Texas Cooperative EXTENSION
The Texas A&M University System

Productive Rotations on Farms in Texas PROFIT

L-5436
2-03

Reduced/Conservation Tillage in South and Central Texas

C. R. Stichler and S. D. Livingston*

AS COSTS CONTINUE to rise and commodity prices remain relatively constant, producers must either produce more grain per acre — or reduce the cost of production. Most producers have already trimmed variable costs, and the only remaining option to further reduce cost is tillage. Conservation tillage does not imply no-till, although it is one of the reduced tillage options. By adopting reduced tillage, most producers do not need to purchase equipment but can still profit from most of the advantages of to tilling.

Reduced or conservation tillage yields are comparable to conventional tillage. Many benefits are derived from reduced/conservation tillage systems if a producer has the commitment and tenacity to solve its associated problems. Actual savings of "out of pocket" variable production expenses range from a few dollars to as much as $40 an acre, depending on a producer's management. Cost savings are achieved by:

- Reduced equipment costs
- Lower horsepower, as a result, smaller tractors needed
- Less maintenance and repair cost
- Increased equipment life
- Decreased fuel cost
- Reduced labor cost

Many intangible savings and benefits are also achieved, such as increasing soil health and improved soil and water conservation through:

- Increasing organic matter over time, which improves water holding capacity and increases populations of earthworms and beneficial microbes
- Reducing the number of weed seeds brought to the surface by tillage
- Lessening runoff, which allows greater amounts of water to infiltrate the soil and less water loss to evaporation. One to 3 inches of water can be saved just by reducing soil evaporation or drying from tilling.
- More personal and family time

Depending on the system a producer uses, there may be some disadvantages. Conservation tillage is a "new" way to farm that is not accepted by many landlords or neighbors. The producer needs an increased awareness of weeds, knowledge of herbicides and timeliness and may need to purchase planter attachments, spray equipment and fertilizer injection attachments. The producer must also adjust to residue in the field and on the soil surface.

*Associate Professor and Extension Agronomist and Professor and Extension Agronomist, The Texas A&M University System

Conservation Tillage Systems

Reduced/con-till is not just the implementation of one practice or set of practices; it is an entire program of production. Adopting reduced tillage changes the way a crop is produced. It is a different production pattern and philosophy. A producer must consider everything he does and the implication of each operation on future crops. Planning must be done 4-6 months in advance. For example, what is done at harvest will greatly impact the condition of the field for the next spring planting.

Equipment Needed

Some additional equipment will be needed, such as residue or trash managers, different closing wheels and fertilizer coulters/injection attachments, depending on the level of reduced tillage the producer plans to adopt. The closer a producer is to no-till, the more important it is to acquire some pieces of equipment. Equipment for planting, fertilizing and cultivating (if used in a reduced/con-till system) should cut and roll rather than pull and drag. Equipment with shanks will catch and drag residue, while equipment with coulters will cut the residue to allow the equipment behind it to run in the soil without residue buildup.

A precision type planter may be required, rather than a "buster" or black-land planter that plows the row, places the seed, covers with loose soil and packs the soil with a wheel or tire. Planters are needed that just slice into the soil and place the seed in the bottom of a groove with covering attachments, such as spiked closing wheels, that push and firm the soil around the seed from the side.

Residue or trash managers are spiked wheels mounted in front of the individual planter units. These should be adjusted to just skim the top of the soil or dig slightly and push the residue to the side so residue is not "hair pinned" or pushed into the seed trench. Residue managers will move soil if necessary. If soil is dry, they can be adjusted to run deeper to remove some of the dry soil so seed can be properly placed.

Spiked closing wheels should replace the hard rubber or packer wheels on the back of a planter. Since the soil surface becomes firmer with reduced tillage, equipment must aggressively close the seed trench.

Seed firmers have become a regular attachment on most con-till planters. There are wheels, spoons and long linear attachments that generally bolt on the seed drop tubes to press the seed into the moist soil at the bottom of the seed trench. Most producers prefer the long banana-shaped, linear seed firmers.

