

# **Retrofitting Air Seeders for Successful Direct Seeding**

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Over the past decade there has been an increasing trend in the adoption of direct seeding in Saskatchewan. At present, approximately 50% of all Saskatchewan's cropped acres are now direct seeded. Some factors that seem to be driving this trend include an increase in energy costs, farm consolidation, and deterioration in soil quality. Producers who have made the successful transition into low disturbance seeding are also now beginning to realize the benefits. They include:

1. Yields equal to or slightly better than conventional practices
2. Labour and fuel savings
3. Extended equipment life
4. Higher soil organic matter and carbon levels
5. Reduced soil erosion losses
6. Better moisture availability at seeding
  - Improved snow trapping
  - Higher water infiltration rates and reduced runoff losses
  - Reduced soil moisture evaporation rates

Producers considering a transition to zero till need to assess their situation and determine the economic viability of direct seeding. Making the change involves more than just buying equipment and changing herbicide usage. It also involves evaluating the existing practice and planning the transition to a direct seeding operation. Factors such as the capital cost of equipment and variable cost of production will no doubt have an effect on net return. Other factors such as farm location, size, soil type, crop rotations, current seeding technology, and the producer's age and management ability will also influence the transition.

In a low disturbance seeding system (LDS) the seeding tool becomes very important, as it will be the only tillage operation on that field. As such, the seeding equipment must be set up properly to do the best possible job of seeding. When making the switch to LDS, producers can consider one of three options. They can modify existing equipment, purchase used equipment, or buy new equipment. The financial situation of the farm will dictate the decision the producer makes as indicated in Table 1.

**Table 1: Capital Cost of Converting to Zero Tillage (\$/M of Seeder)**

Upgrade	Used Zero till	New Zero till
495 to 2100	3000 - 4000	6000 - 8000

*Source: Nagy, 2001*

When modifying existing equipment, such as air seeders with openers and packers, producers must ensure it is designed to seed into trash and residue. Crop residue management is the first step in successful direct seeding. Residue management must begin in the fall when combining. Effective residue management requires both the straw and chaff to be properly spread to avoid or minimize problems at seeding time. The problems of excessive chaff concentrations, poor straw distribution and stubble height may result in plugging problems, toxic effect on seedlings, hair pinning, nutrient tie-ups and poor and uneven emergence. In many cases, excess residue prevents seed to soil contact. A reduction in contact between the seed and soil will mean that the seed cannot take on enough moisture to swell and germinate. As a result, the weed seeds become the first seeds to germinate, and are the first seedlings to emerge. The weed seedlings will have an advantage over the crop seedlings and out-compete the crop for valuable moisture and nutrients.

When it comes to the residue from cropping options, cereals usually produce more straw than oilseeds. On the other hand, oilseeds such as canola and mustard will produce more chaff. If the chaff is not spread properly, some crop chaff - such as that of canola and mustard - can have allelopathic or toxic effects on next spring's germinating crops.

The Prairie Agriculture Machinery Institute (PAMI) recommendations for successful direct seeding are that straw be spread over 80% of the width of the swath while chaff be spread over 50% of the swath. At present most combine manufacturers offer optional straw choppers that will provide satisfactory straw spreads of up to 30 or 35 feet. In addition, after-market straw choppers are also available. PAMI has several performance evaluation reports on straw and chaff spreaders that may be of interest to producers.

The ability of the seeding implement to clear residue must also be considered during harvest. The general rule of thumb for hoe and knife openers is that stubble height should not exceed the shank spacing of the seeding implement (i.e. 10" row spacing, 10" stubble height). On the other hand, producers who decide to use disc openers can seed into taller stubble heights since less disturbance occurs. They should, however, be aware of the effects of hair pinning with excessive ground residue.

Producers who are not satisfied with the straw and chaff distribution behind a combine can utilize heavy harrows. Heavy harrows do a good job of spreading the straw but will not spread the chaff; the chaff stays wherever the combine places it. Harrowing is an additional operation, but it is an option to helping producers manage residue if necessary.

When retrofitting an air seeder, producers must also determine what row spacing is required for your soil zone. Research indicates that 12-inch row spacing in the Black and Gray soil zones did not reduce yields when compared to other row spacing. In the Brown or Dark Brown soil zones, spacing of 10 inches or less is preferred, since wider row spacing in drier soil zones has reduced yields. Implications of wider row spacing include lower seedbed utilization and less swath support. These implications are usually offset by lower machinery capital costs due to fewer openers required. This leads to a reduction in draft requirements and fuel usage, along with improved drill clearance with residue.

## Opener Selection

Many long time direct seeders say that producers will explore opener options or experiment with different ones before they are satisfied with one particular opener. Opener selection should be based on a number of factors, including type and amount of disturbance, soil texture, the presence of rocks, topography, fertilizer type and rates, opener wear rate, moisture availability, draft requirements and operational speed. In many cases producers will be looking over the fence to see what the neighbors are using and also asking what works or what does not work.

Openers on direct seed equipment must be able to operate in heavy residue conditions and in soils with higher surface moisture conditions. Openers must safely place seed and fertilizer into the soil and create an environment for quick germination and quick seedling establishment within the row, while leaving the opposite between the seed rows.

