BEST MANAGEMENT PRACTICES

No-Till: Making It Work

Agriculture and Agri-Food Canada

Ontario
Ministry of Agriculture, Food and Rural Affairs

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Table of Contents

A word about measurement...

In this book, most metric units are presented with Imperial equivalents immediately following in parentheses. Where common usage dictates, only one of metric and Imperial appears.

INTRODUCTION

No-till is one of this century's biggest breakthroughs in agricultural technology.

It gives meaning to the term "sustainable agriculture", because it is practical, profitable, maintains production targets, and protects soil and water quality on and off the farm.

For centuries, the moldboard plow was used to till land. It works well on flatter, wetter, fine-textured ground where solid manure, hay and pasture are part of a cropping system. But where moldboard tillage is used repeatedly on sloping, lighter, and medium-textured soils, it is a major cause of soil erosion. Most of us have witnessed one or more of the following: degraded farmland, eroded topsoil during snowmelt and rainstorms, dust storms in spring, sediment-choked streams, reduced yields, increased inputs, and dwindling returns.

In the past 30 years, innovative farmers have turned their attention to soil conservation. One area they've examined in partnership with researchers, extension staff and agribusiness is tillage. Their imaginative explorations have led us to the subject of this book.

Many who have adopted no-till, now swear by it. There are some farmers for whom no-till hasn't worked. Others are in the process of implementing it.

Whether you're a cash cropper, livestock producer or vegetable grower, you'll find information and tips in these pages that will help make no-till work in your operation. It's based on the combined experience and talents of no-till farmers, researchers, agri-business professionals, and soil and crop experts.

No-till is a system. Take the time to evaluate each component to perfect it.

Laurence Taylor, Huron County

JC Allin and Sons Inc/ Rural Life

This photo from 1914 shows that no-tilling wheat after soybeans is not a new idea.

NO-TILL DEFINED

In a no-till crop production system:

- the field is left virtually undisturbed from harvest to planting, except for nutrient injection
- fields are no longer plowed, and plant residues remain on the soil to offer protection from erosion
- a narrow seedbed is prepared by the planter or drill during the planting operation, to allow adequate seed and fertilizer placement
  - alternatively, the row strip may be pre-tilled during a separate pass
- weed control is accomplished primarily with herbicides, but shallow inter-row cultivation may still be used for emergency weed control.

No-till farming will reduce cropland erosion and runoff. When soil and crop inputs stay on cropland, water quality can be maintained. Less sediment in surface waters means less costly ditch and harbour clean-outs.

INTRODUCTION

TYPES OF NO-TILL

LESSONS LEARNED FROM T-2000

In 1985, 23 farmers working 40 farms across Ontario began cooperating in T-2000, a five-year research project. They were all committed to trying to make a conservation tillage system work.

Aided by soil conservation advisors, within two years cooperators had overcome common difficulties and were sharing many concepts with their neighbours. By Year 3, it was obvious that results were as good as, if not better than, conventional systems. Conservation tillage and no-till systems were being accepted.

Strip Till. Planters and drills are set up with one or more coulters per seed row, and sometimes row cleaners, to prepare narrow strips of soil that optimize seed-to-soil contact. Strip till can be adapted to many conditions, regardless of crop.

Slot Planting. A slot is opened in untilled soil, and seed is placed at an appropriate depth. Several combinations of seed-firming devices and press wheels are used to close the slot, helping achieve adequate seed-to-soil contact. This is no-till in its purest form, and is especially suited to soybeans, wheat and other cereals on many soils. Slot planting doesn't work well in heavy crop residue, and moist, fine-textured soil.

Pre-till. A narrow strip is tilled with one of a variety of implements. The process encourages the loosening and decomposition of residue over winter, and speeds drying in the spring. Come spring, soils are ready to plant earlier. Pre-tilled strips speed germination and emergence, and help keep cereals in rotation. An extra pass over the field is required, but for some farmers, it's worth it.

Ridge Till. Using sweeps, disc openers, coulters or row cleaners, the ridge is cleared for planting. Residue is left on the surface, between ridges. Warmer soil temperatures in the ridges encourage seedlings to push through earlier. Ridges are re-formed with a cultivation. This also provides mechanical weed control, reducing herbicide use. Ridges require controlled wheel traffic and reduce seedbed crusting. Ridge till also works well in fine-textured soils, especially during cold, wet springs.

INTRODUCTION

MAKING IT PAY

In nearly all cases, conserving soil and water is a given in a no-till system. Today, the focus of making no-till work is to reduce costs. No-till saves money by:

- ▸ reducing labour
- ▸ reducing fuel requirements
  - ▷ in a 1986 Ontario study, no-till was three times more fuel-efficient than a system based on the moldboard plow
- ▸ reducing investment in capital
  - ▷ investment in equipment in a typical 1000-acre operation can be slashed by a third
- ▸ increasing long-term productivity.

Experienced no-till farmers will tell you that the first three years require commitment, compromise and courage.

In 1973, I did 500 acres, and now in 1996 I crop more than 1,000 [without an increase in labour]. All because of no-till.

T-2000 participant Clinton Pottruff, Brant County

A crop system is like an ecosystem. Every time we change one component, all of the other components are affected – often in a chain reaction.

Don Lobb, Huron County

A SYSTEMS APPROACH TO CHANGE, ADAPTED FROM DON LOBB

A crop production system includes all the components that you control while producing the crop – such as management practices, crop inputs and soil conditions.

For overall effectiveness, each component in the system should be considered on its own and as part of the whole system.

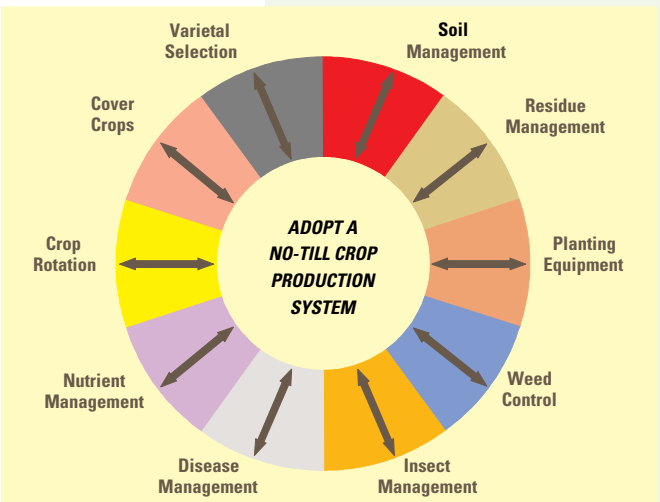
In a management system, an introduced change in practice will always affect more than one component in the system.

The diagram on the right illustrates the principles of the no-till system concept. Key components of the system are placed around the perimeter. The arrows in the diagram point in both directions to show that each component affects the whole system – and the system affects each component. (Each component is interactive.)

Understanding the systems approach is the key to making no-till work.

The remainder of the book is earmarked according to the components of the wheel by the shading of the wedges in the wheel.

Further, where there are interactions in each section, the interacting components will be highlighted.



INTRODUCTION

HOW IT WORKS – A CASE STUDY

A cash crop producer wants to try no-till soybeans into corn residue. The following outlines how this change will affect other components within the system.

WEED CONTROL AND VARIETAL SELECTION

Primary and secondary tillage are no longer part of the system. Tillage will no longer destroy weeds ahead of planting. Also, over time, a new weed spectrum will develop, requiring a new weed control strategy. The strategy may include herbicides that decrease yield. This may in turn require different varieties that are more tolerant of the herbicides used. A yield reduction, which at first is associated with the tillage change, may in fact be caused by a different level of tolerance to a new herbicide.

RESIDUE AND DISEASE MANAGEMENT

Reduced tillage will leave more residue on the soil surface, making it more difficult to plant the crop. This results in the soil being cooler and wetter, and having a greater potential to cause root disease.

Check the system for the following opportunities to reduce this risk:

- ▸ add tillage coulters to the planter to loosen and dry the soil along the crop row
- ▸ delay planting date if necessary to allow the soil to warm and dry
- ▸ select a disease-tolerant variety, and
- ▸ use crop rotation (i.e., soybeans after corn; not soybeans after soybeans) to reduce the risk of root disease problems.

Disregarding any of these solutions can cause a yield reduction that need not be attributed to the change to no-till. Check the system for all opportunities to reduce the potential for a yield reduction. Watch for further interactions within the system. For example, in time, earthworm populations will increase, improving aeration and drainage in the soil, and reducing the need for aggressive strip tillage.

INTRODUCTION

NO-TILL CALENDAR

A successful no-till program starts at harvest ... and goes all year round. It takes planning to help no-till work. The following calendar provides general guidelines to help you get ready.

CALENDAR FOR NO-TILL BEST MANAGEMENT PRACTICES

	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.
LEARN MORE ABOUT NO-TILL	Attend farm shows, no-till meetings and tours. Contact local experts, agribusiness and extension staff to assist with troubleshooting.											
	Read extension material. Try the internet.						Visit no-till seed variety plots to evaluate varieties.					
NUTRIENT MANAGE-MENT		Plan nutrient management practices.			Apply starter fertilizers.				Soil test.			
							Inject nitrogen fertilizer or liquid manure.					
									Apply lime (if necessary).			
									Apply solid manure.			
						Apply liquid manure.						
PLANTING / TILLAGE EQUIP-MENT	Repair/ modify planting equipment.									Pre-till or disc (if necessary).		
							Prepare drill for winter cereals.					
						Cultivation and ridging in ridge till.						
CROP ROTATION AND RESIDUE MANAGE-MENT	Study crop variety results. Place orders for spring planting.								Plant cover crops and winter cereals.			
					Renovate pasture by inter-seeding legumes using no-till.					Harvest and spread residue evenly.		
								Spread cereal residue at harvest and bale straw.		Review crop rotation. Make changes where necessary.		
INSECT, WEED AND DISEASE MANAGE-MENT	Repair spraying equipment.				Apply pre-plant contact herbicides and burndowns.				Apply pre-harvest burndowns where appropriate.			
					Apply residual herbicides.							
						Cultivate and band-spray in ridge till system.				Make note of weeds at harvest.		
						Apply post-emergent herbicides.						
	Finalize weed control program.						Scout crops carefully and frequently for weeds, insects and diseases.					

SOIL MANAGEMENT

Soil Management

Like each component of the no-till system, soils are important. They are the foundation of any cropping system. However, they can be very complex, which can make them difficult to manage. It is essential to understand soils to manage them effectively.

Some soil properties are inherent, such as texture, drainage and slope, and are not readily altered by cropping and tillage practices. Poor drainage could limit no-till success on a field. Soil texture will influence planter setup.

Other features are very much affected by cultural practices such as soil structure, organic matter content, soil moisture, and the ecology of soil life. Such features must be considered before getting into no-till. And no-till will usually improve these features over time.

In general, no-till is more easily adapted to some soil conditions than others. However, in challenging soils – rehabilitating soil management practices, equipment modifications or with time – no-till can be made to work. The key, according to most producers, is listening to the experience of no-tillers on similar soil.

Before converting a field to no-till:

- **make sure the field is level, i.e., no strikeouts or dead furrows**
- **pick stones, since they will not be moved aside easily by planting equipment.**

No-till soils become more consolidated in the first few years, by as much as 10-20%. But, over time, if undisturbed by primary tillage and aided by increased earthworm and other faunal activity, the soils will develop better structure and macropores.

SOIL MANAGEMENT

PRINCIPLES

Natural soil properties of no-till fields should be known and understood before attempting any fine-tuning of the system.

NO-TILL EFFECTS ON SOIL PROPERTIES

SOIL FEATURE	SIGNIFICANCE TO NO-TILL
SOIL TEXTURE • the relative coarseness or fineness of soil (e.g., sandy loam, clay, silt loam)	• soils with high silt contents are: ◦ slower to dry ◦ highly susceptible to soil erosion and moderately susceptible to compaction • can be more difficult to prepare seedbed in clayey soils • sandy and loamy soils can be easier to work within no-till systems
SOIL DRAINAGE • the integration of how quickly water naturally moves through soil and water table activity (e.g., well, imperfect or poorly drained)	• soils with poor natural drainage take longer in the spring to dry and warm up – crop residues can compound the problem, delaying operations and slowing seedbed readiness • will improve with time
SOIL STRUCTURE • aggregating or binding of soil particles and organic matter	• poor initial structure may cause seedbed problems at first (e.g., crusting, setting up) • generally, overall seedbed structure will improve after 3-5 years, depending on soil conditions when no-till was introduced

In no-till, the populations of earthworms, spring tails and mites increase. With the residue removed, numerous earthworm holes are visible.

We used to pick stones with a tractor and loader and make three passes. Now I pick with a 4-wheeler, a little box and I'm done in one pass.

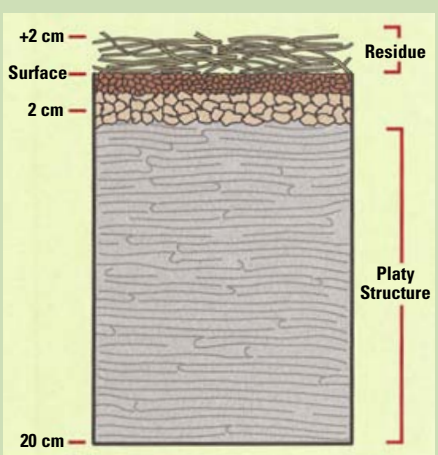
Jack Fraser, Stormont, Dundas and Glengarry United Counties

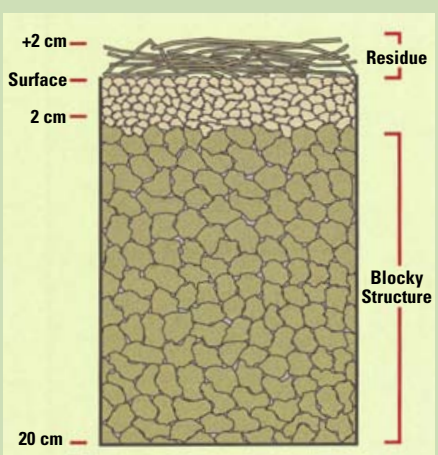
SOIL MANAGEMENT

NO-TILL EFFECTS ON SOIL PROPERTIES, cont'd.

SOIL FEATURE	SIGNIFICANCE TO NO-TILL
ORGANIC MATTER • decomposed and incorporated plant residues, manures and soil fauna	• low initial organic matter levels in some soils may lead to seedbed structure problems • levels near the surface will rise over time as tillage is reduced and crop residue levels are sufficient
SOIL ECOLOGY • soil fauna, flora, microbial life and the quality of the soil habitat	• soil habitat improves as organic matter levels increase and physical properties improve – and as habitat improves, so do the diversity and numbers of soil life
TILE DRAINAGE • the use of designed subsurface drainage systems to remove excess water from cropland	• soils with standing water or high water tables in the spring (and imperfect or poorly drained rating) are not suited to no-till • tile drainage should be installed or upgraded in wetter fields prior to switching to no-till
SOIL MOISTURE • the amount of plant-available water in the soil during the growing season	• initially, soil seedbed moisture levels will increase with the insulation effect of crop residues on the soil surface • as soil porosity and overall soil structure improve, some excess soil moisture will be drained • crop residues will help preserve moisture for crop growth • the continuous macropores allow roots to grow deeper into the soil, allowing access to more moisture

NO-TILL SOIL STRUCTURE ON SANDS AND CLAYS





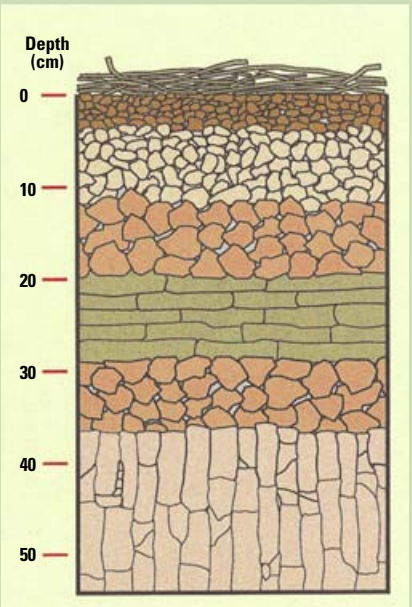
The top layer is very active biologically and produces relatively stable aggregates. However, these break down easily with coulter action to create a fine seedbed. Take a look under the residue cover and compare the soil surface to exposed soil.

Below the surface, soils with a coarse to medium texture (left diagram) will take on a platy appearance, while clay soils (right diagram) will have a thin granular layer over small- to medium-sized blocky aggregates. Over time, the clay will develop a definite structure and the aggregates will be easy to break apart with your fingers.

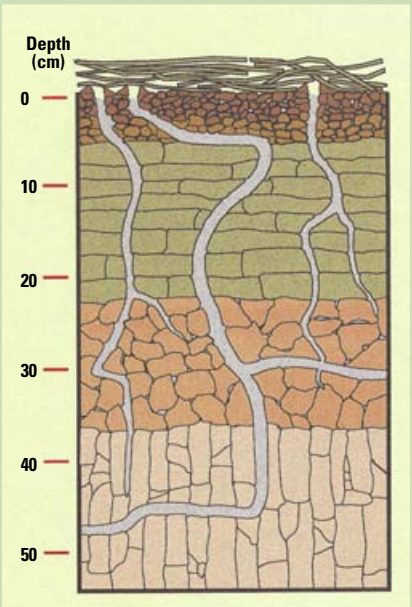
The structure illustrated here takes time to develop and may be subtle.

SOIL MANAGEMENT

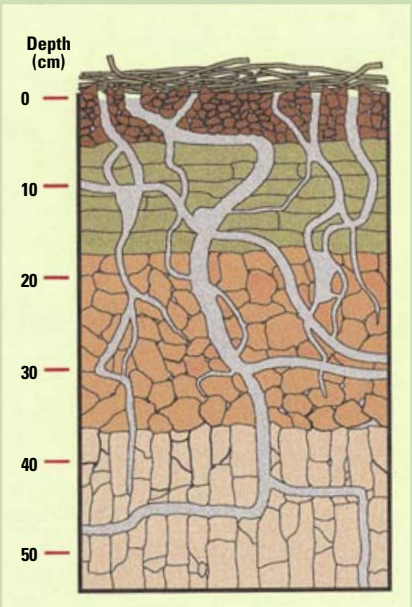
SOIL CHANGES WITH TIME



In the first few years of no-till, the properties of a somewhat degraded loamy soil don't change much. Eroded soils retain light colours, surface crusting may still occur, and plow pans (if present) remain intact. Conditions aren't yet suitable for an increase in soil animal activity, particularly by earthworms.

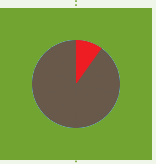


After three or more years in no-till, a previously degraded loamy soil will begin to show signs of life. With the absence of tillage and increase in organic matter, earthworm numbers increase dramatically. Surface seedbed changes from a weak, medium blocky structure to a stronger, fine granular structure. Below this layer, soils may form a thicker layer with a platy structure.



After 10 or more years, the soil is nearly rehabilitated. Increases in soil organic matter and earthworm activity help form a thicker and more stable fine-surface seedbed structure. Subsurface platy structures are broken up by combined action of crop root penetration, earthworm channeling and frost action. Long-term no-till soils begin to look like soils found in extensive pastures and woodlands.

SOIL MANAGEMENT



WHEN TO PLANT

Many problems could be solved and equipment adjustment time reduced if no-tillers planted at the right time.

The land may look dry, but at the depth you want your equipment to operate, it may not be. Here are some tips to check if the land is ready.

