

# FIELD CROP PRODUCTION

## INTRODUCTION

Producing high yields has always been an important part of farming. When input costs were low compared to crop returns, the best way to farm was to fertilize for maximum yields and then, add a little extra. The feeling was that you could lose more with too little input than with too much.

With the costs of fertilizer, fuel and other inputs increasing and crop prices not keeping pace, the emphasis has changed. Inputs are carefully measured so that the yield from each unit is worth more than the cost of the input. The greatest yields do not necessarily give the greatest profit.

In recent years, the focus has widened to include environmental factors in the crop production equation. It is no longer acceptable to ignore what happens beyond the fence because of the way we farm.

Best management practices are tools for meeting today's agricultural goals. To be a best management practice, an action must maintain or increase crop returns while minimizing the impact on the environment. There is no one system for all farms. The combination of practices appropriate for your farm will depend on individual problems and opportunities.

The first part of this booklet will help you understand the basics such as soil management, residue management, crop rotation, pest management, nutrient management as well as the importance of using a systematic approach to change. The next three sections focus on different types of tillage: conventional tillage, mulch tillage and no-till/ridge tillage. And finally, the booklet provides some non-tillage options that improve the environment.

The booklet cannot provide you with all the possible information. Rather, it gives you the basics and provides references for further reading.

Some terms used in this booklet may be unfamiliar. To avoid confusion, we are using the following definitions for the different types of tillage:

**Conventional tillage** is any system which attempts to cover most of the residue, leaving less than 30% of the soil surface covered with residue (or crop remains) after planting. Usually, the moldboard plow is used along with a variety of other tillage tools.

**Mulch tillage** is any system where soil is disturbed between harvesting one crop and planting the next. However, in this case, more than 30% of the soil surface is left covered with residue after planting. Chisel plows, offset discs or modified moldboard plows are the common implements. Other terms that you may hear to describe this system are reduced tillage, minimum till or conservation tillage.



Conventional tillage leaves less than 30% residue.



Mulch tillage leaves more than 30% residue.

**No-till** is any system where the soil is not disturbed between harvesting one crop and planting the next. Some tillage may be done by attachments to planting equipment to assist seed and fertilizer placement.

**Ridge tillage** is a specific form of no-till where crops are planted on pre-formed ridges. Inter-row cultivation is done after the crop has emerged in order to control weeds and re-form the ridges.

You may wish to change your cropping system for many different reasons such as: to save money, to increase yields, to save labour, to solve erosion problems, or to reduce pesticide use. Whatever the reason, the first stage of change is to assess where you are now and what your goals are. Once you have done that, this booklet should help outline some of the options available. Good luck!

## REASONS TO CONSIDER CHANGING YOUR SYSTEM

### *On-Farm Concerns*

**Soil loss** by erosion creates an economic loss because it removes the most productive layer of soil first and exposes less productive layers. Lower layers have less organic matter and fewer available nutrients. Therefore, yield potential will drop. Eroded soil will require large amounts of fertilizer to improve fertility and will be harder to manage because of poor soil structure due to low levels of organic matter. Soil loss is a waste of a basic resource which affects the farm's future productivity.

See the section on Non-Tillage Options for more information.



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Ridge till is a system where crops are planted on pre-formed ridges.

**Yield** is affected by many factors: soil productivity, soil type, drainage, weather, crop genetics and farm management. The best way to improve yields may vary from field to field and even, within one field. When making a decision on a tillage system, remember:

- ▶ Lower yields may not always mean lower profits. Different amounts of time, equipment costs, input and management go into different systems.
- ▶ Research comparing corn yields under different tillage systems shows the following (see table). These results could vary with different crops and different management.

### CORN YIELD INDEX

SOIL TYPE	MULCH TILL	NO-TILL
SAND	98	105
LOAM	99	97
CLAY LOAM	96	104
CLAY	92	94

**Five Year Average (Moldboard = 100)  
From 1991 Tillage 2000 Report.**

**Farm input** costs such as labour, fuel, and machinery decrease as tillage decreases. Reducing inputs saves money and resources. Planting a crop with fewer trips across the field increases productivity and allows more timely planting.

