Drills and Drill Components for Conservation Tillage in Michigan
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DRILLS AND DRILL COMPONENTS FOR CONSERVATION TILLAGE IN MICHIGAN

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Planting conditions in a conservation tillage system are not as uniform as in a conventionally tilled field with a prepared seedbed, but the planting objectives are the same. We want to open a seed furrow, place the seed at the correct depth, cover the seed with soil and firm the soil over the seed. Conventional drills are designed to do this in tilled soil with a prepared seedbed. No-till drills can operate in conventionally tilled fields, but they are designed to do a good job in tougher conditions such as sods or hard, uneven soils covered with crop residue.

The drill is the most important piece of equipment used when direct drilling alfalfa, small grains, soybeans, drybeans or any other crop in a conservation tillage system. It has to be adjusted correctly and have coulters, openers and press wheels that work together to handle various planting conditions. This bulletin explains the characteristics that allow no-till drills to plant in untilled, residue-covered conditions and explains how specific drill components such as coulters and press wheels contribute to drill performance.

The drill frame

Compared to conventional grain drills, no-till drills have larger, heavier frames that will hold up in rough fields without being bent or racked. They are also designed to hold additional weight or ballast to help force the coulters and openers into the ground. Water drums or tractor weights are a convenient way to add or remove ballast as planting conditions change. In tough no-till conditions, ballast can be added for good residue cutting and opener penetration. The ballast can be removed for planting in soft soils and tilled fields.

The weight of the drill is transferred to the cutting coulters and the opener assemblies through down-pressure springs or rubber buffers. The

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down pressure can be adjusted according to field conditions. The pressure springs or rubber buffers maintain pressure on the coulters for residue cutting and soil penetration but allow the coulter to trip and reset if rocks or other obstructions are encountered.

Drive Mechanisms

In addition to making soil penetration and residue cutting possible, the weight of the drill helps keep the drive mechanism in contact with the soil. Common drive mechanisms include coulter drives, drive wheels and transport wheel drives. The drive mechanism is an important component of the drill that needs operator attention. Coulter drives can slip in loose soil; wheel drives may slip if down-pressure springs lift the drill off the ground. Seed and fertilizer delivery will stop if the drive mechanism stops turning,

Fluted coulters till more soil than other types of coulters.

Row Spacing and Residue Clearance

The row spacing on no-till drills is typically 7 or 8 inches but may range from 6 to 10 inches. To improve crop residue or trash flow between the coulter and opener assemblies, the coulters are usually mounted in two ranks. The second rank is usually 8 inches or more behind the first rank.

Plugging of the opener assemblies may be a problem in fields with heavy, loose residue. Plugging is usually not a problem if the residue is evenly distributed and anchored to the ground, and if the cutting coulters are doing a good job of cutting. Smaller coulters (14-16 inches) create a smaller tunnel for residue flow past the coulters and opener assemblies. These smaller coulters may plug with residue more frequently with larger coulters (17-19 inches).

Residue Pinning

If the coulters do not cut the crop residue cleanly, it may bunch up or snowplow in front of the furrow opener. This can plug the drill or allow residue to pinch into the bottom of the seed furrow without being cut. Residue that is pinched in the seed furrow can result in poor seed-soil contact. Seed placed on top of the residue may germinate if adequate moisture is available, but the residue will interfere with root development and emergence will be spotty. Residue pinning is most likely to occur when the residue from the previous crop is not evenly distributed, or when heavy residue covers moist or loose soil. Straw spreaders that distribute the residue evenly over the field at planting time will help eliminate problems with residue pinning.

Coulters

The most important function of the cutting coulters is to slice through surface residue. Coulters also till and loosen the soil ahead of the furrow openers. The type of coulter, coulter size and the depth that the coulters should run are factors to consider when setting up a conservation tillage drill. Your choice of coulters will depend upon the soil and residue conditions and the seedbed requirements of the crop.

Coulters

Coulters cut through crop residue and loosen the soil for seed placement. The choice of coulters depends upon soil and residue conditions and the seedbed requirements of the crop.