1. Use a shovel and the following chart to see if it's ready. Much will depend on your soil type.
2. Try the drill (or planter). Check for trenches, dislodging of soil or seed, or smearing of soil.

   When it's ready, plant no more than 1-3 cm (½-1") deep into the moisture to reduce distortion of seedbed. Be sure to plant into the moisture, not on top of the moisture – especially with soybeans.

As soil improves over several years, you may be able to plant earlier.

FEEL TESTING SOIL – IS IT READY TO PLANT, YET?

MOISTURE	COARSE (sands)	MEDIUM (sandy loams, loams, silt loam)	FINE (clay, clay loams)	SOIL CONDITIONS
BONE DRY	dry, loose and single-grained; flows through fingers	hard clods that break into powder	soil surface is hard, baked and cracked	could be too dry to plant, especially in clay soils
DRY	appears and feels dry; does not form a ball under pressure	appears to be dry; does not form a ball under pressure	somewhat crumbly; will form a weak ball that will not hold together	suitable for planting
MOIST	appears to be dry; does not form a ball under pressure	somewhat crumbly; forms a weak ball that will not hold together	forms a ball but will not form a cigar shape thinner than 1 cm; will not ribbon	suitable for planting, providing the planter does not smear the soil and the furrow closes
WET	sticks together slightly; may form a weak ball under pressure	forms a strong ball readily; very pliable	ribbons out between fingers easily; has a slick feeling	do not plant; wait for soil to dry

Note: When testing to see if the soil is fit for planting, run the planter at planting or tillage coulter depth and check the soil in the row to that depth.

SOIL MANAGEMENT

TROUBLESHOOTING

PROBLEM	CAUSES	BEST MANAGEMENT PRACTICES & TIPS
SOIL COMPACTION • water ponds on surface • crops showing nitrogen deficiency • poor root growth	• past tillage practices • planting, spreading manure and harvesting in wet conditions • excessive traffic and axle loads	• avoid field operations when soil is wet • improve soil structure by including forages, cereals and cover crops in the rotation ◦ use manure where possible • limit number of passes and axle weight **Note:** Sub-soiling can be a temporary remedial measure if conditions are right. The long-term benefit of proper soil management is the best solution.
RUTTING • ruts left from crop harvest	• wet harvest conditions	• light tillage the following spring
PILES OF SOIL OR UNEVEN SETTLING OF SOIL	• tile line excavation and installation	• light cultivation and levelling of affected areas
POOR NO-TILL CORN PERFORMANCE ON CLAY SOILS • poor germination • poor emergence • poor vigour • low yields • shallow root system	• cool, wet soils • coarse seedbed • wet soils combined with heavy cereal residue • soil compaction and poor soil structure	• improve soil structure and improve organic matter levels by including forages and cereals in the rotation, cover crops and manure where possible • bale and remove cereal straw • tile drainage • plant when soil is fit • use 3-coulter system or 2-coulter with row cleaners • crop-row pre-tillage (pre-tillage tool)

In the T-2000 program, we used a paraplow for two years and studied the effects for three years. There was no economic benefit from this practice.

Wilf Riddell, Middlesex County

To make no-till corn work on my clay ground, I now use 3-13 wave ¾" coulters shimmed so they won't run in a straight line. The outside coulters throw soil to the center of the row.

Randy Molzan, Lambton County

I have used the Trans-till (pre-tillage tool) for corn on clay soil after wheat underseeded to clover. The additional cost is partially offset by reduced costs for planter modifications.

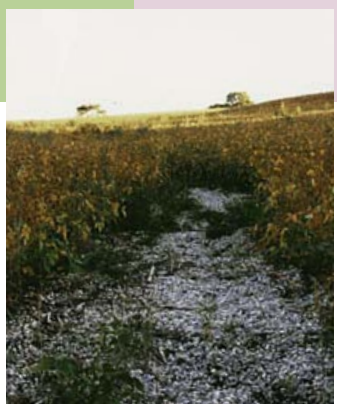
Laurence Taylor, Huron County

SOIL MANAGEMENT

TROUBLESHOOTING, cont'd.

PROBLEM	CAUSES	BEST MANAGEMENT PRACTICES & TIPS
SOIL EROSION • runoff during storm events • light-coloured soils on knolls • crops show drought and nutrient deficiency symptoms • rills and gullies	• low organic matter levels • poor soil structure • compacted soils • erodible soil type • steep slopes • aggressive tillage up and down slopes • knifing-in nitrogen fertilizer • incomplete residue cover	**Preventative Measures** • improve soil structure and organic matter levels by including forages, cover crops, and cereals in the rotation ◦ use manure where possible **Control Measures** • residue management • erosion control structures, e.g., grassed waterways • crop at right angles to steepest, longest slope • spread straw or hay where more residue is needed to protect the soil

Solutions to many soil problems can be found in *Soil Management*, another Best Management Practices book.



Murray Lobb has combined no-till with erosion control structures and practices. Stone-filled gullies are providing excellent erosion control on his farm.

Remedial Measures for Eroded Knolls

A few years back my brother and I worked with Doug Aspinall, Adam Hayes and Peter Johnson of the Ontario Ministry of Agriculture, Food and Rural Affairs to improve soil conditions on our eroded knolls. We moved the topsoil from the draws where it had been since the last time a moldboard plow had been used. Some knolls got soil, others soil and manure – the rest got nothing. Crop yields improved by 30% on knolls where soils were replaced. Now no-till will keep the soil in place.

Wilf Riddell, Middlesex County

Note: Consult an expert for advice on how much soil to move and where to take it from.

RESIDUE MANAGEMENT

Crop residues are those parts of the crop plants that remain in the field following harvest.

Managed properly, residues from the previous year's crop will:

- protect soil from erosion
- improve seedbed quality, by adding organic matter
- increase soil moisture, by trapping precipitation.

Managed poorly, residue can:

- delay seedbed warming and cause uneven drying
- interfere with seed and input placement
- inhibit seedling emergence.

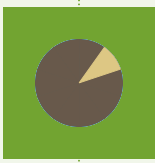
Most fine-tuning of no-till systems involves improvements to residue management.

Each type of residue presents its own management challenges. Corn stalks will require equipment that will cut through, move aside and work remaining residue into the seedbed. Straw and chaff have to be managed at harvest to encourage even distribution throughout the field.

Besides type, the amount of residue must be considered.

The average percent residue cover after harvest for various crops is grain corn 85%, winter wheat 95%, soybeans 30% and silage corn 5%. The tables on page 17 of *Field Crop Production* (Best Management Practices) show the straw-to-grain ratio for some crops and the amount of corn stalks and straw for various yields. A 130 bu/ac corn crop would generate 8 tonnes of residue.

The amount of residue depends on previous crop, the yield, and treatment of the residue. Grain corn will leave much more residue than silage corn or soybeans.



Residue Management

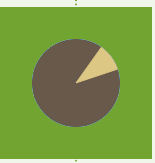
When going to the field to harvest a crop, consider that you are not only harvesting that crop, but you are actually preparing your seedbed for the following year.

Wilf Riddell, Middlesex County

Crop residues help keep the moisture in the seedbed. Emerging seedlings can benefit during drought years.

No-till fields provide habitat for all kinds of wildlife.

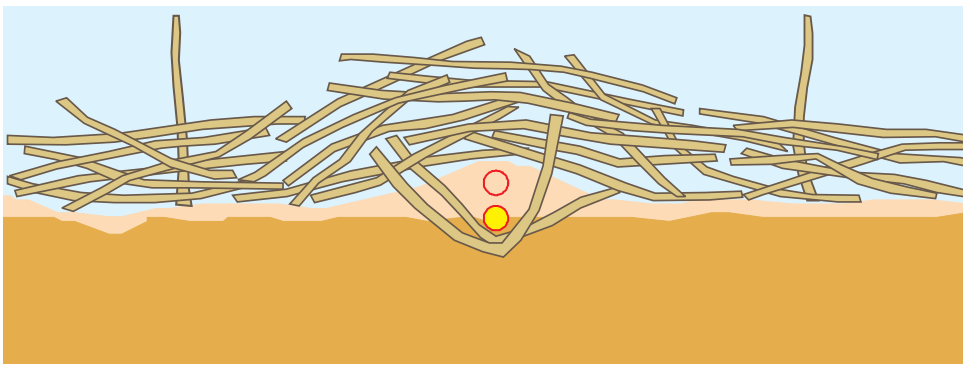
RESIDUE MANAGEMENT



Residue Management

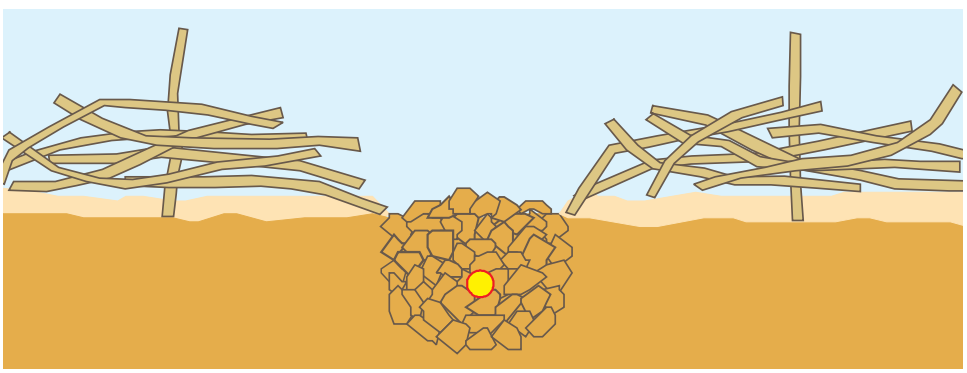
Residue management is the one part that made the most significant improvement in our system. The only modification we made to our combine was to add a chaff spreader so cereal chaff is spread over a wider area.

Bruce Shillinglaw, Huron County



Poorly distributed residue can impede germination in two ways. It can:

- **prevent the accurate placement of seed (seed depth) and,**
- **create a cool, moist, pest-infested environment in the seedbed.**



Coulters and row cleaners can move residue off crop row and reduce the impact of poorly distributed residue.

KEYS TO SUCCESSFUL RESIDUE MANAGEMENT

Managing residue effectively is an absolute necessity to make no-till work.

Uneven distribution of chaff may cause cold seedbeds, poor seed-to-soil contact, uneven emergence, and weed escapes – leading to yield loss.

This requires:

- ▸ an understanding of the effects of crop residues on the seedbed
- ▸ practical experience with no-till equipment, and
- ▸ the ability to adjust your residue management practices to suit the conditions you may encounter.

RESIDUE MANAGEMENT

Know the amount of residue you will be dealing with:

- ▸ was the previous crop a high yielding/high residue crop?
- ▸ was any tillage done to the residue?

Spread residue evenly behind the combine to eliminate windrows:

- ▸ add straw and chaff spreaders to the combine
- ▸ residue should be spread the full width of the combine header
- ▸ some combines may require straw choppers.

Modify or choose equipment to handle residue left on the soil surface:

- ▸ add coulters or row cleaners to cut or clear residue from the row
- ▸ a 15-20 cm (6-8") cleared strip is adequate for corn.

Choose residue levels that will reduce soil erosion:

- ▸ grow more high residue crops on soils that are prone to erosion.

John Munn, Huron County, removes the rear toolbar from the planter and uses the 3-coulter system/row cleaners to pre-till wheat straw prior to corn, soybeans or white beans and to apply phosphorus and potassium.

OTHER METHODS

CROP-ROW PRE-TILLAGE

To overcome problems with cold, damp soil at planting time, some farmers are doing a form of crop-row pre-tillage. Pre-tillage is usually used to improve growth in corn and occasionally soybeans. Most are performing this added field operation in early fall when the soil is dry and malleable.

Clear residue from the row area and till next year's seedbed strips 20-30 cm (8"-12") wide and at least 10 cm (4") deep. Farmers using this approach typically till 15 cm (6") deep in the fall and follow with shallow (4 cm [1½"]) tillage the following spring.

The implement must be equipped with markers so that it can till precisely where next year's crop row will be planted.

Some farmers incorporate fertilizer while preparing this strip.

Money spent on this implement is partially offset as the requirement for heavy-duty equipment on the planter can be reduced. Light spring strip tillage may be required.

A crop-row pre-tillage implement could serve the needs of several no-till farmers, who would each have a more modest investment in no-till planting equipment.

Becker Farm Equipment

Laurence Taylor, also from Huron County, does crop-row pre-tillage in the fall after wheat to help corn on clay ground. He uses:

- **1 cutting coulter, followed by**
- **an adjustable depth chisel tooth, and**
- **2 fluted coulters.**

RESIDUE MANAGEMENT

TILLAGE ROTATION

Tillage rotation is the use of primary (e.g., chisel plow) or secondary (e.g., disks) tillage in a no-till system, usually before corn. It may be useful for one or more of the following:

MANURE MANAGEMENT	• helps fit solid manure application or emergency application of large volumes of liquid manure (or sludge) into no-till system • helps fit knoll remediation into no-till system
FERTILIZER OR LIME APPLICATION	• incorporating lime is the quickest way to correct soil pH • corrects a severe stratification problem
EXCESSIVE RESIDUE	• high yielding, high residue crops (wheat/rye) may at times benefit from residue incorporation

In no-till soils, tillage will:

▸ increase the likelihood of wind and water erosion

▸ destroy the continuity of macropores in the tilled zone

▸ cause the temporary loss of some soil life.

To make no-till work in horticultural crops, cover crops are killed with a burndown and areas in the field to be planted are "pre-tilled". Pre-tilling is necessary since coulters on a trans-planter do not move fast enough to till the soil or clear residue.

RESIDUE MANAGEMENT

TROUBLESHOOTING

PROBLEM	CAUSES	BEST MANAGEMENT PRACTICES & TIPS
UNEVEN CROP EMERGENCE • missing plants • poor crop vigour • insects feeding on seeds or seedlings	• uneven residue distribution at harvest (results in uneven warming and drying of seedbed)	• use chaff spreaders • use straw spreaders
	• residue piles (from stopping the combine or from water movement)	• remove residue piles • use harrows to spread piles • when stopping the combine, back up a short distance to spread the residue • cut low, bale straw, and remove from field • to prevent movement by water, don't cut straw or chop stalks
	• excessive residue	• cut low, bale straw, and remove from field • pre-till crop-row strips • adjust coulters and row cleaners or planting equipment
	• poor seed placement	• adjust or add coulters and row cleaner setup • pre-till crop rows
	• feeding on seeds or seedlings	• use a seed treatment to protect against insect feeding • move residue from the row to reduce slug damage

Chopped straw or stalks are more prone to runoff during storm events. Dense mats will prevent seedbed from warming and drying.

Set combine head to cut low. Bale straw and remove it.

PLANTING EQUIPMENT

In no-till, effective crop establishment requires the proper selection of no-till tools or components. Knowing the nuts and bolts of no-till equipment is fundamental to setting up and fine-tuning your equipment to suit your operation.

Because equipment will be your largest investment, it will also be among your best opportunities to save in the long run. Less equipment can do more acres in no-till.

When you bring the planter or drill to the field, you're immediately reminded that the field looks almost the same as when you harvested the previous crop.

Without the benefit of several tillage passes, your planting equipment must:

- cut residue
- move excess residue
- loosen the seedbed for good seed-to-soil contact
- place seed in moist soil
- properly place other inputs
- close planting furrow and adequately press soil around seed.

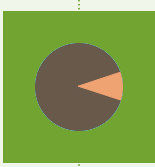
Failure to meet most or all of these goals will result in uneven germination and emergence. And this can cause further problems with pests and growth during the growing season.

In this section, you'll learn:

- the components of no-till planting equipment
- how no-till planting components can be put together
- how to fine-tune the system, and
- how to troubleshoot.

Six years ago we grew 1,300 acres of crop and required three 4-wheel drive tractors. Today a 145 hp tractor is more than adequate to grow our 1800 acres plus 500 acres of custom work.

Bob Hart, Oxford County



Without tillage, no-till planting equipment has to help create favourable seedbed conditions.

PLANTING EQUIPMENT

COULTERS

Properly selected coulters should:

- ▸ cut residue
- ▸ move residue (fluted coulters)
- ▸ till narrow strip of soil for seed and fertilizer placement.

TILLAGE COULTERS COMPARED

	TYPE & SUITABILITY	COMMENTS
	RIPPLE/PLOW • up to 50 cm (20") diameter **Suitable for:** • drills with frame-mounted coulters • planters with 3-coulter system • planters with coulters and row cleaners	• relatively low pressure required to penetrate soil • cuts residue • accomplishes deep tillage with minimal soil disturbance • leaves smoothest seedbed under damp soil conditions
	FLUTED • 43 cm (17") diameter • 8 waves per blade • 3-5 cm (1-2") flutes **Suitable for:** • drills with coulter caddy (3 cm or 1" flute) • 2-coulter planter setups (5 cm or 2" flutes)	• the long cutting edge on fluted coulters requires high downward pressure • with a wider flute and more waves per blade, more tillage action occurs and more pressure is required • works well for fertilizer and manure incorporation • good in dry soil, but can be a problem in damp conditions because soil may be thrown from seedbed, particularly on clays and clay loams • wider flutes do more tillage and will incorporate more than narrow flutes

PLANTING EQUIPMENT

TILLAGE COULTERS COMPARED, cont'd.

	TYPE & SUITABILITY	COMMENTS
	FLUTED • 43 cm (17") diameter • 3/4-7/8" flute, 12-13 waves/blade • 5/8" flute, 24-25 waves/blade **Suitable for:** • drills with coulter caddy • 3-coulter planter setups • coulter and row cleaner planter set-up	• good for fertilizer and manure incorporation • less of a problem in damp soils • will not till as wide an area as wider coulters • 24-25 waves/blade are ideal for mounting on planter units; best for dry clay soils
	BUBBLE • usually 43 cm (17") **Suitable for:** • drills with coulter caddy • coulters and row cleaner planter setup	• shoulders on the bubbles impede penetration on hard soil • straight leading edge makes it cut effectively • provides more tillage than a ripple coulter • may cause sidewall compaction in damp clay soil
	STRAIGHT-EDGED COULTERS **Suitable for:** • ridge till cultivators	• straight edge cuts residue and penetrates mellow soils well • don't move or incorporate residue effectively

Eighteen-wave blades are also available and perform similarly to 24-wave blades.

This is a 24-wave blade coulter.

PLANTING EQUIPMENT

ROW CLEANERS

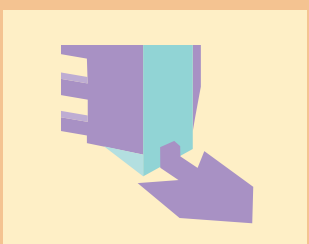
Row cleaners should be selected to move residue from the row in no-till, and to move soil and residue from the ridge top in ridge tillage. They are usually mounted on the planter unit or just ahead of it. They must be adjustable so that they can be set to move only residue in no-till.

ROW CLEANERS COMPARED

	TYPE & CONFIGURATION	COMMENTS
	NOTCHED DISK V configuration **Suitable for:** • ridge till planters • no-till planters	• moves residue effectively and much better than smooth disks • low power requirement when set to run shallow • not effective in sod situations • may be difficult to control depth on fields with variable conditions
	SPIDER WHEELS V configuration **Suitable for:** • ridge till planters • no-till planters	• can be set to lightly rake soils and speed drying • low horsepower requirement when set to run shallow • under some conditions, may wrap with residue • interlocking spiders may be bent • can be set to do shallow tillage requiring slightly more horsepower
	3-COULTER TILLAGE SYSTEM **Suitable for:** • no-till planters • pre-tillage	• if not too deep, it can effectively clear the crop residue • easy to operate, but requires more power than notched disks or spider wheels • popular on clay and variable soil conditions • speed is required to move the residue

PLANTING EQUIPMENT

ROW CLEANERS COMPARED, cont'd.

