TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

No-till corn in soybean residue.

NO-TILL

The move to the no-till system is gaining popularity in North America. Farmers, who are concerned with soil and water quality, find no-till systems a profitable alternative. Three points describe no-till:

- ►Fields are no longer plowed.
- ►Plant residues remain on soil to protect it from erosion.
- ►During the planting operation, a narrow seedbed is prepared by the planter/drill to allow adequate seed and fertilizer placement.

RIDGE TILL

Ridge till is an alternative to no-till. It requires more initial effort and investment so consequently, is not adopted as readily. This system is more adaptable to poorly-drained soils than no-till. The same basic principles for no-till apply along with the following:

- ►A cultivator forms a ridge during early summer. The following year's crop is planted onto the ridge.
- ►Once established, the ridges are not removed.
- ►The establishment of permanent ridges means that traffic is limited to specific areas within the field. This reduces soil compaction in the root zone. However, it often requires wheel-spacing modifications to machinery.
- ►Weeds are controlled with a row crop cultivator which reduces the need for herbicides.
- ►At the present time, forage crops are not usually grown on ridges.

Ridge till soybeans into corn stalks.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

TRANSITION PHASE – GETTING FROM A TO B

Experienced no-till and ridge till farmers often talk of a transition period of three to five years before seeing the full benefits of the system. During this transition phase, a number of changes occur.

- ►The soil structure will improve.
- ►Residue management changes.
- ►The type of pests and their control may change.
- ►Equipment will change.
- ►Crop rotations may change.
- ►Nutrient management changes.

This is a period of adjustment for you and all the components of your cropping system. The following table illustrates one example.

POTENTIAL CHANGES OVER TIME – NO-TILL

	SOIL	PLANTER	ROTATION	WEED CONTROL
No-till start-up.	Poor structure Poor drainage.	Two coulters.	Continuous corn.	Severe annual weed problem. Pre-emergent weed control.
Changes after 3 years of no-till.	Improved structure and drainage.	Two coulters and a trash whipper.	Corn, soybeans and wheat.	Minor annual weed problem. Post-emergent weed control.

As soil structure changes, the soil will dry and warm up faster in the spring. This will, in turn, have an effect on planting dates. Satisfactory results may be experienced during the first year of no-till or ridge till if all the parts of the crop production system are considered.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Soil Changes from Tillage Systems

- Organic matter levels gradually increase at the surface.
- Soil structure will improve (better aeration, water movement and root growth).
- Soil will be firmer.
- Soil life will increase (more worms, insects, bacteria and fungi).

Change varies because it depends on initial soil conditions and the crops being grown. For example, crop rotations which include cereal and forage crops show the quickest improvements because of their fibrous root systems.

SOIL MANAGEMENT

THE NATURAL CHOICE

No-till/ridge till farmers feel that their soil approaches the natural situation. To gain a better understanding of this environment, think about the Canadian forests. Tree leaves fall onto the soil surface to provide a permanent cover, so you rarely see erosion. Below the dead leaves exists a vast population of worms, fungi, bacteria and other soil life. This underground world decomposes leaf litter and helps feed the trees.

It may be difficult to relate forests to modern agricultural practices. But, what happens in a forest is similar to how no-till/ridge till farmers handle their land. They do not till fields and crop residue is left on the soil for protection. Beneath the residue, as in the forest, exists a healthy soil life.

Surface litter, as on a forest floor, encourages diverse soil life.

No-till fields provide the closest environment to the active forest.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

SOME SOILS ARE HARDER TO MANAGE

Fine sandy loams, silt loams and clays are trickier to manage in no-till/ridge till. They can be slower to dry under heavy residue. With time, the structure of these soils improves and timing of planting operations may change.

- ▸Delays in planting may be necessary if soils are too wet.
- ▸It's important not to wait too long to plant though, or clay soils will become too dry and hard.
- ▸Spring soil conditions from year to year will differ requiring proper machinery selection and adjustment.
- ▸Ridge tillage may help planting delays because of wet conditions. Ridges will dry out and warm up faster than non-ridged ground.

REDUCED SOIL COMPACTION

The risk of soil compaction can be reduced with no-till because the number of trips over a field is reduced. In ridge till, traffic is further limited to specific areas of the field.

SOIL LIFE

Residue on ridge till/no-till fields favours soil life which, in turn, improves soil structure, decomposition and the amount of air in the soil. Earthworms grind and mix residue placing it in a moist environment. Their excrement is more readily available to soil microbes. With a readily available food source, the soil microbes become more active and increase the rate of decomposition of residue.

Management Changes from Tillage Systems

- ▸ **Seedbed is prepared with very little tillage.**
- ▸ **Some soils may be slower to dry in the spring. Usually, this is a concern during the transition phase.**
- ▸ **Some soils may dry faster as soil structure improves.**

Piles of residue over earthworm holes.

No-till planting of soybeans.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Residue Changes from Tillage

- ► 30 to 80% of soil surface is covered with crop residue after planting.
- ► Residue may slow warming and drying of soil in the spring.

The residue was spread evenly last fall and the field is ready to plant.

Management Changes from Tillage Systems

- ► Residue must be spread evenly at harvest.
- ► Planting delays are possible during the transition phase.
- ► Field operations and equipment must change to accommodate surface residue.

RESIDUE MANAGEMENT

The most obvious concern for first-time no-till/ridge till farmers is residue. Residue is important and will not cause problems if managed properly.

Residue management is the heart of the no-till/ridge till system. All field operations – planting, fertilizing, inter-row cultivation, weed control and harvest – must be adapted. Managing crop residues prior to planting allows these operations to proceed more smoothly.

When residue remains on the soil, it acts as insulation. This slows the rate of soil warming during the day as well as the rate of cooling at night and may delay planting during the transition phase. Short rotations, earthworms and increased microbial activity will improve soil structure and drainage and help speed up soil warming.

CHOPPING CROP RESIDUE

Farmers have different opinions about chopping residues. Some of these views seem contradictory but make sense when addressing the situation at hand.

ADVANTAGES	DISADVANTAGES
If stalks are chopped in ridge till, the tops of ridges will dry out and warm up more quickly allowing earlier seeding.	Chopping residue makes a thick mat which reduces soil warm-up. Dark soil absorbs more heat than light-coloured residue.
In warm locations, weeds may germinate more quickly allowing better burn-down treatments.	In ridge till corn-following-corn on heavy clay, chopped stalks accumulate in valleys.This may keep soil too wet and cause rutting. If land slopes, chopped residue in valleys may wash off during heavy rains and accumulate in low lying areas.
In ridge till, chopping stalks will leave cleaner ridges for smooth planting. This may not be a concern for more experienced operators.	Chopping uses fuel, wears out machinery and adds a pass over the field.

Leaving stocks unchopped offers the following advantages:

- ►Standing residue traps more snow and increases soil moisture reserves on lighter textured soils.
- ►Standing residue slows heat loss from cool air currents.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

CROP ROTATIONS

Crop rotations are crucial to the success of reduced tillage systems. They help in residue management and are important for improving soil structure. Rotations also help break disease and insect cycles.

CROP SEQUENCES FOR RESIDUE MANAGEMENT

As mentioned, crop residues can slow the rate of soil drying. This does not necessarily delay planting.

Plant corn into soybean residue - soybeans leave little residue on the soil surface and what is there readily decomposes. If corn is planted in soybean residue, cold ground should not be a problem.

Plant soybeans into corn residue - soybeans are usually planted later than corn. This gives soil covered with corn residue enough time to warm up.

Plant corn or soybeans into cereal residue - cereals and forage crops have fibrous root systems which improve soil structure and drainage. Cereals are often underseeded with a cover crop such as red clover. In this case, a fall herbicide treatment reduces weed problems. Often, soils such as silt loams and clays with cereal residues are slow to dry and warm in the spring. In these soils, planting corn directly into cereal stubble has reduced yields.

There are three common solutions:

►Use trash whippers or coulter tillage to help soil warm up.

►Lightly till the residue.

►Wait till spring to kill the underseeded crop as it will help dry the soil.

No-till soybeans in cereal residue.

Corn on ridges following soybeans.

No-till soybeans planted into corn residue.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

The Following is an Example of a No-till Rotation for livestock operations:

YEAR 1 ▸ Oats underseeded with alfalfa.

YEAR 2 ▸ Alfalfa.

YEAR 3 ▸ Alfalfa.

YEAR 4 ▸ Alfalfa.
▸ August 15th: inject liquid manure.
▸ September 15th: burn-down treatment.

Year 5 ▸ No-till corn silage.
▸ September: inject liquid manure + cover crop.

YEAR 6 ▸ No-till barley.
▸ June: broadcast cover crop.
▸ August: inject liquid manure.

YEAR 7 ▸ No-till grain corn.

YEAR 8 ▸ No-till soybeans.

Start rotation over.

ROTATION EFFECT AND DISEASE PREVENTION

When a crop is planted into its own residues, yields go down. Researchers are not sure why. It may be a combination of factors including: pests, diseases and toxic effects of plant residues. Wheat residue seems to cause corn and soybeans to perform poorly on clay and silt loam soils in cold and in wet, early growing conditions.

