



Direct Seeding

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Agdex 519-24

Ground Opener Systems

The key equipment issue in direct seeding is ground opener selection. The ground opener is the part of a planter that penetrates the soil to place seed and fertilizer. It has a soil-breaking wear point, a soil dividing body and delivery tubes to place seed and fertilizer. It often also has deflecting surfaces to guide the soil back over the fertilizer and seed furrows.

A ground opener must:

- place seed and fertilizer for the best crop germination and growth.
- leave the soil surface smooth enough for crop spraying and harvesting.
- sufficiently “blacken” the soil surface in the seed row if there is a concern about soil being warm enough for seed germination during early seeding.
- have low draft requirements and high wear resistance.
- produce a furrow shape that matches the packer wheel contour and width.

Opener performance is influenced by soil moisture content, soil texture, soil density, seeding depth and forward speed. Choosing ground openers to suit the conditions on your farm from the variety available on the market can be difficult. This factsheet outlines factors to consider in making your best choice.

Crop Germination and Growth Needs

The ground opener must deliver the seed into the soil at a depth that best meets the requirements for seed germination and crop growth.

Seed placement into moist soil

Seed must be placed into moist soil and surrounded by soil particles small enough to reduce open spaces in the seed bed. Coarse soil lumps in the seed bed increase soil moisture loss and reduce seed germination.

For good seed-to-soil contact, the ground opener must either cause very little soil movement, so the soil profile is fractured very little, or cause enough agitation to create soil particles small enough to fall in around the seed. The latter case may require harrowing to spread the soil over the seed row.

Soil depth above the seed

Depth of soil cover is measured after the last implement passes over the planted field. Soil cover depth must meet the needs of the particular seed type. Larger seeds can emerge from deeper in the seed bed. For example, Danto pea seed can be placed 2 inches (50 mm) deep into moist soil, but Polish canola seed emerges best when covered with only 0.5 inches (15 mm) of soil.



Every ground opener design creates its own particular flow of soil around it. Thus, each opener design results in a different furrow opening, seed placement and soil cover. The furrow from a specific opener is affected primarily by the soil's clay and moisture content. Additional passes of equipment, such as on-row packing wheels, harrows, or other soil levelling and packing equipment, will change the depth of soil cover above the seed.

Soil packing on the seed row

Soil must be repacked around and above the planted seed to prolong the contact of the seed with moisture from the soil. Packing reduces the loss of moisture from the seed bed by creating a denser soil layer at the surface.

A fine balance often exists between packing enough to reduce moisture loss and packing too much, which in some soils **may cause a crust** that prevents seedling emergence. The measure of adequate packing is often that all the soil lumps are **crushed both around and above the seed**.

Most ground openers require a packer to close and pack the soil in the furrow to create a good seed bed. The packer's shape and width must conform to the furrow and the location of the seed underneath. A direct, minimum disturbance planter requires an on-row packer. A wide sweep opener that cuts the full width of the seed bed requires a harrow, rod-weeder, packer or a combination of several systems to finish the seed bed.

Fertilizer placement

Fertilizer must be placed near enough to the seed to supply nutrients for good early growth, but not so near that it can cause crop stand damage. Too much fertilizer placed too close to the seed can cause injury to the germinating seeds, resulting in reduced crop emergence. (For more information, see *Soil Fertility Implications when Converting to Direct Seeding*, Agdex 519-10, and *Alberta Fertilizer Guide*, Agdex 541-1.)

In a double shoot system (see page 3), the soil buffer is a zone between the fertilizer bands and seed rows where there is neither seed nor fertilizer (Figure 1). The opener, since it is placing both the seed and the fertilizer, must leave a soil buffer of at least 0.5 to 0.75 inches (13 to 20 mm). To achieve this buffer width, the spacing between the centres of the fertilizer and seed outlets (shown on Figure 1) has to be at least 2.0 inches (50 mm).

