### Understanding Conservation Tillage Practices

- There are many potential economic and environmental advantages for no-till or conservation tillage systems.
- Generally, a tillage system should provide a proper environment for seed germination and root growth for crop production.
- Each system has advantages and disadvantages that need to be assessed for each field situation.
- Soil erosion, temperature, moisture conservation, nutrient retention, and organic matter are factors affected by using a specific tillage system.

For the last few decades there has been a major trend away from extensive tillage to prepare a proper environment for seed germination and root growth. The decline in cultivation was possible due to the advent of effective herbicides for weed management. The residues on the soil surface can reduce soil and wind erosion and provide economic advantages of less fuel and labor cost.

### Pros of Conservation Tillage Practices:

- Conserves soil moisture by reducing evaporation at the soil surface.
- Depending on tillage method, 60 to 90 percent residue remains on the soil surface to help reduce erosion. Residue can protect soil particles from rain and wind erosion.
- Requires less labor and fuel and reduces soil compaction due to fewer tillage passes across the field.
- Improves soil health and reduces runoff by increasing organic matter, which helps to improve soil structure and increase water infiltration.
- Firmer soil conditions during harvest.
- Potentially less air pollution from dust and diesel emissions.
- Residue provides food and cover for wildlife.

### Cons of Conservation Tillage Practices:

- Increased dependence on herbicides for weed management.
- Slow soil warming in the spring, especially on poorly drained soils.
- Requires planter modification or a no-till planter.
- Scouting is required because insect, disease, and weed problems may be different compared to pests that are found in conventional tillage systems.

### Conservation Tillage Systems

#### No-till

In this system, crop residue on the soil surface is not disturbed and should remain on the soil surface from harvest to seeding and from the latter to harvest. This practice helps reduce soil erosion, especially on highly erodible soils, and allows for adequate stand establishment. Soil is only disturbed when a narrow band is created by a coulter, seed furrow opener, row cleaner, or other attachments to the planters or drills for planting or drilling operations. No-till planters and drills should be able to cut the crop residue and penetrate the undisturbed soil. About 60 to 70 percent of residue after planting is generally required to manage erosion and conserve soil moisture, depending on soil types, field conditions, and residue source.

The disadvantages of the system include dependency on herbicides for weed management, requires a no-till planter or planter modification, planting may be delayed due to wet, cool soil temperatures, and problems with different insect, disease, and weed species.

#### Strip-till

Usually used in fields that are poorly drained or fields with very little slope. This system is mostly beneficial in cold, wet spring conditions. Typically, strip-till is similar to no-till except that narrow strips are tilled while the rest of the field is left untilled. The system is implemented in fall in conjunction with anhydrous ammonium application. Strip-till can help warm up the seedbed earlier than a no-till system.

#### Ridge-till (ridge-plant or till-plant)

Specialized planters and cultivators must be used to maintain the permanent ridges created for planting a row crop. The ridge tops are cleared of the previous crop residue at planting, to allow for the new crop to be planted on the ridges. After harvest, crop residue is left undisturbed on the soil surface until planting time. Maintenance of the ridges is essential and requires modified or specialized equipment for a successful ridge tillage system.

#### Mulch-till

Any conservation tillage system, except no-till and ridge-till, is called mulch-till. Deep tillage might be performed and crop residues are mixed with the soil. Different implements must be used to perform mulch-till. The tillage tools that are used must leave at least 30 percent of the residue on the soil surface.

Selecting the best tillage system for a specific situation requires the consideration of several factors:
Fertilizer Management
Tillage systems affect fertilizer management as the immobile elements of phosphorus (P), potassium (K), and limestone move slowly in most soils unless they are physically mixed during tillage operations. Soil fertility levels for conservation tillage at deeper depths may be reduced, which requires fertility management, based on soil test results.

Soil pH and Liming. In a no-till system, nitrogen (N) fertilizers applied to the surface reduce soil pH in the top two to three inches. Soil test samples for pH should be taken in the upper two inches, while nutrient samples should be collected from depths of six to seven inches. Lime should be applied, based on soil test recommendations to correct soil pH to the appropriate levels for crop growth and development. Keep in mind that over-liming or liming just before planting should be avoided in fields where triazine herbicides are used. High pH can increase the activity of these herbicides and potentially result in crop injury. If only the top two to three inches of the soil is acidic, half of the recommended lime should be applied.

