

TILLAGE OPTIONS – MULCH TILLAGE

Mulch tillage leaves at least 30% of the soil surface covered by crop residue. In this section, we look at how practices change when moving from conventional systems into mulch tillage. Other terms that are sometimes used for this system include: **reduced tillage, minimum till or conservation tillage.**

Mulch tillage is the ideal system to use if you want to reduce tillage but have forages or manure to worry about. This system allows you to leave residue on the soil surface and work manure into the soil.

Changes from Conventional System

- ▶ Mulch tillage is compatible with most soils except clays and imperfectly or poorly-drained clay loams.
- ▶ Soil temperature and moisture are affected, which may delay tillage or planting by a day or two.
- ▶ High levels of surface residue reduce soil erosion.

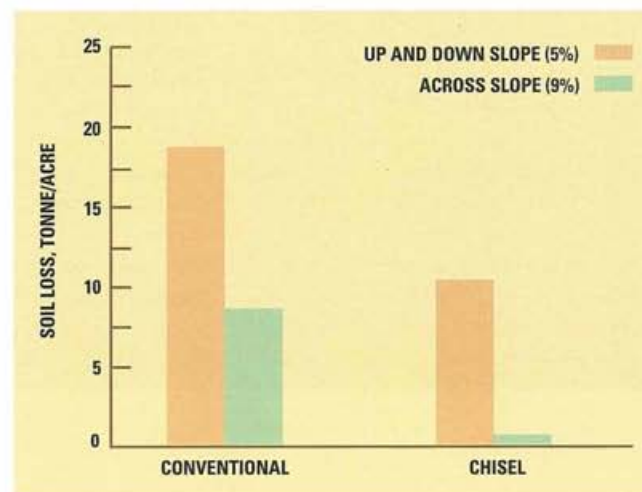


After planting at least 30% of the soil surface is covered by crop residue.

SOIL MANAGEMENT

EROSION CONTROL

Residue Levels - from the section on Understanding the Basics, we know that different crops leave different amounts of residue. In a mulch till system, various amounts of residue can be easily handled with the proper equipment. By leaving residue on the soil surface, mulch tillage is one of the best systems for erosion control.



The effect of type of tillage and tillage direction on soil loss. A considerable advantage is shown for chisel plowing cross slope as compared to moldboard plowing in either direction or chisel plowing up-and-down slope.

Tillage Direction - tillage direction has a major effect on soil loss. As shown in the diagram, erosion is reduced dramatically if the land is worked across the slope instead of up-and-down the hill.

Eliminate Trips over the Field - clumps are broken down by tillage. The more a soil is tilled, the smaller these clumps become. The soil is then more likely to erode and crust. Limiting the number of tillage passes and leaving more residue near the surface not only reduces erosion and crusting but also increases the organic matter content at the soil surface. This makes soil easier to manage.

TILLAGE OPTIONS – MULCH TILLAGE

SOIL TEMPERATURE

Temperatures are influenced by the amount of residue cover and by soil moisture. Mulch tillage can lead to cooler temperatures because of the residue left on the soil surface. Removing residue from row areas and choosing varieties that tolerate cold and have early seedling vigour will overcome this problem.

RESIDUE MANAGEMENT

Mulch tillage is one of the best means to manage residue to benefit the soil, while saving time and fuel. When you work the residue into the top inches of the soil you speed up the breakdown of residue to humus. Also, because the soil is being worked, mulch tillage will help soil to warm and dry more quickly in the spring.

Equipment may have to be modified to handle the increased residue. See the table on page 20 to know the amount of residue you'll be working with in your system. In a mulch till system, planting equipment may have trouble cutting through residue because the soil is loose underneath. Proper changes to equipment can overcome this. See the section on equipment for ideas. High residue levels can be reduced through choice of equipment, the number of trips over a field and by including low residue crops such as soybeans in your crop rotation. Aim for 30 to 60% residue at planting.

CROP ROTATION AND COVER CROPS

Crop rotations offer opportunities to break pest cycles, to control problem weeds, to improve soil structure, to increase crop yields and to save money on crop inputs such as fertilizer. Examples are:

- ▶ Legume forage crops offer savings in the nitrogen requirements of the next crop.
- ▶ Early cereal harvest allows an opportunity to control perennial weeds.
- ▶ Soybeans leave the soil in “mellow” condition, meaning it is easy to work and prepare for the next crop.
- ▶ Red clover or alfalfa may break up compacted layers if left for more than one year.

Changes from Conventional System

- ▶ Adjust harvest equipment to spread straw and chaff evenly.
- ▶ After planting, 30-40% of the soil surface will be covered with residue.
- ▶ If using rotary till or plain chisel equipment, chop corn stalks.
- ▶ Equipment must be changed to handle the increased surface residue.

Changes from Conventional System

- ▶ Crop rotation is essential to break pest cycles.
- ▶ Mulch tillage works with all crops in the rotation. Perennial forages should be chemically killed to avoid regrowth problems.
- ▶ Heavy residue crops, such as corn, must be chopped, either with the tillage implement or in a separate pass.

