10 Transition from Clean Till to Surface Residue Systems

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Whether or Not to Park the Plow

Each producer's situation is unique. Only the producer can decide whether to make operational changes or not and when and how such changes should be made. Making the transition from a farming system based on intensive tillage to one where substantial amounts of residue are left on the soil surface is like most major changes: it involves substantially more thought than simply trying to decide whether to park the plow or trade it off. This chapter will outline some of the most important factors that need to be considered before and during this transition.

An important factor to remember is that any successful farming operation is a complex and unique system. It is not possible to change one component of the system without affecting other components. Consequently, choice to leave more crop residues on the soil surface entails substantially modifying the present system or developing an entirely new one. If these changes are not made, it is highly unlikely that the system will work properly. It will either fail to take advantage of the full potential offered by high-residue systems or, even worse, will result in substantial management difficulties. If an attempt is made to change from low-residue to high-residue farming simply by changing the amount or type of tillage used, it is somewhat like attempting to change from gasoline to diesel power simply by pumping the gas out and filling the tank with diesel.

So where does a producer start? The best place is to reflect on the current mode of operation. Why are things done in a certain manner by one producer while neighbors operate differently? Maybe the producer milks cows, has less available capital, or values fishing time more than the neighbor. These factors will not necessarily change. What is good or bad about the present system?

The next step is to study successful and unsuccessful high-residue systems that have been tried both in the immediate area and in other regions. Try to determine what makes the successful systems work and the poor ones fail. Resist the temptation to adopt someone else's system lock, stock, and barrel. It may work wonderfully for them but fail badly for you.

Obtain as much professional advice and information as possible. In other words, read the rest of this book and any others available. Attend seminars, field days, and workshops that focus on high-residue farming.

Do as much as possible the easy and cheap way by learning from other's successes and failures. In today's agriculture, a producer cannot afford to learn by making unnecessary mistakes. There is no single recipe that will allow all producers to successfully make the transition to high-residue fanning. There are, however, some general broad categories that should be considered in determining how to make the transition. In the discussion that follows, these considerations are broken into economic, agronomic, and psychological categories.

Economic Considerations in Changing to a Surface Residue System

From an economic standpoint the best way to make the change to a surface residue system depends on each producer's ability to take risk, how well they have done their homework (as mentioned previously), their labor situation, the type of machinery owned, and whether or not the land is considered to be highly erodible. If a sufficient amount of planning is done, a producer can develop an improved system. Once a good system is designed, the quicker the change can be made the better. A quick change limits the amount of time two sets of equipment are owned, allows taking full advantage of an improved system more quickly, and will probably return a better trade-in value on unneeded equipment. This approach, however, carries with it more financial risk if a producer is not adequately prepared agronomically, economically, or psychologically for making the change.

A number of producers will choose to make the switch quickly for economic reasons other than those already mentioned. Some have land classified as highly erodible and consequently face substantial financial loss if they do not adopt conservation practices relatively soon. In this case the financial risk associated with not being in compliance may outweigh the risks involved in making the change quickly. . Others may have reached the point where they need to trade equipment and wish to reduce the cost associated with this transaction. Some producers are facing a change in their operation that will require them to hire additional laborers if they continue to use tillage extensively. They may wish to make the switch to avoid the expense and time involved in training new laborers. Still others may wish to devote more time to other enterprises either on or off the farm.

Producers with less ability to take risks, less concern with highly erodible land, or less confidence in their choice of tillage, planting, cultivating, and spraying equipment may take a slower approach in changing over to a surface residue management system. This approach will generally entail renting appropriate equipment or hiring custom operators owning the equipment to perform the work that allows trying a high-residue system on a limited number of acres. The slower transition is more likely to be used in areas where there is insufficient research or experience available or examples to follow to allow producers to adequately design the agronomic aspects of their systems without some field testing. Moving slowly will allow the producer and the producer's partner, landlord, or banker to become more comfortable with high-residue farming. If the new system is first tested on a small portion of the farm, at least some of the parcels of land should be continuously treated with high-residue techniques rather than trying the technique on different parcels of land each year. As discussed more fully in the long-term effects chapter, many of the benefits of high-residue systems take several years to fully develop. Weaknesses in poor systems develop more quickly but may still not be evident the first year.