Herbicide use may increase in the short-term with decreased tillage as a result of using herbicide for spring weed burnoff to replace weed control by tillage.

Problem weed species also change as tillage changes. This may cause you to modify the herbicide program. Eventually, though, careful management will reduce the need for herbicides. In a ridge till system, banding herbicides will reduce application rates by one-half to two-thirds.

Reducing the number of field passes for planting reduces labour needs. No-till and ridge till systems reduce labour by as much as one-third to one-half from conventional tillage. Chisel plowing requires 25% less labour than moldboard plowing.

In the long-term, reduced tillage reduces capital costs. As tillage decreases, the need for large equipment also decreases. In a no-till or ridge till system, the largest tractor

required will be the one used to pull the planter (or grain buggy). Most farmers keep their plows when they move to a new system until the system proves itself. Eventually, farmers will be able to sell equipment that is no longer needed. A good opportunity to make changes comes when an old plow needs replacement. Use the money that would have gone into buying a new plow for alternate tillage equipment.

Equipment needed for tillage systems:

- ▶ Machinery inventory for conventional tillage includes the moldboard plow, disc, harrow and field cultivator.
- ▶ Switching to mulch tillage will require the purchase of a chisel plow or offset disc. Higher residue levels may require modification to cultivation and planting equipment. For example, trash whippers may be needed to clear residue ahead of planter units.
- ▶ Switching from mulch till to no-till requires the purchase of residue coulters and trash whippers for the planter, a heavier frame for strength and weight, and springs for more downward pressure. It may also require purchase of a new planter or drill.
- ▶ Starting into ridge tillage requires planter attachments to clean the ridge top. Guide wheels or automatic guidance systems keep the planter on the ridge. Special inter-row cultivators are used between the ridges during the growing season. To keep traffic off the ridge, wheel spacing must be adjusted for all equipment.

**Energy** use declines with a reduction in tillage. See the table below for more detail.

### ENERGY REQUIREMENTS FOR DIFFERENT TILLAGE SYSTEMS

OPERATION	TILLAGE SYSTEM (NUMBERS SHOW LITRES OF DIESEL FUEL/HECTARE)			
	CONVENTIONAL	CHISEL PLOW	DISC	NO-TILL
MOLDBOARD PLOW	17	–	–	–
CHISEL PLOW	–	11	–	–
DISC	6	6	6	–
INCORPORATING HERBICIDES	6	6	6	–
SPRAY HERBICIDES	1	1	1	1
PLANT	4	4	4	5
CULTIVATE (EACH TIME)	4	4	4	–
MACHINERY AND REPAIR	17	15	12	6
<b>TOTAL</b>	<b>56</b>	<b>47</b>	<b>33</b>	<b>12</b>

"Renting or borrowing of equipment lets you look before you leap."

## OFF-FARM CONCERNS

### *Sediment*

Sediment, or eroded soil, deposited in Ontario waterways is a burden to all. Financially, it increases the costs of maintaining drains and shipping channels. Environmentally, sediment can destroy fish habitat and spoil recreational waters.

Sediment also contains soil nutrients and during spraying season, pesticide residues which can contaminate surface water. When sediment collects in one spot, at the bottom of a slope, for example, concentrated levels of pesticides may be toxic to crops.

Tillage systems that reduce soil erosion decrease sediment. Also see the section on Non-Tillage Options for more information.

### *Nutrients*

Plant nutrients can be lost from any soil if nutrient application rates are too high. Nitrogen may be lost by leaching, which contaminates groundwater. Phosphates and potassium may be lost into surface water with eroded soil. Excess phosphates are a particular concern in watercourses.

Tillage systems which leave a lot of residue on the soil surface, reduce loss of nutrients by soil erosion. Residue also reduces run-off.

Nitrate loss is affected by adding more nitrogen (in the form of manure, fertilizer or legume residues) than crops require.

### *Pesticides*

Pesticides can contaminate water because of the following: spray drift, spills near wells or streams, or improper disposal. However, entry into the water system may also result from surface run-off or leaching to tile drains and groundwater from farm operations.