--SMOOTH COULTERS have an advantage in hard soils where penetration is a problem and in heavy residue where cutting is a problem. They may have a disadvantage if some tillage and soil disturbance is needed.

--FLUTED COULTERS have an advantage when tillage is needed for soil warm-up, improved seed/soil contact or fertilizer placement. They may have a disadvantage on moist and sticky soils or on hard soils where planter weight limits soil penetration.

--BUBBLE COULTERS AND RIPPLE COULTERS are the most versatile coulters for no-till drills. They till less soil than fluted coulters but more than smooth coulters. They have an advantage where soil type and planting conditions vary widely.

Smooth Coulters

Smooth coulters have sharp edges that do very little tillage or soil loosening. They simply cut through the soil and residue so the furrow opener can place the seed without pinning residue in the furrow. Smooth coulters require less weight per coulter for soil penetration than other coulters that do more tillage.

The excellent residue cutting and soil penetrating ability of smooth coulters makes them well suited to a wide range of tough conditions, such as in heavy residue where cutting is a problem or in hard soils where penetration is difficult. Smooth coulters may be at a disadvantage if some tillage and soil disturbance is needed.

Fluted Coulters

Some farmers want coulters that do more tillage than smooth coulters. Fluted coulters loosen the soil and remove residue from the surface. Tilled soil dries and warms sooner than undisturbed, covered soil. Rapid soil warm-up is an important consideration when planting corn, but for most drilled crops, rapid soil warm-up is not that important. Alfalfa, forage grasses and small grains are cool-season crops that are not as adversely affected by cool soils. Soybeans and drybeans are planted later than corn, so the soil is usually warmer at planting time.

Fluted coulters do more tillage than any other type of coulter. These coulters cut a rectangular profile in the soil ranging from 1 to 3 inches wide. The aggressive action of the fluted coulter requires more weight per coulter for residue cutting and soil penetration than other coulters. Heavy down-pressure requirements may limit the use of fluted coulters on drills when soils are hard or covered with a heavy residue. Drill attachments, such as a coulter caddie, transfer tractor weight to the fluted coulters for better penetration.

Fluted coulters have a tendency to throw soil out of the seed furrow when the soil is moist or sticky, or when the coulters are set to run deep or at high speeds. Wide fluted coulters move more soil and have greater down-pressure requirements than narrow fluted coulters. Fluted coulters have an advantage when tillage is needed for faster soil warm-up, or when improved seed/soil contact or fertilizer placement is needed. Fluted coulters may have a disadvantage on moist and sticky soils and at faster planting speeds because clumps of soil can be thrown out of the seed furrow. On hard soils, fluted coulters require increased weight for soil penetration.

Bubble Coulters

Bubble coulters have a sharp, smooth cutting edge similar to that of a smooth coulter. This sharp edge makes it a good coulter for cutting heavy residue in firm soil. Bubble coulters cut a V-shaped profile in the soil. When run shallow, the bubble coulter simply cuts through the residue and into the soil. As the coulter runs deeper, the

coulter begins a gearing action that loosens and tills the soil. Bubble coulters have an advantage in heavy residue where cutting is a problem, and in hard soils where drill weight limits the penetration of fluted coulters.

Ripple Coulters

Ripple coulters, along with bubble coulters, are probably the most versatile coulters for no-till drills. They do more tillage than smooth coulters, but till less than fluted coulters. Ripple coulters cut a rectangular profile in the soil 3/4 to 1 1/2 inches wide. They provide good residue cutting and soil penetration in firm soils yet till enough soil for rapid soil warm-up and good seed-soil contact in heavy soils. Ripple coulters require more drill weight per coulter for soil penetration than smooth coulters but less weight than fluted coulters. Ripple coulters and bubble coulters have an advantage when soil types and planting conditions vary and where some tillage is needed but planter weight limits penetration of fluted coulters.

Coulter and opener depth adjustments

--Coulter and opener depth adjustment is not as precise with drills as it is with planters. Seed placement will be shallower in hard soils and deeper in soft soils.