Fertilizer must be soil-injected since the soil is not inverted and mixed. Fertilizer applied on the soil surface will result in nitrogen losses into the atmosphere, nutrient runoff and unavailability due to placement in shallow, usually dry soil. Phosphorus moves only small distances ($^1/_4$ to $^1/_2$ inch) each year from the point of application. Since roots do not absorb nutrients in dry soil and are not active near the surface, fertilizer on the surface is generally not available. Fertilizer equipment may include the following:

* A spoke wheel applicator that pokes holes into the soil at 8-inch intervals and injects th nutrients
* A coulter with a jet stream of liquid sprayed into the slit made by the coulter or a knife attached behind the coulter to run in the slit
* Pop-up or starter fertilizers placed with or near the seed at planting time. However, do not use on sandy soils due to injury.
* Strip till equipment with residue managers, coulters and a shank that is run in the fall to till a strip in the planting zone and inject fertilizer below the intended seed placement
* Chisels for fertilizer placement if stale seed beds are formed in the same place each year and furrows are maintained by moving the residue to the top of the bed. However, the knives should be bent under the row so the tip of the knife will apply nutrients closer to the seed when planted.

Reduced/con-till does not mean reduced weed control. Good spray equipment is important since most weed control will be accomplished by the use of herbicides. To cut costs, herbicides such as glyphosate, 2,4-D, diuron, atrazine, paraquat, flumioxazin (Valor) should be applied when weeds are small and easy to kill. With transgenic crops, applications must be made timely and often in a narrow window of time, such as Roundup Ready crops. In addition to broadcast application equipment, hooded sprayers are necessary to control grassy weeds in sorghum and also in middles of non-transgenic herbicide resistant crops.

Finally, *chaff choppers and spreaders behind combines* reduce wind rowing of residue.

Herbicides

Since most weeds will be controlled with herbicides, producers need an increased knowledge of:

* Herbicides that can be used prior to planting and on a crop
* Residue and crop rotation problems with the use of some long lasting products
* Proper weed identification, name of weeds, when they germinate and at what depth
* Post-emergence products that control weeds, at what rates, under what conditions and weed size.

Soil Considerations

Most producers are overly concerned with soil compaction. Soil scientists consider soils that require more than 300 pounds of pressure to push a 1/2 inch pointed rod through it to be compacted. Reduced/con-till soils will be and should be firm but not have compacted layers or zones. Soils do not need to be — nor should they be — loose and fluffy. Soil that is too loose and fluffy will not allow moisture to rise, and seed that is placed in loose soil will often fail to germinate due to quick drying or inadequate seed-to-soil contact. Soil moisture will not be absorbed into a seed if there is air space around the seed, much like a paper towel will not absorb water unless it touches the water.

There is a difference between soil compaction and soil firmness. Compaction results when the weight of equipment, such as a disk or tractor tires running over the soil, crushes the air spaces out of the soil and mashes the soil particles together. Compaction generally refers to a layer 8-10 inches deep, generally 2-3 inches thick, that has become so firm that water and roots are unable to penetrate or are greatly restricted from penetrating. It is most often caused by driving or running equipment when the soil is too wet. The best way to check for compaction is, during the growing season, to dig a trench across the row 15-18 inches deep. Look for roots growing at sharp angles all at the same depth, which indicates an impervious layer. A simpler method is to use a 3/8-inch rod and make a 3-foot long "T. While pushing the rod into moist soil, any differences in soil firmness can be quickly be noted. If a layer is found, check with a shovel for hard pans. Remember, however, to do it during periods when the soil is moist. Dry soils are naturally firm.

Harvesting equipment will cause soil compaction if it is driven on top of beds or down a seed row when soil is moist. Wheel spacers or other modifications should be added to keep equipment out of the seed drill or plant row and in controlled traffic furrows between the seed drill. Grain carts and boll buggies should be driven only in furrows to prevent compacting the planting zone.

Dry soils will always be harder or firmer than wet soils, but this does not constitute compaction. In Texas, where much of the land is semi-arid or less than 25 inches annual rainfall, the soils are usually dry and will be firmer but not compacted.

Under dryland conditions, there are many benefits to a small row. If soil moisture is low, having a row to move out of the way to get to moisture without planting in a deep trench may make the difference between a stand or crop failure. A stale seed bed system or strip tillage with discs to make a small row should be considered rather than no-till.

Fertilizer

Fertilizer should be applied timely and precisely. Since the soil is no longer being mixed, stratification may begin to occur after several years. Stratification is the layering of nutrients in the top 3 inches of soil caused by surface application of plant nutrients or by years of decaying plant material on the soil surface. As the residue decays, insoluble nutrients, such as phosphorus, concentrate at the surface. Depending on the crop being grown and the surface moisture, roots may not grow in the top 3 inches — and the nutrients are not used.