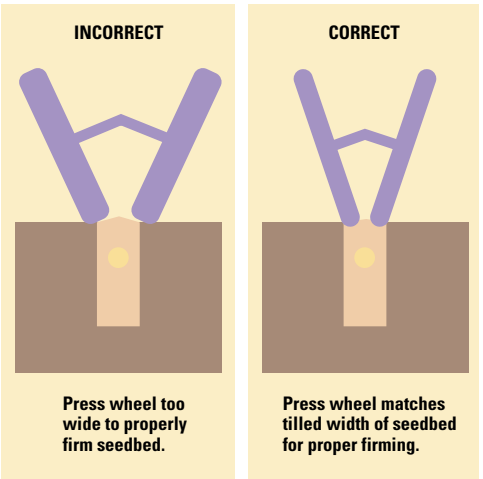
	TYPE & CONFIGURATION	COMMENTS
	COMBINATION COULTER/ ROW CLEANER **Suitable for:** • ridge till planters • no-till planters	• does minimal tillage directly ahead of the seed row • cuts and clears residue effectively
	HORIZONTAL DISK **Suitable for:** • ridge till planters	• usually used as ridge cleaners • moves too much soil for no-till • easier to set shallow than sweeps
	SWEEP **Suitable for:** • ridge till planters	• usually used as ridge cleaners • effective for levelling ridge tops • moves too much soil for no-till

PLANTING EQUIPMENT

PRESS WHEELS

Press wheels firm the soil over and around the seed. They must work within the tilled strip of soil prepared for seed and fertilizer placement.

Press wheels can play a role in depth control on drills.



PRESS WHEELS COMPARED

	TYPE & SUITABILITY	COMMENTS
	V-TYPE PRESS WHEEL **Suitable for:** • planters and drills	• combined width should not exceed the width of loosened soil in the seed trench (less critical in sandy conditions) • V-type press wheels may inhibit residue flow in narrow rows • cast iron and rubber wheels are available • down pressure can be adjusted on some models
	CLOSED CENTRE PRESS WHEEL **Suitable for:** • drills • some planters	• works well where loose soil would push up between V-type press wheels (i.e., sand) • used for depth control on variable soils

PLANTING EQUIPMENT

PRESS WHEELS COMPARED, cont'd.

	TYPE & SUITABILITY	COMMENTS
	RIBBED CENTRE PRESS WHEEL COMBINATION WITH CLOSING DISKS **Suitable for:** • planters	• works well under a wide range of soil conditions • requires closing disks or strip tillage to loosen a strip of soil as wide as the press wheel • rib allows better plant emergence under crusting conditions
	NARROW 3-5 cm (1"-2") PRESS WHEEL **Suitable for:** • drills	• used primarily to firm seed in the bottom of the seed trench with no-till drills (1") • used to firm soil on top of seed (2")
	"COMBINATION" PRESS WHEEL 3 cm (1") + V-type **Suitable for:** • planters and drills	• ensures excellent seed-to-soil contact and covers the seed without compacting the soil on the seed

OTHER COMPONENTS

SEED DEPTH CONTROL

Planting units need sufficient downward pressure to make seed openers work precisely.

Planting units should not bounce. (Speed can influence this.)

Excessive pressure on downward pressure springs will result in damage to planting units, possibly causing planter drive wheel slippage.

If your planter is not equipped with walking beam gauge wheels, then install this necessary attachment to improve seeding depth on rough ground.

PLANTING EQUIPMENT

Seed firming devices can improve seed-to-soil contact.

SEED FIRMING DEVICES

Seed firming devices, while not a requirement, provide significant benefits to some soils. They can improve seed-to-soil contact and the accuracy of seed placement. **Caution:** in wet situations, seed firming wheels (especially small diameter wheels) may become clogged with mud.

MARKERS

Hard soil and heavy residue require more effective and durable planter markers. Use heavy-duty bearings and notched disk blades for aggressive action. Angle the marker for more aggressive marking action. Add weight to the marker for good penetration.

Planter markers may require a depth band to avoid moving too much soil. Foam spray markers can be an alternative where soil disturbance is a concern.

Notched disc blades work well as markers in hard soil and heavy residue conditions. The one shown includes a depth band.

TRASH GUARDS

Heavy residue, particularly corn stalks, can become lodged in drive chains and sprockets. Protect against damage and planting interruptions with purchased or home-fashioned guards. Protect the following components:

- fertilizer and herbicide delivery lines – lines can also be run behind metal components (frame, components) or metal tubes can be welded on to run lines through
- drive chains.

NO-TILL SEED DRILLS

SETTING UP SEED DRILLS

To make drills work in no-till, you need to concentrate on:

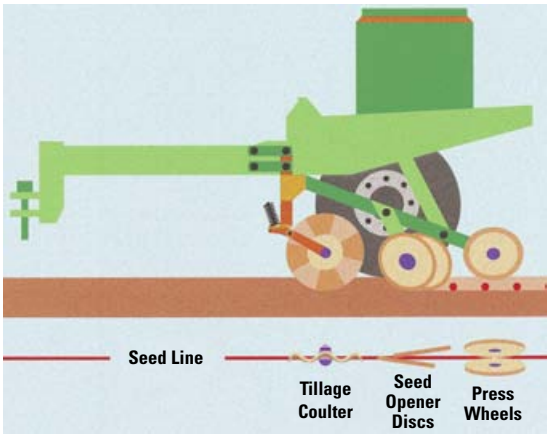
- managing excess or problem residue
- keeping the seed openers at the right depth
- matching the press wheels to soil conditions.

The following illustrates the setup of components of a no-till drill (single disc opener).

Trash guards protect planting equipment from damage by lodged corn stalks.

No-till drills are mostly used for seeding cereals, forages and soybeans.

PLANTING EQUIPMENT



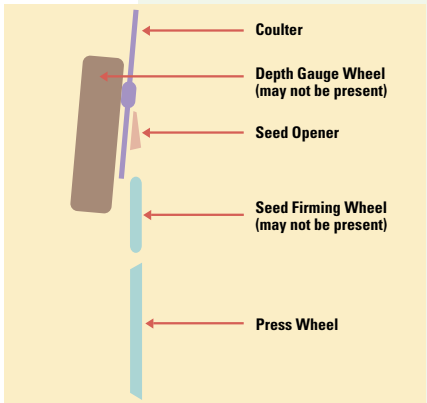
The components of a no-till drill.

A number of features are common on no-till drills. Other features have been specially designed to improve performance. There are three common drill designs that facilitate seed and fertilizer placement:

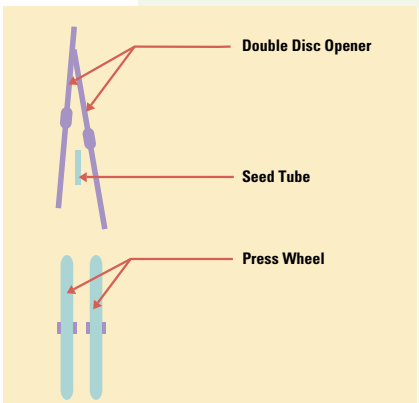
Single disc opener – a single straight coulter running at a slight angle tills a narrow seedbed and creates a slot for the seed. The seed is placed in the slot with a shoe positioned directly beside and behind the coulter hub. Some drills have a depth gauge wheel for better seed depth control. Soil is firmed around the seed using a narrow 2.5 cm (1") press wheel.

Double disc opener – the seed opener consists of two sharp discs, one leading the other. By staggering one ahead of the other, a narrower zone is tilled, allowing for easier penetration and better residue cutting. This system works best when it follows coulters. The discs have either a smooth or serrated leading edge. Seed is delivered to the seed slot by a tube located behind and between the discs. Depending on the width and extent of tillage, a range of press wheels may be used – typically, a single 5 cm (2") by 33 cm (13") or a double V 2.5 cm (1") by 30 cm (12").

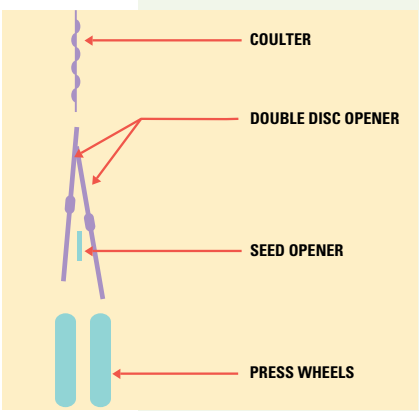
Disc opener + tillage coulter – a tillage coulter leads the disc opener. This coulter cuts residue, and tills a narrow seedbed for seed and fertilizer placement. As the distance between the opener and tillage coulter increases (as in coulter caddy setup versus endwheel no-till drill), the aggressiveness (i.e., the width of the coulter) should be increased. This allows proper tracking of coulter and double disc opener. The seed slot opener can be an offset double disc unit, but usually is a conventional unit. The press wheel should be matched to the zone of tillage. The wider the zone, the wider the press wheel.



Single disc opener.

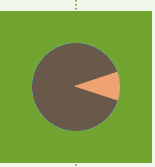


Double disc opener.



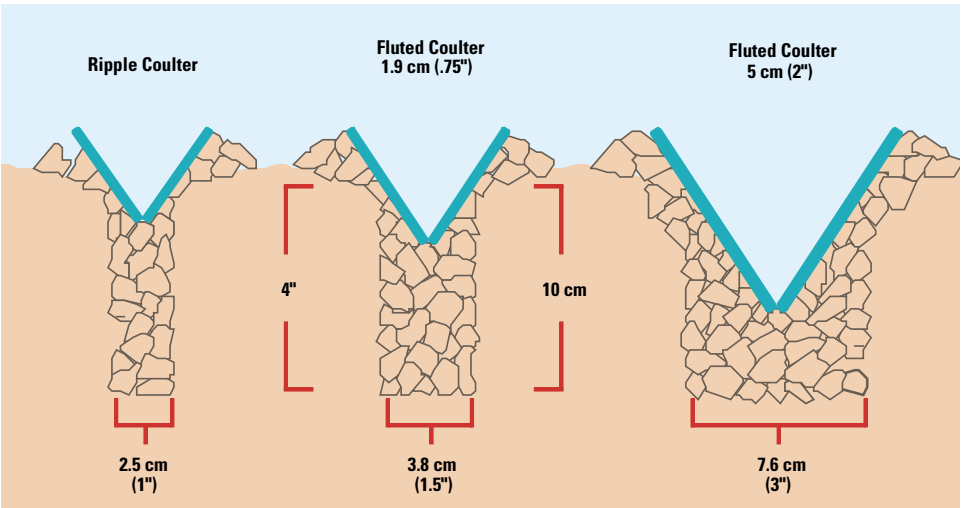
Disc opener and tillage coulter setup.

PLANTING EQUIPMENT



Planting Equipment

When using narrow row settings, plant at an angle to old crop rows to reduce residue plugging.



A ripple coulter tills a narrow strip of soil, which may restrict opener depth. A wider-tilled strip may be necessary to improve seed or fertilizer placement. A narrow-fluted coulter is usually adequate, but a wide-fluted coulter may be necessary for wide openers.

FINE-TUNING THE SEED DRILL – CHECKLISTS

FOR DEPTH CONTROL AND PENETRATION

Make sure coulter caddy is level with the seed openers.

Check for disc wear and make adjustments as necessary.

Adjust depth stops on wheels to maintain a constant depth.

Add or remove weights to ensure proper penetration under the toughest soil conditions in the field, even when the seed and fertilizer hoppers are empty.

Adjust downward pressure springs as needed.

Make sure tillage coulters are aligned with seed openers.

Add sufficient weight to ensure proper penetration of the openers, even when seed and fertilizer hoppers are empty.

FOR RESIDUE MANAGEMENT

Adjust cutting depth and pressure.

Match coulters to residue:

- ▸ wider coulters (up to 3 cm [1"] fluted) will move more residue
- ▸ ripple or narrow coulters will cut residue more effectively.

Use wider row spacings.

Stagger seed units.

Note: always match width of press wheels to width of zone worked, unless 4" press wheels are being used for depth control in sandy conditions.

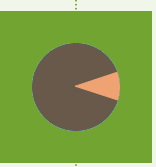
Harrows are often added to the back of a drill to help move soil back over the seed row, and spread residue evenly.

PLANTING EQUIPMENT

TROUBLESHOOTING NO-TILL SEED DRILLS

PROBLEM	CAUSE	SOLUTION
SHALLOW SEED/FERTILIZER PLACEMENT	• poor coulter penetration	• add weight • adjust coulter depth • change type of coulter – a narrower coulter is easier to get into the ground • ensure coulters are sharp, not worn out • avoid planting when the soil is too dry
	• poor tracking of seed/fertilizer unit	• line up tillage coulter with fertilizer or seed opener • do not plant around corners • choose a wider or more aggressive coulter (especially on coulter caddies) • ensure bushings and linkages are tight and not bent
	• seed unit bounce	• increase tension on seed unit down pressure springs • reduce speed
	• poor seed unit penetration	• check seeding depth setting and mud buildup on gauge wheels • increase spring pressure on the unit and decrease on the press wheel(s) • adjust depth of coulters to ensure loose soil to planting depth • align tillage coulters with openers and check for wear
POOR SEED TRENCH CLOSURE	• inadequate firming of soil	• increase downward pressure on press wheel or change to a heavier press wheel • change to a narrower press wheel or wider, deeper tilled strip (more aggressive coulter tillage)
	• soil too wet	• plant when the soil is at proper moisture • install tile drainage to improve variable soil moisture conditions • use rotary hoe, walking chain harrow or shallow coulter tillage to move residue and speed drying

PLANTING EQUIPMENT



TROUBLESHOOTING NO-TILL SEED DRILLS, cont'd.

PROBLEM	CAUSE	SOLUTION
ERRATIC SEED DROP/SKIPS	• slipping drive wheel/coulter	• add weight to the drill • ensure coulters are not holding the unit out of the ground • use narrower coulter blades, go shallower • add fluid to the drive wheel • do not use excessive downward pressure on seed units
SEED PLACED TOO DEEP	• planter units running too deep	• remove weight from the drill • adjust depth setting on the units • add depth stops to the hydraulic cylinders on the lift wheels • adjust press wheels to proper depth • change to a wider press wheel to ensure depth control
RESIDUE PLUGGING	• poor residue flow	• there should be adequate space between seed units, press wheels, lift wheels, etc. to allow for good residue flow • residue flow can be improved by staggering the seed units • stagger coulters – 6-8" offset on 17" blades • use a narrow type press wheel
	• too much residue	• drive at an angle to old crop rows • plant between the old rows • bale the straw • spread residue evenly at harvest • use rotary hoe, walking chain harrow or shallow coulter tillage to move residue around
	• residue not cut	• match coulter size to depth of cut (see page 35) • make sure coulter blades are sharp and not worn • adjust coulter depth • use rotary hoe, walking chain harrow or shallow coulter tillage to move residue around • use a ripple (plow) coulter
UNEVEN PLANT STAND	• residue incorporated into tilled strip	• adjust coulter depth and travel speed so that residue is thrown clear of the crop row

PLANTING EQUIPMENT

Weight may be added inside the drill or planter frame.

For good seed unit penetration, ensure the tillage coulter is aligned with the seed opener.

Coulters should be sharp and set at the proper depth for good residue cutting.

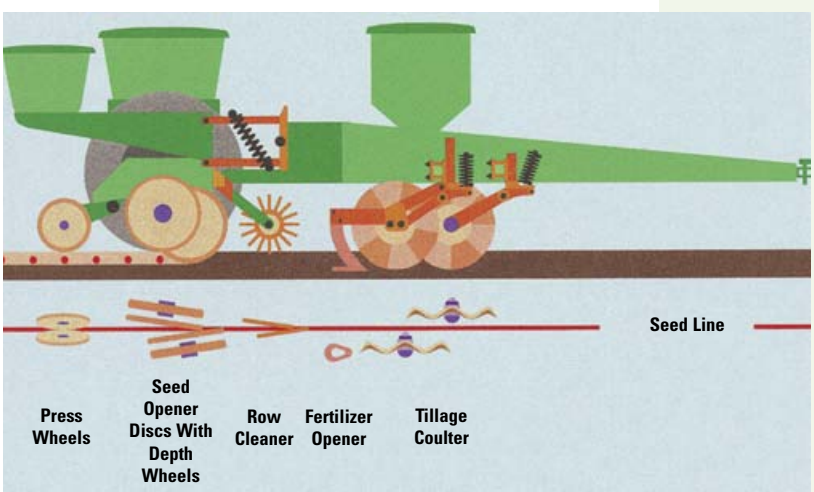
NO-TILL PLANTERS

PLANTER SETUPS

To make no-till planters work, you need to concentrate on:

- coulter setup
- uniformity of seeding depth and placement
- weight.

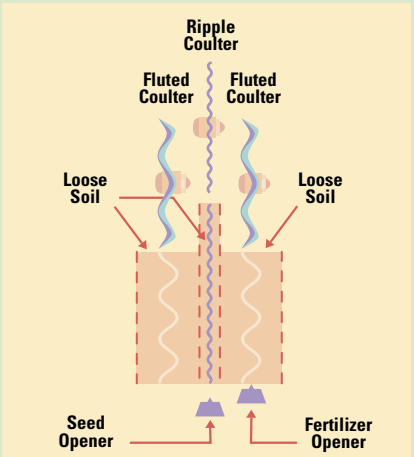
Ensure the planter is adjusted for field conditions.



The components of a no-till planter. The coulters till the soil for seed and fertilizer placement. The row cleaner moves residue from the row.

PLANTING EQUIPMENT

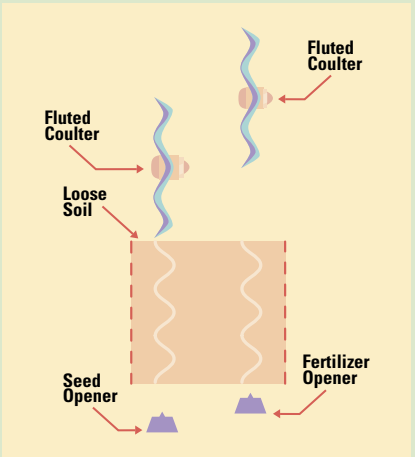
COULTER SETUP AND SELECTION



3-Coulter System

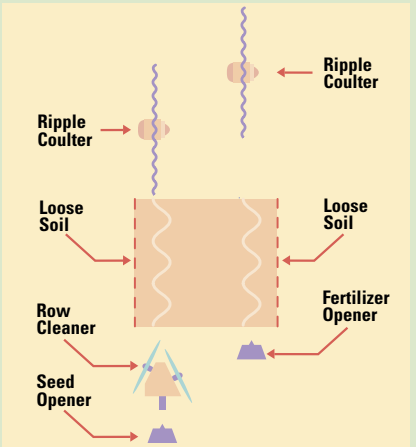
Two outside coulters are at least 5 cm (2") away from the seed zone. A fertilizer shoe or knife may follow one or each. The centre coulter (in line with seed opener) ensures the seed slot opener places seed at the proper depth, in tilled soil that is clear of residue. Tips:

- the centre coulter should lead the other two coulters
- planter speed must be adequate to move residue off row.



2-Coulter System

The two coulters used are set closer together so the tilled zone is narrower. Coulters with left and right arms allow residue to flow between them more easily.