--For large seeded crops such as soybeans and small grains, make the initial depth setting for coulters and openers at the desired depth of seed placement.

--Actual depth of seed placement will vary with soil and residue conditions. Measure seed depth from the amount of soil covering the seed and fine tune depth adjustments accordingly.

--Small seeded legumes such as alfalfa may need to be placed directly at the soil surface rather than through the disk openers.

Furrow openers

Three types of furrow openers are commonly used on disk drills: double disk openers, single disk openers and offset double disk openers. Hoe openers can also be used.

Single Disk Openers

Single disk openers require less down-pressure for soil penetration than double disk openers. Because they attack the soil at a sharper angle than double disks, they disturb less soil than double disk openers. Single disk openers are usually used without cutting coulters on no-till drills.

OffSet Double Disk Openers

Offset double disk openers combine a single smooth coulter with a single disk opener mounted a few inches off center and to the rear. The smooth coulter cuts the residue and the angled disk opens the furrow. Less soil is disturbed than with a double disk opener.

Boot Or Hoe-Type Openers

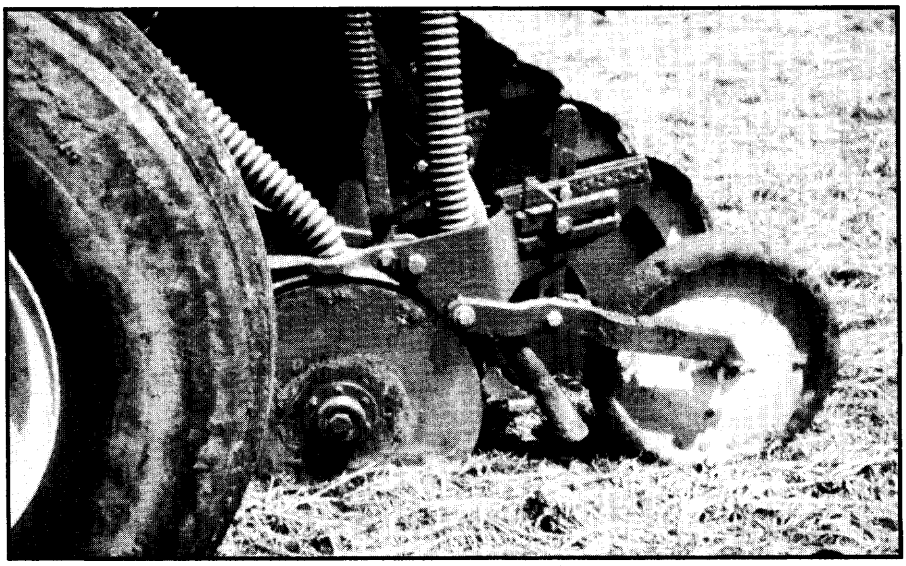
Boot or hoe-type openers usually follow cutting coulters. The wings at the bottom of the boot cuts roots and loosen the soil at the bottom of the seed furrow. This type of opener has just been introduced in Michigan. Early indications are that this type of opener compares favorably with disk openers when results are measured in terms of seed emergence rates in sod and no-till seeding of forages.

Coulter adjustments and depth control

Coulter depth adjustments vary among drills but usually involve changing the hitch angle for deeper or shallower penetration. Opener depth adjustments usually involve moving clips to increase pressure on the opener rod pressure springs or adjusting the depth rod on the gauge-press wheel assembly.

Depth control is not as precise with drills as it is with row crop planters. With row crop planters, depth control bands on the seed furrow openers maintain uniform depth of seed placement. With few exceptions, depth control bands are not used on drills. The narrow spacing between openers limits residue flow through the drill when depth control bands are used and can cause the drill to plug up.

When planting conditions are good, the coulters can be set to run at the depth of seed placement. As long as the residue is being cut, the furrow opener will be able to place the seed near the desired depth, but the actual depth will vary with soil conditions -- expect shallower placement in hard soils and deeper placement in soft soils. If the soil is not being thrown out of the seed furrow, the cutting coulter can be set deeper than the desired depth of seed placement. Running the coulters deeper may provide more loose soil for seed coverage but may throw even more soil from the furrow. To check seed depth, measure the amount of soil covering the seed, not the depth from the seed to the surface of the undisturbed soil. The key to coulter depth adjustment is to check the seed location behind the press wheels. The openers on most no-till drills can be adjusted for more depth and down-pressure in the wheel track in tilled and soft soil.



