



# Conservation Tillage

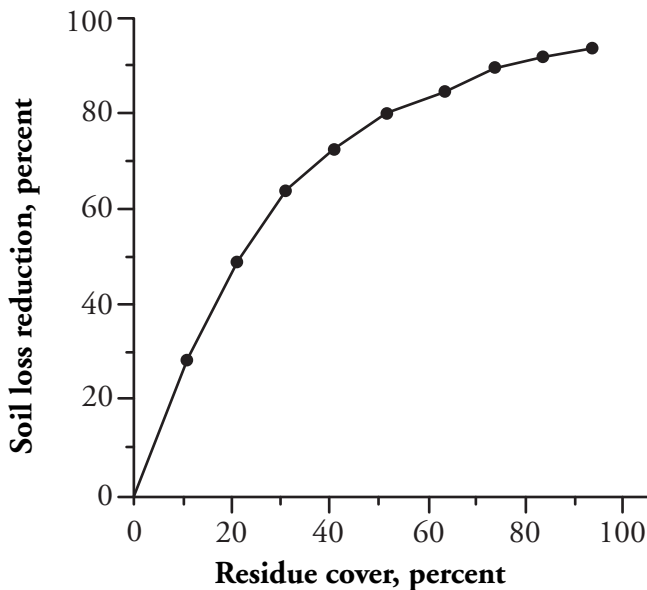
## Planning

Selecting a tillage system is one of a crop producer's most important management decisions. At one time, moldboard plowing was acceptable for nearly all soils. However, it is now apparent that moldboard plowing is not appropriate for many soils, primarily because of the wind and water erosion hazard created by a "clean-tilled" system. In addition, moldboard plowing requires greater fuel and labor inputs than many conservation tillage systems.

Conservation tillage systems reduce preplant tillage operations, thus reducing soil erosion while saving labor and fuel. Conservation tillage may represent a broad spectrum of systems, but is best described as tillage that leaves a minimum crop residue cover of 20 to 30 percent on the soil surface after planting.

### Effect of Residue on Soil Erosion

Research at Iowa State University and many other mid-western states has shown that 20 to 30 percent residue cover will reduce erosion by 50 percent of that occurring from a cleanly tilled field. Figure 1 illustrates the



**Figure 1. Effect of residue cover on reducing soil erosion.**

effectiveness of crop residue cover on soil loss resulting from water erosion. Crop residue cover also is the major defense against wind erosion.

Crop residue is effective in controlling erosion because it protects the soil surface from direct impact of raindrops and creates a rough surface to slow down the velocity of runoff water. Management of crop residue is the most efficient technique for controlling soil erosion in terms of investment and convenience.

Data obtained from monitoring small watersheds as well as that obtained from artificial rainfall simulators have verified the effectiveness of crop residue cover for erosion control. Residue management with various tillage systems is one of the primary factor to be considered when selecting a conservation tillage system. Limiting the number of field operations is also important. This is especially true following crops with low volumes of residue or fragile residue such as soybeans.

Crop residue reduces surface crusting, sealing, and rainfall-induced soil compaction, all of which increase runoff by reducing infiltration. Runoff can be reduced if the soil infiltration rate is maintained and soil surface storage allows more time for infiltration. Later in the season, mulch created by residue protects the soil from sun and wind, thus reducing water loss from evaporation. Throughout the winter, standing residue helps conserve moisture by trapping winter snowfall.