At present, many opener configurations exist on the market, including single shoot, double shoot and even triple shoot openers. A single shoot opener, such as a knife or spreader tip, is well suited for use on an air seeder. Single shoot openers utilize a single air delivery system to deliver seed and fertilizer. The amount of fertilizer that can be placed with this system will depend on the amount of seedbed utilization that occurs with the opener. An opener with a three inch spread will be able to place more fertilizer with the seed than a one inch knife opener. Openers that can utilize this type of delivery system include knife, spoon, disc and shovel. If producers wish to use higher fertilizer rates and create less disturbance, they should consider applying nitrogen in a low disturbance banding operation or consider switching to double shoot openers.

Double shoot openers utilize two delivery systems to deliver seed and fertilizer. The openers can create significantly more soil disturbance and higher draft requirements than single shoot openers. There are many opener choices from different manufacturers that will utilize this delivery method. With a double air delivery system, producers can separate the seed and fertilizer. This allows them to place higher rates of fertilizer without inhibiting germination and emergence. With most openers in this class, the distance of separation is approximately one inch to the side or one inch to the side and one inch below the seed, or in the center of two successive openers as is the case of the mid row band.

Openers that can utilize this method include side band, paired row and mid row band. Single side band openers generally disturb less soil and appear to provide more consistent seed-fertilizer separation when compared to paired row openers. In most cases, paired row openers do not leave a true-paired row; the seed placement is more of a ribbon effect or a seed scatter over the width of the opener. Mid row band places the fertilizer in a separate band between every second pair of seed rows. This method utilizes coulters or knives to apply the fertilizer mid row, and ensures that growers can place extreme amounts of fertilizer without worrying about seedling emergence issues due to fertility.

All three forms of fertilizer can be used with either side, paired or mid row band openers. Producers should, however, be cautioned regarding the use of anhydrous ammonia with either paired row or side band. The ammonia needs to be placed deeper and to the side of the seed, and producers must ensure the separation between the ammonia band and the seed is maintained.

Failure to do so will cause germination and emergence problems. Because of the ribbon effect of the paired row openers, maintaining that separation between the ammonia band and seed is more difficult. Producers should note side band openers do offer more aggressive fertilizer separation than paired row openers.

Seedbed quality is critical in any cropping system, and this quality should not be compromised. Even seeding depth with each shank is crucial on a retrofitted air seeder. Producers should watch for sprung shanks, and ensure wings are leveled from front to back. On many air seeders depth control and ground-following capability may need to be improved - especially in areas of rolling topography. Producers may have to convert the rigid hitch on the air seeder into a floating hitch. Producers should also be aware of opener wear, as this issue will compromise seed-fertilizer separation. Seeding depths from opener to opener will also be that much more difficult to maintain.

## **Packing**

Packing increases soil density, which indirectly benefits seed and water interchange mechanisms. Packing over the seed reduces the depth the seedling has to emerge and creates an environment for the seed to swell, germinate and emerge at a faster rate than the weed seeds in between seed rows.

On row packing is essential in a direct seeding operation. On row packing results in uniform packing of soil over the seed and provides no packing between the seed rows. It also evens out the seeding depth, which results in even emergence. Random packing, through the use of coil or crowfoot packers, should not be utilized in a direct seeding operation. This method is only 20% efficient, and does not provide accurate packing of the seed row. It also promotes weed growth in between the rows and creates more disturbance through the knockdown of stubble.

With regards to packer options, the general rule of thumb is to match the width of the packer with that of the opener. A packer that is narrower than the opener will not pack all the seeds evenly. A packer that is wider than the opener will also pack weed seeds along side the seed row or ride on the opener trench and fail to pack the seeds in the bottom of the seed row.

There are two types of on row packers: shank mount packers and rear mount packers. Both packers have advantages and disadvantages, and either form will work when retrofitting an air seeder. When using an air drill, producers will see a greater amount of force from the packer wheels.

The choice to use a steel or pneumatic rubber packer will depend on soil type. Steel packers should be used in coarser textured soils whereas pneumatic tires are better designed for heavier textured clay soils. Pneumatic packer tires tend to flex, causing some of the mud to drop off.

With regards to packer configurations with single side band and paired row openers, producers should ensure maximum separation between the seed and the fertilizer. This can be achieved with a round or a steel V-shaped packer over the fertilizer row. This can push the seed off to the side by as much as another half inch away from the fertilizer. If the packer is centered over the

seed row, the seed shelf may actually be crushed, pushing the seed onto the fertilizer. Flat packers are not recommended for use with either the side band or paired row opener, as flat packers tend to crumble the seed shelf created by the opener.

## **Conclusion**

Seven steps to retrofitting air seeders for successful direct seeding:

1. Start with an appropriate opener.
2. Select packer to match opener.
3. Choose the right trip.
4. Select row spacing.
5. Select the required frame.
6. Choose the air cart to meet requirements.
7. Match all above criteria to available tractor horsepower.

The selection and use of equipment can greatly affect the financial success of the farm.

In the short term, producers who switch to direct seeding may see an increase in capital cost expenditures. The amount of investment depends on the existing machinery complement. Producers must determine the amount of financial risk they can handle. If the cost of transition exceeds cash flow expectations or impacts debt load, producers may have to re-evaluate their decisions regarding investments and implement the transition into direct seeding over a longer period of time.