Avoid deep placement of small seeded legumes by placing the seed at the surface, in front of the press wheels

Alfalfa and Small-Seeded Legumes

It is usually difficult to place seed through the disk opener shallower than 3/4 inch. This is too deep for small-seeded crops such as alfalfa, which should be placed within 1/4 inch of the soil surface. Farmers who have problems with seeding alfalfa too deep can redirect the drop tubes to place the seeds directly in front of the press wheels. When placed at the surface the press wheels firm the small seeds into the tilled soil.

Fertilizer placement

Decisions about fertilizer placement will depend on crop requirements, the fertilizer being applied, soil conditions, cost, equipment availability and equipment capability. There are several options for fertilizer placement with a no-till drill:

1. *Surface broadcast (preplant or through the drill).*
2. *Broadcast incorporated (preplant).*
3. *Placed with the seed.*
4. *Banded over the seed.*
5. *Banded under the seed.*
6. *Side-banded.*

When fertilizer is applied through the drill, it is important to check the location of the fertilizer relative to the seed. Seeds vary in their tolerance of fertilizer. Seedlings may be damaged in two ways: high rates of soluble fertilizers may cause salt damage, and nitrogen-based fertilizers may cause ammonia toxicity. These problems are most likely to occur when fertilizer is applied at high rates or when the fertilizer is placed too close to the seed.

Most drills drop the seed and the fertilizer together through the disk opener. Seed and fertil-

izer may be placed in bands separated by soil If the soil is dry and flows readily, However, there is usually some mixing of the seed and the fertilizer, and sensitive crops may be damaged.

Surface Broadcast

Fertilizer can be broadcast over the row by removing the fertilizer drop tube from the opener assembly and redirecting it so that the fertilizer drops behind the opener after the soil has covered the seed. The main objections to surface banding are the volatilization losses of nitrogen and inefficient use of nutrients caused by not placing them directly in the root zone.

In the Furrow with the Seed

Some seeds are very tolerant of fertilizer and can be placed in the furrow with the fertilizer. The seed and fertilizer can be:

1. Premixed and run through the same hopper.
2. Run through separate hoppers and dropped through a common furrow opener.

Banded Under the Seed

Banding the fertilizer under the seed may be a possibility with shallow-seeded crops such as alfalfa if the seed is placed over the band after soil has flowed over the fertilizer. Redirecting the seed drop tubes behind the openers can separate the seed from the fertilizer band. This may not be an option with large-seeded crops that require deeper seed placement.

Side-Banded

Side-banding is an option with some drills. Side-banding involves placing the fertilizer in a concentrated band in its own furrow through a separate set of furrow openers. Side-banding units usually split one fertilizer band between two seed furrows.

Press wheels

Press wheels help provide good seed-soil contact by pushing the seed into the furrow, closing the furrow and firming the soil over the seed. Press wheels improve emergence in all conditions and greatly improve emergence in dry conditions. Press wheels follow the ground contours more closely than a rigid cultipacker in no-till conditions.

Press wheels should match the amount of soil loosened. Dry, loose soils need more packing than damp, cohesive soils. No-till and sod planting where little soil is loosened require more concentrated packing than planting in loose soils. Some press wheels simply firm the soil that remains in the seed furrow after the openers place the seed. Other press wheels actively move soil into the seed furrow. Rubber press wheels flex as they roll over the ground. This flexing allows them to shed sticky, damp soils that might build up on rigid press wheels.

Press wheels

Press wheels help improve emergence in all conditions and greatly improve emergence in dry conditions. Dry, loose soils require more packing than damp, cohesive soils.
--Narrow or small diameter press wheels provide more localized pressure over the seed furrow than wider or larger diameter press wheels.
--Dual-angled press wheels actively move soil over the seed furrow.
--Wider press wheels on the opener/coulter assembly provide flotation to maintain consistent seed depth in soft soils.