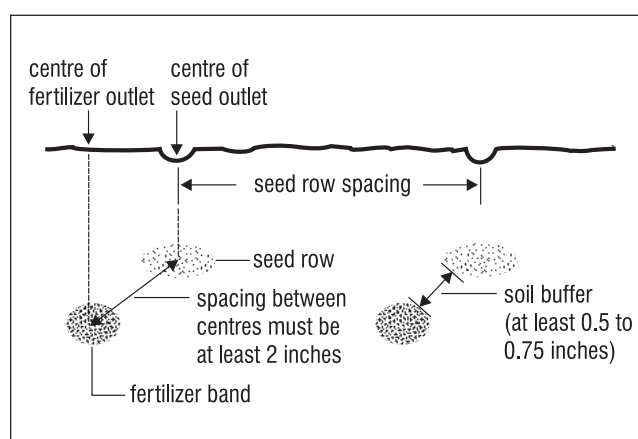


Figure 1. Buffer zone between seed and fertilizer in a double shoot, single side band opener system

The soil buffer can be lost if the scatter of seed and fertilizer increases when planting in clay or wet soil, from travelling too fast and from too much fan speed on an air cart. Seed that lands in the fertilizer band may not germinate, or the seedlings may emerge and mature late and be weak. A worst-case result is a low plant population because it gives way to weeds and reduced yields.

Crop establishment

Once a crop emerges, it needs to have sufficient nutrients and sufficient control of weeds, insects and diseases to produce desired yields. The selection of a ground opener depends, in part, on how many of the needed tasks it must perform. For example, in some cropping systems, the opener has to place all the fertilizer as well as seed and kill any germinated weeds present at planting.



The greater the number of tasks the opener must perform, the more complicated the opener and the seeding operation become. Complicated ground openers are usually more sensitive to varying soil conditions. Achieving good results in soil that is too wet, too dry, too hard or soft, or “too” anything else will demand more attention in the selection and operation of the ground opener.

Ground Opener Types

The soil condition in each field should be assessed to select the appropriate equipment and adjust it properly. Compromises and balances may be necessary to use one opener in different conditions. If, however, these compromises cause potential yield reduction, then consider using different opener types.

Dedicated and add-on opener types

Opener types can be classified by whether they are dedicated to a specific planter or adaptable to a variety of planters.

Openers dedicated to the planter – John Deere 1850 drill (disc type), Haybuster 8000 (hoe drill), Conserva Pak, New Nobel Seed-O-Vator, New Noble 2200 with Nutri-band opener, Seed Hawk and Harmon all have openers specific to the planter. Some of these planter designs have been in use for more than 10 years. Their continued use attests to features suitable for some conditions and farm systems.

Add-on openers – These openers can be attached to the standard shank of an air seeder or air drill. Most of the current air seeders and some air drills can accept any type of ground opener whether made by the same or another manufacturer. The main consideration is that the shank and opener stem angle are compatible. When adding a new opener type to an air drill, make sure the packer wheel conforms to the furrow created by the opener. The Morris and the Case IH (Concord) air drills can be equipped with an edge-on shank that requires a specific opener.

Opener types by delivery systems and seed placement

Opener types can also be classified by the method of delivering seed, fertilizer and other products to the opener and by the seed placement pattern they produce.

Delivery system – Seed, fertilizer and other products are delivered to openers in three ways: single, double and triple shoot. Delivery lines may be one air line and an anhydrous ammonia (NH_3) line, two air lines, two air lines and an NH_3 or liquid fertilizer line, and so on.

Seed placement – Single shoot openers can place the seed in various row widths, from 1 inch to as much as 8 inches. Double shoot openers place seed either in a pair of rows (called paired rows) above and on each side of the fertilizer band, shown in Figure 2, or in one row on just one side of the fertilizer band (called single side banding), shown in Figure 3.



Figure 2. Double shoot, paired row opener



Figure 3. Double shoot, single side band opener

- **Double shoot, paired row opener** – Paired rows have the advantage of giving the crop roots close access to the fertilizer band for optimum nutrient uptake. Paired rows create a wider effective seed row. The wider row helps to support windrowed crops.

Often, the seed rows of the pair are not distinct. Although most of the seed is placed in the rows, some seed bounces into the area between the two rows. This result leaves the impression of a wide single band rather than paired rows.

Usually this is not a problem. However, in wet soils or soils with high clay content, where not enough soil flows around the opener, some seed may fall into the fertilizer band.

This type of opener needs the greatest attention to adjustment and operation to ensure the seed is in a good position to germinate and emerge.

- **Double shoot, single side band opener** – All the companies that make paired row openers also make single side band openers. The seed placement tube is simply placed on one side only. This placement improves the flow of soil around the opener to cover the fertilizer band, to more consistently separate the seed and fertilizer. A fairly distinct and narrow seed row results that, at 12-inch row spacing, may prevent windrowing of cereal crops.