TILLAGE OPTIONS – MULCH TILLAGE

When planning a crop rotation, consider the following factors;

- ▶ Livestock needs.
- ▶ Equipment.
- ▶ Economics.
- ▶ Soil and climate.
- ▶ Other crops in the rotation.
- ▶ Amount of residue left from the crop.

There is no doubt that the best rotations are forage-based. In a mulch till system, surface residue will protect summer-seeded forages from erosion and catch snow for winter protection. For red clover-based forages/cover crops, frost seeding (broadcasting seed on frozen ground in the spring) works well. Residue acts as a mulch, keeping moisture close to the seed. Management of forages is similar to a conventional system.

COVER CROPS

Consider cover crops as part of the rotation when working in a mulch tillage system. Look at the type of crop, how it will be controlled (winter killed vs. chemical killed), and the amount of residue it will leave. Usually, it is best to use chemicals to kill a legume cover crop in the fall to make sure it is dead in the spring. Don't rely on tillage to kill the crop.

Some cover crops such as red clover leave a lot of residue on the surface. It may be best to work the ground in the fall to help dry the soil in the spring. In the spring, be prepared to kill some cover crops early. For example, rye should be killed early so it doesn't rob moisture from the next crop. In addition, early killed rye will not leave as much residue, making it easier to handle.



Alfalfa or red clover in the rotation will improve soil structure and help break pest cycles. Also a legume will provide nitrogen to the next crop.



Cover crops such as red clover help protect the soil from water erosion during the winter and early spring months.

TILLAGE OPTIONS – MULCH TILLAGE

TILLAGE AND CROP ROTATIONS

When a change is made from a conventional system to mulch tillage, a chain reaction is set in motion which will affect your entire management system. Crops which leave little residue, such as beans or cereal with the straw removed, are relatively unaffected by the change as long as they are rotated with another crop. However, high-residue crops, such as corn or alfalfa, need more attention in a mulch tillage system.

Corn stalks can be easily disced or chiselled if the chisel plow is equipped with a gang of coulters or discs to slice through the stalks to prevent plugging. If your chisel plow does not have this feature, you may have to make an extra pass with a stalk chopper before tillage to break the residue into small pieces that won't interfere with other tillage passes. Because the corn residue is not buried, but mixed into the surface layer, it should be followed by a crop other than corn in the rotation.

Alfalfa and clover may not be completely killed by chiselling because some ground may not be sufficiently disturbed. It is better to spray the forage prior to tillage to get a good kill. Long-established alfalfa will probably have some quackgrass in it, so spray it with glyphosate to kill both. On clover, 2,4-D is a better choice to kill the legume. If you are farming lighter soils such as sands or loams, tillage can be delayed till spring without hurting yields. The untouched residue protects soils over winter.

NUTRIENT MANAGEMENT

Test your soils before applying any nutrients. For more information, see page 27.

PLACEMENT

Placement is most critical when soil fertility is low. If soil fertility is high, there is less response to fertilizer placement. For this reason, start mulch tillage on fields which have tested medium to high for nutrients. Once you are comfortable with a system, and have learned to work with residue and made the necessary adjustments to your equipment, you may want to start experimenting with fertilizer placement if fertilizer is required.

Because soils in mulch till systems tend to be a little cooler and wetter than in conventional systems, there may be a benefit to using starter fertilizer.

The remaining fertilizer can be broadcast and incorporated with secondary tillage passes as in the moldboard system. Rates of application depend on the soil test. Nitrogen fertilizer must be injected or incorporated into soil.

A bean crop has relatively little straw and the ground is left "mellow" so very little or no tillage may be necessary to plant wheat. If the straw is well chopped and spread, it might need only one levelling pass with a cultivator to get a seedbed. If the next crop is another cereal or corn, fall tillage can be delayed to allow weeds to grow before destroying them either chemically or mechanically, whichever is appropriate.

Changes from Conventional System

- Use starter fertilizer in soils that test low in nutrients to improve growth in cooler soil conditions.
- Nitrogen is best injected or worked in immediately.
- Liquid manure can be incorporated with a disc or chisel plow. Twisted shovels on the chisel plow will give better soil mixing than sweep teeth. With sweeps, too much manure tends to stay on the surface.
- Solid manure may be difficult to work in if it is spread too thickly.

TILLAGE OPTIONS – MULCH TILLAGE

MANURE

Manure is both a fertilizer resource and a source of pollution. As a fertilizer, it contains nitrogen, phosphorus and potassium. It is also a good source of micronutrients and organic matter. For more information on nutrient values in manure, see the Livestock and Poultry Waste Management booklet.

Manure nutrients are preserved if manure is worked in within several hours of application. Incorporation also reduces the risk of rainfall washing manure off the field. Liquid manure can be incorporated with a disc or a chisel plow. The twisted shovel on a chisel plow does a better mixing job than the sweep. If the sweep is preferred for your soil type, consider a combination tooth (sweep and twisted shovel) to get the advantages of each. Mounting both sets will require more horsepower as more soil is being moved.

A thick layer of solid manure on top of residue can make it difficult for the chisel or disc to penetrate the soil. Make sure solid manure is spread evenly and only to the thickness that your tillage equipment can handle.



Photo courtesy of Loyal Equipment Ltd.

Manure should be injected where there is high residue.