Wide, Ribbed Press Wheels

Four-inch wide, deeply ribbed press wheels deliver localized pressure over the seed furrow for good seed/soil contact with narrow cutting coulters in no-till conditions. They also provide enough flotation to prevent planting too deep in soft soils and tilled fields.

Dual, V-Configured Press Wheels

Narrow press wheels increase pressure over the seed, while wider press wheels decrease

pressure over the seed. These dual, one- inch V-configured press wheels firm the soil from the sides and actively move loose soil over the seed furrow. This leaves the soil directly over the seed furrow loose and slightly elevated, which helps prevent water puddling and soil crusting. One-inch V-configured press wheels are well suited for very firm soil conditions when drilling soybeans, drybeans or other large-seeded crops, but they may dig in in soft soils or bury small-seeded forage crops. Two-inch press wheels should be used in soft and tilled soils.

Single Vertical Press Wheels

Single vertical press wheels are well suited for no-till alfalfa seeding. Two-inch rounded rubber press wheels apply pressure directly over the seed furrow. These press wheels match up well with fluted, bubble or ripple cutting coulters when planting in soft or tilled soils.

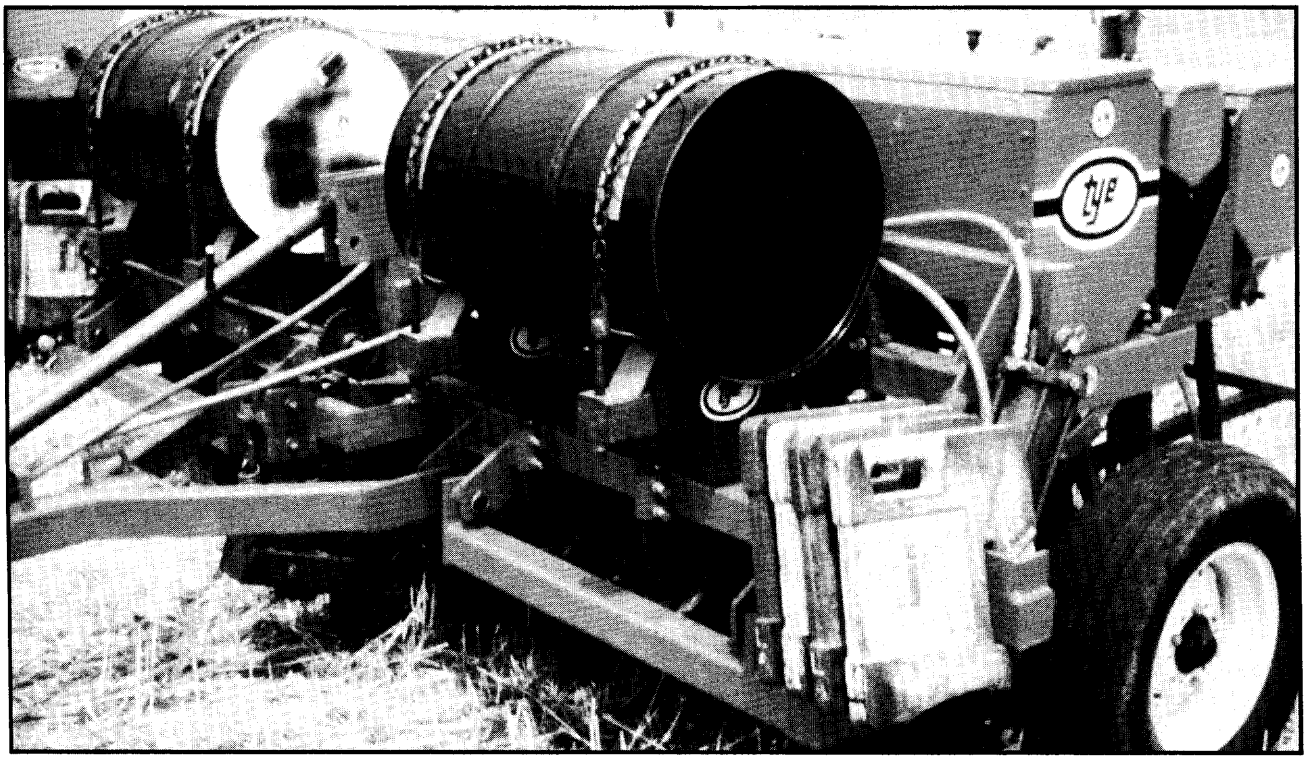
One-inch rounded rubber press wheels match up well with narrow cutting coulters in firm soils and in heavy residues. Remember that on most drills, the press wheels also help control opener depth. If one-inch press wheels are used in conventionally tilled fields, the press wheels may provide too much down-pressure and not enough flotation to maintain shallow planting depths in soft soil.