This opener type performs better than a paired row opener in wet, sticky soils.

Since the openers are not symmetrical, they cause side draft. They must be installed in equal numbers of left- and right-hand seed furrows.

- **Single shoot opener** – This opener has a single delivery system (Figure 4). It can be used to place seed only or to place seed and fertilizer together in the same row. It leaves a seed row slightly narrower than the opener. Special designs are available that create a seed row width of 1 to 6 inches (25 to 150 mm), or sweeps can be used for a spread of 5 to 10 inches (125 to 250 mm).



Figure 4. Single shoot opener

Single shoot openers provide the best seed placement. However, the crop type and planting conditions limit the quantity of fertilizer that can be placed with the seed (for more information see *Alberta Fertilizer Guide*, Agdex FS541-1). Pre-banding or mid-row banding are options for applying greater amounts of fertilizer.

- **Semi-dependent opener** – This opener (Figure 5) is a variation on the double shoot, single side band opener. It forms distinct furrows for each of the seed and fertilizer bands, and leaves a seed row slightly narrower



than the opener. The seed opener follows behind and slightly to the side of the fertilizer point, ensuring that soil covers the fertilizer band before the seed is placed. There is little chance of fertilizer and seed mixing.

The relative adjustment of depth and sideways offset allows precise positioning of the seed and fertilizer. This adjustment may affect both soil disturbance and power requirements.



Figure 5. Semi-dependent opener

Ground Opener Operation

Seed row spacing and seed row width issues

Seed row spacing is the distance from the centre of one seed row to the centre of the next. Seed row width is the distance across an individual seed row. (See *Direct Seeding Systems: Terms, Definitions and Explanations*, Agdex 570-7, for more information on these terms.)

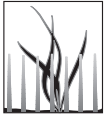
Seed row spacing and width influence several factors related to ground opener operation:

- **Machinery cost** – Wider row spacing reduces the number of openers and trip assemblies. A 12-inch (300 mm) spaced machine may cost 7 to 10 per cent less than an 8-inch (200 mm) spaced machine.

- **Planter power requirements** – The total power requirement of a planter is the total of the following: the rolling resistance of the tractor, implement and supply tanks carrying seed and fertilizer; the power needed for fans, meters and attachments; and the draft of the ground openers. The opener draft may be one-half to two-thirds of the total power requirement. Therefore, increasing the row spacing from 7 to 9 inches (175 mm to 225 mm) could mean a saving of 10 to 15 per cent in draft.

The power required by some individual openers has been reported in *Testing of Double Shoot Openers* (Alberta Farm Machinery Research Centre (AFMRC) Evaluation Report 721). Generally, the draft of an opener depends on the depth of the fertilizer point below the seeding depth and the total amount of soil moved by the opener. A narrow knife or shovel-type single shoot opener operating at a shallow depth in good moisture may only require about half the power of a normal chisel plow. However, a large double shoot opener with a deep running fertilizer point may need twice as much as that chisel plow. Many farmers report needing less power than with their previous cropping methods.

- **Soil disturbance and loss of residue** – Each opener loosens a strip of soil slightly greater than its own width. It also deposits moist soil on an area immediately beside the row. Openers spaced farther apart reduce this effect. The less soil and crop residue disturbance, the less soil moisture will be lost, and the fewer weed and volunteer crop seeds will germinate as a consequence of the disturbance. At this time, one cannot predict if this effect will reduce the cost of herbicides for weed control.
- **Heavy residue clearance** – Ease of crop residue clearance through the planter depends on the stubble height, amount of loose straw on the surface and the quality of chopping and spreading achieved.



As a starting point, stubble height can be cut equal to the planter's shank spacing. For example, if the shank spacing is 8 inches (200 mm), then cut the stubble height to 8 inches (200 mm). With experience, some operators can get good clearance through stubble taller than the shank spacing if the stubble is vertical and well anchored in the ground.

Another factor affecting residue clearance is the distance from one opener to another or to a machine member like a wheel. The distances vary with individual machines. Four ranks (rows) of openers provide greater distance between the shanks, removing the chance of wheels interfering with shanks and openers in heavily strawed fields.