Changes from Conventional System

- Rotation is more important.
- Insect and disease types will be different but will not cause more problems if managed properly. Scout fields to watch for new problems.

PEST MANAGEMENT

CROP DISEASES

Mulch tillage affects plant diseases directly and indirectly. Surface residue provides food and shelter for many types of disease organisms. For example, fusarium is of great concern to wheat and corn producers, particularly if they also feed hogs. In a mulch tillage system, avoid planting wheat after corn to overcome the potential problem of fusarium.

Crop rotation is the most cost-efficient means of reducing disease. The disease cycle is broken by planting a non-susceptible crop into the residue of a host crop. The longer the break between similar crops, the less opportunity for disease to get established.

Another way of reducing potential problems is to plant disease-resistant varieties. OMAF Publication 296 provides information on hybrids and varieties and their resistance to various diseases.

TILLAGE OPTIONS – MULCH TILLAGE

INSECTS AND SLUGS

Insects and other pest numbers may increase if there are a lot of weeds in the field. Weeds can act as a food source or an egg-laying location for pests. While the insect populations will be reduced by tillage, make sure that all vegetation is dead at planting time. Modify planting equipment to move residue away from the row area so young seedlings have a good chance to get established without pressure from insects and slugs.

Crop rotation offers the best control of pests. Different crop sequences will help break insect cycles.

Crop scouting on a regular basis will keep you aware of the type and extent of insect damage and help you plan for the next crop.

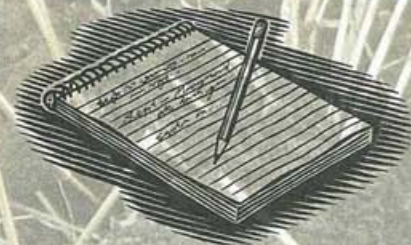
WEEDS

Changing tillage means changing your approach to weed control. Tillage buries weed seeds at different depths so they tend to germinate in flushes. An even flush is easiest to control but does not happen in mulch tillage conditions. Scout your fields and plan your spray program for the weeds that you have in your fields.

For the first few years, while you are learning the system, apply pre-plant, incorporated herbicides at the higher rate recommended for your soil type. If large amounts of crop residue interfere with good mixing action of the soil, consider using pre-emergent or post-emergent herbicides instead. These should be applied at normal rates.

Successful weed control depends on good crop management practices. Timely planting, good populations and fertility allow the crop to compete with weeds.

OMAF Publication 75 provides recommendations for appropriate herbicides and their rates of application.



Herbicide programs will change in a mulch till system. Consider using pre-emergent or post-emergent herbicides.

TILLAGE OPTIONS – MULCH TILLAGE

Changes from Conventional System

- ▶ Secondary tillage and planting equipment need to have better clearance capacity.
- ▶ Planting equipment may need to be fitted with coulters and trash whippers to move residue out of the row area.
- ▶ Combine should be equipped with good straw and chaff spreaders.
- ▶ Chisel plows, discs and rotary tillage equipment are used for primary tillage.

EQUIPMENT

Mulch tillage calls for modifications to all production equipment, including harvesting, tillage and planting equipment.

Choosing the right tool for soil conditions and amounts of residue is a high priority. When the primary tillage implement is changed, it sets off a chain reaction through the whole system. As more residue is left on the surface, secondary tillage implements may have to be adjusted or traded in for better clearance tools. Planting equipment may not be able to handle the high residue conditions left by mulch tillage, so you may have to add weights, heavy down-pressure springs, coulters, trash whippers, etc. If your planter is very light, it may not have the frame strength for modifications. Be prepared for changes throughout the system.

Mulch tillage can be achieved with many different tillage tools that leave various amounts of residue.

CHISEL PLOWS

Chisel plows are used for primary tillage. There are several types available. The coulters-chisel plow is the most common in southern Ontario. It combines a gang of discs or coulters in front of the chisel teeth to work in all residue conditions. The cutting action of the coulters/discs is necessary for handling corn stalks. This makes it easier for secondary tillage. After one pass, 30 to 75% of the residue is left.

The plows are solidly constructed with high clearance and shanks spaced 30 to 40 centimetres (12 to 16 inches) apart. This usually prevents plugging but in high residue or wet conditions, it can still be a problem. Spring-mounted chisel shanks vibrate and shed residue better than rigid shanks. They also last longer in stonier soils.



There are several types of chisel plows. This is referred to as a chisel plow with no disc/coulters on the front.



This coulters-chisel plow has a gang of coulters ahead of the chisel teeth.

TILLAGE OPTIONS – MULCH TILLAGE

Chisel Teeth

Chisel plows can be fitted with straight points, twisted shovels or sweeps in a variety of widths. Narrow points are only suitable for sandy soils, while twisted shovels which leave 28 to 40% residue cover are ideal for medium-textured soils such as loams and silt loams. Heavier soils such as silty clay loams or clay loams respond best to 40 to 45 centimetre (16 to 18 inch) sweeps; these give the best shattering action on these soils. The sweeps leave 40 to 60% of the residue on the soil surface after one pass and work all the soil the width of the machine. Only one pass is needed as each subsequent pass reduces the amount of residue. A sweep and twisted shovel can be mounted together on the shank. This is done to get the full shattering effect of the sweep and to incorporate more residue with the twisted shovel.