Never plant wheat into wheat or corn residue - potential disease problems exists with wheat regardless of the tillage system employed. See the OMAF factsheet on Fusarium Head Blight. Excessive soil moisture and damp weather may increase disease risk. Large quantities of residue on the soil aggravate the problem but do not cause it.

COMMON CROP ROTATIONS

Without Forages

▸ Corn - Soybeans - Cereals underseeded with red clover.
▸ Corn - Soybeans.
▸ Soybeans - Cereals.

Edible beans may replace soybeans in any of the above.

With Forages

Harvesting forages during summer months takes labour away from row crop cultivation and manure applications. Change the timing of manure operations to August and September. Then, cover crops can tie up nutrients applied to the soil.

SUMMARY OF CROP ROTATIONS

CROP RESIDUE	CROP TO BE PLANTED			
	CORN	*SOYBEANS*	*WHEAT*	*FORAGES*
CORN	Insect and disease problems	Recommended	Avoid - disease potential is too great	Recommended
SOYBEANS	Recommended	Can work well but better to follow with a non-legume crop	Recommended	Usually works well but better to follow with a non legume crop
WHEAT	Soils may be slow to dry	Usually works well if wheat was not under seeded to red clover	Avoid as disease potential is too great	Recommended
FORAGES	Usually works well but watch for slugs	Can work well but better to follow with a non legume crop	Can be done as long as forage is killed completely before planting	Can be done if sod is completely killed (three weeks before planting)

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

NUTRIENT MANAGEMENT

The surface residue found in no-till/ridge till, combined with improved soil structure favours soil life that aids nutrient cycling.

NUTRIENT STRATIFICATION

The absence of tillage allows nutrients to accumulate in the top layers of soil. Nutrient levels below this layer tend to be lower than conventionally-tilled soils. No harmful effects on nutrient uptake and yield have been observed in 25 years of research.

NITROGEN

- ▸Nitrogen applications on cereals are similar to the conventional system.
- ▸Nitrogen for corn should be placed below the residue. Avoid broadcasting urea-based products.
- ▸Many no-till farmers believe approximately 30 kilograms per hectare (27 lbs per acre) of nitrogen should be in the starter fertilizer. No yield benefits result, but early crop appearance is improved.
- ▸Coulters are usually added to equipment to improve fertilizer placement.
- ▸In ridge till, nitrogen is knifed into the ridge (stay away from corn roots) or in the valley. Liquid nitrogen can be dribbled behind the disc hillers on the cultivator where it will be covered with soil thrown by the sweeps.

PHOSPHORUS

- ▸Apply phosphorus in a band at planting time to meet soil test requirements.

POTASSIUM

- ▸Band safe rates of potassium according to soil tests prior to seeding and broadcast the rest.
- ▸When seed drills are not equipped to apply starter fertilizer, fertilizer is broadcast prior to seeding. The tillage action of the drill will incorporate some of the starter.

NOTE: For safe rates of fertilizer, see OMAF Publication 296.

Tubes welded onto the disc furrowers of a ridge till cultivator for liquid nitrogen application.

Nutrient Changes from Tillage Systems

- ▸ **All nitrogen applied to corn must be placed below the residue.**
- ▸ **All phosphorus and most potassium are banded.**
- ▸ **Liquid manure is injected or surface-applied and incorporated.**
- ▸ **With late summer and fall manure applications, plant a cover crop to soak up the nitrates.**

A couple of different coulters mounted on an anhydrous ammonia applicator. The chain welded on the knife helps to close the slot.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Sidedress Applications of Manure in Corn

Injection

- Limited by tanker wheel spacing and tire width. Some manufacturers offer tankers with three-metre (120-inch) wheel spacing.

Surface Application and Incorporation

- Manure could be surface-applied by a tanker equipped with boom mounted tubes to drop the manure between the corn rows.
- Inter-row cultivation with a heavy duty no-till cultivator could incorporate manure.
- In ridge till, the manure could be incorporated during the first cultivation.

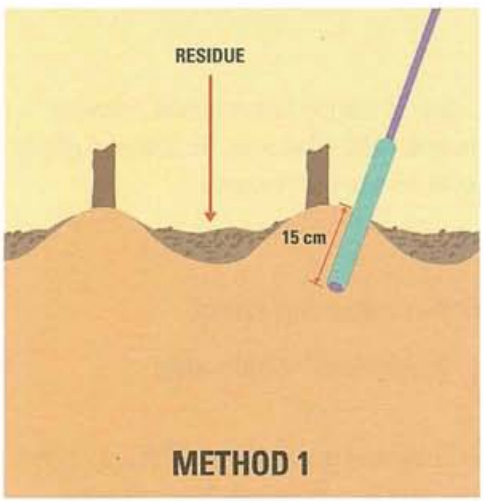
Comments

- A large amount of manure may be needed to meet crop nutrient requirements, depending on soil test results and manure analysis.
- Application must take place before the crop gets too tall. Any delays affect the amount of manure injected. Injecting 10% of your manure tank volume at this time may be a reasonable goal.

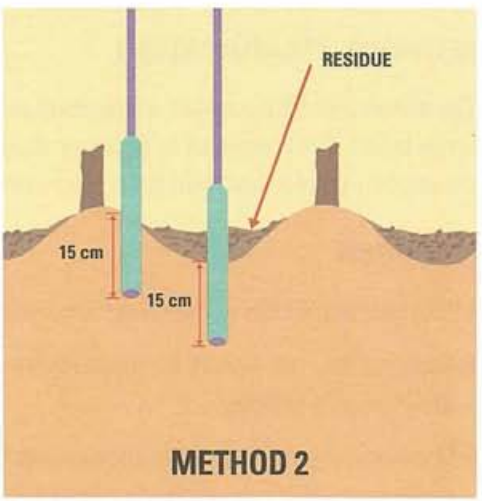
Coulters are mounted in front of injectors to cut residue.

SOIL TESTING

Sample no-till fields the same way that you sample a tilled field except the number of cores should be increased. Ridge till fields may be sampled in two ways:



Insert the probe to a 15 centimetre (six inch) depth into the side of the ridge, about halfway between the valley and ridge top.



Take a composite sample of ridges and valleys.

In both systems, take care not to sample in fertilizer bands.

SOIL CHANGES - IMPLICATIONS FOR FERTILIZER MANAGEMENT

Higher levels of organic matter and improved soil structure, combined with increased soil life, improve nutrient uptake by plants. This may lead to reduced fertilizer requirements.

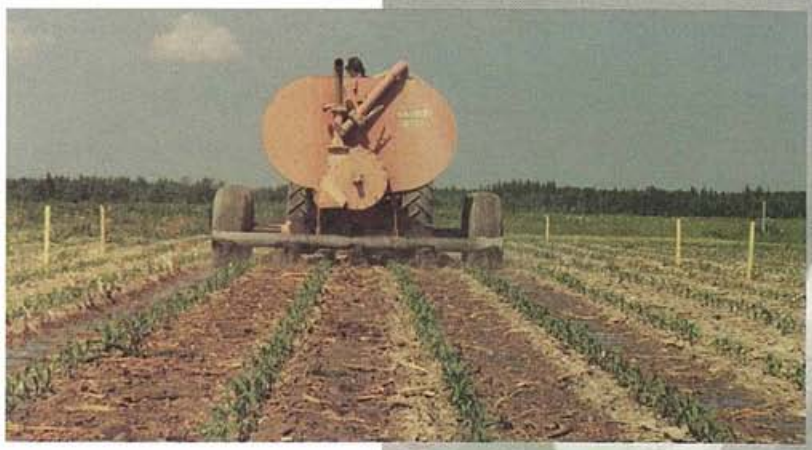
MANURE APPLICATION TO NO-TILL/RIDGE TILL SOILS

In no-till/ridge till systems, tillage is reduced; therefore, manure cannot be properly incorporated. This increases the possibility of loss of nitrogen to the air and contamination of run-off. There is not enough research on manure application in no-till/ridge till to determine the best method and timing of application. The following are the currently recommended methods:

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Injection - is the preferred method of application using a drag hose or a tanker with injection knives. Straight-edged bubble or ripple coulters are added in front of the injection knife to cut residue. In ridge till, the wheel spacing and tire width of equipment must be adjusted so the ridge is not tramped. The ridge till system of controlled traffic reduces the risk of compaction. In no-till, sweeps could be spaced 76 centimetres (30 inches) apart and the crop could be planted into undisturbed ground in between.

Surface application and incorporation - tillage is not the best option but may be necessary in some situations. Manure is surface-applied and incorporated with a light discing or cultivation.



A tanker surface applies liquid manure between corn rows before inter-row cultivation.

PEST MANAGEMENT

Insects or diseases compete with the crop and restrict its ability to grow. It's important to deal with pest problems right away. Herbicide costs may be higher during the transition period. Insects and diseases are not difficult to control if prevention is practiced.

Pest Changes from Tillage Systems

- **There will be a shift from annual weeds to winter annuals and perennials.**
- **Perennials will not be spread by tillage implements.**
- **Insects and diseases will be different but with proper management will not be any more of a problem.**

WEED CONTROL

Weed control is challenging but certainly not impossible. The ideal situation is that there are no weeds present as the crop emerges. This is often achieved by applying a burndown treatment. A burndown treatment is the application of a non-selective herbicide just before, at, or shortly after seeding the crop. Weeds that emerge after the burndown are controlled by the same pre-emergent and post-emergent herbicides used in other tillage systems.

