January 2006
Tested at Lethbridge
AgTech File EL0204
ISSN 0383-3445
Group 9 (f)

Evaluation Report 767

TESTING OF AIR-SEEDER OPENERS 2004/2005

INTRODUCTION

Direct seeding has become a common seeding practice over the last two decades. Pneumatic seeders are the prevalent type of unit used to direct seed. There are numerous makes and models of openers that fit on pneumatic seeders and new openers are developed every year. The Agricultural Technology Centre (AgTech Centre) tested several new openers for performance in 2004 and 2005. The testing of new openers assists producers to determine if a type of opener will work in their seeding situation.

TEST PROCEDURE

Testing of openers was split into three parts for all openers and four parts for some openers.

First, the operation of the openers was tested in actual field conditions. The openers were mounted on one of two research air-seeders (**described in Figures 1 and 2**) and operated in a field South of Lethbridge over 13 to 15 acres (5 to 6 ha) per opener. The soil type was loam brown chernozem. Seed and fertilizer placement was measured and opener performance was observed during field operation. Performance was measured by the separation of the seed and fertilizer rows with double shoot openers, seed and fertilizer placement with single shoot openers, soil penetration, draft, soil disturbance and flow around the openers. Ease of operation and adjustment was also observed.

Figure 1. One air-seeder is a 3-point hitch mount with a large rear support wheel. The seeder is 10 ft (2.8 m) wide and is made up of two frames. The main frame supports the material tanks and delivery system. There are four seed and fertilizer tanks that use an electric driven and monitored fluted metering system. The material is delivered to the openers using a pneumatic venturi system. There are air delivery material blockage sensors in each hose. The second frame is a sub frame that is interchangeable to the main frame. There are several sub frames constructed which are designed to accommodate different types of shanks with different mounts and spacings. Eight to ten shanks can be mounted on the sub frames. There are different widths of gang packers available that mount to the rear of the sub frame for on-row packing if required. The sub frames are easily changed in the field.

Figure 2. The other air-seeder is an 8 ft (2.4 m) wide floating hitch cultivator. The cultivator has 4 rows of 8 C-shanks with 12 in (305 mm) spacing. A Gandy air pneumatic seed/fertilizer metering applicator system is mounted above the cultivator frame. The Gandy material box is split in half for seed and fertilizer. A gang packer mounted at the rear of the cultivator provides on-row packing.

The second part of the opener testing measured the draft of each opener in the field using a draft cart designed at the AgTech Centre.

The draft cart has a main frame supported by a solid hitch and two rear wheels. There is a sub frame within the main frame. The sub frame is independently adjustable for height and accommodates a series of load cell transducers to measure the draft of one opener. The draft tests were completed in a clay loam brown chernozemic soil at 4 mph (6.4 km/h) at three operating depths for all openers.

The third part of the opener testing was the operation of the openers in the Alberta Soil Bin Test Facility. Horizontal, vertical, lateral soil forces, seed and fertilizer placement and soil disturbance were measured during the operation of each opener in the soil bin. The soil bin dimensions are 58 ft (17.7 m) long, 10 ft (3.1 m) wide and 24 in (610 mm) deep. The bin contains a dark brown loam soil. The actual useable length of the bin for measurement is 40 ft (12.2 m). A carriage is mounted on rails and is pulled along the bin by a chain and electric motor drive system. The drive carriage contains an instrumented, adjustable sub frame where a soil opener is mounted. An electric seed/fertilizer metering and air supply system deliver material to the soil opener for seed and fertilizer placement measurements. Pot barley is used to simulate the seed and fertilizer in the soil bin.

Three of the openers were complete with shank and trip assemblies, which attributed to the fourth test part. The trip force, angle and displacement, was measured for the three opener assemblies. Inclinometer and displacement transducers were used to measure the shank and opener movement and angle change through the tripping range action. The vertical movement was the amount of vertical clearance measured to determine the obstacle clearance for the opener.

DESCRIPTION OF OPENERS

Six air-seeder openers from four manufacturers were included in the test. Four types of openers were tested and are listed below:

1. Single Shoot Disk: The seed and fertilizer is placed in a narrow band between a pair of disks. **K-Hart 3611 and 2612 Double Disk.**
2. Paired Row Double Shoot (Deep Fertilizer Bander): The fertilizer is placed below and between two rows of seed. **Dutch Paired Row.**
3. Paired Row Double Shoot (Shallow Fertilizer Bander): The fertilizer is placed between and at the same depth or slightly deeper than the two rows of seed. **Dutch Low Draft Paired Row, Gen 300 T2.**
4. Two Shank Double Shoot: The seed and fertilizer are placed with separate openers. The fertilizer is usually placed with the leading opener at the same depth or below the seed. **Straw Track Seed Master.**

DISCUSSION

Figure 3 describes the measurements listed in the **Tables** for each opener in the following report.