Twisted shovel.



Sweep tooth.



Combination twisted shovel/sweep tooth.

Chisel plows can be fit with different types of points.



TILLAGE OPTIONS – MULCH TILLAGE

CHISEL TEETH SELECTION

TYPE OF TOOTH	HP/SHANK	SOIL TYPE	RESULTS	% RESIDUE ON SURFACE*
STRAIGHT POINT	12 - 15	Best in light soils	Minimum incorporation of residue. Not all the soil is worked.	35 - 50
TWISTED SHOVEL	15 - 20	Sand to silt loam	Leaves soil surface ridged. Not all the soil is worked.	28 - 40
SWEEP	20	All types	Leaves most residue on the surface. Soil surface is relatively smooth. All of the soil is worked.	40 - 60
COMBINATION OF SWEEP AND SHOVEL	15 - 20	All types	Incorporates residue and works all the soil.	30 - 50

* Lower number for low residue crops such as soybeans. High number for high residue crops such as corn and cereals. If using a chisel plow without coulters/discs, residue levels will be five percent higher.

Soil Penetration

In compacted, poorly-structured soils, you may have a problem getting the chisel plow to penetrate the ground. To overcome this, two options are available:

Add a deep banding tip (eg. Agri-Tech hardened point)

- ▶ To the end of sweep point.
- ▶ To assist in penetration of soil.
- ▶ To reduce wear of sweep.

Use straight points on front shanks for soil penetration

- ▶ Follow with sweeps or twisted shovels on rear shanks.
- ▶ Make sure soil conditions are dry.



A deep banding tip on the sweep may help the chisel plow penetrate compacted, poorly structured soil.

TILLAGE OPTIONS – MULCH TILLAGE

Set up and Operation

When using twisted shovels, it is important to set them up so there are equal numbers of left and right shovels. If there are three rows of shanks, the first row of shovels should all turn the soil in the same direction, the second in the opposite direction and the third would be split, turning soil towards the centre of the plow. Left and right shovels are turned towards each other to form ridges. A combination of sweeps and shovels may be used. The most common is to have twisted shovels on the front row(s) and sweeps on the back row.

Discs or coulters on the front of chisel plows are set to run just deep enough to cut the residue. Discs may be set deeper to work in more residue. In order of ease of adjustment, depth may be controlled by:

- Hydraulics.
- A ratchet.
- Nut and bolt arrangement.

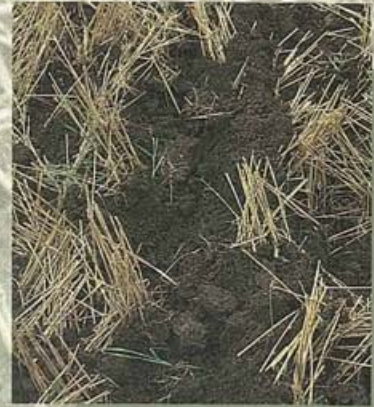
On variable soils, the hydraulic system is useful. The choice between discs or coulters depends on the amount of residue to be worked into soil. Coulters incorporate less than discs. Discs may be adjusted to different angles. The straighter the angle, the less residue that will be incorporated.

For proper shattering action, chisel plows must run at speeds between 8 and 11 km/h (five and seven miles per hour) and on soils dry at working depth. The operating depth for the chisel plow with twisted shovels is 15 to 20 centimetres (six to eight inches) and 10 to 15 centimetres (four to six inches) for sweeps. Tillage is usually done at an angle to old crop rows.

In wet conditions, the chisel plow is less effective at soil shattering and can cause soil smearing. A moldboard plow works better on clay and clay loam soils. In wet falls, chisels may not work adequately on medium-textured soils.

Sometimes, after chisel plowing with twisted shovels ridges are left which cause problems. Uneven soil drying occurs which may lead to uneven emergence across a field. This problem can be overcome by using sweeps on the back row of the chisel plow or adding a levelling device (such as a buster bar harrow) on the back to level the ridges.

Before buying or even borrowing a chisel plow, make sure you have a tractor with enough horsepower to pull it in your fields. You will need roughly 15 horsepower per shank. For example, a seven-shank chisel plow requires a 105 horsepower tractor. On heavier soils such as clay loams, up to 20 horsepower per shank will be needed.



Chisels must be used when the soil is dry for proper shattering action.



A buster bar can be added to the back of a chisel plow to help level the ridges.

TILLAGE OPTIONS – MULCH TILLAGE

DISCS

Discs are used for both primary and secondary tillage. Residue is mixed into the soil about three-quarters of the depth of tillage. It will leave 30 to 70% of residue after one pass. It breaks up the residue and loosens the soil surface. Use of the disc in wet soil conditions can lead to compaction at the tillage depth. This is caused by pressure exerted by the curvature of the blade. This problem can be minimized by varying the depth of tillage every year, or by alternating primary tillage tools every few years. If poor root-growth or surface ponding is seen after a few years of discing, using a chisel or moldboard plow to a depth of three or five centimetres (one or two inches) below discing depth, will usually ease the problem. If the problem is back in a year or two, consider a permanent change to a chisel plow.