### Comparison of Tillage Systems

No single tillage system is best for all situations at all times. Selecting the best tillage system for a particular soil and cropping situation requires matching the operation to the crop sequence, topography, and soil type. Rotating tillage systems to coincide with crop rotations often provides a better alternative than a single system. For example, a no-till system could follow soybeans while a chisel or disk system might follow corn. This rotation may provide adequate cover following soybeans while providing an opportunity for some tillage in the less fragile and more abundant corn residue. These opportunities may



**Table 1. Advantages, disadvantages, and typical field operations for selected tillage systems.**

<b>System</b>	<b>Typical field operations</b>	<b>Major advantages</b>	<b>Major disadvantages</b>
Moldboard plow (clean tillage)	Fall or spring plow; two spring diskings; plant; cultivate	Suited to most soil and management conditions. Fall plowing is excellent for poorly drained soils. Excellent incorporation. Well-tilled seedbed.	Little erosion control. High soil moisture loss. Timeliness considerations. Highest fuel and labor costs.
Chisel plow	Fall or spring chisel; spring disk; plant; cultivate	Less erosion than cleanly tilled systems. Less winter erosion potential than fall plow or fall disk. Fall chiseling is well adapted to poorly drained soils. Good to excellent incorporation.	Additional operations often performed result in excessive soil erosion and moisture loss. In heavy residues, stalk shredding may be necessary to avoid clogging.
Disk	Fall or spring disk; spring field cultivate; plant; cultivate	Less erosion than from cleanly tilled systems. Well adapted for lighter to medium textured, well drained soils. Good to excellent incorporation. Few residue clogging problems.	Additional operations often performed result in excessive soil erosion and moisture loss. Soil compaction associated with disking wet soils.
Rotary-till	Rotary-till and plant; cultivate	Excellent erosion control up to planting time. Excellent incorporation when used full width. Well-tilled seedbed.	Depending on use, low erosion control after planting; possible soil crusting; possible increased power requirements.
Ridge-plant (till-plant)	Stalk chopping; planting on ridges; cultivate to maintain ridges	Excellent erosion control if on contour. Well adapted to poorly drained soils. Excellent for furrow irrigated areas. Ridges warm up and dry out quickly. Low fuel and labor costs.	No incorporation. Creating and maintaining ridges. Keeping planter on top of ridge.
No-till	Spray; plant into undisturbed surface; postemerge spraying or cultivation as necessary	Maximum erosion control. Soil moisture conservation. Minimum fuel and labor costs.	No incorporation. Increased dependence on herbicides. Not suited for poorly drained soils or weed infested fields. Management is highly critical.

exist for fields where erosion rates are low to moderate or where other erosion control practices reduce the need for high residue cover to meet erosion control requirements.

Table 1 lists advantages, disadvantages, and typical field operations for five common conservation tillage systems in addition to the conventional moldboard plow system. Many tillage systems are named after the primary tillage tool used prior to planting. However, the distinguishing characteristic between systems should be the residue cover remaining after planting. For example, if disk and chisel systems are used to bury residue with multiple passes, they are little different than a moldboard system.

## Matching Systems to Field Conditions

Matching tillage systems to a farming enterprise requires the consideration of soil characteristics, weed pressure, accessibility to equipment, and management ability. Because of the variety of conditions encountered, there is no one best tillage system. Usually, two or three tillage systems are well suited for each soil type and condition. For example, ridge or till planting is better suited to a soil that tends to be poorly drained or wet in the spring because the ridges dry out and warm up sooner. For the same soil, fall tillage, such as chiseling, also can be a good choice and would help reduce soil compaction commonly associated with working or driving on wet soils. However, no-till is generally not well suited to wet soils because the residue may slow drying. In well drained soils, no-till is an appropriate alternative.

## Soils

To assist in matching tillage systems to different soil types, SCS has a WEBFAT rating for each soil mapping unit in Iowa. This system rates the type of limitation of various tillage systems based on wetness and soil temperature, W; water erosion, E; wind erosion, B; flooding frequency, F; topsoil thickness, A; and soil tilth, T. You can check with your local Soil Conservation District Office to determine the WEBFAT rating of each soil mapping unit for 10 different tillage systems. This data can assist you in selecting appropriate tillage systems for your soil.