After a few years of good control, annual weed pressure will decrease. Experienced farmers say, "Use a well-planned, broad-spectrum weed control program during the first few years, then you can worry about fine tuning the program and reducing the amount of herbicide used."

A well timed burndown treatment followed by pre-emergent herbicides provides excellent weed control.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

First cultivation of ridge till corn.

NO-TILL VS. RIDGE TILL: DIFFERENCES IN WEED CONTROL

On the Ridge

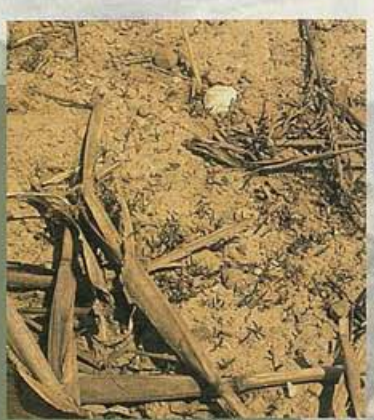
In ridge till systems, crops are planted on the ridge every year. The ridge till planter clears residue and soil from the ridges so weed seeds are cleared away. Because ridges can often be planted sooner than no-till, the crop may get a head start on weeds.

Banded Herbicide Applications and Mechanical Weed Control

Aside from the spring burndown, all ridge tillage herbicide applications may be banded on the ridge. Two mechanical cultivations control weeds in the valleys. The usual band width is 25 centimetres (10 inches) which reduces herbicides by about two-thirds. This has less impact on the environment and savings can offset the cost of cultivation. Conversely, labour, fuel and machinery costs increase during the growing season. Pre-emergent herbicide application is not affected by residue since the ridge is cleared at planting. Rotary hoes are also being used to reduce herbicide use on the row.

Small weed escapes within the crop row may be controlled during the ridging pass as soil is pushed up against the crop burying them. This effect will be less important in soybeans if shields are used on the cultivator. These escapes can also be controlled by band spraying a herbicide on the row while cultivating the row middles. This can be done as an overall or spot treatment.

No-till farmers also have the option of banding herbicides and inter-row cultivating once they are comfortable with the no-till system.



Emerging weeds are now controlled with a burndown prior to planting.

CHANGES IN WEED CONTROL

Absence of Tillage and Pre-Plant Incorporated Herbicides - this class of herbicides is not normally used with no-till/ridge till. A burndown treatment is used to replace tillage for early weed control.

Changes in Annual Weed Pressure - tillage kills or suppresses annual weeds but it also brings dormant seeds to the surface. When soil is no longer disturbed, as in no-till, surface seeds eventually germinate and the potential seed bank is reduced. Good weed control in the first few years of no-till/ridge till will decrease annual weed pressure.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Changes in Perennial Weed Pressure - perennial weeds grow deeper into the soil profile and generally spread via underground roots and shoots called rhizomes. With tillage, underground plant parts are cut. This either kills the plant or stunts its growth. Tillage also spreads the cut up roots and rhizomes which, in turn, infest a larger area the following season. Eliminating tillage stops or slows the spread of weeds by that means. Proper herbicide application is important. Identify weeds and attack them when they are young. During the three to five-year transition phase farmers may have to contend with new species such as dandelion, wild carrot or goldenrod, fleabane, while continuing to fight annual and perennial weeds from the conventional system.

Perennial weeds such as quack-grass stay in smaller patches and are easier to control.

CULTURAL WEED CONTROL

Cultivar or Variety Selection - selecting hybrids or varieties for early growth and vigour is important because no-till/ridge till soils tend to be cooler. This allows the crop to compete successfully with weeds.

Seeding Operation - timely seeding controls weeds. Seeding too early into a cold soil may result in a poor stand, while seeding too late reduces the growing season. In either situation, the crop suffers from weed competition.

Cover Crops - development work remains to be done to find more species adapted to Ontario conditions.

Cover crops can affect weed control by:

- ▸Competing with late-season weeds and reducing their numbers and the amount of seed produced.
- ▸Increasing residue which impedes germination and early growth of many annual weeds.

Cautions: Some cover crops become problem weeds and may require special management to prevent interference with the succeeding crop.

- ▸When starting out, don't use cover crops until you are more familiar with the system.
- ▸Seek advice about which species are best suited to your area and crop rotation.

An oat cover crop which has been winter killed.

Planning Ahead

- ▸ Identify problem weeds in the fall and control perennial weeds.
- ▸ Apply fall burndown to control sod, interseeded and cover crops
- ▸ Apply spring burndown to control escaped perennials, sod, interseeded and cover crops and to control emerging weeds.
- ▸ Apply spring pre-emergent weed control.
- ▸ Apply spring post-emergent weed control (chemical and mechanical).

NOTE: All these treatments may not be necessary but combinations would be used on a farm.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Quackgrass killed prior to planting.

Well established dandelions are hard to kill.

Alfalfa which has been killed in the fall.

CHEMICAL WEED CONTROL

Late Summer and Fall Applications

Fall treatments are preferred for the following reasons:

- ►Added stress of winter can improve control.
- ►2,4-D, dicamba and glyphosate take time to work if applied in the spring, which may delay seeding.
- ►If perennial broadleaf weeds such as Canada thistle and milkweed are present, spring treatments may not work well.
- ►Spring growth may remove valuable moisture needed for the next crop.
- ►Fall treatment reduces the risk of residual herbicides having an affect on the following crop. For example, dicamba affects soybeans.

Alfalfa and dandelions are usually controlled with a fall treatment. Herbicides such as 2,4-D or dicamba may work better on other legumes and broadleaf weeds. A few legumes can be tolerated if there is a good control measure available for the following crop.

Persistent Broadleaf Perennials - common examples are Canada thistle, field bindweed, sow thistle, milkweed, dogbane, ground cherry, horsenettle and wild carrot. In the fall, perennials move sugar downwards into roots and rhizomes to build up reserves for winter survival and early spring growth. Apply herbicides which absorb through leaves and move down to roots such as glyphosate, dicamba and 2,4-D. If weeds were cut by harvesting operations, allow them time to regrow before spraying.

Germinating Broadleaf Perennials and Winter Annuals - includes the seedlings of broadleaf perennials and winter annuals such as chickweed, shepherds's purse, and false flax. The herbicides mentioned above can be used when weeds have emerged and are actively growing.

Dandelions - if dandelions are left untreated, they become very hard to kill. It is best to treat them when they are small.

Perennial Grasses: Quack, Brome, Orchard, Timothy - perennial grasses often grow late into the fall and resume growth early in spring. Treat in either spring or fall.

Sod and Cover Crops - old, established grass pastures, grass legume mixtures, alfalfa and clover crops are best killed in the fall if a different crop is to follow.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Burndown at Seeding

Burndown herbicide treatment replaces tillage. Crops are least able to compete with weeds in the early stages of growth, so a timely burndown is essential for success. Time burndown treatments close to crop seeding time. Perennials, winter annuals or cover crops should be controlled one to two weeks prior to crop emergence. If treatments are to follow planting, wait two or three days for weeds to regrow through residue. Non-selective herbicides, such as glyphosate or paraquat, can not be applied once the crop is up.

Weed Control after Burndown

Weed control after burndown and seeding is similar to conventional tillage. For the most accurate, up-to-date information on herbicide use and rates, consult the label or OMAF Publication 75 – A Guide to Weed Control.

DISEASE CONTROL

The main disease of concern in no-till/ridge till is Fusarium Head Blight. However, no-till/ridge-till systems do not cause this disease; weather is the main culprit. Extended periods of cool and damp weather encourage the spread of plant diseases, although heavy crop residues may increase problems. The following measures prevent problems:

Rotations - crop rotations break the disease cycle. A crop planted into its own residue is more susceptible to disease. Alternate grass family crops with legume family crops. When two crops of the same family follow each other, plant the most susceptible crop first. For example, corn should follow wheat because wheat is more likely to have problems.

Variety selection and seed treatment - choose disease-resistant varieties and be sure to use seed treatments.

Clear residue - add extra coulters or trash whippers to have a residue-free band the crop can grow in.

INSECT CONTROL

In addition to the disease control measures, consider the following:

- ▸When corn follows corn, chop residue to help reduce the corn borer population.
- ▸No-till soybeans following wheat underseeded to clover can result in spider mite infestations in hot dry years.
- ▸Cutworm moths are attracted to heavy residue and winter annuals in early spring. If egg-laying conditions are favourable (e.g. warm, calm, clear nights following storm fronts from the southwest), be on guard.
- ▸Slugs can also cause problems in heavy residue conditions. Cool, damp weather may increase the problem. Remove residue from rows or kill all vegetation before planting.

Residue has been cleared away from the row to reduce insect and disease problems.