Offset vs. Tandem Disc

The offset disc gets better penetration and handles residue more easily than the tandem disc. Because of its heavy frame and larger blades, the offset disc can be used on more soil types and in almost all residue conditions. The heavy frame is needed so that extra weights can be attached for better penetration in hard ground. Tandem discs are usually only used for primary tillage on light soils and in cereal stubble. Only blades larger than 60 centimetres (24 inches) should be used for primary tillage.

The offset disc will leave more residue on the soil surface than a tandem disc.

Blade Selection and Spacing

A wide variety of blades are available with smooth or notched edges and a variety of thicknesses and sizes. Make sure you know what kind of blade you want before buying a disc. Changing blades is expensive and time-consuming. If possible, rent or borrow different types of discs to see how they perform on your soil before buying.

Notched blades help penetrate hard ground and work better in heavy residue situations. Because notched blades are more expensive than smooth ones and they wear faster, some producers use them only on the front gang and put smooth blades on the back.

Compromise on blade spacing will be necessary if the disc is used for both primary and secondary tillage. Wider spacing 28 to 33 centimetres (11 to 13 inches) is preferred for primary tillage for better residue flow. Narrower spacing 23 to 28 centimetres (9 to 11 inches) is better for secondary tillage because this provides uniform incorporation of fertilizers and pesticides and the soil surface is left level. Some discs come with a wider spacing on the front gang and narrower spacing on the rear gang.

TILLAGE OPTIONS – MULCH TILLAGE

Set up and Operation

To get the best results, the disc should be operated at speeds of 6 to 10 k/m/h (four to six miles per hour) at a depth of 10 to 15 centimetres (four to six inches). Count on at least 14 HP per 30 centimetres (foot) of working width. As with the chisel plow, you may find that more horsepower is needed as the soil type gets heavier.

The most difficult aspect of working with discs is setting them so that they produce a level surface. A disc that is improperly set will leave trenches and hills at either edge. Always check the disc for level operation from front to back first, then from side to side. This is done by running the disc in the field for about a hundred metres (300 feet) at working speed and judging the results. The diagram shows the results if the disc is levelled front to back, if the front is set too low or if the back is set too low. When the disc is properly adjusted, the back section should be 3 to 5 centimetres (one to two inches) lower than the front. The sections can be raised or lowered using manual or hydraulic devices. After making adjustments, do another test strip to check results. Repeat until the soil surface is left smooth.

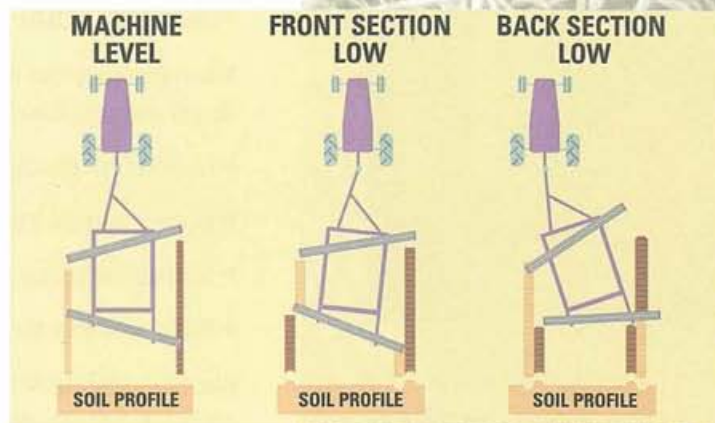
Once the machine is levelled front to back, check for side-to-side level operation. The soil should be worked to the same depth on either side. Depth control is determined by the wheels of the implement, so make sure tires are properly inflated and on the ground when checking depth.

ROTARY TILL IMPLEMENTS

A rotary till implement (eg. Aerway) is a primary/secondary mulch tillage implement you can use on lighter soils. Its success has been limited on heavier soils due to problems getting adequate penetration. It is a single tool bar equipped with non-powered rotating knives. The frame is heavy enough that extra weights can be attached. This implement can be used for one pass tillage, although it is more common to make two passes. It will leave considerable residue on the soil, while leaving the surface relatively level. Material which survives the winter should be killed, as rotary tillage may not destroy all plants.

SECONDARY TILLAGE

Secondary tillage should be kept to a minimum to conserve residue. It should be sufficient to mix in fertilizers, work in pre-plant herbicides and level the surface. Heavy residue, like corn stalks, can cause plugging problems. Field cultivators may need to have a few tines removed and others re-spaced for better residue flow. An overall spacing of 13 to 15 centimetres (five to six inches) between tines should give the best compromise between residue flow and a level seed-bed. It may be necessary to trade in the S-tine cultivator for a high clearance C-shank cultivator. C-shank cultivator frames are stretched and raised to make residue flow easier.



Levelling the offset disc.



Rotary till implements will leave a high percentage of crop residue on the soil surface.



Secondary tillage should be kept to a minimum. Consider using a once over implement such as pictured to eliminate trips over the field.

TILLAGE OPTIONS – MULCH TILLAGE

PLANTING EQUIPMENT

When planting into tilled soil, aim for residue levels between 30 and 40% after planting. To get uniform stands in mulch till fields, planters must:

- ▶ Clear or cut residue ahead of the seed opener.
- ▶ Open a narrow trench in firm, moist soil.
- ▶ Maintain accurate depth control and seed placement.
- ▶ Press seed into the soil, cover and firm soil over the seed.