## Weeds

When matching tillage systems to field conditions, previous weed pressure should be considered. A producer must know what weeds are present in a given field and what the options are for control. While tillage traditionally has been used for weed control, the increased emphasis on residue management has caused tillage operations to be reduced or eliminated, increasing dependence on herbicides for weed control. Herbicide labels should be checked and the application rates adjusted to match soil conditions. Many herbicides commonly used for

conventional tillage also can be used with conservation tillage systems. However, herbicides that require incorporation may not be compatible with some conservation tillage systems. When weed seeds are on the soil surface, till planting is an option that may reduce herbicide requirements. Sweeps or other row cleaning devices push weed seeds to the area between the rows where weeds can be controlled by crop cultivation.

## Equipment

Accessibility to equipment capable of operating in residue also influences the selection and use of conservation tillage systems. To reduce potential residue clogging problems, provide more effective erosion control, and maximize herbicide performance, residue should not be in bunches or windrows. Thus, one of the first considerations in equipment for conservation tillage is a combine equipped with a straw spreader or chopper. Depending on crop and amount of residue, a shredding operation prior to tillage or planting also may be desirable. In heavy residue conditions, some implements use a coulter to cut the residue and reduce clogging. Examples include planters, anhydrous applicators, and combination tillage tools.

The key element is having a planter capable of working in residue-covered soils. The most common requirement for the planter is a residue-cutting coulter in front of the planting unit. Planters generally require additional weight for penetration into firm soil conditions, such as no-till into sod. Most modern planters can be used with little or no modification in soybean residue that is evenly spread.

Another important equipment consideration is access to a properly equipped sprayer. Since tillage may not be available in some systems, weed control will depend on uniform and accurate herbicide application. Failure to apply herbicides properly may result in weed infestations that reduce yields and pose weed control problems in subsequent years.

## Management

A producer's management ability must be considered when selecting a conservation tillage system. Success with conservation tillage will require timely, informed decision making and rapid implementation of control measures. With traditional tillage systems, mistakes in weed control could be corrected with additional tillage operations. This is not the case for many conservation tillage systems. There is little opportunity to easily correct mistakes when tillage operations are reduced or eliminated. Conservation tillage can be successful for producers who want to make it work and are willing to make informed decisions and quick corrections.

Management throughout the season is essential. Pest control is critical. Fields must be scouted regularly. Potential problems must be identified, assessed as to their economic importance and, if necessary, treated. If a pesticide is required, additional information regarding soil conditions, crop and weed growth stages, and crop rotation must be considered. A timely pesticide application, uniformly distributed at the correct rate, is essential for satisfactory pest control.

Field scouting should be initiated during the previous season to help plan for the following year. Scouting for weeds previous to spring planting can be valuable. For no-till systems, fields should be checked and sprayed if necessary while other farmers are doing spring tillage. Early pre-plant application of herbicides is gaining popularity since early weed suppression can eliminate the need for "burn down" herbicides. Also, residual herbicides have a better chance of being activated early in the season.

### **Tips for Conservation Tillage**

Tips for starting a successful conservation tillage system include the following.

1. Start with a few acres the first year.
2. Get ideas from professionals and successful farmers.
3. Start with fertile soils in fields without a weed problem.

4. Use a good planter and sprayer.
5. Mechanically cultivate if required to control weeds.
6. Use a good fertility program.
7. Use other conservation practices along with conservation tillage including contouring, waterways, strip-cropping, and terraces.
8. Use good crop scouting practices, including residue assessment.
9. Be patient.

For more information on conservation tillage systems, see the following publications:

- AE-3050 *Conservation Tillage-Effects on Soil Erosion*
- AE-3051 *Conservation Tillage-Effects on Water Quality*
- AE-3052 *Conservation Tillage-No-till Systems*
- AE-3053 *Conservation Tillage-Ridge-till Systems*
- AE-3054 *Conservation Tillage-Fertility Practices and Equipment for No-till and Ridge-till*
- AE-3055 *Conservation Tillage-Cultivators for No-till and Ridge-till*
- AE-3056 *Conservation Tillage-Planters for No-till*
- AE-3057 *Conservation Tillage-Planters for Ridge-till*

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