The main advantages of the "go slow" approach are really more related to agronomic and psychological considerations than to economic ones. The only benefit of going slow from an economic standpoint is to reduce risk. The slow approach reduces the risk associated with poor agronomic planning and allows the evaluation of machinery before purchases are made. While reliance on custom work and rented machinery reduces risk it generally increases costs. More importantly, many of the economic advantages associated with high-residue systems result from spreading the workload, better timeliness, and lower horsepower requirements-improvements that are not readily evident when only a limited number of acres are involved. This does not mean that there is no value in using the "go slow" approach but rather that these additional factors and their disadvantages should be considered.

Most producers are probably going to take an approach somewhere in between the "all at once" and "go slow" approaches. This will be directed toward quickly adopting a relatively simple, low-risk system. As soon as it is working properly they will begin to evaluate ways to fine tune and change that system to make it better. This middle-of-the-road approach is very similar to what most farmers do with their present practices, which are constantly being modified in an attempt to make them better.

Agronomic Conditions Affecting the Switch to a New System

"Much information is published on the agronomic aspects of high-residue systems. Initially many of these data appear to be contradictory; some trials show one system or technique to be superior while others produce almost opposite results. The key to rationalizing these apparent discrepancies is to determine what different circumstances existed in the trials and why these caused the results that occurred. Soil analysis will produce understanding of why some practices work in some situations and fail in others.

The usefulness of a careful analysis is illustrated by the following example. Two tillage comparison studies conducted in central South Dakota produced apparently contradictory results. In the first study conventional tillage produced greater returns than no-till or minimum tillage. In the second study no-till returns were higher than minimum-till returns, and minimum-till returns were higher than conventional-till returns. Several differences in the management techniques contributed to the results. The most important was probably crop rotation. The first study used winter wheat-fallow and continuous wheat under the three tillage methods. The second study used wheat-soybean and wheat-com-soybean rotations. Both studies took place in an area that receives 18.5 inches of precipitation on average annually. The rotations used in the first study led to significant yield losses from disease and weed problems when tillage was reduced or eliminated. Even if these losses could have been controlled, water use was not sufficiently intense to take advantage of the increased moisture that resulted from tillage reductions except in drier-than-normal years. The more diverse rotations in the second study limited disease and weed pressure resulting in reduced production-costs. In addition the rotations used contained high-water-use crops that could take full advantage of the moisture saved by reducing or eliminating tillage.

So which tillage method is best? It depends on which rotation is used. Which rotation is best? It depends on which tillage method is used. The apparently conflicting results actually make perfect sense when these interactions are understood. A good comparison in these studies is between the best tilled system (wheat-fallow) and the best no-till system (wheat-corn-soybeans). Or even better, compare your present system against what could be done if less tillage allowed more-intense rotations.

In making the decision to switch to a high-residue system, some general principles of the system should be recognized. Several management considerations become more important once tillage is reduced. These involve rotation, competition, and sanitation and each are discussed in the text that follows. Almost all of the management problems reported to be associated with reduced-tillage systems can be traced directly to a failure in one of these categories.

Crop Rotation

The art and science of proper crop rotation was the cornerstone of agriculture until quite recently. Intensive tillage in conjunction with modern technology has allowed producers to move more toward monocrop (single-crop) rotations than was possible less than 20 yr ago. Most producers are at least somewhat aware of the benefits of crop rotation in limiting disease, weed, and insect pressure, but many lack experience in using this concept Proper rotation can prevent most pest problems from getting out of hand and significantly reduce the reliance on chemical control methods. It is not uncommon for a well-managed no-till system that uses rotation properly to use less pesticides than a conventional -tillage system that does not use a proper rotation. On the other hand, no-till or some other high-residue system using a poor rotation will usually require more chemical inputs than the same rotation done conventionally.