Planting equipment may need modifications in high-residue situations. If you are in the market for a new planter, look into some of the conservation models which have heavier frames and down pressure springs for better soil penetration, coulters to remove residue, offset double disc seed openers, gauge wheels at the seed opener for better depth control and press wheels for improved seed trench closing.

Seed Openers

The preferred type of seed opener for planters is the offset double disc opener. Offset double disc openers can slice through residue and reduce plugging problems. They also offer better depth control as they do not ride up and over residue. Drills have three options for seed openers: single coulter with shoe, offset double disc and double disc. All work well in high residue situations.

Coulters

Chisels and discs leave the soil soft, so that coulters which should slice residue may instead, push it into the ground. Rather than planting into soil you would be dropping seed into a fold of residue (hairpinning). There will be no soil-seed contact and more chance of toxic effects from residue. The ripple coulters do the best job of slicing through residue. Planters may need a coulters and a trash whipper mounted in front of seed openers for proper seed placement in heavy residue.

Trash Whippers

Trash whippers are a set of discs slightly offset, which whisk larger pieces of crop residue and soil clumps out of the row area. There are many types and styles available: smooth-edged, notched or toothed and a variety of sizes. Preferences depend on individual tastes. All require care in setting at the correct height to move residue, not soil.

The more rough and uneven the ground is, the more difficult it is to set the trash whippers at a height where they remove enough residue without cutting a trench in the seedrow. Trash whippers should be mounted on the seed unit for better depth control.



The offset double disc opener is the preferred opener for planters in high residue situations.



Notched trash whippers handle high residue situations easily and move the residue off the row area.



Smooth-edged trash whippers are another option. Trash whippers must be set properly to move residue, not soil from the row area.

TILLAGE OPTIONS – MULCH TILLAGE

Press Wheels

Arguments abound about which configuration is best. The two most popular types are the V-style and the rubber-tire style. What you need for mulch till systems are heavier press wheels that have narrow points of contact and squeeze the furrow closed.

Press wheel choice will depend on your soil type and moisture conditions at seeding. Press wheels should:

- ▶ Cover the seed with soil not residue.
- ▶ Firm but not compact soil around the seed.
- ▶ Avoid crusting after planting.

Time spent adjusting press wheels is time well spent.



The most popular type of press wheels are the wide rubber tire style (left) and the V-style (right). Choice will depend on your soil and planting conditions.

Seeding Rate

Seeding rates are not different from a conventional system. In rougher conditions, reduce speeds to maintain depth and get adequate seed coverage. Check your tire pressure to reduce slippage, which also affects your seeding rate! Monitor plant populations to ensure seeding rate was adequate. The planter must be adjusted to maintain the correct seeding rate.

Planter Set-up/Field Operation

In high residue situations, it becomes important to check the planter in the field when it is actually operating. Check:

- ▶ Seeds are being placed at the proper depth and spacing.
- ▶ Press wheels are closing the seed trench properly.
- ▶ Trash whippers are set properly to move residue (not soil) from the row area.
- ▶ Coulters are cutting residue, not pushing it into the ground.
- ▶ Residue guards are in place to protect moving chains, etc.



With proper planter set-up in a mulch till system you should have an even stand of healthy soybeans.

TILLAGE OPTIONS – MULCH TILLAGE

HARVEST EQUIPMENT

The importance of well-spread residue is particularly important. Combines should be equipped with chaff and straw spreaders capable of spreading residue evenly over the full working width of the combine. This is the first step in any mulch tillage program.



In a mulch till system it is important that residue and chaff are spread evenly across the harvest width.

There is no doubt that the cost of modifying equipment or, in some cases, replacing equipment, will make the change to mulch tillage more expensive. However, there are savings in reduced labour and fuel, not to mention soil saved once your program is running.

Best Management Practices for Mulch Tillage

- ▶ Match tillage implements to tractor horsepower. It's better to use a smaller implement on a larger tractor than the other way around.
- ▶ Only till when the soil conditions are right. Avoid wet fields.
- ▶ Only till when necessary. No-till planting wheat into bean stubble may be an option.
- ▶ Till across slopes to cut erosion losses. Chisels and discs are quite capable of working on gentle curves, but do not make tight turns with the implement still in the ground.
- ▶ Set coulters on chisels just deep enough to cut residue to avoid excessive wear.
- ▶ Chisel plows and discs perform better in corn residue if the field is worked at a slight angle to the old rows.
- ▶ Make sure that right and left throwing twisted shovels are alternated on chisels.
- ▶ Both chisels and discs should be checked for level operation.

GETTING STARTED

Select the most appropriate tillage system for you. As you change systems, other management aspects will change as well. Consider the following points as you get started.

Soil type

The lighter your soil, the more options you have. No-till or mulch till will work well. On poorly-drained clay and clay loam soils, the moldboard plow may be the best option.



Chisel plow at a slight angle to old corn rows to prevent plugging problems.

TILLAGE OPTIONS – MULCH TILLAGE

Drainage

If you are considering mulch tillage, improve drainage first. Residue on the soil surface will slow the drying process.

