop to help maintain residue for ground cover. Cover crops are discussed in Chapter 2.
Figure 1-3. Runoff water from tilled fields without vegetative cover is rich with sediment and nutrients, the loss of which reduces soil quality. Once transported into the surface drainage system, this runoff water will also impair the quality of surface water bodies.

Figure 1-4. Runoff from fields with ground cover and conservation tillage contains very little sediment and nutrients, preserving soil quality and water quality.

Figure 1-5. A recently planted soybean field is undergoing extreme wind erosion from March winds. Cover crop residue and conservation tillage prevents this type of soil loss and the severe damage to seedlings.

Crop residue distribution in rotations

Residue management is a crucial issue to deal with where winter grain crops immediately precede summer crops. The goal of residue management in these situations is to achieve uniform ground cover following harvest of the grain crop but also to, as much as possible, keep the residue from interfering with cropping practices for the following crops (Figures 1-6, 1-7).

Nonuniform residue distribution results in uneven stands. The coulters or openers on the planter or drill will cut through normal levels of residue but not cut through piles of residue, the bottom of which usually will be moist. This results in hair-pinning of crop residue and poor seed-to-soil contact. Depth placement also will be affected. Depending on the thickness of the residue and planter settings, seeding depth can vary from more than 2 inches where there is little residue to less than 1 inch where the residue is 2 inches or more. This will result in uneven emergence, partial stands and variable early growth.

Residue that is unevenly distributed also can lead to weed control problems because herbicides do not reach the soil or intended targets where residue is piled up.

The best way to minimize crop residue interference is to maximize the combine cutting height, which
Figure 1-6. Special row cleaning tools are usually not needed for planting into crop residue but, when biomass production is very high, such devices may improve seed placement and stand establishment.

Figure 1-7. Winter wheat is an excellent crop or cover crop for Louisiana. Producing plentiful and long lasting vegetation for ground cover that is easy to terminate and plant into. When fall and winter growing conditions favor high biomass production, one option for stubble management is to rotary cut the residue before planting the summer crop.

minimizes the amount of residue going through the combine. Vertically standing crop residue that is attached to the soil is much easier to plant into than crop residue lying horizontally on the ground. Spreaders and choppers are available for all combines to help with residue distribution. Chaff spreaders also can help to spread fine materials that otherwise would be distributed directly behind the combine. When growing conditions favor high biomass production, planter attachments are available that will manage the residue and ensure good stands (which will be discussed further in Chapter 8: Equipment).

Residue cover provides all the environmental benefits of conservation tillage, such as erosion control, infiltration improvement, evaporation reduction and enhanced soil biological activity. Properly used, residue from cash crops and from cover/green manure crops minimizes soil and nutrient loss from cropland (Figure 1-8). This is one of the most important components of conservation tillage. On the other hand, too much or badly managed residue can create significant problems during crop establishment that will have a significant effect on productivity and profitability.

Figure 1-8. No-till planted cotton following a soybean crop is a beneficial rotation that increases nitrogen efficiency – use of the legume residual nitrogen by cotton – among other benefits of rotations that increases yield. Limited interrow cultivation is used but enough crop residue remains on the surface to qualify as a conservation system.

Soil biological activity

A high level of diverse soil biological activity is indicative of good soil quality. Soil quality improves when biological activity increases. A diversity of soil organisms – bacteria, fungi, earthworms, insects and plant roots – contributes to soil biological activity.

Soil cover from crop residue and the absence of soil disturbance are beneficial for most of the beneficial soil-inhabiting organisms. Crop residue and rooting patterns play a primary role in determining the types and quantity of biological activity. It is the primary source of nutrients for soil organisms, and different crops benefit specific organisms. Greater diversity in the crop mix produces greater diversity in soil organ-
Crop rotation is an important component of disease, weed, nematode and insect control and is often the primary control mechanism for nematodes and diseases. Disease-causing organisms and insects survive on crop residue and in the soil on root systems. Crop rotation for insect and disease management is therefore very important in conservation tillage.

Rotations help to control many of the common root and stem diseases that affect row crops. Control of reniform and root-knot nematodes especially requires crop rotations that facilitate the use of nonhost crops and resistant varieties.

In no-till situations, perennial weeds can become a problem, but selection of rotational sequences can minimize establishment of these species. The different herbicide programs used for different crops help to control development of herbicide-resistant weeds, too. Seeds of many weeds buried in the soil, if they require light for germination, will not germinate in no-till fields. Winter grain crops and cover crops are strong competitors with weeds and reduce weed infestations in late winter and early spring. Having a winter crop also provides the opportunity for selective herbicidal control of winter weeds while maintaining abundant ground cover.