Coulter Plus Row Cleaner

This system normally uses two coulters. If fertilizer units can penetrate untilled soil, only one coulter is needed. This system uses bubble, fluted or ripple coulters. The tilled zone is narrow (with two coulters). Residue is removed by row cleaners mounted on the seeding unit. The configuration you choose will depend on the type of residue on the soil.

PLANTING EQUIPMENT

COULTER BLADE SELECTION

In a **2-coulter system:**

- ▸ choose 5 cm (2") fluted coulters for a wider tilled zone
- ▸ a 3 cm (1") fluted coulter will till a narrower zone and leave a finer seedbed.

A combination can be used, e.g., a 3 cm (1") fluted coulter in front of the starter fertilizer, and a 5 cm (2") fluted coulter for nitrogen application.

In a **3-coulter system:**

- ▸ a 5 cm (2") fluted lead coulter will throw residue farther but won't throw much soil
- ▸ two 3 cm (1") fluted coulters would follow
- ▸ different coulter combinations can also be used
- ▸ a row cleaner may be added to this system but may be too aggressive under most conditions.

Using 2 coulters and row cleaner:

- ▸ 3 or 5 cm (1" or 2") fluted coulter is in front of the starter fertilizer
- ▸ 24-25 wave blade or ripple coulter is in front of the seed opener.

If the coulter is not located in front of the seed opener, then use a 1" or 2" coulter as in the 2-coulter system. A third coulter could be added to this system.

COULTER DEPTH AND ARRANGEMENTS

Coulters should till soil to the desired width and depth. Some farmers till a seedbed 3" wide and 5" deep. Others till 8" to 10" wide and 6" deep. As the amount of tillage increases, so do equipment cost, planter weight and horsepower requirements. It is important to avoid more tillage than necessary for crop conditions.

Easy adjustment is also important as soil conditions change from field to field and within a field – hydraulic adjustable coulter bars are an advantage.

Mount tillage coulters on a toolbar, not on seeding units. Seeding units are the precision part of the planter and should not be subjected to abuse.

In a 2-coulters/row cleaner and 3-coulter system:

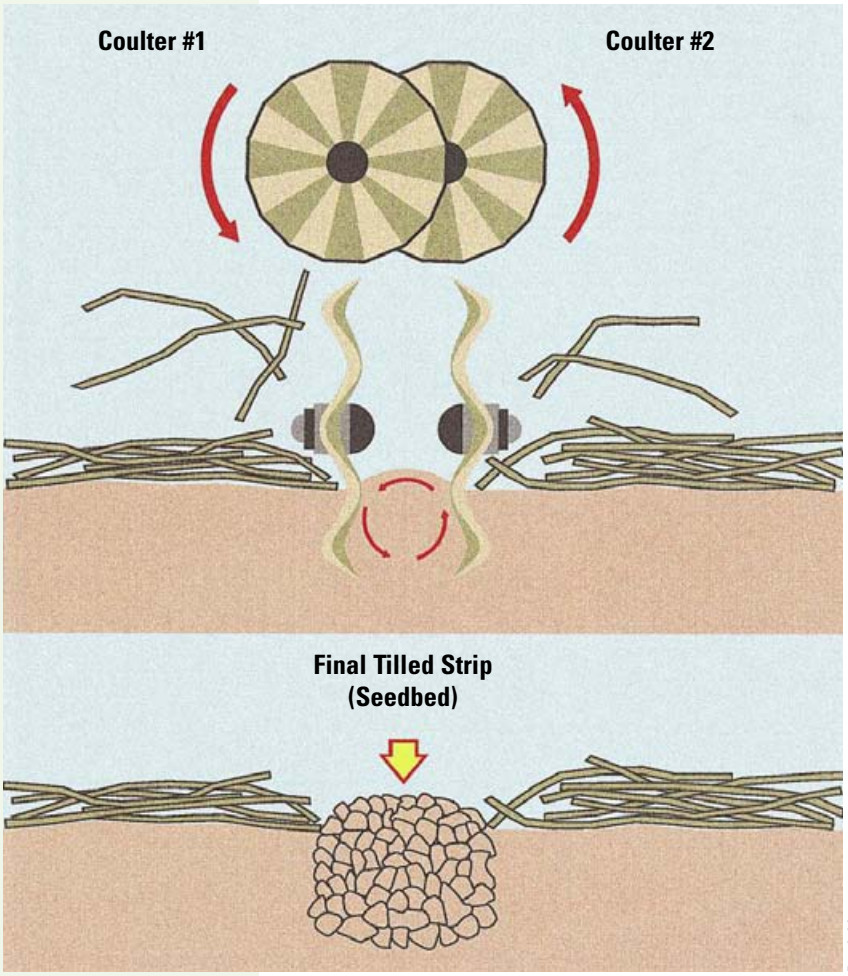
- ▸ when the coulter is in line with the seed and there is no further tillage (i.e., no coulters behind and to the side of it) then the coulter should be set no deeper than 1 cm ($^1/_2$") below seed depth
- ▸ tillage coulters should be set to run as deep as dry soil or as deep as desired
- ▸ when a coulter is in line with the seed, and tillage coulters follow, then set the coulter to run as deep as dry soil.

Peter Johnson of the Ontario Ministry of Agriculture, Food and Rural Affairs explains the importance of proper coulter selection and setup to achieve a good stand.

SETUP TIP

When mounting coulters for the first time, drop the planter down until the parallel linkage is level. Then measure from the toolbar and add an amount equal to the depth the coulters will run. Test in the field.

PLANTING EQUIPMENT



Don Lobb

Coulters in action creating a seedbed. Soil is crumbled between them and residue is thrown from the row area.

WHY OFFSET TILLAGE COULTERS?

Coulter #1 is rotating up at the same point where Coulter #2 is rotating down because Coulter #1 is mounted ahead of Coulter #2.

Opposing rotating directions due to offset coulters cause the soil to be rolled and crumbled between the coulters. This creates good soil loosening with minimal soil being thrown from the seedbed by the coulters, particularly when coulters with narrow waves or ripples are used.

The final seedbed is in a condition similar to that of conventional tilled soil – hence a good seed environment and no need for abuse of precision-planting components. Excessive down pressure and cast-iron press wheels are usually not needed.

PLANTING EQUIPMENT

RESIDUE FLOW

COULTERS

Residue flow through multiple coulters can be improved by:

- using right and left coulter arms to avoid obstructions between close coulters
- staggering coulters, which makes plugging less likely and also improves soil crumbling between coulters.

Coulters must cut residue effectively to avoid plugging, so they must be kept sharp. Sharpen with a grinder. Deeper tillage requires larger diameter coulters to avoid pushing residue in front of them.

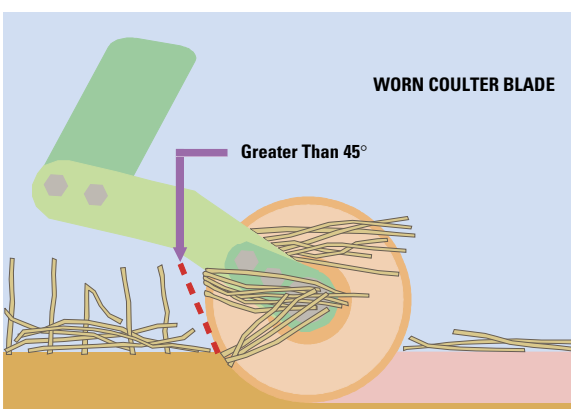
SEED UNITS

Residue flow can be improved by staggering the seed units.

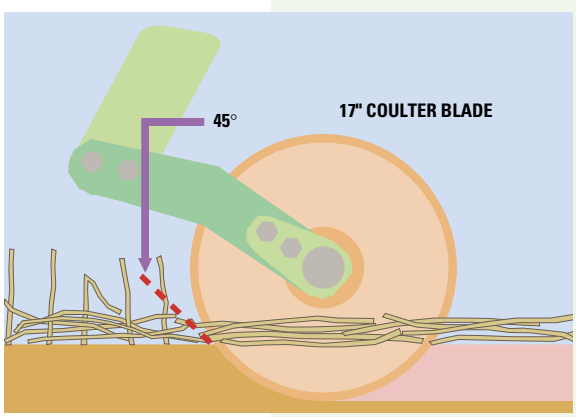
WEIGHT

Additional weight is often needed to:

- resist upward lift of the frame by coulters – when the soil is hard or dry, the coulters may not penetrate the soil to the desired depth, which may prevent planting units from planting at the desired depth
- keep drive/gauge wheels in good contact with the soil to avoid slippage.



Replace coulters when they start to push residue.



A coulter that is not worn will have the proper angle to cut residue.

PLANTING EQUIPMENT

WEIGHT REQUIREMENTS

The amount of required weight will depend on:

- ▸ number of rows
- ▸ number and type of coulters per row
  - ▷ coulters with long cutting edges, such as fluted coulters, require more weight for penetration than straighter blades
  - ▷ use the fewest tillage coulters possible to achieve necessary tillage effect – each coulter added increases the weight, power requirement and costs
- ▸ soil conditions
- ▸ wheel configuration of planter frame
- ▸ coulter location on the frame.

Adequate planter weight is necessary to ensure coulter penetration in hard dense soil, often as much as 400 pounds per coulter. Planter frame strength is important to withstand this stress.

POSITIONING OF WEIGHTS

Mount coulters toward the front of the planter and add weight toward the rear of the planter to reduce the total weight and power requirement.

Correct Positioning of Weights on a No-till Planter for Coulter Penetration

The planter frame is really a simple lever, hinged at the tongue of the drawbar. To minimize horsepower requirements, you will want to know where to place the minimum additional weight for the maximum effect.

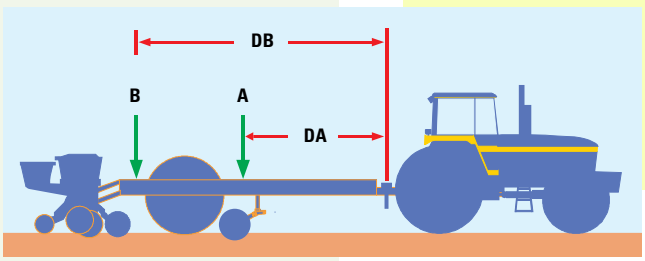
The following is the equation used to calculate the effect of a weight placed at different points on a planter.

$F_B \times DB = F_A \times DA$ Where F_B = 1000 lbs

F_A = $(F_B \times DB)/DA$ DB = 15'

= $(1000 \times 15)/10$ F_A = unknown force

= 1500 lbs DA = 10'



Placed at point A, 455 kg (1000 lbs) will put 455 kg of force on the coulters. The same weight at point B will put 680 kg (1500 lbs) of force on the coulters.

PLANTING EQUIPMENT

FERTILIZER PLACEMENT ATTACHMENTS

FERTILIZER FORM	FUNCTION	TYPE OF ATTACHMENT	COMMENTS
DRY	• to place fertilizer beside and below the seed	• single disc opener	• disc cuts residue
		• coulter and double disc	• offset discs work better • the disc angle should not be too wide
		• coulter and knife	• this setup is prone to plugging with residue and small stones
		• coulter and fertilizer tube	• this setup relies on the fluted coulter to incorporate the fertilizer (incorporation may not be as deep as desired)
	• to place fertilizer with the corn seed	• insecticide unit	• fertilizer is placed in the seed trench (granule size is a consideration)
LIQUID	• to place fertilizer beside and below the seed • to place pop-up fertilizer with the seed	• coulter and injector • fertilizer tube	• fertilizer is injected in the slot opened by the coulter

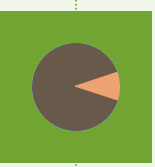
The coulter must cut residue to allow proper placement of fertilizer.

Note: Make sure fertilizer is placed a sufficient distance from the row, and safe rates are used.

TROUBLESHOOTING NO-TILL PLANTER EQUIPMENT

PROBLEM	CAUSE	SOLUTION
SHALLOW SEED/FERTILIZER PLACEMENT	• poor coulter penetration	• add weight to the planter frame • adjust tillage coulter depth • change type of coulter – a narrower coulter is easier to get into the ground • avoid planting when the soil is too dry • ensure coulters are sharp
	• poor tracking of seed/fertilizer unit	• line up tillage coulter with fertilizer or seed opener • monitor parallel linkage for wear, as this can affect coulter and seed unit alignment • on coulter caddies, a wider, more aggressive coulter may be necessary
	• planter unit bounce	• install oscillating depth stops on gauge wheels • increase seed unit downward pressure • increase width of tilled zone • keep hoppers full • reduce planting speed

PLANTING EQUIPMENT



TROUBLESHOOTING NO-TILL PLANTER EQUIPMENT, cont'd.

PROBLEM	CAUSE	SOLUTION
SHALLOW SEED/FERTILIZER PLACEMENT	• poor seed unit penetration	• adjust seeding depth of unit • adjust spring pressure on the unit and/or the press wheel(s) • adjust depth of tillage coulters • align tillage coulters with openers • increase width of tilled zone
	• worn double disc openers	• check double disc wear and replace when diameter is less than 1" of normal • compensate for the smaller diameter by adjusting depth stops • replace worn discs
POOR SEED TRENCH CLOSURE	• inadequate firming of soil	• increase downward pressure on press wheel • change to a narrower press wheel or wider tilled strip • change coulters to till wider area (more coulters)
	• soil too wet	• plant when the soil is at proper moisture • use a burndown to speed soil drying • install tile drainage to improve variable soil moisture conditions • bale and remove cereal straw • pre-tillage
ERRATIC SEED DROP/SKIPS	• slipping drive wheel/coulter	• add weight to the planter • add fluid to the drive wheel • change to a more aggressive drive wheel/coulter • reduce down pressure on seed units • use fewer tillage coulters
SEED PLACED TOO DEEP	• tillage coulters set too deep • planter units running too deep	• raise the coulters up • adjust depth setting on the units • add pressure to the press wheels • remove weight from the planter
RESIDUE PLUGGING	• poor residue flow	• there should be adequate space between seed units, press wheels, lift wheels etc. to allow for good residue flow
	• too much residue	• plant between the old rows • remove the straw from cereal fields • spread residue evenly at harvest
	• residue not cut	• match coulter size to depth of cut • make sure coulter blades are sharp • delay planting until residue is dry • adjust coulter depth
EXCESSIVE HORSEPOWER REQUIREMENTS	• tillage coulters or row cleaners set too deep • too much coulter tillage	• raise tillage coulters • raise row cleaners to just clear residue from the row • use fewer coulters • till shallower

PLANTING EQUIPMENT

RIDGE TILL PLANTERS

Ridge till planters clear the tops of ridges of residue and a small amount of soil, and move them into valleys between the ridges. Row-crop cultivators provide subsequent weed control. There are several ways to clear the top of ridges, as outlined on page 20 and in *Field Crop Production* (Best Management Practices).

EQUIPMENT CONSIDERATIONS FOR NARROW-ROW CORN

Narrow-row corn is considered any row width less than the 28" to 36". Much of the work done by researchers and farmers over the past few years has concentrated on the effects of narrowing rows. But little attention has been paid specifically to no-till narrow-row corn.

Consider the following:

- narrow rows mean less space between rows for residue flow
- nitrogen application options are limited
- the additional residue may impact the following crop.

Be sure that someone is examining components and setup after each field.

Many ridge tillers are no-tilling on the ridge with the 2-coulter and row cleaner setup.

WEED CONTROL

One of the biggest obstacles to the adoption of no-till is the perception that you grow weeds – not crops. Weeds aren't necessarily worse or more difficult, but the situation is different.

Understanding change in the soil seed bank, weed spectrum, and weed control practices is the key to effective weed control in a no-till system.

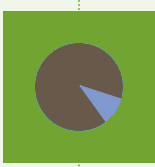
The **no-till seedbed** and **weed bank** differ from the conventional situation in these ways:

- weed seeds stay on or near the surface where they are subject to predation, extreme cold, desiccation and decomposition
- over time and with management, the number of annual weed seeds in the germination zone is reduced
- the minimal soil disturbance favours the local spreading of deep-rooted perennials and winter annuals, making them easier to control.

Weeds are different in no-till. Generally, the **weed spectrum** will change in these ways:

- in the first year of no-till, annuals and perennials can be a problem
- in Year 2, the number of annual weed seeds is reduced by natural and cultural means
- in Year 3, the perennials, biennials and winter annuals peak. But with burndown control (discussed later), their numbers are also reduced.

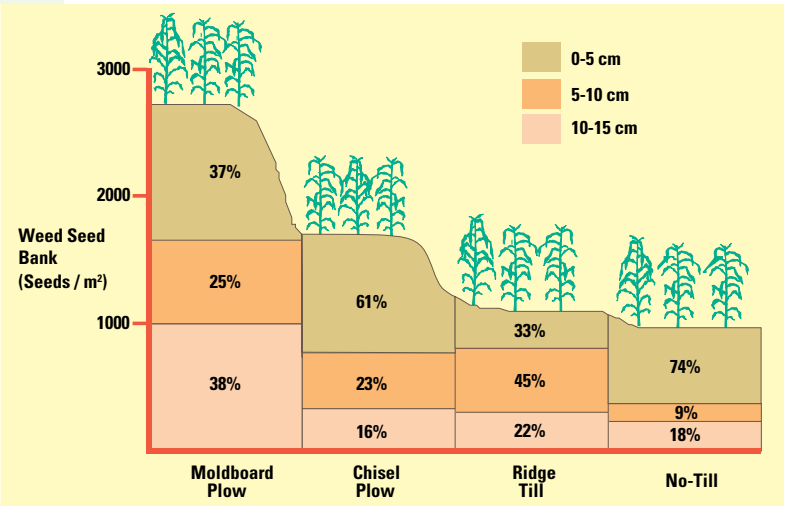
Dr. Clarence Swanton of the University of Guelph found that up to 90% of weed seeds on the soil surface in no-till systems was lost to insects, wildlife, and weather.



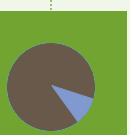
Weed Control

In no-till, good weed control gets better and poor weed control gets worse.

WEED CONTROL



Shown here are the effects of tillage methods on depth and population of weed seeds.



Weed Control

WEED CONTROL STRATEGIES

In no-till you lose two tools: the use of tillage and pre-plant incorporated herbicides. However, you are not spreading weeds with tillage.

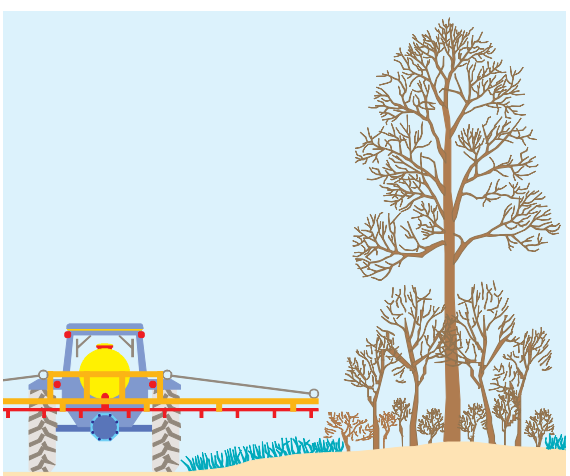
Other weed management tools remain, but the strategy changes.

PREVENTATIVE MEASURES

Use weed-free seed sources. Well-cleaned or certified seed is best.

Control weed sources at field perimeters, but be careful not to kill sod borders or wildlife habitat in fencerows.

Scout fields and keep records: help prevent local problems from spreading.



Preventing the invasion of weeds from treed fencerows is an important preventative measure. However, wildlife trees and shrubs should not be killed as well.

WEED CONTROL

CULTURAL METHODS

Rotate crops – changing crops each year will prevent many weeds from getting established, provide more competition, and allow herbicide rotation.