Erosion potential

Long, steep slopes have more erosion problems and require more drastic changes in both cropping and tillage. Complex slopes are difficult to manage with just cropping changes. Tilling on the contour or cross-slope is easier with chisel plows or offset discs than with the moldboard plow. Secondary tillage and planting can also be done cross-slope if the slope is simple. With complex slopes, it might be more effective if primary tillage is done on the contour and secondary tillage and planting are done the length of the field. Protect soil through the winter and early spring by leaving residue on the soil surface or planting cover crops.

Cropping program

What crops will you be working with? How much residue will they generate? Crop rotation is more critical with mulch tillage because it helps control weeds, insects and diseases. Crop sequence is also important as problems may arise when some crops follow each other such as corn and wheat.

Weed pressure

Know what weeds to expect in your fields and how to control them. Walk your fields regularly to see what is happening. Be prepared to use the rotation to advantage in controlling perennial weeds such as milkweed and quackgrass. Your options for chemical weed control may be slightly different than with a conventional system so be prepared for change.

Available equipment

Assess your tillage and planting equipment and its ability to handle residue. Plan modifications, adjustments and trades in advance.

Management ability

Talk to successful mulch tillage farmers and attend conservation meetings. By anticipating problems, you can be prepared with alternative solutions. Be willing to make changes in your system. Keep an open mind, use some patience and you will be successful.



Drainage is an important component in a mulch till system. Make sure wet fields are tiled first before starting mulch tillage.



Leaving residue on the soil surface will help prevent soil erosion. Know how much residue you will be working with so you can modify your cropping program as needed.



Renting conservation equipment and trying it on a limited number of acres is the best way to start and learn the new system.

TILLAGE OPTIONS – MULCH TILLAGE

IMPLEMENTING A MULCH TILLAGE SYSTEM— A FIVE-YEAR PLAN

The following is a plan to implement a mulch tillage system over a period of five years. You may be able to speed up or slow down the process depending on your farm situation.

- YEAR 1** ► Identify your soil types from a soil map available at the OMAF office.
- Make a rough map of your farm, locating buildings, fencelines, woodlots, wet areas and slopes. Make several copies of the map.
 - Keep field-by-field records.
 - Scout your fields, noting locations of weed problems and identifying weed species. If you can not identify a weed, take it to the OMAF office for identification.
 - Test the soil in your fields if you have not done so in the past three years.
 - Plan to correct any drainage problems before starting a mulch tillage program.
 - Outline your crop rotation on paper. Plan to start your system after a bean or after a cereal crop, if straw is removed.
 - Check tine spacing of your secondary tillage equipment for proper residue flow. Tines should be about 15 centimetres (six inches) apart.
 - Locate mulch tillage equipment available for rent in your area, including secondary tillage equipment. Look for a variety of types and configurations to experiment with.
 - Evaluate your planter and drill's ability to operate in residue. Locate conservation planters and drills available for rent.
 - Read up on mulch tillage in farm papers, OMAF factsheets, attend soil and crop project tours and consult with extension staff.
 - Talk to successful mulch tillage farmers, find out what similarities you have and what your differences are. Choose farmers with similar soil conditions if possible. See what mistakes they made and learn from their experience.



Scouting is very important to keep ahead of the changes that occur in a mulch till cropping system and will help you keep accurate records.

TILLAGE OPTIONS – MULCH TILLAGE

- YEAR 2** ► Fertilize according to soil test recommendations.
- Keep up field records of problem areas, weeds and other pests. Plan your control options for all crops in your rotation.
 - Adjust the straw spreader on your harvest equipment or find a custom operator who has a good straw spreader on his.
 - Start with a small area of 2 to 4 ha (five to ten acres) with a rented piece of equipment.
 - Work the chisel or disc across the slope, regardless of row direction to prevent water running down the furrows.
- YEAR 3** ► Continue to keep field records and evaluate crop progress on small plots.
- Secondary tillage and planting should be timed according to your soil conditions, not according to what your neighbours are doing. Working or planting the ground when it is too wet will result in a cloddy seedbed and a reduced stand. You may plant a day or two later than you would under conventional systems. Be patient.
 - Expand the acreage worked to include more types of residue.
 - Try different teeth on the chisel plow or a combination of twisted shovels and sweeps to see what works best for your soil and residue type.
- YEAR 4** ► Continue monitoring crop progress and keeping field records.
- Evaluate weed control and pest management. Get advice if necessary to make changes.
 - Prepare a budget for buying conservation equipment. Find out the value of equipment to be traded in. Check the prices of available equipment. You may continue renting for a few years.
 - Make needed adjustments to planting equipment to handle more residue.
 - If all your equipment will handle residue, mulch till corn ground.
- YEAR 5** ► Evaluate program and make changes as necessary.
- Assess your need for new equipment and make the necessary purchases. Modify existing equipment if possible.
 - Continue to update your crop and pest management skills.
 - Keep field records up-to-date.

By following this plan, keeping good records and monitoring your progress you should be able to implement mulch tillage successfully.



Taking yields on your trial fields will help you make decisions on changes needed in the cropping program.



Attending conservation tours will help keep you updated on the newest technologies that are working at the farm level.