Besides the pest management aspects of crop rotation there are other benefits that are less understood and probably under used. These include the potential for better management and use of water, improved workload spreading, and better control of the seedbed environment for good plant establishment of the succeeding crop. Workload spreading allows substantial reductions in labor, power, and machinery costs while improving timeliness. Producers with irrigation or those in areas that normally have adequate or surplus moisture will use this concept less than those in drier areas. The profitability associated with growing full-season (highwater-use) crops often makes it more feasible for irrigation farmers to concentrate on a few specific high-value crops. In dryland areas more diversity in crops is required to manage scarce water supplies, and the workload-spreading aspects of rotational planning can provide major benefits.

The use of rotations to better manage and use water has applicability to both humid and arid regions. Reducing tillage enhances water entry into the soil and saves water. That can be either good or bad depending on whether that increased moisture is put to beneficial use or allowed to become a management problem. Soil, depending on type, can only hold about 1-2.5 inches of available water per foot of depth before it begins to drain away. The ideal condition is to have the root zone fully recharged, but not overfull, when the crop begins to use water. When the soil can no longer hold additional water, problems can occur with leaching, denitrification, runoff, diseases, and inability to handle traffic.

A proper rotation, designed for the tilling system used, will make good use of the water available. The rotations that have traditionally been used under conventional tillage are appropriate for the water conservation aspects of that tillage system. That is why this match has been successful and popular. In some years it is a little too wet or a little too dry and the system doesn't work well, but in most years the relationship between water received and water used by the crop matches quite well. When tillage is reduced, additional soil water is saved and the frequency of years when it is too wet will increase unless the rotation is changed to use more water.

Failure to change rotation has led to the belief that no-till causes fields to be too wet If proper rotations are used that will be true only when conventional tillage systems are also too wet. Cropping intensity and therefore water use can be increased by introducing more full-season crops into the rotation and eliminating fallow or perhaps substituting a nitrogen fixing cover crop in lieu of fallow. In more humid regions where rotations are already heavily dominated by full-season crops with conventional tillage, the options include double cropping or the use of a cool-season cover crop. Reduced tillage will only show advantages from a crop production standpoint in drier-than-normal years and may result in decreased productivity in wet years unless rotations are changed.

The example that follows illustrates how rotations can be designed around weather conditions and designed to make good use of water. A no-till producer wishing to grow corn in eastern North Dakota or northeastern South Dakota is less concerned with a lack of soil moisture and more limited by soil temperatures than a producer in central South Dakota who normally finds moisture much more limiting to com production than lack of heat. Consequently, the fast producer will probably plant much of his com following low-residue crops such as soybeans while the producer in the drier area would use a higher residue such as a small grain to precede com. Where weather is highly variable from year to year as is common on the Great Plains, it is usually wise to include some rotational sequences that do well in nontypical years. In other words the first producer in this example may plant some com following wheat to provide some protection in a very dry year. However, in a cool, wet year this com may not mature properly. Likewise, the central South Dakota farmer could plant com following soybeans or sunflowers on a limited acreage. This would produce well in a wet year and be used for forage in a dry year.

Another aspect of rotation that needs careful study when adopting high-residue systems is the ability of each crop in the rotation to provide a good seedbed environment for the crop that follows. Another example involves the common practice of seeding wheat following com using conventional tillage. This rotation does not work well in high-residue systems, since the amount and type of residue left by corn hinders proper seed placement and early growth of wheat and can lead to severe head scab infections during flowering.

Weed control provided by a rotation in a high-residue system is also important to consider. The main purposes cited for the use of tillage are to control weeds and create a. favorable environment for crop growth. When tillage is significantly reduced or eliminated, a good share of this job must be done through a well-planned rotation. Designing such a rotation requires a producer to have a good understanding of the climate and soils involved on the farm and the conditions each crop prefers during its seedling stage and the rest of the growing season.