Manage residue – even distribution of residues at harvest will create an even cover over the field, reducing weed seedling establishment.

Plant cover crops – cover crops that are planted or grow (i.e., red clover) after harvest will crowd out weeds.

The three most important measures for weed control in no-till are burndown, burndown and burndown.

Jim Shaw, weed scientist and farmer, Kent County

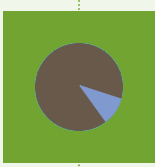
MECHANICAL METHODS

Cultivation – inter-row cultivation can be combined with sidedress nitrogen applications and chemical controls.

CHEMICAL METHODS

Pre- and post-emergence are still useful herbicide application techniques in no-till systems. Residual pre-emergence herbicides can be combined with burndown herbicides. Post-emergence treatments can target the weeds that are present. Refer to OMAFRA *Publication 75* and the label for proper timing of post-emergent herbicides. Remember: in no-till, almost all herbicide is applied post-emergent for some weeds, regardless of the crop stage.

Burndowns are the single most important chemical control method. They can be applied to emerged weeds before, during or after planting.



Weed Control

Burndown: a non-selective herbicide treatment to remove all existing vegetation.

PRINCIPLES AND ADVANTAGES OF BURNDOWN TREATMENTS

The primary objective of a burndown is to remove all existing living vegetation so that the soil warms up earlier and when the crop emerges, it has no competition. Weeds that emerge before the crop are the most competitive. They must be controlled by a burndown. Weeds that emerge later than the crop are not as competitive as those that emerge at the same time as the crop. Burndowns are applied:

- in the fall to control perennial weeds, red clover, perennial forages, volunteer cereals, etc.
- in the spring to kill existing vegetation before crop emergence (annual and winter annual weeds).

Choose the appropriate burndown and rate to match the weed spectrum present in the field.

Care must be taken to ensure that the burndown herbicide being applied does not drift onto neighbouring crops, especially horticultural crops. All hydraulic nozzles produce some fine droplets that can move off-target, even with a gentle breeze.

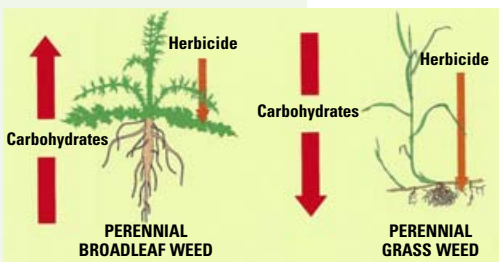
WEED CONTROL

A burndown herbicide must be broad spectrum, without leaving residual product in the soil that could cause problems for the crop. It also has to be cost-competitive. Ideally, the burndown product should be translocated to have a potent effect on perennial weeds. Common burndown products have minimal or negligible impact on ground water quality or wildlife.

Refer to the Conservation Tillage section of OMAFRA *Publication 75* for more information on burndown treatments.

PERENNIAL WEED CONTROL

Spring burndown treatments are most effective at controlling established perennial grasses. Established perennial broadleaf weeds are at the wrong stage of development, with the exception of dandelions. Stored sugars are being moved upwards from stored reserves to support new shoot growth. Translocated burndown chemicals work best when materials move in the opposite direction – shoot to roots. Broadleaves are more susceptible at bud to flowering, when plant sugars move downward to roots and other underground storage organs.



Spring burndown treatments are more effective on quackgrass and less effective on perennial broadleaf weeds than later season applications. That's because translocated burndown chemicals work best when materials move from shoot to roots.

For consistent results, the next best time to treat perennials is towards the end of the growing season (pre- or post-harvest). Perennials respond to day length and temperature fluctuations. These are the triggers that induce them to store energy for winter survival. The plant has produced seed and is finished growing. All photosynthates are moving towards the roots for overwintering. The weed will move herbicide into the root system and go into the winter in a weakened state. If the herbicide doesn't kill it, chances are the winter will.

Weed Control

ABOUT THIS TABLE

The next table is designed to help no-tillers control or suppress a number of weeds. The information was gathered from the label, researchers, industry personnel and farmer experience. Once you identify the weed that you wish to control, look in the table for which products may work. Then look in OMAFRA *Publication 75,* read the label, and talk to the company representative or a ministry crop advisor for rates, timing of application and other information regarding control of that weed.

The Ontario Ministry of Agriculture, Food and Rural Affairs and Agriculture and Agri-Food Canada do not offer any warranty or guarantee and they do not assume any liability for any crop loss, animal loss, personal injury and environmental hazard caused by the use of a pesticide mentioned in this publication.

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL

WEEDS GERMINATING FROM SEED	EMERGED SEEDLINGS TO MATURE PLANTS

SPREADING ATRIPLEX (ANNUAL)

Key characteristics are:
- reproduces only by seed
- similar to lambsquarters
- leaves opposite each other near the base only.

To control in corn:
- choose from many soil-active pre-emergence broadleaf herbicides.

To control in soybeans:
- choose from many soil-active pre-emergence broadleaf herbicides.

Key characteristic is:
- unlike lambsquarters, each flower is enclosed between green, triangular to diamond-shaped bracts.

To control in corn:
- Roundup (pre-crop emergence)
- Pardner
- 2,4-D, Banvel, Kil-Mor, Shotgun.

To control in soybeans:
- Roundup (pre-crop emergence)
- Blazer + Basagran (on small seedlings).

COMMON CHICKWEED (ANNUAL OR WINTER ANNUAL)

Key characteristics are:
- reproduces by seed and leafy stems that root at the nodes to form dense patches
- leaf blades are oval with pointed tips.

To control in corn:
- Atrazine, Bladex (pre or post)
- Striker (pre or post)
- Fieldstar (pre or post).

To control in soybeans:
- Sencor, Lexone (pre-emergence)
- Afolan, Linuron, Lorox (pre-emergence)
- Afesin (pre-emergence)
- Pursuit (pre-emergence).

Stems of mature plants are prostrate, spreading or nearly erect, 5-50 cm (2-20") long.

Key characteristics are:
- small, white flowers throughout the growing season.

To control in corn:
- Roundup (burndown late fall or before crop emergence in spring)
- Bladex
- Laddok
- Atrazine + oil
- Marksman, Banvel, Clarity.

To control in soybeans:
- Roundup (burndown late fall or before crop emergence in spring)
- Sencor, Lexone (pre-crop emergence)
- Afolan, Linuron, Lorox+oil (pre-crop emergence).

To control in wheat:
- Refine Extra (post)
- Buctril M (post).

CANADA FLEABANE (WINTER ANNUAL OR ANNUAL)

Key characteristic is:
- reproduces by seed.

To control in corn:
- choose from many soil-active pre-emergence broadleaf herbicides.

To control in soybeans:
- Broadstrike Dual
- choose from many soil-active pre-emergence broadleaf herbicides.

Note: Pursuit removes the main growing point, causing the plant to develop multiple stems from auxiliary buds.

Key characteristics are:
- stems of established plants are tall (1-1.8 m) and hairy with few branches
- flowers are yellow green, 3-5 mm wide and are found at the top of the stem.

To control in corn:
- Roundup (burndown before crop emergence)
- Touchdown (burndown before planting)
- Striker (post) • Fieldstar (post)
- post – Banvel, Kil-Mor, 2,4-D.

To control in soybeans:
- Roundup (burndown before crop emergence)
- Touchdown (burndown before planting).

To control in wheat:
- post – Buctril M, Kil-Mor, Banvel, 2,4-D.

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL, cont'd.

WEEDS GERMINATING FROM SEED	EMERGED SEEDLINGS TO MATURE PLANTS

PROSTRATE AND STRIATED KNOTWEED (ANNUAL)

Key characteristics are:
- reproduces from seed only
- leaves are alternate, broad in middle and narrow at both ends
- stems are thin, wiry, prostrate, up to 1 m long.

To control in corn:
- choose from many soil-active pre-emergence broadleaf herbicides
- Bladex.

To control in soybeans:
- choose from many soil-active pre-emergence broadleaf herbicides.

Note: Harder to control once plant is greater than 8-10 cm in diameter.

Key characteristics are:
- forms a deep tap root
- small flowers found where leaf joins stem.

To control in corn:
- Roundup (burndown before crop emergence)
- Touchdown (burndown before planting)
- Marksman (post) • Laddok (post)
- Banvel (post) • Atrazine (post)
- Bladex (post).

To control in soybeans:
- Roundup (burndown before crop emergence)
- Touchdown (burndown before planting)
- Blazer (post)
- Blazer+Basagran (post)
- Basagran (post).

PRICKLY LETTUCE (ANNUAL, WINTER ANNUAL OR BIENNIAL)

Note: A large percentage of the population is naturally resistant to Pursuit.

Key characteristics are:
- reproduces from seed only
- variable-shaped leaves have deep lobes that curve backwards and have spiny midribs.

To control in corn:
- choose from many soil-active pre-emergence broadleaf herbicides.

To control in soybeans:
- choose from many soil-active pre-emergence broadleaf herbicides.

Key characteristics are:
- stems are erect and tall 1.5 m (5')
- fine tufty yellow flowers from June to late fall.

To control in corn:
- Roundup (burndown before crop emergence)
- Touchdown (burndown before planting)
- Marksman (post)
- post – Atrazine, Laddock
- post – 2,4-D, Banvel, Kil-Mor.

To control in soybeans:
- Roundup (burndown before crop emergence) • Touchdown (burndown before planting)
- Blazer + Basagran (post).

FIELD VIOLET (ANNUAL)

Key characteristics are:
- reproduces only from seed
- leaves of young plants are very small with long stalks, rounded blades, and a few shallow teeth.

Key characteristics are:
- stems erect, short or multi-branches, 30 cm (12")
- white and yellow flowers on long thin stalks found from early May to autumn.

To control in corn:
- post – Banvel, Clarity, Marksman.

To control in soybeans:
- Blazer (post).

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL, cont'd.

WEEDS GERMINATING FROM SEED

EMERGED SEEDLINGS TO MATURE PLANTS

FIELD BINDWEED (PERENNIAL)

Key characteristics are:
- reproducing by seed and by extensively spreading whitish, underground roots
- arrowhead-shaped leaves
- slender, smooth stems that grow prostrate or vine-like.

Key characteristics are:
- flowers on long stalks, white or pink, 2.5 cm (1") diameter, funnel-shaped.

To control in corn:
- Kil-Mor
- Banvel, Clarity
- Caliber, Cobutox, Embutox, Tropotox Plus
- Ultim
- Roundup (spot treatment, or post-harvest)
- Touchdown (spot treatment or post-harvest).

To control in soybeans:
- Roundup (spot treatment, pre-harvest, post-harvest)
- Touchdown (spot treatment or post-harvest)
- Blazer, Basagran (suppression).

To control in wheat:
- Roundup (pre-harvest, post-harvest)
- Touchdown (post-harvest)
- post harvest – Banvel, Clarity, Kil-Mor, Tropotox Plus, Caliber, Cobutox, Embutox, 2,4-D.

DANDELION (PERENNIAL)

Key characteristic is:
- reproduces only by seed.

To control in corn:
- Marksman
- Atrazine.

To control in soybeans:
- Sencor, Lexone
- Afolan, Linuron, Lorox
- Pursuit.

Farmer experience says that Roundup + Pursuit or Roundup followed by a post application of Pursuit + Basagran is effective.

Fall applications are generally more reliable than spring applications. The control of this weed in the spring is dependent on a burndown followed by a residual herbicide that has some activity on the weed.

Key characteristics are:
- bright yellow flowers
- white seed heads.

To control in corn:
- Kil-Mor • Ultim
- Marksman
- Roundup, Touchdown, Amitrol-T (burndown late fall or before crop emergence in spring).

To control in soybeans:
- Amitrol-T (burndown or post-harvest)
- Roundup (burndown late fall or before crop emergence in spring, post-harvest or pre-harvest)
- Touchdown (burndown in fall, or before planting or post-harvest).

To control in wheat:
- Amitrol-T (burndown before planting or post-harvest)
- Roundup (burndown before crop emergence, pre- or post-harvest)
- Touchdown (burndown before planting or post-harvest)
- Kil-Mor (spring-suppression)
- Spring (suppression)-Caliber, Cobutox, Embutox, Tropotox Plus
- 2,4-D (spring-suppression or post-harvest).

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL, cont'd.

WEEDS GERMINATING FROM SEED	EMERGED SEEDLINGS TO MATURE PLANTS

DOGBANE (PERENNIAL)

Key characteristics are:
- spreads by seed and underground in rhizomes
- leaves are opposite, oblong and drooping.

To control in corn:
- choose from many soil-active pre-emergence broadleaf herbicides.

To control in soybeans:
- choose from many soil-active pre-emergence broadleaf herbicides.

Key characteristics are:
- stems are slender and smooth
- flowers are in bunched clusters.

To control in corn:
- Kil-Mor, Banvel – apply as late as possible (drop pipes)
- Roundup (spot treatment)
- Touchdown (spot treatment).

To control in soybeans:
- Roundup (pre-harvest, spot treatment or wick wiper)
- Amitrol-T (spot treatment or wick wiper)
- Touchdown (spot treatment or wick wiper).

GOLDENROD (PERENNIAL)

Key characteristic is:
- reproduces by seed and rhizomes.

This is a tough weed. Control will be improved with a burndown, followed by a residual herbicide that has some activity on the weed.

Key characteristics are:
- 20-200 cm high
- branching only in upper part.

To control in corn:
- high rates of Banvel (split application)
- Banvel + Phenoxy mixtures
- high rates of Amitrol-T, Roundup, Touchdown (spot treatment).

To control in soybeans:
- high rates of Amitrol-T (spot treatment)
- high rates of Roundup (spot treatment or pre-harvest)
- high rates of Touchdown (spot treatment).

To control in wheat:
- post-harvest Estaprop, Dichlorprop-D, Turboprop.

HORSETAIL (PERENNIAL)

Key characteristics are:
- young plants emerge from blackish rhizomes found up to 1 m (3 1/3') below the soil
- young shoots are light-coloured, hollow and jointed.

While horsetail tolerates most herbicides, farmers have had some success with Striker + Ultim.

Key characteristics are:
- shoots are green, slender, erect hollow stems with branches but no leaves
- resembles small pine tree.

To control in corn:
- Ultim • Striker • MCPA
- Elim.

To control in soybeans:
- Amitrol-T (high rate, burndown before crop emergence)
- Linuron + oil (high rate) + 28% N (burndown before crop emergence)
- Blazer (post).

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL, cont'd.

WEEDS GERMINATING FROM SEED	EMERGED SEEDLINGS TO MATURE PLANTS

MILKWEED (PERENNIAL)

Key characteristics are:
- reproduces from seed or shoots emerging from undergound roots
- opposite leaves are tapered, oblong, and have pointed tips and smooth edges.

To control in corn:
- choose from many soil-active pre-emergence broadleaf herbicides.

To control in soybeans:
- controlled by many soil-active pre-emergence broadleaf herbicides.

NOTE: Pre-harvest Roundup is a good option in wheat.

Key characteristics are:
- tall (1-2 m), erect stems with whorled branches at top
- flowers are white to purplish
- seed pods are green and warty.

To control in corn:
- Ultim + Banvel, Ultim + Pardner
- Marksman • Pardner, Atrazine
- Banvel • Kil-Mor • Roundup (spot treatment)
- Touchdown (spot treatment).

To control in soybeans:
- Amitrol-T
- Roundup, Touchdown (wick wiper, spot treatment)
- Blazer, Blazer + Basagran (suppression).

YELLOW NUTSEDGE (PERENNIAL)

Key characteristics are:
- reproduces from seed and rhizomes
- leaves are shiny, grass-shaped.

To control in corn:
- early pre-emergence – Dual, Frontier.

To control in soybeans:
- early pre-emergence – Broadstrike Dual
- early pre-emergence – Dual, Frontier.

Key characteristic is:
- stems are triangular.

To control in corn:
- Laddok (post) • Basagran (post)
- Atrazine + oil (post).

To control in soybeans:
- Pursuit + Basagran (post)
- Pursuit (post)
- Basagran (post).

ORCHARD GRASS (PERENNIAL)

Key characteristic is:
- reproduces from seed or emerges from clumps.

To control in corn:
- many soil-active pre-emergence grass herbicides.

To control in soybeans:
- controlled by many soil-active pre-emergence grass herbicides.

Key characteristics are:
- stems are flat and 90-150 cm tall.

To control in corn:
- high rates of Roundup, Touchdown – fall application (best) or burndown before crop emergence.

To control in soybeans:
- high rates of Roundup, Touchdown – fall application (best) or burndown before crop emergence.

QUACKGRASS (PERENNIAL)

Key characteristics are:
- spreads by light-coloured underground stems that have hard, white, sharp-pointed tips and seeds
- leaves are flat, nearly smooth.

To control in corn:
- choose from many soil-active grass herbicides.

To control in soybeans:
- choose from many soil-active grass herbicides.

Key characteristics are:
- may form a green fluorescent spike
- stems are erect 30-120 cm (1-4 ft.) tall.

To control in corn:
- Roundup, Touchdown (burndown before crop emergence, spot treatment or post-harvest)
- post – Ultim, Elim EP.

To control in soybeans:
- Assure • Venture • Select
- Roundup (burndown before crop emergence, spot treatment, pre- or post-harvest)
- Touchdown (burndown before planting, spot treatment or post-harvest).

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL, cont'd.

WEEDS GERMINATING FROM SEED	EMERGED SEEDLINGS TO MATURE PLANTS

RYEGRASS (PERENNIAL)

Key characteristics are:
- grows as a bunch grass, not from rhizomes.

To control in corn:
- choose from many soil-active pre-emergence grass herbicides.

To control in soybeans:
- choose from many soil-active pre-emergence grass herbicides.

Use the full rate of Roundup in the fall.

Key characteristics are:
- has stems and heads about the size of quackgrass
- only one fluorescent stalk.

To control in corn:
- Roundup, Touchdown (burndown before crop emergence, spot treatment or post-harvest).

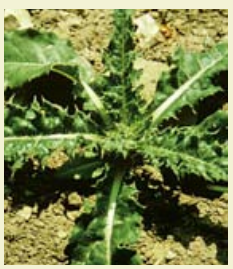
To control in soybeans:
- Roundup (burndown before crop emergence, spot treatment, pre- or post-harvest)
- Touchdown (burndown before planting, spot treatment or post-harvest)
- post – Assure, Venture, Select.

CANADA THISTLE (PERENNIAL)

Key characteristics are:
- reproduces from seed and by horizontal roots, which produce new shoots, often forming dense patches
- leaves more or less lobed, spiny and alternate
- stems erect, 20-150 cm (1-5') high, branched, slender, smooth.

To control in corn:
- choose from many soil-active broadleaf herbicides.

To control in soybeans:
- choose from many soil-active broadleaf herbicides.



Note: This weed is controlled best in corn or wheat.

Key characteristics are:
- flower heads are numerous, purple or sometimes white.

To control in corn:
- post – Striker, Banvel/Clarity, Kil-Mor
- post – Tropotox Plus, Caliber, Computox, Embutox
- Roundup, Touchdown (spot treatment).

To control in soybeans:
- Roundup (burndown before crop emergence, spot treatment or pre-harvest)
- Touchdown (burndown before planting or spot treatment)
- Blazer • Amitrol-T (burndown before crop emergence)
- Basagran + Blazer • Basagran.