Management Changes from Tillage Systems

- ▸ Pre-plant incorporated herbicides are no longer appropriate.
- ▸ Banding herbicides and inter-row cultivation work with ridge till weed control and may be used in no-till.
- ▸ A burndown herbicide is often used to control weeds prior to crop emergence.
- ▸ All cover crops, sod crops and inter-seeded crops must be dead before planting.
- ▸ Avoid planting wheat into corn residue because of fusarium concerns.
- ▸ Clear residue from the row to reduce slug problems.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Equipment Changes from Tillage Systems

- ▸ **Coulters and/or ridge cleaning devices added to the planter.**
- ▸ **Use no-till drills or add coulters to the front of conventional drills.**
- ▸ **Planters and drills must have adequate residue flow.**

EQUIPMENT

BUYING NEW VS. MODIFYING OLD PLANTING EQUIPMENT

There are three ways to describe equipment available for no-till and ridge till systems: Equipment that is specially designed for no-till/ridge till; conventional equipment that is adaptable; or after-market products that convert conventional equipment.

Modifying old equipment may be cheaper but it usually requires a great deal of work. Welding on a frame extension may be necessary. Talk to someone already involved in no-till or ridge till for advice.

Ridge cleaners attached to the front of a conventional planter.

NO-TILL EQUIPMENT

Evaluating a Drill or Planter

Residue cutting - all equipment should have sharp coulters and/or offset disc openers to cut through residue.

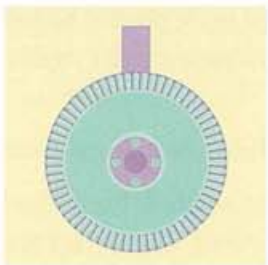
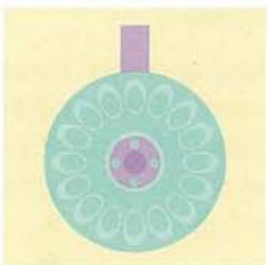
Coulter selection - each coulter differs in use and function. All are designed to penetrate and till soil but vary in the depth of tillage and the horsepower required to pull. The table on the following page provides more detailed information.

Drill with coulter caddy set-up for no-till.

Coulters and trash whippers added to a planter for no-till.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

SELECTING A COULTER

COULTER		COMMENTS
PLOW/RIPPLE		• Relatively low pressure required to penetrate soil. • Cuts residue. • Tills narrow zone of soil.
BUBBLE		• Straight edge cuts effectively. • Shoulders may make penetration of hard soil difficult. • Bubbles at side of coulter provide more tillage than plow type. • Side-wall compaction may result from use in wet conditions.
WAVY/FLUTED		• Wavy edge makes soil penetration more difficult. • Tills the widest area by lifting and shattering soil. • In wet conditions, soil may be thrown out of seedbed.

Soil penetration/tillage - coulters or openers should penetrate soil providing a narrow, tilled seedbed of the right depth and width.

Coulter adjustment - soil conditions may vary within a field so adjustment of coulter depth must be easy. Mounting coulters on hydraulic frames may help when soil conditions are variable.

Weight/strength - approximately 182 kg. per 30 cm. (400 pounds per foot) of drill is necessary to ensure coulters function well. Planter frame strength is important to withstand increased stress on equipment.

Residue flow - arrange equipment so residue flows between openers, coulters and press wheels.

Coulters are staggered to improve residue flow.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

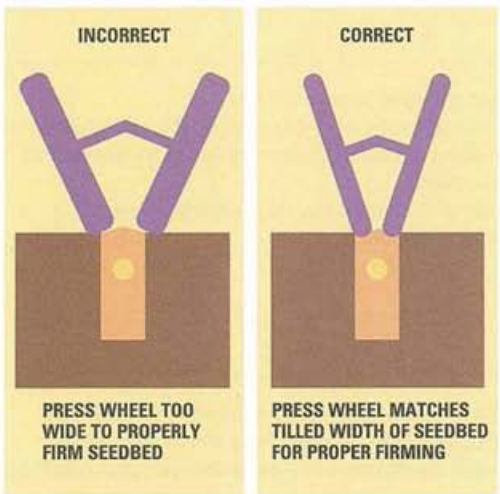
Residue removal and incorporation with the three coulter system.

Residue removal - no-till corn needs a 15 to 20 centimetre (six to eight inch) area with no residue. Add two or more aggressive coulters to either incorporate or toss off residue. Disc furrowers or trash whippers use rotating discs to sweep residue off the row area.

Drive system - reduce wheel slippage by adding fluid, increasing down pressure on wheels, changing to a deeper tread or adding weight to the planter. Reduce coulter slippage by increasing downward pressure or switching to a wider coulter such as the wavy type.

Chain guards - planting into corn residue may dislodge drive chains. Guards prevent this.

Press wheels - no-till coulters tend to leave a loose seedbed. Press wheels firm the seedbed. The correct press wheel depends on the width of the tilled seedbed.



Press wheel selection.

Planting around corners - turning corners is very difficult because of the distance between the front coulters and the rear openers. Swivel coulters can help.

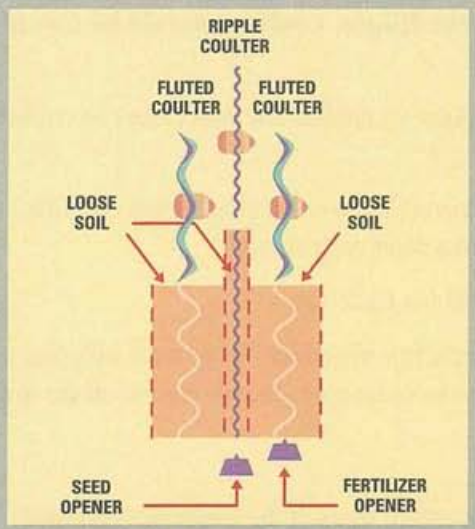
Markers - soil conditions at planting may make it difficult for conventional markers to penetrate soil. Adding weight to the marker arm, using a weight hub on the marker disc blade, or using a notched disc blade will all help.

Harrows - seed coverage and crop emergence improve if harrows are added to drills.

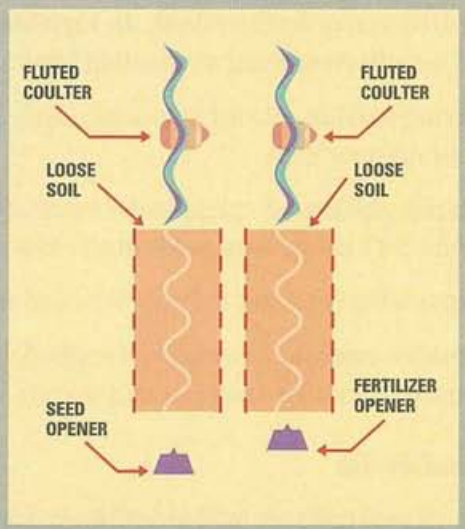
No-till drill with harrow added to improve seed coverage.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

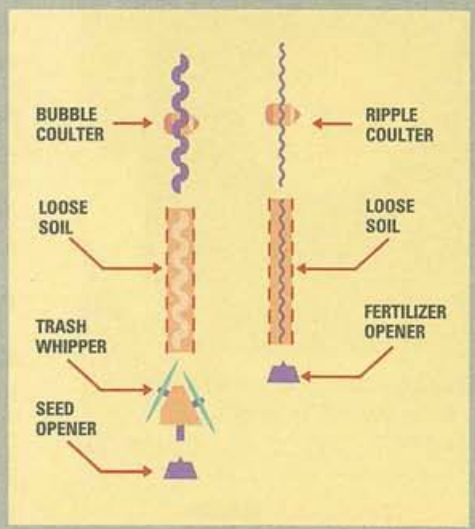
THREE CONCEPTS FOR SELECTING AND PLACING COULTERS ON PLANTERS.



THREE COULTER SYSTEM
Two outside coulters are at least five centimetres (two inches) away from the seed zone. A fertilizer shoe or knife may follow each. The centre coulter (in line with seed opener) ensures the seed slot opener places seed at the proper depth, in tilled soil clear of residue.



TWO 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.



COULTERS PLUS TRASH WHIPPER
This system normally uses two coulters. If fertilizer units can penetrate untilled soil, only one coulter is needed. This system uses bubble or ripple coulters. The seedbed is very narrow. Residue is removed by trash whippers linked to the seeding unit. There are a variety of configurations depending on the type of residue on the soil.

Adjusting Equipment

When using no-till, some additional equipment adjustments are necessary:

Coulter alignment - coulters used to cut residue and till soil should align with seed or fertilizer openers.

Level equipment - start by levelling seeding equipment. This allows proper depth control of both seeding units and coulters.

Soil conditions - plant when the field is dry enough for the coulters to shatter the soil but not throw the soil from the row.

Speed is required to make coulter systems work. Increasing speed throws more residue off the seedbed. However, too much speed will throw soil out too. As each coulter is added, additional power will be necessary. Match the coulter system to the tractors available and your soil type.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Depth gauge wheels keep the seed from being planted too deep in variable soils.

Adjust coulter depth - set the coulter depth so that planting equipment prepares a good seedbed. Coulters should run about one centimetre (one-half inch) below the desired seed or fertilizer depth. **In variable conditions, coulters should be mounted on a hydraulically-controlled frame.**

Spring tension - do not tighten too much. Stones in untilled soil won't move so coulters must ride over them.