Steel V-Shaped Press Wheels

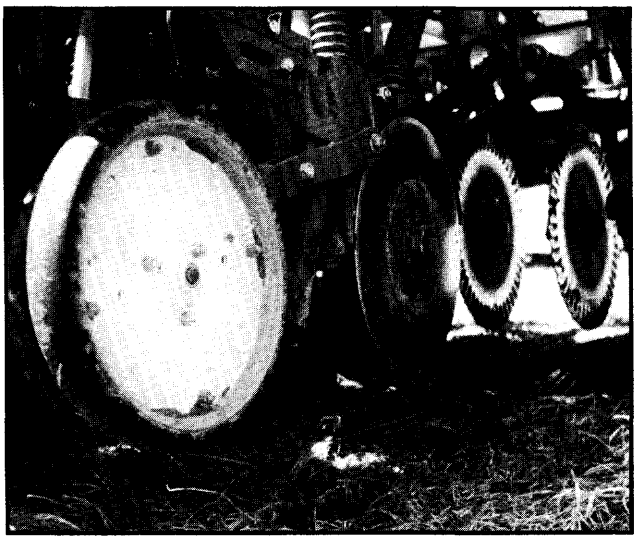
Steel V-shaped press wheels are well suited to dry soils and sod planting where very little tillage is done by the leading cutting coulters. The press wheel tracks directly over the seed furrow and applies highly localized pressure that pushes the seed into the seed furrow and leaves a slightly uneven surface.

Remember

Some of the most valuable time you spend when drilling crops in a conservation tillage system is the time off the tractor checking seed placement, seed coverage and soil firming. The drill and drill components are important, but they are not as important as the skill and care taken by the operator. Be prepared to experiment and make whatever changes and adjustments are necessary to get the job done.



Add ballast for hard soils and where there is heavy residue, remove ballast for soft and tilled soils.

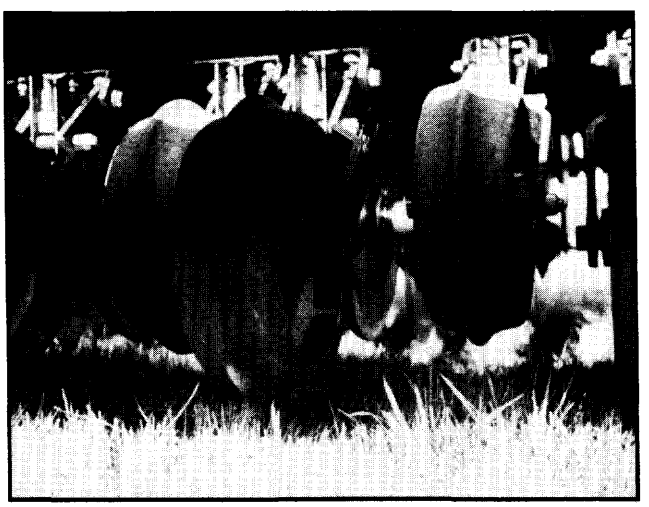


No-till coulter, opener and press wheel assembly

Bubble Coulters

2-inch, vertical presswheels

1-inch, V-configured press wheels



4-inch, semi-pneumatic, deeply ribbed press wheels

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