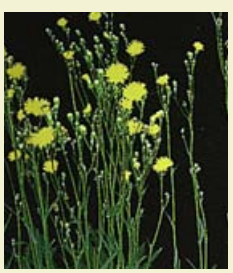
To control in wheat:
- Roundup (pre- and post-harvest)
- Touchdown (post-harvest)
- post-harvest Banvel, Clarity, Kil-Mor, Tropotox Plus, Caliber, Combutox, Embutox, 2,4-D.

SOW THISTLE (PERENNIAL)

Key characteristics are:
- reproduces from germinating seeds and from buds on underground roots
- leaves are similar to dandelion
- stems are erect – up to 1.5 m.

To control in corn:
- choose from many soil-active broadleaf herbicides.

To control in soybeans:
- choose from many soil-active broadleaf herbicides.



The burndown treatment will not give season-long control.

Key characteristics are:
- bright yellow flowers
- up to 4 cm across.

To control in corn:
- post (drop pipes) – Banvel, Clarity, 2,4-DB, 2,4-D
- Marksman (post, drop pipes)
- Roundup, Touchdown (spot treatment).

To control in soybeans:
- Roundup (spot treatment, pre-harvest)
- Touchdown (spot treatment) • Blazer.

To control in wheat:
- Roundup (pre-harvest and post-harvest)
- Touchdown (post-harvest)
- Banvel, Clarity, 2,4-DB, 2,4-D (post-harvest).

WEED CONTROL

PROBLEM WEED CONTROL IN NO-TILL, cont'd.

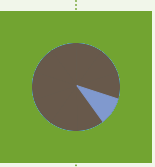
WEEDS GERMINATING FROM SEED	EMERGED SEEDLINGS TO MATURE PLANTS
WILD CARROT (BIENNIAL, SHORT-LIVED PERENNIAL)	
 **Key characteristics are:** • seedlings emerge throughout the season with two long cotyledons • first true leaf has three main divisions. **To control in corn:** • choose from many soil-active broadleaf herbicides • Striker • Fieldstar. **To control in soybeans:** • Broadstrike Dual • Pursuit.	 **Key characteristics are:** • second year stem erect 1 m • deeply penetrating tap root • large compound white flower. **To control in corn:** • Amitrol-T, high rates of Roundup, Touchdown (burndown, spot treatment). **To control in soybeans:** • Amitrol-T (burndown) • Roundup (burndown, spot treatment or pre-harvest) • Touchdown (burndown before planting or spot treatment).
WIRESTEM MUHLY (PERENNIAL)	
 **Key characteristics are:** • reproduces by seed or by short, scaly, many branched rhizomes • stems are slender, wiry up to 100 cm long. **To control in corn:** • choose from many soil-active grass herbicides. **To control in soybeans:** • choose from many soil-active grass herbicides.	 **Key characteristics are:** • stems are many branched. **To control in corn:** • high rates of Roundup, Touchdown (spot treatment, post-harvest). **To control in soybeans:** • Roundup (burndown before crop emergence, spot treatment or pre-harvest) • Touchdown (burndown before planting or spot treatment) • Fusilade • Venture • Select • Assure. **To control in wheat:** • Roundup (pre-harvest and post-harvest) • Touchdown (post-harvest).
WOODY SPECIES (BROADLEAF TREES AND SHRUBS)	
Key characteristics are: • seedling or sprout from root collar • varied-shaped leaves from numerous sources. **See the table Susceptibility of Woody Plants to Various Herbicides and Mixtures as Foliage Spray and the Brush Control section in OMAFRA *Publication 75*. Tillage will also help to control these.** **Note: Other glyphosate products include Glyfos, Laredo, Renegade and Wrangler. Check label for registrations.**	 **Woody plants must be leafed out for control with burndown.** **Key characteristics are:** • woody stems 3 cm-1 m tall. **To control in corn:** • Banvel, Clarity • Marksman • 2,4-D • Kil-Mor • Roundup (spot treatment). **To control in soybeans:** • Roundup (spot treatment).

A number of brand names of pesticides are given in this chart as a convenience to the grower. This is neither an endorsement of the product nor a suggestion that similar products are not effective. Many of the products listed above have various formulations available. Refer to the Herbicides Used in Ontario table in OMAFRA *Publication 75*.

WEED CONTROL

Weed pressure will be greatest in the first year of no-till. Extra diligence in weed control at this time can save a lot of grief in following years.

**Don Lobb,
Huron County**



Weed Control

TIPS

CROP COMPETITION

Select crops that provide greatest competition for weed infestations.

Crops grown in narrow rows shade the ground faster and compete better with weeds.

RESIDUE MANAGEMENT & WEED CONTROL

More residue cover means fewer annual weeds. The more aggressive the tillage, the more weed seeds are planted.

CROP ROTATION & WEED CONTROL

Select crops that provide greatest competition for weed infestations.
Select crops that allow chemical family rotation.

NUTRIENT MANAGEMENT & WEED CONTROL

Feed the crop, not the weeds. Weeds benefit from broadcast fertilizers.
Band or sidedress fertilizers on no-till crops.

MECHANICAL CONTROL

Inter-row cultivation or cultivation with band spraying can reduce the amount of post- and pre-emergence product used in no-till and ridge till.

CHEMICAL CONTROL

Remember, other than the lack of tillage and pre-plant incorporated options, most chemical options remain in no-till and ridge till. Residual pre-emergents can be combined with burndown. Not all products are registered for tank mixing: check the label. Post-emergents can be combined with cultivation or nitrogen sidedress applications.

Clean up problems before they start. Use spot treatments and field border applications to prevent the spreading of weeds.

Timing is everything:

- ▸ kill perennials in field and perimeters in the fall
- ▸ kill weeds when they're small
- ▸ kill sod and clover crops in fall.

Avoid spraying over natural habitat areas such as wood-lots, windbreaks, water-courses, wetlands and wildlife corridors.

WEED CONTROL

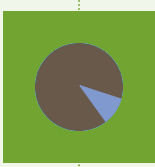
TIMING OF BURNDOWNS

		Advantages (+) or Disadvantages (–)
Before planting	+	no soil or residue to move
	+	weeds are dead at planting
	–	could be done too soon
During planting	+	saves time and money
	+	more weeds have emerged
	+	include a residual herbicide for one pass control
	–	could be too windy/dusty at planting
	–	planter may cover weeds with soil and residue
After planting	+	allows for flexibility in field operations
	–	crops could emerge before treatment
	–	drift could injure adjacent crops
	–	weeds may be covered with soil and residue

Broad spectrum burndowns with minimal residual effects are the best choice. Wait the specified time before planting after certain chemicals.

We time our spring burndown just before planting. By that time not only are the perennials established, but most of the weed seeds have already germinated.

Randy Molzan, Lambton County



SPRAYER ADJUSTMENTS

Add foam markers to the sprayer to assist with burndown application accuracy.

The sprayer should be able to work in rough conditions.

Select nozzles, water volumes, etc., to ensure good coverage of the weeds.

Foam markers help when applying burndown.

WEED CONTROL

ROW-CROP CULTIVATORS

High clearance residue cultivators may be used for no-till weed control and in the ridge till system:

- to build ridges
- for nitrogen sidedress applications
- to kill inter-row weeds.

Cautions and Considerations:

- if you disturb soil in valleys of sloping land, rills may form
- cultivation could disturb weed seed and macropores
- combine operations may be more difficult after cultivation in no-till (due to loose soil between rows, disturbed stones, etc.)
- post-emergence in-row herbicide treatments can be applied with the cultivator
- a narrow shank will move less soil.

Refer to *Field Crop Production* (Best Management Practices) for more information on row-crop cultivation.

High clearance residue cultivators may be used for no-till weed control and in the ridge till system.

INSECT MANAGEMENT

Pests normally include: weeds, insects, nematodes, fungi, rodents, bacteria, viruses, and any other organisms that attack plants and cause economic loss.

No-till crops are susceptible to the same number of pests – insects, slugs and nematodes – as conventional crops. However, with the slightly different "habitat" found in no-till, some types do better and others do not fare as well. General control methods are similar to any other cropping system. The difference is that with no-till, the pests may differ from those you're used to dealing with.

Living and dead vegetative cover creates sheltered, cooler and slightly wetter environments above and below ground for pests. Delayed emergence under these conditions may increase the risk of pest attack.

For example, cutworms and armyworms have life cycles that depend on pre-crop vegetation.

The same habitat conditions that attract pests also attract beneficial insects (e.g., wheat residue attracts beneficial spiders).

The increased diversity of animal life attracted to no-till fields also helps to keep populations of any one species in control.

Insect Management

Some farmers have found that 28% nitrogen and water sprayed on slugs in the evening is an effective control measure.

For many pests, the best control method is to keep your fields as weed-free as possible.

INSECT MANAGEMENT

BEST MANAGEMENT PRACTICES

	DESCRIPTION	DAMAGE CAUSED	CONDITIONS PREFERRED	BEST MANAGEMENT PRACTICES & TIPS
 **Black cutworm.**	Several species attack corn. The most common is black cutworm. In the larval stage, they are smooth, ranging from grey to dark brown to almost black. Moths are dull-coloured millers attracted to light.	Usually cut small plants at ground level or tunnel into the stalk of young corn plants. Before 5-leaf stage is most susceptible.	Favour late planting, preplant weed infestations, particularly winter annuals, volunteer wheat and grassy weeds and reduced tillage. Moths fly in from the south on warm days in early spring. The females are attracted to green vegetation to lay eggs.	Kill green vegetation in the fall or early spring completely to deprive insect of host. Chemical control recommended if more than 5% of plants show damage and worms are still under 2.5 cm. Granular insecticides are not recommended for cutworm control alone.
 **Wireworm.**	Larvae are thin, copper-coloured segmented worms that may reach 4 cm long.	Most often attack germinating seeds, destroying seedlings before emergence. Can also feed on roots and lower stems of emerged plants. Problem in corn and wheat.	Prefer sandy soils, particularly on eroded knolls. Most likely found in fields with history of grasses such as pastures or fields with frequent cereal crops. Worm needs 2-5 years to complete life cycle. Damage most severe in second crop year following grassy sod.	Kill all vegetation to deprive adults of homes for eggs and larvae of food. Seed treatments will protect crop as it germinates and emerges. No protection for plants after emergence. Crop rotation is a good preventative measure.
 **European corn borer.**	Larvae are whitish in colour with dark brown or black heads and black or brown spots in rows down their backs. Moths are cream-coloured and active at night.	Newly hatched larvae feed on developing leaves in the whorls before tunnelling into the plant to feed on the tassel, stalk or ear shank. Plant becomes susceptible to stalk rots and lodging.	Full-grown larvae overwinter inside the base of corn stalks. In the spring, they form cocoons and emerge as adult moths in early June.	Chemical control measures are rarely justified in field corn. Select hybrids with good standability. New hybrids with built-in Bt resistance to corn borer are now available in Canada. Bt is *Bacillus thuringiensis*, a bacterial control effective against corn borer. Area-wide stalk chopping may help to reduce corn borer populations, but will only be successful if most growers participate.

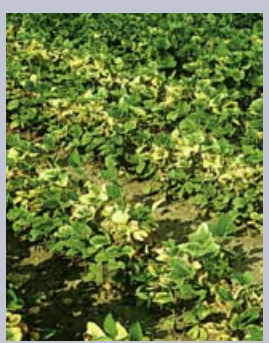
INSECT MANAGEMENT

BEST MANAGEMENT PRACTICES, cont'd.

	DESCRIPTION	DAMAGE CAUSED	CONDITIONS PREFERRED	BEST MANAGEMENT PRACTICES & TIPS
 **Spider mites.**	Tiny round 8-legged arthropods that are white, green or red in colour with dark spots on either sides of their bodies.	In soybeans, mites suck plant juices from the undersides of leaves, giving plants a sand-blasted look. Fine silky threads are spun on leaf undersides. In heavy infestations, leaves turn yellow, then brown and die.	Most numerous during hot, dry periods. Drought conditions will drive them from fencerows, too. Mites can thrive in green vegetative crops or cover crops and move onto young bean plants after spring burndown. High winds will spread them across fields.	Four or 5 mites per leaf or one severely damaged leaf per plant prior to pod fill can cause yield depression. Can spot apply insecticide to prevent spreading to rest of field.
 **Seedcorn beetle and seed corn maggot (not shown).**	Whitish spindle-shaped larvae that lack both a definite head and legs. Adults are shiny black or black with brown stripes (5-7 mm long).	Maggots tunnel into the seed and stems of seedlings. Damage appears as areas of poor stand or as weak, wilted bean seedlings. Beetles tunnel into the seeds.	Adult flies are attracted to lay eggs in soils with a decaying smell. Beetles tunnel into seeds. Muck soils, weedy fields, stubble or manure increase risk. Heavy crop residue reduces soil temperature, delaying emergence and increasing the risk. The maggots that hatch from these eggs do the damage.	If the stand is seriously damaged, replanting is the only recourse. Diazinon and Lindan applied as a seed treatment protect against seed corn maggots and beetles.
 **Potato stem borer.**	Pinkish worm. When mature, measures about 40 mm long.	Feeds on seedlings by boring into base of plant. Leaves of plant turn brown from tip downwards. Plant wilts and dies.	Overwinters as eggs on grassy weeds. Found primarily on edge of fields associated with grassy weed patches.	Control grassy weeds in fields and fencerows.

INSECT MANAGEMENT

OTHER NON-INSECT PESTS

	DESCRIPTION	DAMAGE CAUSED	CONDITIONS PREFERRED	BEST MANAGEMENT PRACTICES & TIPS
 **Slugs.**	Slugs are mollusks, related to snails and clams.	They feed on tender areas of leaves between veins, leaving shredded tissue. They feed only at night and leave shiny slime trails. They also feed on germinating seeds below ground. Damage is more serious in beans because of exposed growing points.	Need cool damp conditions, so are more of a problem in cool wet springs. Especially like clay soils. Only feed at night. Found under stones, or crop residue, or go dormant in soil during the day. If they dry out, they die.	Remove residue from crop row to dry the soil. Bale and remove wheat straw. For high risk fields, kill all vegetation in the fall. Avoid no-till soybeans in red clover residues. As macropores develop, damp slug-prone soils are less likely. No chemical control registered.
 **Soybean cyst nematode.**	Microscopic wormlike organisms – less of a problem in no-till.	Damage root system and prevent uptake of water and nutrients. Causes stunted and yellow plants in circular patterns up to 50 m in diameter. Damaged roots will be dark with few nodules. May see 1 mm white to brown cysts.	Particularly damaging on lighter soils under dry conditions.	Use pedigreed seed. Wash soil off equipment and do everything possible to reduce soil movement between fields. Rotate to non-host crops such as corn or small grains. Avoid beans or peas for 4 or 5 years.

DISEASE MANAGEMENT

Septoria on tomatoes has wind-blown spores that will infect fields if its host is not fully decomposed.

Overall, disease pressures are not worse in no-till crop production systems. You may get more upper plant diseases – something to consider if you grow horticultural crops, as this could affect crop quality. But in general, there will be fewer root diseases with time. As with weeds and insects, the no-till habitat will be favoured by those diseases that prefer cooler, wetter and less disturbed surface conditions.

Diseases that prefer the cool, moist conditions of no-till are particularly challenging on poorly drained clay soils.

Soil conditions such as seedbed structure will improve in no-till over time, and with that comes a better aerated growth environment for plant roots.

Diseases may have less impact on no-till crops. No-till soils are less drought-prone. Many diseases (especially root rots) have a greater impact on yield in droughty conditions.

Root diseases such as phytophthora prefer the cool, moist conditions of no-till, particularly on poorly drained clay soils.

The best disease treatments are **preventative.** Remember:

- good soil management reduces incidence of disease – for best management practices that improve soil structure, prevent or reduce soil compaction, as well as increase internal drainage, refer to *Soil Management* (Best Management Practices)
- seed treatment can help control of seed decay (Phomopsis), damping off
- crop rotations break disease cycles
- rotation becomes even more important with horticulture crops in order to keep disease to a minimum in no-till
- varietal selection – beyond specific disease resistance or tolerance, the key is to look for the better overall performers for your maturity zone
- good crop nutrition helps fight diseases.

Healthy crops form the best defense.

DISEASE MANAGEMENT

BEST MANAGEMENT PRACTICES

	DISEASE	CONDITIONS	IMPORTANCE	BEST MANAGEMENT PRACTICES & TIPS
CORN	Anthracnose	• warm and rainy • high residue	• affects leaves and stalk	• plant several hybrids to spread out risk • choose resistant hybrids • crop rotation
	Gibberella	• warm and wet near silking	• affects ear, seedling and stalk • mycotoxins in the grain	• crop rotation • choose tolerant hybrids • choose hybrids for your heat unit area • plant early • use a seed treatment
	Fusarium	• warm and wet near silking	• affects ear, seedling and stalk • mycotoxins in the grain	• crop rotation • choose tolerant hybrids • plant early • use a seed treatment
	Diplodia	• wet conditions late in the season	• affects stalk and ear	• avoid late hybrids • harvest early • crop rotation
	Pythium	• warm and wet	• affects seedling, root and stalk	• use a seed treatment • good drainage will help • crop rotation
	Northern corn leaf blight	• wet conditions in residue	• affects leaves	• choose resistant hybrids • crop rotation
	Eyespot	• moist conditions • high residue	• affects leaves and stalk	• choose resistant hybrids • crop rotation
SOYBEANS	Phytophthora	• cool, wet soils • clay soils	• affects seedling, roots and stem • stand loss	• good drainage will help • crop rotation • resistant/tolerant varieties
	Rhizoctonia	• warm, wet soils followed by drought or herbicide stress	• affects seedling and roots • stand loss	• crop rotation • good drainage will help • use a seed treatment
	Pythium	• wet soils	• stand loss	• use a seed treatment
	Phomopsis	• warm wet conditions at emergence and during pod fill	• stand loss • seed loss	• use a seed treatment • avoid early varieties in long season areas
	White mould	• cool wet conditions August to harvest	• crop loss • affects stem	• no-till reduces survival of fungal bodies (sclerotia)

DISEASE MANAGEMENT

BEST MANAGEMENT PRACTICES, cont'd.

	DISEASE	CONDITIONS	IMPORTANCE	BEST MANAGEMENT PRACTICES & TIPS
WHEAT	Tan spot	• high residue • moist conditions	• affects leaves	• crop rotation • apply foliar fungicide if needed • refer to cereal chapter, OMAFRA *Publication 296*
	Fusarium	• warm and wet at flowering • wet conditions at planting	• affects head and seedling • creates conditions favourable to mycotoxin in the grain	• crop rotation • do not plant wheat into corn stubble • seed treatment • plant several varieties to spread risk
	Septoria	• high residue • cool and wet conditions	• affects leaves and heads	• crop rotation • apply foliar fungicide if necessary
	Eyespot	• high residue • high soil moisture • cool and wet conditions	• affects stem • lodging	• crop rotation
	Take-all	• high residues • moisture conditions	• affects roots • results in empty bleached heads	• crop rotation • apply foliar fungicide if necessary • control volunteer wheat and grassy weeds
	Powdery mildew	• high residues • cool or humid conditions • dense canopy	• affects foliage and stems	• crop rotation • avoid high nitrogen • destroy volunteer wheat before planting wheat • apply foliage fungicide if needed • crop rotation

Fusarium ear mold.

Fusarium head blight.

Rhizoctonia root rot.

NUTRIENT MANAGEMENT

In no-till, nutrient requirements don't change. But in many cases, the type and timing of application practices do. The differences in the no-till seedbed conditions pose challenges for nutrient retention, fertilizer materials, application methods and timing of operations. There are fewer conventional application methods available – modifications to planting and nutrient application equipment can overcome these.