Nitrogen. Liquid N or anhydrous ammonia should be injected into the soil to prevent N volatilization losses, using coulters in front of the injector knives. The same rates of N for conventional tillage are recommended for a no-till system when injecting into four to eight inches below the soil surface. If surface application of N is needed in a conservation tillage system, utilize a nitrification inhibitor to reduce N loss. Research has shown that injecting resulted in higher corn yields in a no-till system than surface N applications, either broadcast or surface banding.¹

Phosphorus and Potassium. If soil test shows low P and K, injecting both nutrients with the planter or manure applicators is highly recommended.

Weed Management
Weed management in conservation tillage systems depends more on herbicides. Pre-emergence or post-emergence herbicides applied on the surface should be used to manage weeds in a no-till production system. Timing of herbicide application and enhancing crop competition can be effective in managing weeds in a no-till system.

Use paraquat or a Roundup® brand agricultural herbicide to manage small annual weeds. Roundup is effective at controlling perennial weeds because it translocates in the plant unlike paraquat. Paraquat or a Roundup brand agricultural herbicide can be tank mixed with atrazine to help manage perennial grasses, like Tall Fescue, in corn or grain sorghum fields. A Roundup brand agricultural herbicide can be tank mix with 2,4-D or dicamba for improved control of difficult to control broadleaves like marestail.

Several of the pre-emergence herbicides used to manage weeds in a conventional tilled system can also be used for no-till fields, but labels should always be checked for products that can be used in no-till fields. Keep in mind that no-till fields require the upper end of the product rate ranges to help ensure enough active ingredient is available to go through crop residue and effectively manage weeds. Always read the label for information on proper application techniques. Visit http://www.roundupreadyplus.com/ for recommendations and the latest information on weed management.

Organic Matter (OM)
The soil OM amount and distribution change with the tillage practice. No-till is considered the most effective system for increasing OM. The slow decomposition of the undisturbed crop residue left on the soil surface helps increase OM in the upper few inches after several years. In addition, no-till can improve root biomass, microbial diversity, and help increase earthworm populations. The OM level of strip-till and ridge-till systems is between that of a moldboard plow and a no-till system.

In summary, conservation tillage is a crop production system that allows the establishment of crops in undisturbed residue of previous crops. Some of the conservation tillage systems include no-till, mulch-till, strip-till, and ridge-till. Soil erosion, compaction prevention, fertilizer placement, weed management, organic matter, and moisture retention are among several factors to consider when selecting one of the conservation tillage systems.

Sources:

For additional agronomic information, please contact your local seed representative.

Monsanto Company is a member of Excellence Through Stewardship® (ETS). Monsanto products are commercialized in accordance with ETS Product Launch Stewardship Guidelines, and in compliance with Monsanto’s Policy for Commercialization of Biotechnology-Derived Plant Products in Commodity Crops. Commercialized products have been approved for import into key export markets with functioning regulatory systems. Any crop or material produced from this product can only be exported to, or used, processed or sold in countries where all necessary regulatory approvals have been granted. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their grain handler or product purchaser to confirm their buying position for this product. Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS. Some of the products discussed herein may be restricted use pesticides. Roundup® Ready® crops contain genes that confer tolerance to glyphosate, the active ingredient in Roundup® brand agricultural herbicides. Roundup® brand agricultural herbicides will kill crops that are not tolerant to glyphosate. Tank mixtures: The applicable labeling for each product must be in the possession of the user at the time of application. Follow applicable use instructions, including application rates, precautions and restrictions of each product used in the tank-mixture. Monsanto has not tested all tank mix product formulations for compatibility or performance other than specifically listed by brand name. Always predetermine the compatibility of tank mixtures by mixing small proportional quantities in advance. DEHALB and Design®, Roundup Ready® and Roundup® are registered trademarks of Monsanto Technology, LLC. Deltapine® and Leaf Design® are registered trademarks of Monsanto Company. All other trademarks are the property of their respective owners. ©2014 Monsanto Company. 140915164543 101614SMK