With conventional tillage the producer in the wetter, cooler, areas probably planted com following wheat, which had been fall plowed. This system worked because there was sufficient moisture accumulated between harvesting the wheat crop and planting the com crop to allow some soil water to be wasted with plowing. The producer ended up with a warm, moist seedbed and a soil profile that was full of moisture in most years. If com was seeded behind soybeans in a conventional-tillage system, the corn often suffered from lack of moisture later in the growing season. In other words, with conventional tillage there was not enough moisture available to allow corn to follow soybeans due to the water wasted by plowing. In this same area, no till com following soybeans does, however, work well most years if the wasted water associated with tillage is eliminated or substantially reduced.

Sanitation and Competition

The other two management considerations in a high-residue system are sanitation and competition. These again are important in conventional farming but become more so when tillage is reduced. Sanitation refers to any practice that prevents weeds, diseases, or insects from being introduced or established on the farm. Preventing a problem is much easier and cheaper than dealing with it later on. Sanitary practices include using weed-free seed, cleaning equipment between fields, eliminating perennial and noxious weeds by spot treatment before they spread, controlling volunteer grain and weeds to prevent insects from laying eggs, and preventing weeds from going to seed as much as possible. Sanitation also includes some considerations more specific to high-residue systems, such as mowing grass along field borders and waterways before the grass produces seed or at least before the combine header has a chance to gather the seeds and spread them 30 ft into the field.

Plants rely heavily on their competitive abilities to survive. Anything that can be done to create an environment that gives the crop an advantage will significantly reduce the ability of weeds to compete. This includes such normal practices as planting good seed, using sound fertility practices, and using well-adapted varieties. Some practices that may help crops compete specifically in a high-residue farming system include using starter or pop-up fertilizers to assure a fast start, using seeding equipment with excellent depth control capabilities to assure uniform stands, increasing seeding rates from what is typical when more water is available, using rows that are as narrow as possible to develop an early plant canopy, designing proper rotations to create an environment that favors the crop, and most importantly doing an adequately uniform job of spreading chaff and crop residues at harvesting time. This last practice cannot be overemphasized. With the equipment available today, it should be possible to spread both straw and chaff evenly over the width of the header. Most custom harvesters have good straw and chaff spreaders, and the rest can obtain them if they want your business.

Most of the concepts discussed in the agronomic section of this chapter are not greatly different from those used with conventional tillage. The difference is that the systems are dissimilar. Some of the old limiting factors associated with conventional tillage (such as lack of soil moisture) become less dominant with reduced-tillage systems, and new ones take their place. The secret is to design agronomic components that allow a producer to take advantage of the strengths and minimize the weaknesses of high-residue systems.

Psychological Considerations in Switching to a New System

The last factor involved in making the change to high-residue systems is psychological. Some producers relish the challenge of making changes in their operations. It is one of the things they like about farming. Other's plan changes for the sole purpose of improving the bottom line. They do not necessarily enjoy the process but hope to enjoy the results. Still others choose not to make any changes in their operation until it becomes clear that what they are now doing is no longer feasible-and change is necessary to survive. Most producers fall somewhere in between these categories. Often a farming operation contains several partners, each with a different philosophy. Consequently, as stated at the beginning of this chapter, each producer must decide what operational changes will be made and how and when they will be made. Producers should not feel pressured by what the neighbors are doing or by information given in farm papers. Instead, they should take an approach that will work for their operation. If a producer must make a decision slowly to convince grandpa, so be it.

No matter how change is approached, producers should expend the effort and gain the knowledge necessary to make the transition successfully. There will be problems. Mistakes will be made with the high-residue system, but we must keep in mind that mistakes were made with the conventional-till system too. Producers that run into a problem should keep in mind that residue on the soil surface did not cause the problem. Instead, some component introduced into the system caused the problem. If this approach is taken, a producer will sleep more comfortably and the transition will go faster and more smoothly.

As a general rule, good managers who are successful conventional-tillage farmers will probably be even more successful by using high-residue systems. In making the change to high-residue systems, producers must make careful observations, plan adequately, and have a positive attitude.

P.S. If you decide not to trade the plow or disk and instead park it under the trees, be sure to take off the tires because grandpa may till all the stubble fields while you're on vacation.