Starter placement - place starter fertilizer correctly. If it is too close, it will burn the seeds; if it's too far away, seeds won't receive nutrients early enough.

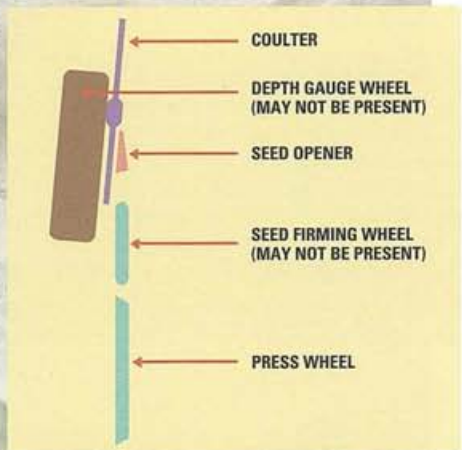
Press wheels - adjust to firm soil around seed not pack it in.

Residue removal - to produce a seedbed that is free of residue, lower trash whippers to move more residue (don't create a trench); or, increase speed to toss residue off the row.

Seed Drills

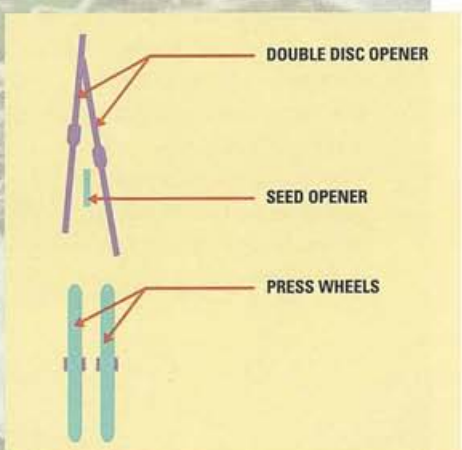
No-till seed drills are used to seed most crops except some of the larger-seeded crops like corn and field beans. Their designs vary from a conventional seed drill to models that are specifically designed for no-till. Each drill can do a good job of no-till seeding in certain situations. The trick is to find a drill that will do the job for you.

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



Single disc opener.

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 centimetre (one-inch) press wheel.

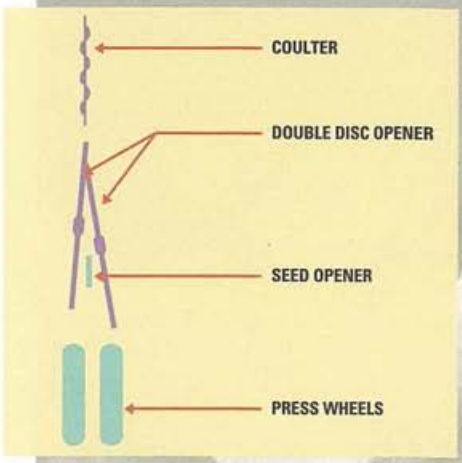


Double disc opener.

Double disc opener - the seed opener consists of two sharp coulters, one leading the other. By staggering one ahead of the other, a narrower zone is tilled, allowing for easier penetration and better residue cutting. The coulters are normally flat discs with 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 centimetre (two inch) by 33centimetre (13 inch) or a double V 2.5 centimetre (one inch) by 30 centimetre (12 inches).

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Disc opener + tillage coulter - a tillage coulter leads the seed slot opener. This coulter tills a narrow seedbed for seed and fertilizer placement. As the distance between the opener and tillage coulter increases (as in coulter caddy set-up vs. 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.



Disc opener and tillage coulter set-up.

RIDGE TILL EQUIPMENT

Many of the no-till principles apply to ridge till. A properly adjusted ridge till planter will perform the following tasks:

- ▸Clear residue from the top of the ridge.
- ▸Remove a shallow surface layer of dry soil with residue.
- ▸Plant the crop into a clean, moist seedbed on the ridge.
- ▸Place fertilizer and band or broadcast herbicides.

Choosing Planting Equipment

There are two planter setups:

A specialized ridge till planter - includes a planter shoe, a sweep, press wheel, and cover discs.

Ridge cleaning units - can be mounted on an existing toolbar of a conventional planter. In some cases, it may be necessary to bolt on an extra toolbar on which to mount the units. This is simple because it requires very few modifications. Farmers may pull a tool bar with ridge cleaning units independently of the planter. On wet soils, this gives the top of the ridge a few hours to dry once residue is removed. Avoid excessive drying, especially on clay soils.

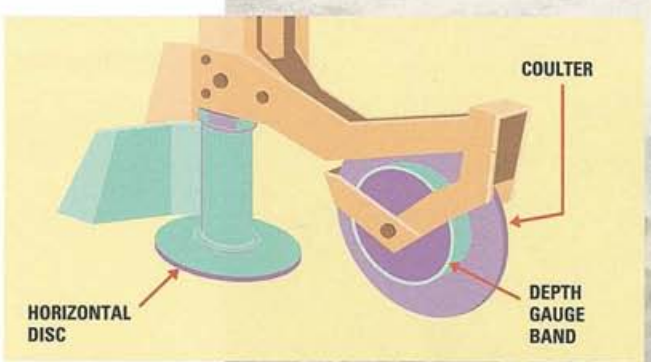


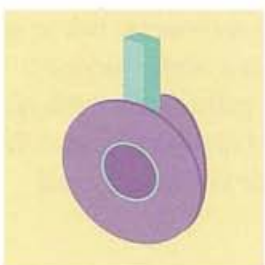
Diagram of a horizontal disc type ridge cleaning unit.

A Closer Look at Planters

Ridge till planters have ridge cleaners to clear residue and a thin layer of soil from the ridge top and a ridge stabilizer to keep the planter on the ridge.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

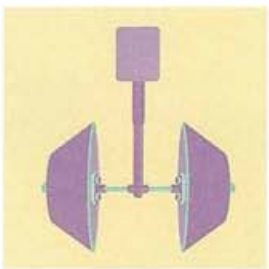
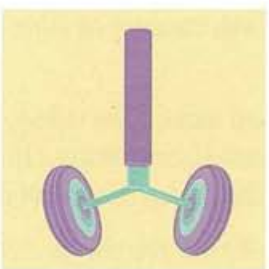
Ridge cleaners - most ridge cleaners have coulters with a depth band running in front of them. The depth band maintains a constant working depth. The coulter cuts residue in front of the sweep and cuts a slot approximately four centimetres (1.5 inches) deeper than the sweep to allow the seed unit to penetrate the soil. The coulter also helps keep the planter on the ridge. Remove just enough soil to leave a clear area for planting.

RIDGE CLEANER		COMMENTS
SWEEPS		• Removes 2.5 cm (1") of soil or less. • Clears a level band of soil 25-36 cm (10-14") wide on top of the ridge.
HORIZONTAL DISCS		• A 36 cm (14") disc rotates in either direction deflecting soil and residue off the ridge. • Clears a level band of soil 25-36 cm (10-14") wide. • "Wing deflectors" direct residue into the valleys.
VERTICAL DISCS		• Vertical discs are offset. • Clears a band of soil approximately 20-30 cm (8-12") wide. • Often a sweep or wing is mounted behind the discs to assist in residue clearing and soil levelling. • The new trash whippers with steel fingers are being experimented with for ridge cleaning.

NOTE: The width of soil and residue cleared will depend on the amount of soil removed from the ridge.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Ridge stabilizers - keeping the planter centred on top of the ridge is very important. If it slides off, plant roots may be pruned during cultivation. Converting a pull-type planter to a three-point hitch will help keep the planter from moving off the ridge. Guidance systems will also keep the planter on the ridge.

RIDGE STABLILZER		COMMENTS
TAPERED WHEELS		• Approximately 40 cm (15") in diameter. • Attach to the front of the planter. • The tapered form keeps it in the valley. • One set is attached at each end of the planter.
LARGE "V" WHEELS		• Approximately 40 cm (15") in diameter. • Attach to the front of the planter. • The wheels ride on the sides of the ridge. • One set is attached at each end of the planter.
SMALL"V" WHEELS		• Approximately 15 cm (6") in diameter. • Attached to the front of some models of ridge cleaners. • Provide depth control for the cleaning units. • The wheels ride on the sides of the ridge. • There is one set per row.

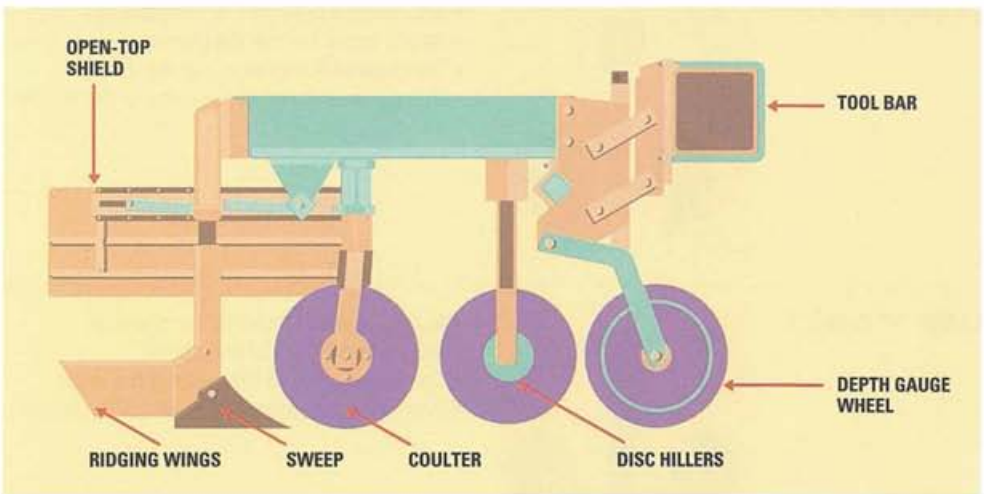
Proper alignment of coulters, disc openers and press wheels will make it easier to keep the planter on the ridge.