Studies of major watersheds in Ontario have shown that few pesticides are found in rivers. However, traces of some are found during spraying season while others, such as atrazine, appear year-round. The most effective ways to control pesticide loss are by managing the soil to reduce run-off, improving handling to reduce spills, proper sprayer calibration and using recommended rates.



Soil moving off the farm in run-off can carry nutrients and pesticides into watercourses.

## ADVANTAGES AND DISADVANTAGES OF TILLAGE SYSTEMS

	ADVANTAGES	DISADVANTAGES
CONVENTIONAL TILLAGE	<ul style="list-style-type: none"> <li>• Familiar to most farmers and machinery widely available.</li> <li>• Incorporates manure without specialized equipment.</li> <li>• Soil warms faster in the spring than with less tillage.</li> <li>• Allows maximum frost action on soil. This breaks the soil into smaller clumps.</li> <li>• Low levels of surface residue permit high levels of water evaporation. This allows earlier planting and is a plus for poorly-drained soils.</li> </ul>	<ul style="list-style-type: none"> <li>• More equipment is needed than in reduced tillage systems.</li> <li>• Low residue levels make soil vulnerable to crusting and erosion by wind and water.</li> <li>• Tillage stimulates weed growth and reduces levels of organic matter.</li> <li>• Working wet soil may cause compaction and the development of plow pans.</li> <li>• During the growing season, high evaporation resulting from lack of residue can reduce crop yields.</li> </ul>
MULCH TILLAGE	<ul style="list-style-type: none"> <li>• Most of the same advantages as conventional tillage.</li> <li>• Residue left on soil surface reduces erosion and water run-off.</li> <li>• Labour inputs are lower than in conventional tillage.</li> <li>• Fewer trips over the field reduce costs.</li> <li>• Management skill levels required similar to conventional tillage.</li> </ul>	<ul style="list-style-type: none"> <li>• Tillage stimulates weed growth.</li> <li>• High residue levels can slow soil warm-up in the spring.</li> <li>• Primary tillage will not be effective under wet soil conditions.</li> <li>• High residue levels require attachments on the planter.</li> </ul>
NO-TILL/RIDGE TILLAGE	<ul style="list-style-type: none"> <li>• Lower input and capital expenses.</li> <li>• Labour inputs per acre are greatly reduced.</li> <li>• More organic matter is located near the surface, which improves soil structure.</li> <li>• High levels of residue drastically reduce soil erosion.</li> <li>• Increased biological activity in soil, which improves structure and increases the speed of pesticide breakdown.</li> </ul>	<ul style="list-style-type: none"> <li>• High residue levels can slow soil warm-up.</li> <li>• Success depends on the characteristics of the soil.</li> <li>• Fewer options are available to work in manure.</li> <li>• Above-average management skills are required.</li> </ul>

## LEARNING COSTS

Learning costs result from inexperience with a tillage system. Making poor decisions or failing to perform a task necessary to the system's success are examples. Mistakes can be costly because they affect time requirements or yield. Research a system carefully before implementing it. It may take a little extra time at the beginning, but will help you avoid errors.

Experience has shown that it is wise to start small and expand a new system as success allows. As one expert says, "A big mistake on a small area is a small mistake, but a small mistake on a large area is a big mistake."

Examples of learning costs:

- ▶ Trying to plant on the ridge without guide wheels. On the day you want to plant, it is too late to find out that the planter won't stay on the ridge.
- ▶ Trying to plant no-till into heavy corn residue and finding that heavy-duty coulters are needed.
- ▶ Having to till a field an extra time to remove ridges and lumps left by poor moldboard plowing.

Before selecting a tillage system, ask yourself the following questions:

- ▶ Will it work for my cropping and livestock system?
- ▶ Are other erosion control measures necessary?
- ▶ Is it suitable for my soil?
- ▶ Does it address the on and off-farm concerns in my area?
- ▶ Can I afford to make the necessary changes and buy the equipment?
- ▶ Do I have the management skills to make the system work?
- ▶ Can I get training, advice and information to improve my skills?
- ▶ Is there someone I can talk to whom has adopted the system successfully?

With proper preparation and consideration, farmers can adopt best management systems for their farm.