TILLAGE OPTIONS – MULCH TILLAGE

TROUBLE SHOOTING

PROBLEM	CAUSE	SOLUTION
Increased run-off	<ul style="list-style-type: none"> • Tilling up and down hill creates channels for water 	<ul style="list-style-type: none"> • Work the field across the slope so water “walks” across the slope rather than “runs” down it.
Surface ponding	<ul style="list-style-type: none"> • Compaction/poor soil structure 	<ul style="list-style-type: none"> • Improve rotation. Use cover crops including legumes and add manure to improve soil structure. • Avoid tilling and manure applications when soil is wet.
Uneven chisel plow penetration	<ul style="list-style-type: none"> • Plow not level • Dull or worn points • Soil too hard for sweeps • Not enough horsepower for proper penetration depth 	<ul style="list-style-type: none"> • Check for level operation front to back and side-to-side. • Check and replace or sharpen points. • Wait for a light rain to soften the soil (Do not till if wet). Put points on front row to break hard soil, leave sweeps on rest. • Remove one or two shanks from each side to reduce working width. Use higher powered tractor.
Residue plugging chisel or disc	<ul style="list-style-type: none"> • Poor residue distribution from combine • Too much straw • Coulters not turning • Coulters set too deep • Twisted shovels arranged incorrectly • Residue too wet 	<ul style="list-style-type: none"> • Adjust or buy add-on spreader. • Bale cereal straw. Set cutting head higher. Rotate high residue crops with low residue crops (i.e. corn, beans). • Set lower to cut deeper into soil. Lubricate or replace bearings. • Set coulter shallower to slice residue. • Arrange so all shovels on the front row throw in one direction. All in the middle row throw in the opposite direction and the third row is split so all throw to the centre. • Wait for drying or frost.
Residue plugging cultivator	<ul style="list-style-type: none"> • Inadequate clearance in cultivator frame 	<ul style="list-style-type: none"> • Remove a few tines and re-space the rest to ease residue flow. Rent/borrow/buy high clearance cultivator. Exchange sweeps for twisted shovels on chisel to bury more residue.
Residue plugging planting equipment	<ul style="list-style-type: none"> • Inadequate clearance for larger pieces of residue. 	<ul style="list-style-type: none"> • Add coulters on planter to slice residue. Add trash whippers to deflect residue out of the row area. Drills should be equipped with staggered seed units for better residue flow. Add coulters/discs on chisel plow to cut residue into smaller pieces.
Poor seed placement	<ul style="list-style-type: none"> • Worn seed openers • Hairpinning • Skips or misses 	<ul style="list-style-type: none"> • Check for wear and replace if needed. • Make sure coulters are sharp and able to cut residue. Add trashwhippers to deflect residue. • Adjust down pressure on drive wheel.

TILLAGE OPTIONS – MULCH TILLAGE

TROUBLE SHOOTING CONTINUED

PROBLEM	CAUSE	SOLUTION
Poor germination	<ul style="list-style-type: none"> • Rotting or diseased seed • Planted too shallow • Cloddy seedbed • Cold seedbed 	<ul style="list-style-type: none"> • Use seed treatment. • Use a crop rotation. • If soil too wet, plant shallower and improve drainage. • Adjust seeding depth to place into moist soil. • Soil worked too wet; delay tillage. • Exchange twisted shovels for sweeps on chisel plow for smoother surface and smaller aggregates. • Add levelling harrow to back of chisel to level surface and reduce moisture variation. • Too much residue, add trash whippers to planter. • Delay planting a day or two. • Change to a hybrid or variety with greater cold stress tolerance.
Uneven emergence	<ul style="list-style-type: none"> • Cloddy seedbed • Uneven moisture due to ridges formed by twisted shovels • Herbicide carryover 	<ul style="list-style-type: none"> • See above under poor germination. • Add levelling harrow to back of chisel plow to reduce ridge height. • Switch to all sweeps or add sweeps on back row. • Less soil mixing may cause herbicides like atrazine to persist and damage the next crop. • Use lower rates or change to less persistent herbicides.
Weed escapes	<ul style="list-style-type: none"> • Inadequate herbicide contact with soil • Perennial rhizomes less disturbed • Second flush of seeds 	<ul style="list-style-type: none"> • Incorporate with two passes. • Increase water volume for better coverage. • Identify weeds and treat at appropriate times. • Inter-row cultivate row crops. • Apply post-emergent spray if economical.
Poor weed control	<ul style="list-style-type: none"> • Use of inappropriate herbicide • Inaccurate rate of application • Weeds too large 	<ul style="list-style-type: none"> • Identify weeds present. • Consult a Soil and Crop Advisor and/or OMAF publication 75 for best control options. • Calibrate your sprayer. • Check nozzles for wear and replace if necessary. • Re-check rates specific to your soil type. • Spray only when chances of wind or heavy rains are minimal. • Maintain constant ground speed. • Scout your fields regularly. • Keep field histories of weeds and diseases, to know what to expect. • Plan herbicide treatments in advance and be ready to apply at the appropriate time.
Disease	<ul style="list-style-type: none"> • Susceptible varieties 	<ul style="list-style-type: none"> • Use resistant varieties. • Follow a crop rotation which breaks disease cycles.