Proper alignment makes it easier to stay on the ridge.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Cultivators

These cultivators are designed for high residue conditions to penetrate untilled ground and rebuild ridges. Farmers considering ridge till systems should not try to use conventional cultivators. Ridge till cultivators handle inter-row cultivation and reformation of the ridge. They may also be used to band herbicides, apply nitrogen to corn and broadcast cover crops on the last pass.



Cultivator parts.

The key parts of the cultivator are:

The tool bar is heavy duty and usually filled with concrete or other material to provide weight for penetration.

Coulters are mounted ahead of the sweeps and travel in the valleys, cutting through residue. The coulter is straight-edged and at least 46 centimetres (18 inches) in diameter. Cutting depth may be controlled by a depth band or depth gauge wheel.

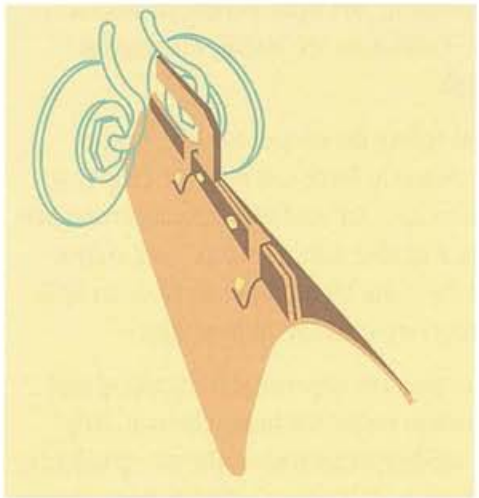
Sweeps loosen the soil in the valleys and cut off emerging weeds. A 36 or 53 centimetre (14 or 21 inch) sweep is used for 76 centimetre (30 inch) crop row spacings. The wider sweep is used during the first cultivation and a narrow one for the second cultivation/ridging operation. The narrow sweep is used to prevent root pruning. Ridging wings are mounted at the back of the sweep during the second cultivation to deflect soil back onto the ridge. Spring-loaded shanks are available to allow sweeps to ride over rocks.

Disc hillers move soil away from the row during the first pass. They should be as close to the row as possible without causing root pruning. They should slightly overlap the herbicide band.

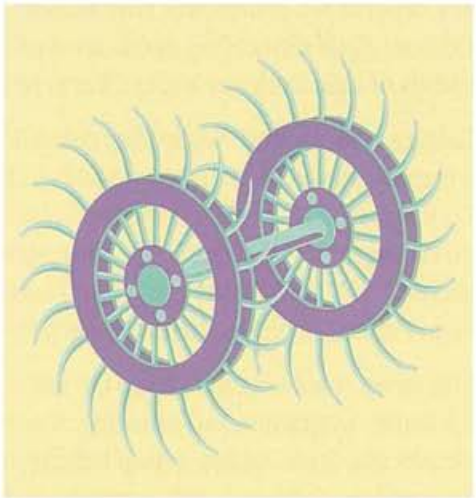
Sweeps and disc hillers on a ridge cultivator.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Shields prevent soil from smothering small plants during the first cultivation. Rolling shields remove weeds close to the row but prevent clumps of soil from touching the crop. Open-top shields can be used for any crop height. Hooded shields are also available.



Hooded shield.



Rolling shields.

Other options include:

Fertilizer attachments to sidedress nitrogen include knives to inject anhydrous ammonia gas or tubes to dribble urea ammonium nitrate.

Banding nozzles may be mounted on the cultivator to direct post-emergent herbicides at weed escapes. This can be applied during the first or second pass.

Lift assist wheels attached to three-point hitch cultivators allow the use of smaller tractors.

Guidance systems are used to keep the cultivator on the row. Steel wands which lightly rub against the crop sense where the cultivator is and make adjustments to a hydraulic steering system.

Nurse tank hitch can be added to the cultivator to pull liquid or gaseous fertilizer.

Banding nozzles on a cultivator for spot spraying in the row.

Lift assist wheels on the back of a cultivator.

The sensing wands of a guidance system on a cultivator.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

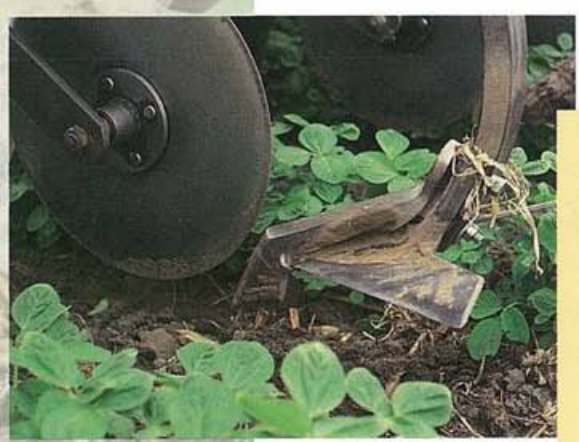
A field of soybeans after the first cultivation.

Operating the Cultivator

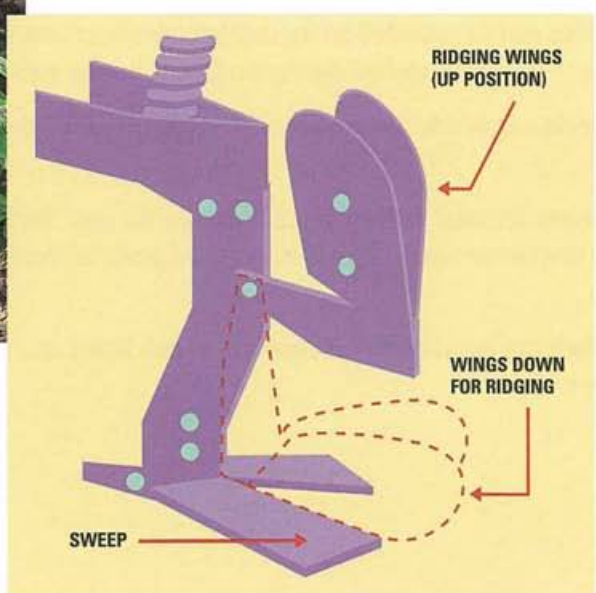
Inter-row cultivation is performed soon after the crop has emerged when weeds are at the seedling stage. The first cultivation also provides loose soil for ridging. Set the sweep at a depth of five centimetres (two inches). This loosens soil while cutting off weeds. Cultivate again if emerging weeds are a problem. Cultivators are usually operated at speeds of eight to eleven km/hr (five to seven mph).

Ridging is performed shortly after cultivation and before the crop is too tall. A set of wings are moved down into position behind the sweep to force soil onto the crop row. Corn is ridged at 46 to 92 centimetres (18 to 36 inches) tall and soybeans approximately 46 centimetres (18 inches). The ridge should be rounded with a flat top. Corn ridges should be 15 centimetres (six inches) high and soybeans 10 centimetres (four inches) high. Pointed ridges are harder to keep the planter on (see diagram next page).

Cultivation should be done when the soil is dry to moist to improve soil fracturing and minimize compaction and smearing. Weed kill is also better. On heavy clay soil, large chunks may form. Adding a deep banding tip or welding metal rods to the sweep will ease the problem. Cultivators with a straight point and wings don't seem to create these chunks.



A deep banding tip on the sweep improves penetration.



During first cultivation the wings are lifted up. Wings are moved down to reform ridges during second cultivation.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Ridges should be rounded not peaked to accommodate planting equipment.

Penetration can be a problem in dry, hard clay. Sweeps should be angled downwards when the cultivator is lowered. A hydraulic cylinder in the top link of the three-point hitch is useful to control the angle of the sweeps and working depth. Deep banding tips will also improve penetration and reduce wear on the sweeps.

Combine Harvester Modifications

Combine wheel spacing can be modified to accommodate row spacing especially in a ridge till system. Spacers are available. Farmers building their own should have them properly engineered.

GETTING STARTED

Choosing to adopt a new tillage system can be confusing. Be aware of what you are getting involved in. Talk to farmers who have been practising no-till or ridge till for more than five years.

It is possible to combine the best of each system to suit a particular farm situation. For example, inter-row cultivate no-till corn. Farmers splitting nitrogen applications find this useful as they are making an extra pass anyway. Dairy and beef farmers gain from hybrid systems.

An extension is added to the axle of a combine to move the wheel off the ridge.