Planting in the same zone year after year may also create nutrient problems. Soil mineralization, the process of nutrients becoming available from soil reserves, takes time. When rooting develops in the same zone year after year without soil mixing, nutrient placement for early growth and development becomes very important.

Fertilizer should be placed in the soil where plant roots can get to it. Two to 4 inches to the side and 2-4 inches below the seed is the recommended place. It can be applied either pre-plant, at planting and/or as early side-dress.

Deep (4-6 inches) placement of phosphorus fertilizer banded near the seed row is usually necessary with long term reduced/con-till applications. Phosphorus can also be placed on the seed as a "pop up" or "starter fertilizer" as long as nitrogen and micro-nutrients are kept low. In high concentration, fertilizer, particularly nitrogen, acts like a salt and will draw moisture out of the delicate seedlings, which desic-

cates and kills them. Pop-up fertilizers should not be applied to seed in dry or sandy soils or damage will occur from the low cation exchange capacity of the soil.

Crop Termination and Residue Management

With reduced tillage, less organic matter is lost through decomposition. When soils are tilled, oxygen is increased in the soil and organic material is buried, enabling soil microbes to more rapidly decompose or "eat" the plant material. A long range benefit of reduced/con-till is an increase in soil organic mater, microbes and earthworms. Residue left on the soil surface also promotes water infiltration and moisture storage.

Crop residues are classified as either fragile or non-fragile. The designation is based on plant characteristics, such as leaves, stems or root crowns, and how easily it breaks down or decomposes. Sorghum and cotton residue decompose more slowly than corn. How a producer handles residue can determine the success of the following crop. Some producers like to shred, while others leave their stalks standing. This decision is based partly on a grower's preference and partly on the amount and kind of residue and the system being followed.

Cotton should be shredded and sprayed *immediately* — within two hours — with a crop stubble labeled phenoxy (2,4-D) herbicide to kill the stalk and roots while the wound is fresh. If the herbicide can be sprayed on a fresh cut stem, it is quickly taken up by the plant. If left for more than a day, the plant cells dry, seal off the injury, and the herbicide is not absorbed. Killing the stalks immediately after harvest will give the roots more time to decay so they are easily removed at next season planting.

A stalk puller can also be used, but regrowth is always a problem. Most producers have to spray anyway — or do more tillage.

There are two main philosophies in handling sorghum residue, and both are successful depending on the system adopted.

- In regions around and north of highway 90, sorghum is best killed with glyphosate pre-harvest, which allows the decay process to begin sooner. Unlike the root crown on cor that easily decays, the perennial root crown on sorghum keeps growing. Spraying pre-harvest also kills any Johnsongrass or broadleaf weeds prior to harvest, allows the combines to run faster and thresh the grain cleaner and dries out any late blooming heads or green spots in the field. In dryer regions — less than 25 inches of annual rainfall — sorghum and cotton residue decompose very slowly. Most producers in this rainfall region prefer to flail shred to get the residue on the soil, where it will cover and form a mulch.
- In South Texas and the Gulf Coast, where harvest is early, wait until the ratoon and germinating sorghum seed grows to a height of 8-12 inches and spray the field with glyphosate. By doing this, the residue cannot float from flooding rains, the seed is not buried with a disc and the sorghum root mass decays "in place," adding to the soil structure without exposing organic matter residues to oxygen and biocombustion.

Corn is easy to handle. Don't do anything. It will rot to nothing by next spring or is easily removed at planting with residue managers. In dry regions, using a flail shredder will evenly distribute residue to form a mulch.

New Practices, New Benefits

One of the most important aspects of making conservation/reduced tillage successful is having the right attitude. Crops can be grown successfully without as much tillage as previously thought. While new practices often pose problems, those problems can be solved. The reduced cost and higher returns are worth the effort.

Produced by Agricultural Communications, The Texas A&M University System
Extension publications can be found on the Web at: *http://tcebookstore.org*

Issued in furtherance of Cooperative Extension Work in Agriculture and Home Economics, Acts of Congress of May 8, 1914, as amended, and June 30, 1914, in cooperation with the United States Department of Agriculture. Chester P. Fehlis, Director, Texas Cooperative Extension, The Texas A&M University System.
2,500 copies, New