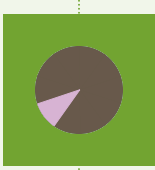
Before beginning a no-till system, soils should be in an acceptable pH range for crops grown.

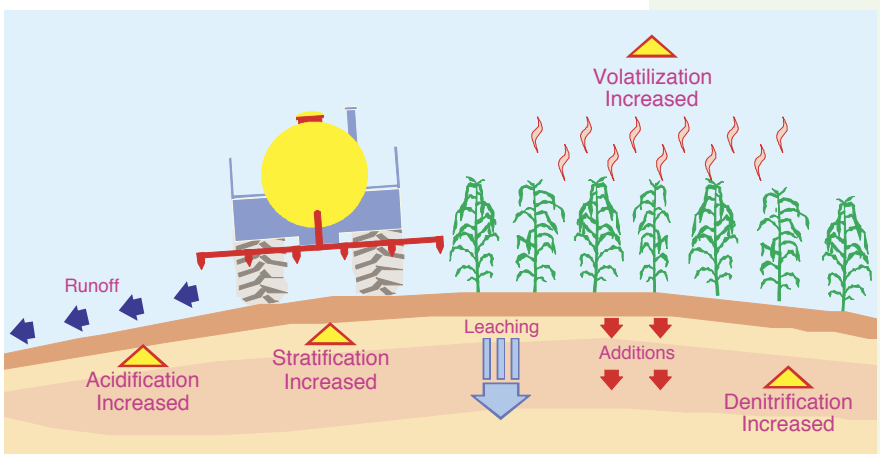
Ideally, nutrient levels (phosphorus, potassium, magnesium, etc.) will be at a medium-high range.

Understanding the fertilizer materials and their activity in no-till conditions is a first step to making nutrient management work in no-till:

- urea or urea-based nitrogen fertilizers should never be broadcast and left on the soil surface, because a portion of the nitrogen could be lost to the air
- surface-applied fertilizers and manures are prone to runoff
- surface-applied manure and nitrogen-based fertilizers could lead to a more acidic soil surface
- soils may become more acidic if lime is not incorporated
- surface-applied or shallow banding of phosphorus and potassium could lead to stratification of these nutrients – this generally is not a problem, except in droughty conditions, as the roots tend to concentrate in this area, and residues preserve moisture, helping uptake
- mycorrhizal activity will increase, in turn increasing phosphorus uptake.

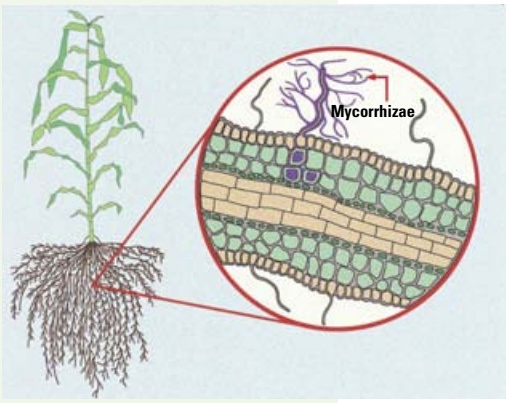
A coulter in front of the knife cuts residue and improves nitrogen placement.





Surface-applied nutrients waste money and increase risk to the environment.

NUTRIENT MANAGEMENT



No-till conditions help the growth of soil mycorrhizae. Soil mycorrhizae assist plant roots in obtaining nutrients (phosphorus) from the soil by increasing the area exploited by the roots.

Phosphorus and Potassium Stratification

Nutrient stratification occurs under long-term no-till conditions. This means that a buildup of phosphorus (P) and potassium (K) occurs on or near the soil surface over time when the soil is managed in a no-till system. This stratification is caused by normal crop demands on the nutrients deeper in the soil profile, and the absence of incorporation.

The nutrient-rich layer with depleted zones below show up after three to five years of no-till management. When fertilizer is applied properly, however, nutrient stratification should not affect yields. To counter stratification, at least some of the phosphorus and potassium requirement should be applied in a band with or near the seed row. Because these two nutrients move very little in soil, plants use phosphorus and potassium applied in a band almost twice as efficiently as they use broadcast fertilizers.

Check the tables in OMAFRA *Publication 296* for safe rates of nitrogen and potassium in starters.

EFFECT OF NITROGEN SOURCE, METHOD AND TIME OF APPLICATION ON NO-TILL CORN GRAIN YIELD, 8 SITE-YEARS, 1990-94

SOURCE	METHOD	TIME	YIELD bu/ac @ 15.5% moisture
No Nitrogen			76.3
Urea	Broadcast	Preplant	130.0
Urea Ammonium Nitrate	Broadcast	Preplant	136.0
Urea Ammonium Nitrate	Coulter injected	Preplant	145.2
Anhydrous Ammonia	Knifed in	Preplant	150.6
Urea Ammonium Nitrate	Spoke wheel injected	Sidedress	147.6
Urea Ammonium Nitrate	Coulter injected	Sidedress	146.3
Anhydrous Ammonia	Knifed in	Sidedress	152.3

Ridgetown College of Agricultural Technology, C.K. Stevenson

The results from eight site-years showed a significant difference among nitrogen source, method and time of application treatments. The anhydrous ammonia and urea ammonium nitrate (UAN) soil-injected treatments gave considerably higher yields than urea ammonium nitrate and urea surface broadcast.

NUTRIENT MANAGEMENT

SOIL SAMPLING IN NO-TILL SYSTEMS

Sample no-till fields the same way you would a conventionally tilled field. When sampling, consider the location of the starter fertilizer band from the previous crop. See OMAFRA *Publication 296, Field Crop Recommendations.*

Sample the top two inches for pH if surface applications of nutrients have been made.

To sample ridge till fields, read page 82 of *Field Crop Production* (Best Management Practices).

For information on nitrate sampling, see OMAFRA *Publication 296.*

Note: the nitrogen soil test will underestimate the amount of nitrogen available to the crop when manure has been applied in the spring, or if cover crops or red clover were killed in the spring. Ask for both the nitrate and ammonia tests when using the nitrogen soil test where manure has been applied. Add the two numbers together to obtain a more accurate indication of soil nitrogen. Sampling for nitrogen at sidedress time will improve the accuracy of the test.

The best way to make manure work in a no-till system is with a full crop rotation.

Chris Brown, Ontario Ministry of Agriculture, Food and Rural Affairs

Manure is not such a big problem in no-till. We can now crop more acres so there's more places and opportunities to spread it. And we don't have to spread it on rough, plowed land.

Kevin Mariott, Lambton County

NUTRIENT MANAGEMENT

BEST MANAGEMENT PRACTICES

NITROGEN

At Planting
- some nitrogen with starter phosphorus and potassium will help emergence and improve phosphorus uptake
- some or all of the nitrogen requirement for corn can be applied at planting behind one of the tillage coulters – at least 4" from the row

We don't need to apply fertilizer to beans. But for corn we put dry starter behind one coulter and 40 lbs. of liquid 28% nitrogen behind the tillage coulter.

Charlie Bolton, Middlesex County

Sidedress
- knifing in and injecting nitrogen are recommended sidedress practices in no-till
- some producers combine sidedress application with cultivation, manure application and herbicide application

We've switched from anhydrous to liquid 28%. It's easier to apply as sidedress.

Murray Lobb, Huron County

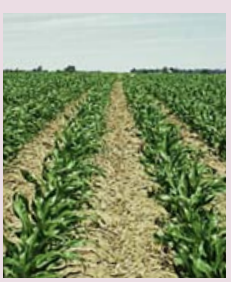
PHOSPHORUS AND POTASSIUM

Broadcast
- phosphorus and potassium where required before starting no-till
- broadcast excess potassium requirements that cannot safely be banded

Band at Planting
- banding with seed or offset by 2" below and 2" beside seed
- over time in no-till, the increased mycorrhizal levels may allow phosphorus application rates to be reduced for corn and possibly beans

When we decided to get into no-till [1986], we tested the soil for phosphorus, potassium and pH levels. We broadcast where there were any problems. Now we test every three years and maintain the levels.

Elwin Vince, Kent County



We do a lot of side-by-side trials in ridge till. We found some inputs weren't paying their way. However, it looks like banding potassium is paying in corn.

Ron McRae, Stormont, Dundas and Glengarry United Counties

NUTRIENT MANAGEMENT

BEST MANAGEMENT PRACTICES, cont'd.

LIME

Broadcast

- get your soil into shape before switching to no-till by broadcasting and incorporating lime – phosphorus, potassium, and manure can be incorporated at the same time (lime mixed with the soil will do a better job at correcting acidity problems)
- once in no-till, incorporate lime if possible
- another option where lime is required is to surface-apply a tonne of lime regularly – coulters will do some incorporation

Lime won't move from where you put it, so surface applications won't help deep problems. Maintenance applications will work, but soil test is best.

Keith Reid, Ontario Ministry of Agriculture, Food and Rural Affairs

BEST MANURE MANAGEMENT PRACTICES

Manure supplies the following:

- ▸ nutrients (nitrogen, phosphorus, potash)
- ▸ organic matter and soil structure improvement
- ▸ food for soil life.

If nitrogen is the most important factor, then a decision will have to be made whether to accept pre-planned tillage or some nitrogen loss.

In a no-till system, there are some options for manure application. Manure in a no-till system works best with full crop rotation. The following are some situations where manure can be utilized:

- ▸ spread on fields that will be planted into corn
- ▸ as a sidedress application in corn (liquid)
- ▸ on alfalfa soon after harvest (rates must be low)
- ▸ **light** application on fields that will be planted to soybeans (choose varieties with shorter heights)
- ▸ applied after cereal crops, especially with a cover crop.

NUTRIENT MANAGEMENT

BEST MANURE MANAGEMENT PRACTICES

LIQUID MANURE

Irrigation

- manure can be applied before, during or after crop using overhead irrigation
  - low rates work best
  - compaction and winter spreading are avoided
- continuous macropores can carry manure to tile drains – applying manure to dry soil or doing light tillage before application will minimize this problem

Caution: measures should be taken to minimize odour and runoff into catchbasins, drains and streams.

Spreaders cause compaction so I irrigate. I apply liquid hog manure from my neighbour at no more than 3-4,000 gal/ac when the crops need it just before planting or as sidedress.

Bruce Shillinglaw, Huron County

Direct Injection

- direct injection before planting or as sidedress (using tractor-mounted injection unit and drag hose) is highly recommended – compaction is minimized and placement is controlled

Injection as sidedress.

Dribble/Broadcast

- liquid manure can be dribbled between rows of growing crops as a sidedress method – incorporation is best, particularly when combined with sidedress nitrogen application and inter-row cultivation

I attached canvas sleeves onto each tube so that the canvas drags along the ground. There's minimal smell and no drift. Within half a day the ground is dry enough to inter-row cultivate.

Randy Molzan, Lambton County

NUTRIENT MANAGEMENT

BEST MANURE MANAGEMENT PRACTICES, cont'd.

SOLID MANURE

Broadcast

- the only way to apply solid manure – try to spread it as evenly as possible
- solid manure is low in ammonium nitrogen so less will be lost to the air (volatilization)
- composted or dry manure has a higher organic matter content – this can be ideal in no-till, especially after wheat

The soil must be dry. I spread dry manure on wheat ground in fall and spring. The ground is chisel plowed in the fall or cultivated once in the spring to incorporate the manure. It is not a "sin" for a no-tiller to work the soil once every three or four years.

Glen Warwick, Huron County

Note: spring manure application that will not be incorporated will lose the majority of the ammonium nitrogen. Regardless of how the manure is applied, one-third of the nitrogen requirement should still be supplied through the planter or as a sidedress application.

OTHER WAYS TO INCLUDE MANURE IN THE SYSTEM

Working in solid or liquid manure at several points in the rotation is still considered part of a no-till system.

After Cereal Harvest

- working in solid or liquid manure along with stubble can perform double duty or even triple duty when cover crops are used the year before corn

After Hay

- as with cereal stubble, solid manure can be worked in after taking the last cut in preparation for next year's corn crop

We are not purists. We will spread manure on wheat stubble in August through the end of September and disc afterwards.

Tom Hayter, Huron County

I spread solid manure on no-till fields as long as they're not near wetlands and water-courses. There is much less runoff on no-till fields. I think solid is easier to manage than liquid manure, even in no-till.

John Miller, Lanark County

NUTRIENT MANAGEMENT

TROUBLESHOOTING

PROBLEM	CAUSE	SOLUTION
SEEDLING DAMAGE	• burn from too much nitrogen near seedling • salt injury from too much potassium near seedling	• use less nitrogen and potassium in starter • band nitrogen farther from seed • split application to starter plus sidedress
RESIDUE PLUGGING	• heavy corn or cereal residue plugs sidedress injection equipment	• mount coulter in front of knife • sharpen coulters • use more aggressive coulter ahead of knife
ANHYDROUS AMMONIA LOSS	• poor slot closure	• add closing discs • fasten a short piece of chain to the back of the knife just above the injection opening
RILLS FORMED IN MID-SEASON	• knifing in nitrogen on highly erodible fields • poor coverage of knifed trench	• get soils into shape – rotate and use soil-building crops • try no-till cropping across the slope, in strips, or along the contour • use closing discs to fill in trench
LIQUID MANURE IN TILE OUTLETS	• application rates too high • irrigation left unattended • good macropore development • injection too deep	• lower rates over more acres or two applications at half the rate • monitor and calibrate irrigation system • use shallow tillage prior to application to break macropores • close up soil after injection or dribbling
PLANTER PLUGS WITH MANURE	• solid manure applied at heavy rates • manure not distributed evenly • manure not worked in	• reduce application rates and spread evenly • use light tillage or crop-row pre-tillage to incorporate solid manure • adjust coulters on planter – 3-coulter system may work best

Shown here are coulters mounted on an anhydrous ammonia applicator. The chain welded on the knife helps to close the slot.

CROP ROTATION

Rotations should include both broadleaf and grass-type crops.

Regardless of the tillage system, rotating crops is always a best management practice. In the absence of tillage, it may become even more important in no-till systems – especially to break insect, disease and weed cycles. Crop rotations can also increase yields, build soil organic matter and enhance nitrogen availability if nitrogen fixing legumes are included. However, there are some challenges in no-till rotations.

CROP ROTATION, PEST MANAGEMENT AND WEED CONTROL

When crops are rotated properly, they can disrupt insect and disease cycles and weed infestations.

Changing crops also means varying the type and timing of management practices. This will further disrupt crop pests, e.g., corn is not a host for the soybean cyst nematode.

Crop rotation allows opportunity for resource building and protection. The inclusion of forage crops in the rotation can improve seedbed structure, add organic matter, and add nitrogen – while their cover protects soil and water resources.

Each crop has particular impacts upon its growth environment, e.g., soybean residue allows seedbed to warm up quickly; legume crops can have dense canopies, yet add nitrogen to soil.

For maximum benefit, rotate grassy crops with broadleaf crops, i.e., corn and soybeans.

Crop Rotation

No-till is an option for some horticultural crops, such as tomatoes.

No-till soils with hay in the rotation rehabilitate sooner.

Crop rotations allow for more opportunities for chemical family rotation and help prevent weed resistance to herbicides.

CROP ROTATION

Continuous cropping can have a greater affect on no-till crops. Continuous corn in clay soils may cause a 10-30% yield reduction.

Corn following wheat in no-till can be a problem because:

- **the cool/wet seedbed reduces corn seedling emergence**
- **phytotoxins released from wheat residue slow seedling growth**
- **slugs may be a problem in a cool wet spring.**

PLANNING A ROTATION

Rotations must be planned to suit each farming operation. Factors affecting crop rotation sequence changes are:

- ▸ livestock feed needs
- ▸ insect pressures
- ▸ equipment available
- ▸ labour and management time
- ▸ cover crops
- ▸ weed control program
- ▸ previous crop (crop sequence and residue)
- ▸ market for crop
- ▸ previous herbicide (chemical) family used
- ▸ disease pressure
- ▸ current seasonal operations
- ▸ available seed
- ▸ soil type/management limitations
- ▸ nutrient management program
- ▸ erosion control/soil quality problems.

SOME TIPS WHEN PLANNING A CROP ROTATION

- ✓ Alternating grass crops with broadleaf crops is the best practice.
- ✓ Continuous cropping is the worst practice: the more crops, the better.
- ✓ Go for added benefits, e.g., red clover grown between cereals and corn can improve the soil.
- ✓ A high residue crop followed by a low residue crop helps maintain sufficient residue cover on the field.

CROP ROTATION

In no-till, crop rotation is very important for weed control. You can plan for and control weeds this year that will affect next year's crop.

Neil Hannah, Northumberland County

In a corn, wheat, white beans, soybeans rotation:

1st = wheat after beans
2nd = beans after corn
3rd = corn after beans or wheat.

Wilf Riddell, Middlesex County

BEST MANAGEMENT PRACTICES

The following table rates crop choices based on the residues and inputs used on the previous crop. To use the table, identify current crop residue and select the highest rated crop (green colour) that can fit into your rotation and crop needs. Those crops in the yellow can be made to work but are more challenging. Crops in the red can be risk-prone. Check the explanation of symbols at the bottom of the table for special conditions and exceptions.

We need forages in our rotation to feed cattle. The added benefit is that hay gets land into shape for no-till.

John Miller, Lanark County

CROP ROTATION

CROP CHOICES, BASED ON RESIDUES AND INPUTS

CROP RESIDUE	CROP TO BE PLANTED					
CEREAL	Edible Beans S, B	Soybeans S, C5, m*, W	Canola S, M	Hay P	Corn D1, S, a*, M	Cereals D1, R
CORN	Soybeans S	Edible Beans	Canola S, H	Hay P	Corn R, C1, I2	Cereals D1, H
SOYBEANS	Corn	Cereals	Hay	Soybeans D2, N, R, D5	Edible Beans D2, D5	Canola D2
EDIBLE BEANS	Corn	Cereals	Hay	Soybeans D2, D5	Canola D2	Edible Beans D2, D5, R
CANOLA	Cereals	Hay	Canola R, D2	Soybeans D2, A	Edible Beans D2, A	Corn A
HAY & PASTURE	Corn S, C3, C4	Edible Beans S, B	Soybeans S,W,B	Canola S	Cereals W	Hay R, D3

*** a lower-case letter indicates it may be a minor concern**

P Heavy residue may make it difficult to achieve good seed placement
H Crop may not be harvested in time for fall seeding
A Adversely affects crop growth
N Soybean cyst nematode may develop and reduce yields
S Slugs may be a problem (especially when red clover is underseeded in a cereal)
M Cereal residue may slow soil warming in the spring and delay planting – winter cereals may be worse than spring cereals
R Yields are usually depressed when a crop follows itself – often more so in no-till
W Weed escapes from red clover underseeding or hay may be difficult to control

C1 Corn rootworm will likely be a problem
C2 European Corn Borer could be a problem
C3 Cutworm could be a problem
C4 Armyworm could be a problem
C5 Spider mites could be a problem following red clover
D1 Potential disease problem such as fusarium head blight
D2 Potential disease problem – white mould, etc.
D3 Forage diseases could increase
D4 Potential development of ear moulds
D5 Root rots may be a problem
B Burndown in the fall is very important for clover and alfalfa control

In a corn, soybean, wheat, and red clover rotation:

1st = wheat after soybeans
2nd = soybeans after corn
3rd = corn after clover
4th = clover after wheat.

Laurence Taylor, Huron County

CROP ROTATION

Frost seeding of alfalfa with a no-till drill on one of the last frosts 1/4"-3/8" deep worked well for us in 1996.

Tom Verkley, Middlesex County

To overcome corn into wheat problems, I lightly disc the wheat stubble right after harvest. It's also a great way to fit manure into the system.