Advantages of Each System

No-till

- **Easy to experiment with.**
- **Less equipment to purchase.**
- **Easy to include forages in rotation.**
- **Less labour. Does not require row crop cultivation.**

Ridge Till

- **More suitable for poorly-drained soils than no-till.**
- **May advance planting date because of earlier spring warm up of soil.**
- **No traffic or soil compaction on ridge.**
- **Manure can be covered with the cultivator and traffic patterns controlled.**
- **Banding herbicides reduces costs.**

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

THINGS TO CONSIDER

NO-TILL	FIELD SELECTION	Coarse textured soils are easier to manage. Good soil drainage either natural or tile will offset some of the potential soil warming and drying problems associated with increases in residue cover. Try to alternate crop families each year. The easiest place to start no-till is with the winter wheat crop into soybean stubble.
	HARVEST	Harvest time of the previous crop is the time to start thinking no-till. Spread residue the full width of the header. Limit compaction and rutting.
	WEED CONTROL	Assess weed problems immediately after harvest. Post harvest control may be required. The timing of a burndown, whether in the fall or closer to planting time, depends on the weeds to control. Typically, a weed control program involves burndown, pre-emerge, or post-emerge treatments. A rescue treatment may be necessary if the target, timing or method chosen were inaccurate.
	PLANTING	Set up a suitable planter/drill that accurately places seed and fertilizer in untilled soil. Plant when residue is dry or brittle. All residue should be dead.
RIDGE TILL SYSTEM	FIELD PLANNING	Sands are easier to manage than silts or clays. Ridges should run across the direction of the tiles. Think about the crop rotation.
	BUILDING THE FIRST RIDGE	The first ridge is formed in the corn crop. Till the field conventionally. Plant with a conventional planter. Purchase a ridge cultivator. Set up and adjust to form a 15 cm (six-inch) high, flat-top ridge. Conduct when corn is 46 cm (18 inches) high.
	HARVEST	All wheel spacing must be adjusted to avoid running on the ridge. Consider controlled traffic ie. all wheel tracks down the same row. Ensure even residue distribution at harvest.
	PLANT RIDGES	The first crop planted on the ridge is soybeans. The series of operations are as follows: burndown, plant and band herbicide, cultivate, cultivate and ridge (see note below).
	HARVEST	Ensure even residue distribution. Scout field for weed problems. Chop corn stalks, if required.

NOTE: - Corn - a 15cm (six-inch) high ridge. - Soybeans - a 8-10 cm (three or four inch) high ridge provided the bottom pods are harvestable. If wheat is to follow soybeans, no re-forming of the ridge is done during cultivation.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

NO-TILL CASE STUDY

This southwestern Ontario cash crop farm was suffering from severe water and wind erosion in the early 80s. Since adopting no-till in 1982, soil erosion has been greatly reduced, soil structure has improved and profits have increased.

FARM DESCRIPTION & BACKGROUND INFORMATION

Soil types - heavy clay, sand, gravel, silt loam.
Topography - rolling, no surface ponding.
CHU - 3300.

EVALUATION OF SITUATION IN 1981

- ▸Too much rill and gully erosion, a bulldozer was necessary to repair fields in the spring.
- ▸Organic matter depletion contributed to soil sealing and crusting.
- ▸Farmer was very concerned about future of farm. A solution was needed to stop soil from moving off the farm.
- ▸A conventional tillage system was used and there were no conservation measures in place.
- ▸Crop rotation - corn and soybeans.

GOALS

- ▸Reduce soil erosion to acceptable levels.
- ▸Improve soil organic matter levels and eliminate soil crusting.

ALTERNATIVES CONSIDERED

- ▸Erosion control structures.
- ▸Rotations with forage crops and cereals.
- ▸Minimum tillage, no-tillage.
- ▸Combinations of the above.

SELECTION

- ▸No-till was chosen because it provided the most soil protection while maintaining farm income.
- ▸Wheat was added to the rotation for soil structure improvement.

INITIAL CONCERNS

- ▸Weed control, residue management and getting the planter to cover seed properly were all concerns.

A field on the case study farm of no-till corn in wheat stubble.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

IMPLEMENTATION

Information Sources

►Ohio Conservation Districts, farmer to farmer networking, government researchers.

Machinery Changes

PLANTER:	YEAR 1	►Added no-till bubble coulters on each unit of conventional planter, installed oscillating depth stops on units (very important on some planters) and added cast iron press wheels. ►Water was put in liquid fertilizer tanks for weight when planting soybeans. ►One planter was used to plant both corn and soybeans.
	YEAR 3	►Replaced fertilizer openers with a coulter and knife.
	YEAR 4	►Due to the larger acreage being farmed and the variability of soil types the original planter became the soybean planter and a second planter was purchased for corn. ►Added an extra tool bar with two wavy coulters (1" for soybeans, 2" for corn) per row to better prepare seed area and one of the wavy coulters with a knife replaced fertilizer coulters and knife for better placement. Weight was added to markers and joints were reinforced. Also a spray boom was added to the back of the planter for pre-emergence herbicide application.
	YEAR 6	►The tillage of the wavy coulters meant that the cast iron press wheels were no longer needed. Put conventional ones back on. Liquid fertilizer tanks were added to apply a portion of the nitrogen requirement.
	YEAR 7	►Added nozzles to band spray herbicides.
SPRAYER:		►Pull type with foam markers. ►Hydraulic floating boom - can raise or lower on the move. ►Added a boom to the front of the planting tractor to spot spray quackgrass.
ROW CROP CULTIVATOR:		►Was purchased to allow banding of herbicides. ►Used for corn only - has spray nozzles to band herbicides in row during cultivation if needed. ►Used to apply liquid nitrogen for corn. ►A note of caution: Row crop cultivation disturbs the residue cover between the rows. On a wet fall it may be necessary to delay harvest for a few days to avoid rutting. Combine wheel spacing may have to be changed to run between the rows.
WICK WEEDER:		►Purchased to control milkweed and dogbane.

The spray boom mounted on the front of the tractor for spot spraying.

Nutrient Management

Soybeans - no fertilizer.

Wheat - broadcast ammonium nitrate in spring, super-phosphate in fall.

Corn - broadcast potassium as needed.

- 60 lbs/acre of actual N at planting - (mixture of 28% and 10-34-0.)
- remaining N applied during cultivation - (28% liquid U.A.N.)

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Crop Rotation

►Corn - Soybeans - Soybeans - Wheat.
►Wheat fields with clover were staying too wet the following spring. The clover is now sprayed in the spring instead of the fall. Growing clover helps field drying in the spring.
►Farmer chose soybean varieties which gave a taller plant and were resistant to phytopthora root rot.

Weed Control

►Velvetleaf has been greatly reduced because tillage no longer aids germination. Seeds remaining on surface do not germinate as readily.
►Canada thistle is now under control as the patches are no longer spread with tillage.
►Weeds generally are now easier to control.

COMMENTS

All of the initial concerns were overcome.
When first starting out, there was no one else in the area going through the same process. A farmer group was important for exchanging information and to help keep morale up.
The no-till system has reduced equipment, labour and fuel costs per acre.

EVALUATION

►Residue protects soil from rain and winds, soil remains in place.
►Organic matter levels have increased.
►Residue cover has reduced soil crusting.

REMAINING PROBLEMS AND PLAN OF ACTION

►Erosion still occurs in runways where concentrated flows of water occur. Runways will be grassed to form permanent grass waterways.

RIDGE TILL CASE STUDY

This cash crop farm is located in southwestern Ontario. Once the ridge tillage system was successfully implemented the owner decided to try strip cropping.

FARM DESCRIPTION & BACKGROUND INFORMATION

Soil types - sandy loam to clay loam.
Topography - level to gently sloping.
CHU - 3250.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

EVALUATION OF SITUATION IN 1981

- ▸Too much wind, sheet and rill erosion.
- ▸Poor soil structure, low soil organic matter levels and soil compaction.
- ▸Low profits.
- ▸Conventional tillage used with no conservation measures.

GOALS

- ▸Improve soil condition.
- ▸Reduce costs and increase profits.

ALTERNATIVES CONSIDERED

- ▸Mulch tillage and then later ridge tillage.

SELECTION

- ▸Although a chisel plow was successful, it was not good enough. Still too much time and money involved in tillage operations.
- ▸Ridge tillage was tried and since then have never looked back.
- ▸Strip cropping was a natural progression of ridge tillage because of the established traffic patterns.

INITIAL CONCERNS

- ▸Compaction in traffic areas between ridges.
- ▸Ridge not staying on sandy soil.

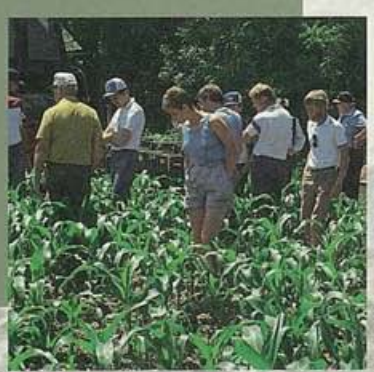
IMPLEMENTATION

Information Sources

- ▸"More Profit With Less Tillage" - Ernie Behn, farmer to farmer networking.