Disc openers and coulter equipped machines are unaffected by stubble and affected very little by loose residue **if reasonable care is given to residue management.**

- **Seed-placed fertilizer rates** – Fertilizer applications may be limited to certain rates depending on the crop type, soil type, soil moisture, fertilizer type and where the fertilizer is located relative to the seed. This rate limitation is primarily a concern for single shoot systems where the fertilizer is placed in the seed row.

Ground opener spacing is also a factor in seed-placed fertilizer rates. The wider the seed rows are spaced, the less of the seed bed is used and proportionally more fertilizer goes to each opener. As a result, for a given fertilizer rate per acre, more fertilizer is actually placed near the seed as rows are spaced farther apart.

- **Windrowing of cereal crops** – In areas where windrowing of cereal crops is necessary, seed row spacing is important. For narrow seed row widths, the row spacing must be no greater than 7 to 8 inches (180 to 200 mm) to support cereal crops that are windrowed in the same direction they were planted. Wider seed row openers of 3 to 5 inches (75 to 125 mm) could allow for ground opener spacing of 10 to 12 inches (250 to 300 mm) in average crops.

Power requirements of add-on openers

Typical 12-inch cultivator sweeps operating at a 3-inch (75 mm) depth require 2.5 to 3.5 horsepower per opener. A hoe drill placing seed to a depth of 2 inches (50 mm) may require 1.5 to 2 horsepower for each opener. Double shoot openers require 2 to 5.5 horsepower per opener, but the horsepower varies with the depth setting, soil moisture and density.

Power requirements generally increase as the fertilizer banding point penetrates deeper into the soil. Dense and dry soils, especially those low in organic matter also add to the draft of the openers.

Special requirements of double shoot openers

Most add-on openers, particularly double shoot types, add considerable depth to the opener assembly. Therefore, ensure adequate clearance in the transport position between the opener point and any roadway obstacles. Also, the trip mechanism must be able to withstand the extra trip force and greater leverage of the fertilizer point.

The shape of the particular opener may significantly increase the penetration depth as the opener trips over rocks. This greater penetration will greatly increase the risk of breakage.



Wear rates

The quality of seed placement depends on the shape of the opener remaining constant over many acres. Carbide tips welded to hardened points help control wear. Over the long term, these tips are a more economical choice for abrasive and dense soils.

Tips for Selecting Ground Openers

All openers on the market work under some conditions. But how do you know if a particular opener design will work well under the conditions on your farm?

You can begin by discussing ground opener performance with your neighbours to learn more about options suited to the conditions in your area. Next, determine which openers will likely meet the requirements for seed placement, handle the amount of residue cover that usually exists on your farm and meet other requirements specific to your operation (such as placing fertilizer or providing some weed control). Then, install one or more of these openers on your planter, try them in several typical conditions on the farm and assess the results.

Ground opener design is often influenced by soil and crop residue conditions in the area where the opener was developed. If these conditions are similar to yours, chances are better that the opener will do a good job on your farm. So ask the manufacturer about the conditions in the area where the opener was developed.

AFMRC has conducted performance tests on a wide variety of ground openers. *Testing of Double Shoot Openers* (AFMRC Evaluation Report 721) provides comparative data on seed band depth, seed band width, fertilizer band width, spacing between the fertilizer and seed bands, opener wear, draft, power requirements and other characteristics for 15 ground openers.

Tips for Operating Ground Openers

Although it takes experience and perseverance to make ground openers work in direct planting, many farmers have developed successful direct planting systems. Here are some tips for ground opener use:

- Check the planter's adjustments in each new field and in areas of the field where conditions are very different. Ensure the crop seed's minimum agronomic requirements are being met. **Compromising here will cost you in crop stand establishment, maybe in yield and certainly in the coffee shop!**
- Double shoot openers may require frequent adjustment of depth and forward speed to ensure good placement of seed and fertilizer.
- When soil conditions are very moist, particularly in fine clay soils, ensure the seed row furrow is sealing adequately to preserve seed bed moisture.
- When assembling components from several sources, pay special attention to ensuring good mechanical arrangements of the planter. Poor assembly causes costly downtime and repairs.

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Factsheets in the Direct Seeding Series are also available through Alberta Agriculture's Internet site at <http://www.agric.gov.ab.ca/agdex/500/index.html>

The brand names used in this factsheet are not intended as endorsements but are used as examples of opener types.