Charlie Bolton, Middlesex County

TIPS FOR MAKING IT WORK

NO-TILL ALFALFA

Forages can be difficult to establish in no-till and difficult to kill. Here are some tips from no-till producers.

It took us three tries to get it right with alfalfa. Since 1990 we insist on excellent burndown, plant into soybean residue, and plant shallow with seed dropping just ahead of the press wheel. A nurse crop is used.

Sam Langman, Simcoe County

I've no-tilled forages since 1991. I direct seed alfalfa into sands and clay with the no-till drill after corn or soybeans using 10% timothy in the mix at 16-18 lbs/ac. But to make it work, soil moisture must be just right and the previous residue spread evenly.

Robert McKinnon, Bruce County

CORN FOLLOWING WHEAT

Corn into wheat often does poorly, whether from cool moist conditions or the adverse effect (allelopathy) that wheat residue has on corn. Some producers, though, are making it work.

MANAGEMENT OF CEREAL RESIDUE ON CLAY SOIL

EFFECTS OF INCREASED RESIDUE	SOLUTIONS
Nitrogen can be tied up in the breakdown of the straw and may not be available to the crop.	• apply more nitrogen or manure
Leaf and stem diseases may become more of a problem.	• plant broadleaf crops, i.e., soybeans • select tolerant crop varieties • remove straw
The soil will be wetter in the spring resulting in: • the potential for increased root diseases	• use appropriate seed treatment • select tolerant crop varieties • remove straw • light tillage (cultivate or disc) or strip tillage
• the potential for increased slug damage	• clear residue from the row • increase seeding rate slightly • remove straw
• cool soils and poor growth.	• clear residue from the row • increase seeding rate slightly • remove straw • light tillage (cultivate or disc) or strip tillage

COVER CROPS

Some producers are trying to work cover crops into their no-till system. Where residue cover is consistently high, cover crops may simply not be necessary. They may overcomplicate the system because of the likely interaction with so many other system components (nutrient management, residue management, weed control, insect and disease management). However, where there is a need to add broadleaf or grass crops to the rotation or in areas where there is insufficient residue (on erodible soils), cover crops can be beneficial.

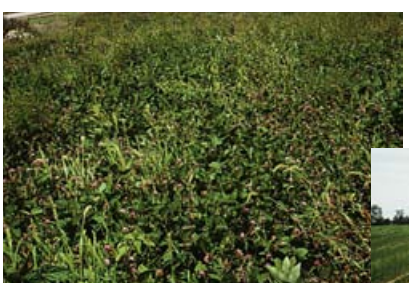
Cover crops can help to make a no-till vegetable system work. No-till in vegetables need a number of modifications to make it work, such as the use of cover crops in a partial or temporary no-till situation to create ground cover and wind strips around strip-tilled areas.

Vegetables are tricky but not impossible to work into no-till crop rotations.

Spring cereals used as cover crops can add to the soil protection potential of low residue crops.

Hort Tip

Use the low rate (0.75 to 1.25 L/ha) of Roundup on rye cover crops to get a slow kill. It could take up to three weeks for the cereal cover crop to die. Meanwhile, it has successfully protected the young tomato or potato plants from blowing soils, and won't require a separate application later in the spring.

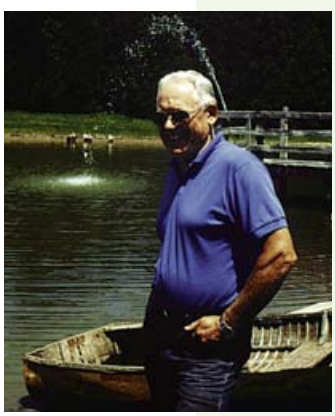


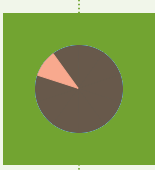
Some cover crops can become a weed management problem if not properly killed.

Cereal strips in tomatoes provide additional erosion protection.

Jack Rigby of Kent County has these tips:

- **don't disk wheat stubble because it makes the soil too rough**
- **keep red clover in the rotation, but manage with care.**





Cover Crop

COVER CROPS

OPPORTUNITIES AND CHALLENGES

OPPORTUNITIES	CHALLENGES
• provide additional erosion protection if crop residue is limited	• the dense mat of cover crops may require further residue management
• provide food and cover for earthworms, soil microbes and wildlife over the winter	• provide food and cover for insect pests such as slugs
• non-legume cover crops convert nitrogen from inorganic to organic, delaying it from leaching	• can tie up available nutrients and cause deficiencies early in the season
• legume crops can provide substantial amounts of nitrogen to the following crop	• match nitrogen release to following crop requirement
• suppression of weeds	• non-certified or improperly cleaned seed can be a source of weed seed
• add organic matter, improve soil tilth and prevent crusting	• some residues may be allelopathic, i.e., impede healthy growth of following crop, e.g., cereals
• decaying roots add macropores, improving water infiltration and soil aeration, thus reducing runoff and erosion caused by water	• macropores can provide speedy route for pesticides, manure, bacteria and nitrates to field drains
• can speed spring drying on wet soils that have poor or restricted internal drainage	• can deplete soil of valuable moisture reserves in a dry spring
• residue can keep soil cool in early summer, reducing moisture loss and organic matter oxidation, while providing a great environment for root growth and microbial activity	• shade the ground and can restrict soil warming in early spring; can also keep soil too wet, delaying drying
• can remedy compaction	• can become a weed management problem if not properly killed
• provide opportunity for trapping nutrients from manures	• timing of nutrient release with crop needs

Cover Crop

COVER CROPS

When selecting cover crops in no-till, ask yourself the following:

☑ 1. **Do you need** the protection or the flexibility in the rotation?

☑ 2. **Killing of cover crop**

- ▸ Does it die over winter?
  - ▷ or present a residue management or moisture problem in the spring?

Note: Cover crops should be killed at least two weeks prior to planting.

☑ 3. **Residue management**

- ▸ Will it form a dense mat?

☑ 4. **Nitrogen management**

- ▸ Will the crop add nitrogen (legume)?
- ▸ Will it trap nitrogen and release it later in the season?
- ▸ How will this affect interpretation of spring nitrate results and timing of nitrogen application?

☑ 5. **Weed control**

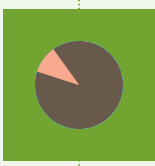
- ▸ Will it become a weed?
- ▸ How much weed control does it provide?
- ▸ Will the spray program need to be adjusted?

Note: Cover crops will not provide complete weed control in no-till.

☑ 6. **Insects and diseases**

- ▸ Does the cover crop carry or encourage insects or diseases which may affect subsequent crops?

For more information regarding cover crop management, see OMAFRA *Publication 296*.



Cover Crop

COVER CROPS

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	BEST MANAGEMENT PRACTICES & TIPS
POOR CROP PERFORMANCE WHEN CORN OR SOYBEANS FOLLOW CANOLA	• canola inhibits mycorrhiza populations	• grow cereals after this cover crop
DROUGHTINESS	• cover crop overwinters, is not killed or reseeds to compete with crop	• select cover crops that are killed over winter • select proper burndown product • try inter-row cultivation or post-emergent treatment (See *Publication 75*)
MATTED VEGETATION • keeps soil wet	• cover crops with excessive top growth • improper burndown treatment	• select more suitable cover crop • crop-row pre-tillage • use 3-coulter system • combine above with additional burndown treatment
COVER CROP BECOMES A WEED IN THE CROP	• poor timing or choice of burndown	• kill the cover crop early • select the appropriate herbicide to kill the cover crop

Make sure cover crops are dead at time of planting.

VARIETAL SELECTION

The same criteria are used to evaluate varieties in no-till as in other cropping systems. High yield and suitable heat unit ratings remain important. However, disease resistance and early growth characteristics are slightly more important. The best advice is to check trial records and verify with test plots on your own property.

The following varietal selection criteria are more important for many crops in no-till.

CRITERIA	RATIONALE
SEEDLING VIGOUR	• no-till seedbed conditions are usually cooler and wetter • vigorous emergence and early growth characteristics help performance of varieties
COLD TOLERANCE	• no-till seedbed is cooler • varieties should be slightly "earlier" or demonstrate a cold germination rate of at least 80% (soybeans)
DISEASE RESISTANCE	• no-till favours those diseases that thrive in cooler, wetter conditions, e.g., eye spot in corn, (see Disease Management on page 62) phytophtora in soybeans • check for disease-resistant varieties
MOISTURE CONTENT	• corn harvest moisture content will be slightly higher (up to 2%) • choose varieties that have consistently lower moisture content
HERBICIDE TOLERANCE	• weed species will change in no-till – a change in herbicide can affect variety performance

Many successful no-till farmers test new varieties on a small scale under their own management and field conditions. They do legitimate side-by-side tests and weigh the results at harvest. That way, they can see how they stack up against current favourites. The need to do their own testing is made even more clear by the differing opinions among researchers, agrologists, and farmers. In conventional research plots, top corn and bean varieties excel, regardless of the tillage system used.

Generally, look for varieties that can withstand and perform in the tougher growing conditions afforded by no-till. No-till variety plots should be observed early in the season to evaluate emergence and early growth. Yield results are more reliable if each variety is in the plot two or three times. Yield results from more than one year for a variety are more reliable.

Evaluate varieties using production practices that are normal for the farm.

Don Lobb, Huron County

VARIETAL SELECTION

CORN AND SOYBEAN VARIETY SELECTION

CORN			SOYBEAN		
FEATURE	**CONVENTIONAL TILLAGE**	**NO-TILL**	**FEATURE**	**CONVENTIONAL TILLAGE**	**NO-TILL**
YIELD	• no difference	• no difference	YIELD	• no difference	• no difference
CORN HEAT UNITS	• no difference	• regional variations	HEAT UNITS	• no difference	• no difference
DISEASE RESISTANCE	• important	• slightly more important	ROOT ROT	• important	• more important
STANDABILITY	• slightly more important	• slightly less important	PLANT HEIGHT	• important	• slightly less
EMERGENCE	• important	• more important	LODGING	• important	• slightly less
MOISTURE PERCENT	• important	• lower moisture percentage is important	COLD TOLERANCE	• important	• more important

You can use the most recent crop variety performance reports to help you select varieties.

In cereals like winter wheat, choose disease-resistant varieties. Some producers prefer shorter heights to reduce residue problems.

NO-TILL AND RIDGE TILL CASE STUDIES

COOPERATORS: SAM AND ROSS LANGMAN

OPERATION

Location:	Elmvale, Simcoe County, Ontario
Enterprise:	• dairy (65 cows), dry manure • field crops (2,500 acres) – corn, soybeans, wheat, canola, hay
Climate:	2600 Corn Heat Units
Soils:	Alliston sandy loam to Simcoe clay
No-till Experience:	since 1989
Proportion No-tilled:	100% in 1990
Crops that are Easiest:	wheat after spring canola; spring canola after corn

Early planting is a must. Even planting through snow achieved an acceptable canola stand.

TRANSITION

- talked to an experienced no-till farmer
- did not get good alfalfa stand in first year
- bought Great Plains No-till Drill with harrows in first year
- aquired Yetter dry fertilizer coulter/opener combination, and notched blade row cleaners for a Case IH 800 corn planter in Year 2; had second poor alfalfa stand
- in Year 7, bought a John Deere 7200 corn planter with a combination coulter/row cleaner mounted on the front of the seed unit, with Yetter dry fertilizer units 4" to the side of the seed row

NO-TILL AND RIDGE TILL CASE STUDIES

TROUBLESHOOTING TIPS

PROBLEM	BEST MANAGEMENT PRACTICES
POOR ALFALFA STAND	• ensures effective burndown • plants seed shallow • drops seed just ahead of press wheel • plants with nurse crop after soybeans
CORN AFTER WHEAT	• uses chaff spreader on combine • bales wheat straw – may disk manure into stubble • uses fertilizer units on planter to apply 25 lb./ac. MAP • plants early as possible – best results when corn planted in damp soil
DRILL PLUGGING WITH CORN STALKS	• on loose soils, drill is adjusted to run shallower
CROP ROTATION PROBLEMS	• crop is changed each year: corn – spring canola – winter wheat – soybeans – alfalfa with spring cereal nurse crop
SLUGS IN SOYBEANS AFTER WHEAT	• removes all straw after wheat harvest • disks stubble to reduce residue

CHALLENGES

▸ the fear of starting – taking the plunge

▸ working manure and hay into the rotation

BENEFITS

▸ saves time – three people farm twice as many acres with smaller tractors, less fuel and less machinery maintenance

Before starting out in no-till, talk to experienced no-tillers with similar soils and conditions. The system that you develop must be suited to your own conditions. Then, you need to overcome the old mindsets – no-till is now a proven system.

Sam Langman, Simcoe County

NO-TILL AND RIDGE TILL CASE STUDIES

COOPERATOR: BOB MCINTOSH

OPERATION

Location:	St. Mary's, Perth County, Ontario
Enterprise:	cash crop, pedigreed seed (uses local livestock manure)
Climate:	2750 Corn Heat Units
Soils:	Perth silt loam
No-till Experience:	since 1987
Proportion No-tilled:	100% in 1992 (swaps land with his brother to improve rotation opportunities)
Crops that are Most Successful:	wheat after soybeans; soybeans after corn; corn after soybeans
Crops that are Least Successful:	corn after wheat

Bob's no-till planter.

TRANSITION

- first tried no-till wheat after soybeans – used a 3-point hitch coulter toolbar ahead of a conventional seed drill to plant the wheat
- then tried soybeans after corn – found that a heavier drill was needed to plant soybeans into corn stalks, so purchased a Case IH no-till drill/coulter caddy unit equipped with tillage coulters
- for corn after soybeans – equipped his standard JD 7000 planter with tillage coulters, then upgraded planter tillage by adding a Kearney tillage toolbar with 3 coulters/row
- for white beans after corn, soybeans or wheat – purchased a Kearney row splitter to plant beans with his planter in 15" rows
- equipped his combine with a chaff spreader to improve crop residue distribution

NO-TILL AND RIDGE TILL CASE STUDIES

TROUBLESHOOTING TIPS

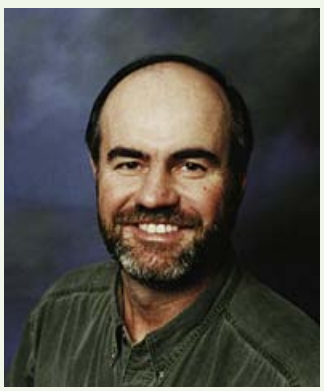
PROBLEM	BEST MANAGEMENT PRACTICES
WEED CONTROL	• uses regular burndowns with Roundup • now finds weed control easier in no-till
CORN AFTER WHEAT	• changed rotation so that corn follows soybeans • when corn must follow wheat, uses chaff spreader • shallow disks wheat stubble after manure application
Beans into Corn NITROGEN DEFICIENCY IN BEANS	• uses 15" splitter bar for the planter, so that he can plant without knocking down corn stalks
NO-TILL CORN	• does spring burndowns • does not plant into wheat (see corn after wheat above) • applies dry fertilizer forms of phosphorus and potassium in row at planting • continues to sidedress with anhydrous but also applies 30 lbs. of nitrogen with band at planting

CHALLENGES

- ▸ duplication of equipment during transition – it's an extra cost
- ▸ looking beyond tillage as the only cause when dealing with problems
- ▸ getting beyond comparisons with conventional systems and focussing on making no-till system work
- ▸ convincing oneself that it will work

BENEFITS

- ▸ more time for family
- ▸ improved soil quality
- ▸ more consistent yields on poorer land



Talk to other experienced no-tillers and LISTEN. You don't have to spend large amounts of money on equipment to start no-till.

Bob MacIntosh, Perth County

NO-TILL AND RIDGE TILL CASE STUDIES

COOPERATORS: SHAWN AND RON MCRAE

OPERATION

Location:	Bainsville, Ontario – north shore of St. Lawrence River, 4 miles west of Quebec border
Enterprise:	corn and soybeans (425 acres) in ridge till; half of the acreage is in narrow strips – alternating 6 rows of corn and 6 rows of beans
Climate:	2700-2800 CHU
Soils:	Bainsville silt loam and Allendale sandy loam with elevated deposits of Eamer loam

Tillage/Cropping System History:

1970-1983	• conventional tillage – monoculture corn production
1983-1988	• reduced tillage (chisel plow) – corn/soybean rotation
1988-1990	• no-till (zone tillage with planter using 2" wavy coulters) – corn/soybean rotation
1990-present	• ridge till – corn/soybean rotation (strip cropping 50% since 1992)
Proportion of Crops in Ridge Till:	• 100%

TRANSITION

- ▸ soil structure/tilth hit a low point in early 1980's, due to excess tillage with monoculture corn
- ▸ tried chisel plowing (100%) with high residue cultivator – impossible to create a good seedbed
- ▸ tried no-till (100%) and found marked improvement in soil structure and resistance to erosion – however, despite excellent results with soybeans, corn performed poorly due to cold, wet seedbed (no spring tillage to interrupt capillary movement of moisture to surface of silt loam soil)
- ▸ switched to ridge tillage to obtain a better seedbed for corn and reduce herbicide dependence

NO-TILL AND RIDGE TILL CASE STUDIES

EQUIPMENT

- spring glyphosate burnoff with homemade sprayer designed to travel in established wheel traffic lanes, and with three 15-ft. boom sections to operate in narrow strips
- Hiniker planter is designed for ridge tillage with horizontal disk ridge skimmers (adjusted for minimum soil displacement)
- Hiniker cultivator is designed for high residue conditions and equipped to sidedress nitrogen (UAN) 7" either side of the corn row while reforming the ridges
- John Deere row crop bean header is used for combining soybeans – notable benefits are gentler pickup, increased effectiveness in lodged conditions, independent knife heights, and stone guards

Strips of corn and soybean residue prior to planting.

TROUBLESHOOTING TIPS

PROBLEM	BEST MANAGEMENT PRACTICES
NO-TILL EARLY CORN VIGOUR	• switched to ridge till for drier, warmer seedbed, resulting in quicker emergence, more vigorous early growth and lower seedling mortality
RESTRICTED ROTATION	• ridge till generally restricts the producer to row crop production, although narrow row small grains, etc., can be seeded and harvested on ridges
COMBINING SOYBEANS	• a conventional flex head can be used to combine soybeans, but a row crop bean header is probably better for picking up lodged or low-lying plants
PRODUCTION/ INPUT COSTS	• although a glyphosate burndown is broadcast, pre- or post-emergent herbicide can be banded over the row, while inter-row cultivation controls weeds between rows, thus reducing herbicide expenses • to combat nutrient stratification, fertility should be maintained in the ridge by banding fertilizer at relatively low rates (compared to broadcasting) • relative to conventional tillage systems, ridge till equipment requires less power to operate, reducing fuel consumption and equipment repairs

NO-TILL AND RIDGE TILL CASE STUDIES

CHALLENGES

- ▸ limited applicable research
- ▸ balancing economic with environmental concerns
- ▸ grower must be prepared to make modifications to equipment and management
- ▸ finding workable multi-crop rotation

BENEFITS

- ▸ lower input costs
- ▸ more efficient use of applied fertilizer
- ▸ controlled traffic – overall reduction in compaction while providing firm traction
- ▸ reduced soil and residue mixing builds soil organic matter and structure, thus providing increased resistance to soil erosion and better precipitation infiltration
- ▸ spreads workload more effectively than conventional tillage

Some ridge tillers claim that cultivation does it all in ridge till. Don't believe it! Burndowns are every bit as important in ridge till!

Shawn and Ron McRae

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