Machinery

PLANTER:	▸Double frame semi-mounted with lift assist wheels. ▸Kinze planter units with Hiniker horizontal disc ridge cleaners. ▸Hiniker V-wheels used to stabilize planter on ridge.
SPRAYER:	▸Pull type, 500 gallon with 15, 30 & 45 foot booms.
CULTIVATOR:	▸Hiniker Econo-Till - 6 x 30". ▸Hiniker 5000 - 6 x 30". ▸2 Sukup "autoguide" guidance systems.
COMBINE HARVESTER:	▸Case IH 1660 with 24.5 x 32 tires, 6 x 30" corn head, 15 foot flex head, 6 x 30" John Deere row crop head. (used for soybeans).



A group of farmers visit the case study farm to learn more about ridge till.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

Nutrient Management

Soybeans - no fertilizer.
Wheat - 80 lbs amonium nitrate sidedress.
Corn - 3 gallons of 6-24-6 on seed
- 100 lbs 12.5-0-37.5 banded in ridge
- 150 lbs actual N as anhydrous ammonia sidedress.

Potash deficiency - banded potash in ridge.

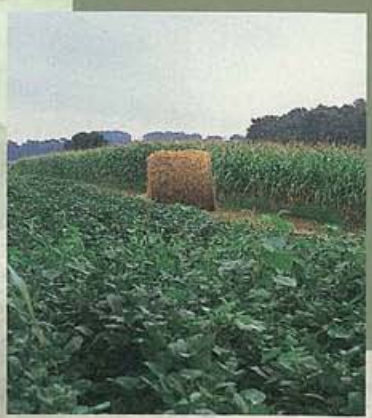
Crop Rotation

►Corn - Soybeans - Winter Wheat.
Strip Cropping - Corn-soybeans-wheat are strip cropped in 15 ft widths.
- Higher populations are planted on the outside corn rows.
- Soybeans must resist lodging in strip cropping.
- Wheat is no-tilled into soybean ridges.

►Experimenting with hairy vetch & red clover after wheat.
►Cold tolerant hybrids are important.

Weed Control

►Dandelions initially a problem.
►Wirestem muhly mainly a problem in corn.
►Trees can be a problem - willow and walnut.



Corn - soybean - winter wheat strips.

COMMENTS

►System allows for strip cropping due to permanent nature of ridges.
►Traffic is controlled off row area.
►Chemical can be banded to reduce cost and potential environmental impact.
►Yields do not drop during first years.
►Works well on all soil types on the farm.

EVALUATION

►Residue incorporated in top 1" - 2" of soil has improved structure.
►Small tractors have helped reduce compaction.
►Surface residue prevents wind erosion.
►Initial concerns were not a problem.

REMAINING PROBLEMS AND PLAN OF ACTION

►Some soils need more organic matter.
►Possible use of compost or cover crops to help correct this problem.

The ridge till planter used on the case study farm.

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

TROUBLE SHOOTING

PROBLEM	CAUSE	SOLUTION
Planter plugging with residue	• 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 on drills by staggering the seed units. **Nt**-drive at an angle to old crop rows.
	• Too much residue	• **Nt**-drive at an angle to old crop rows. **Nt**-plant between old crop rows. Remove straw from cereal fields. Spread residue evenly at harvest. **Rt**-shred corn stalks. Rotate between high and low residue crops i.e. corn and soybeans.
	• Residue not cut	• Use a 43 cm (17") coulter in front of the planting unit. Make sure coulter blades are sharp. Delay planting until residue is dry. Adjust coulter depth.
Planter will not stay on top of ridges	• Improper planter set-up	• Make sure all the coulters and cleaners are aligned properly and are set at a uniform depth. Make sure planter is level from front to back. Add a guidance system. Add ridge stabilizers.
Seed and fertilizer placement too shallow	• Poor coulter penetration	• Add weight to planter frame. Adjust tillage coulter depth. Use narrower coulter. Avoid planting when soil is too dry and hard. Ensure coulters are sharp.
	• Poor tracking of seed/fertilizer unit	• **Nt**-line up tillage coulter with openers. **Nt**-on coulter caddies a wider more aggressive coulter may be necessary.
	• Planter unit bounce	• Install oscillating depth stops. Use a row cleaning device. Increase seed unit down pressure.
	• Poor seed unit penetration	• Adjust seeding depth of unit. Adjust spring pressure on the unit and on the press wheel(s). Replace seed unit disc openers. Align tillage coulters with openers.

Nt - Specific to no-till. **Rt - Specific to ridge till.**

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

TROUBLE SHOOTING CONTINUED

PROBLEM	CAUSE	SOLUTION
Seed and fertilizer placement too deep	• Tillage coulters set too deep	• Raise coulters. Reduce pressure on springs.
	• Seed units too deep	• Adjust depth setting on the units. Add depth stops to the lift wheels.
Poor seed trench closure	• Inadequate firming of soil	• Increase down pressure on press wheel. Change to a narrower press wheel.
	• Soil too wet	• Wait for soil to dry. Kill vegetation sooner and thus speed soil drying. Install tile drainage.
Erratic seed drop/skips	• Slipping drive wheel/coulter	• Add weight to planter or drill. Add fluid to drive wheel. Change to a more aggressive drive wheel/coulter.
Poor seed-to-soil contact	• Hairpinning	• Remove more residue from the row. Install tillage coulters in front of openers. Sharpen coulters. Replace worn seed unit disc openers.
Poor germination and emergence	• Cool soil temperature	• Install tile drainage in poorly drained areas. Delay planting until soil warms up. Clear residue out of the plant row. Till the soil in plant row. Kill growing vegetation sooner i.e. in the fall before vegetation becomes too dense.
	• Seed and seedling disease	• Use a seed treatment. Rotate crops. Select varieties for disease resistance. Use high quality seed.
	• Inadequate soil moisture	• Plant into dead residue, burn off weeds or cover crops well before planting. Control red clover and alfalfa in the fall. Plant earlier.

Nt - Specific to no-till. **Rt - Specific to ridge till.**

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

TROUBLE SHOOTING CONTINUED

PROBLEM	CAUSE	SOLUTION
Poor root growth	• Soil compaction	• Avoid traffic on field when wet. Utilize rotations or cover crops which improve soil structure.
	• Wet soils	• Improve surface and subsurface drainage.
	• Fertilizer burn	• Make sure product rates are safe. Make sure product is safe. Check that placement is not too close to seed.
Poor early growth and reduced stand	• Seed planted too deep	• Plant just into moisture usually 2.5 to 4 cm (1" to 1.5") deep (especially for early corn).
	•Too much ridge scraped off	• **Rt**-scrape off only enough to reach moisture, avoid exposing less well structured soil.
	• Nutrient deficiency	• Use starter fertilizer to improve early uptake. Soil test to determine fertility problems.
	• Cool wet soil	• Select varieties and hybrids with good seedling vigour and early cold stress tolerance. Improve drainage.
	• Detrimental effects from decomposing residues	• Avoid planting crop into its own residues. Alternate grass and legume type crops.
Nutrient deficiency	• Low soil nutrient levels	• Soil test and apply recommended nutrients.
	• Low nutrient availability	• Band phosphorus and potash in row area.
	• Poor nitrogen placement	• Inject all nitrogen for corn below residue.
	• Nitrogen losses due to denitrification	• Improve drainage and soil structure. Apply nitrogen close to when it is required.
Poor weed control	• Vegetation not controlled prior to emergence	• Use a burndown herbicide prior to crop emergence. Identify weeds prior to planting. Match the burndown treatment to weeds present.
	• Failure to recognize change in weed spectrum	• Scout for weeds on a regular basis. Select the appropriate weed control method for your weeds.
	• Improper timing	• Control the weeds at the proper growth stage (remember in no-till weeds get off to an earlier start).
	• Cultivator throwing weeds back in row	• Replace sweep with 5 cm (2") straight chisel tooth on 1st cultivation. Drive slower.

Nt - Specific to no-till. **Rt - Specific to ridge till.**

TILLAGE OPTIONS – NO-TILL AND RIDGE TILL SYSTEMS

TROUBLE SHOOTING CONTINUED

PROBLEM	CAUSE	SOLUTION
Disease	• Susceptible varieties	• Select disease resistant varieties.
	• Poor crop rotation	• Follow a better cropping sequence. If cover crops are used, ensure that they break the disease cycle. Use seed treatments. Avoid planting wheat into corn residue.
Cultivator will not go into the ground	• Not enough weight on cultivator	• Add weight, adjust down pressure spring.
	• Sweep angle not correct	• Install hydraulically adjustable top link on 3-point hitch.
	• Sweeps worn	• Replace, or install deep banding tips.
Cultivator makes too many slabs, knocks down corn	• Cultivating too deep	• Adjust depth gauge wheels.
	• Soil structure problems	• Rotate to cereals to improve surface structure. On first cultivation replace sweep with 5 cm (2") straight chisel tooth. Deep banding tips will help.
Cultivator plugging with residue	• Residue too damp	• Allow to dry out.
	• Cultivator not set deep enough	• Adjust depth gauge wheels.
	• Uneven residue distribution	• Install straw spreader on combine.
Cultivator will not track straight	• Gauge wheels not at same depth	• Set them all at the same depth.
Guidance system not tracking properly	• Wands not sensing the row	• Use setup where two wands channel one crop row rather than two rows.

Nt - Specific to no-till. **Rt - Specific to ridge till**