All openers tested during this project were operated on 12 in (305 mm) row spacing. The horsepower ratings in the report do not account for tractive efficiency or the rolling resistance of the seeding unit. Tractive efficiency is normally 80 % for hard soils and 70 % for loose soils. Tractor efficiency is normally 80 %. Rolling resistance of the seeding unit is 10 hp (7.5 kW) for air delivery tanks and 0.5 hp/ft (1.2 kW/m) for packers.

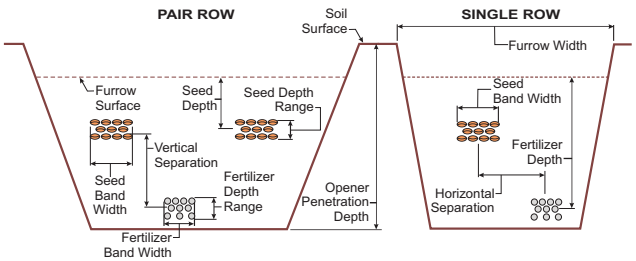

Figure 3. Explanation of Seed and Fertilizer Placement Figures.

K-HART 3611 DOUBLE DISK OPENER

MANUFACTURER:

K-Hart Industries
Box 520
Elrose, Saskatchewan, Canada
S0L 0Z0
Phone: (306) 378-2258
Fax: (306) 378-2926
Email: sales@khartindustries.com
Website: www.khartindustries.com

RETAIL PRICE: (April 1, 2006)

($690.00 Canadian for complete opener)
($32.00 Canadian for replacement disks)

Figure 1. K-Hart Model 3611 Double Disk Direct Seeding Unit.

GENERAL DESCRIPTION

The K-Hart Model 3611 double disk opener is a single shoot double disk tool bar mounted seed opener and packer (**Figure 1**). The unit mounts to the bottom of a frame with two U-bolts. The opener consists of offset double disk openers followed by a packer. An adjustable tension spring supplies downward force to the double disk. The packer wheel is mounted on a pivot arm that is connected to the rear of the main disk mount. The packer wheel is a semi-pneumatic rubber tire that is spring loaded on the pivot arm to gauge packing pressure.

RESULTS AND DISCUSSION

QUALITY OF WORK:

The average seed and fertilizer placement is listed in **Table 1** and shown in **Figure 2**. Seed and fertilizer placement at shallower depths than listed, resulted in narrower furrow widths at the soil surface and a slightly narrower seed/fertilizer band. All the following tests were completed with the double disk tension spring set at the maximum for adequate soil penetration.

Table 1. Average Seed and Fertilizer Placement.

Variable	in	mm
Disk Penetration Depth	2.3	58
Seed/Fert. Depth Range (soil cover)	0.5 - 0.6	13 - 21
Seed/Fert. Band Width	0.6	15
Furrow Width at Soil Surface	3.5	89

The openers had good penetration in average and moist soil conditions. Penetration in dry and/or hard packed soil with the spring tension set to maximum was inadequate. The opener created very low soil disturbance in average soil conditions, but soil sticking to the disks in wet conditions caused high disturbance. Seed and fertilizer placement was very good with proper disk to soil penetration. Stubble clearance was very good. The packer wheel created sufficient soil packing over the seed and could be adjusted from light to firm.

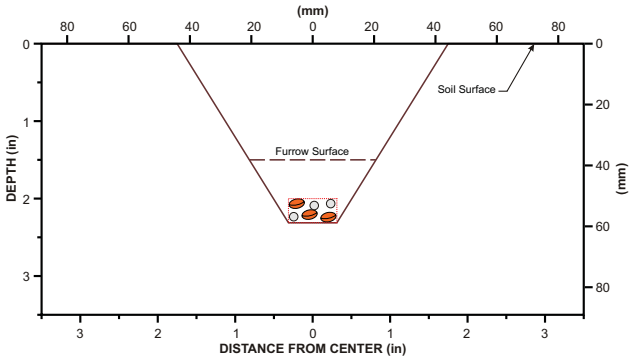

Figure 2. Average Seed and Fertilizer Placement.

POWER REQUIREMENTS

Draft: Average draft (drawbar pull) ranged between 68 to 150 lb (303 to 668 N) at disk penetration depths from 1 to 2.3 in (25 to 58 mm). For comparison, a 12 in (305 mm) wide sweep opener ranged from 215 to 280 lb (957 to 1246 N) over a 3 to 3.5 in (76 to 89 mm) tillage depth.

The drawbar power needed to operate each disk opener at 5 mph (8 km/h) varied from 0.9 to 2 hp (.7 to 1.5 kW). For comparison, the drawbar power needed to operate a 12 in (305 mm) wide sweep opener varied between 2.9 to 3.7 hp (2.2 to 2.8 kW). Increasing ground speed will increase power requirements.

Vertical and Side Forces: The following results are based on soil bin and in-shop test results only. The disks on the K-Hart 3611 unit tripped vertically and the force was adjustable by changing the spring tension. Force exerted on the disks by the spring ranged from 160 to 700 lb (712 to 3115 N) depending on the spring setting and disk displacement. The highest vertical force occurred at the maximum trip height. The disks had a total displacement of 9.6 in (244 mm) for tripping over obstacles during operation. **Figure 3** summarizes the disk forces.

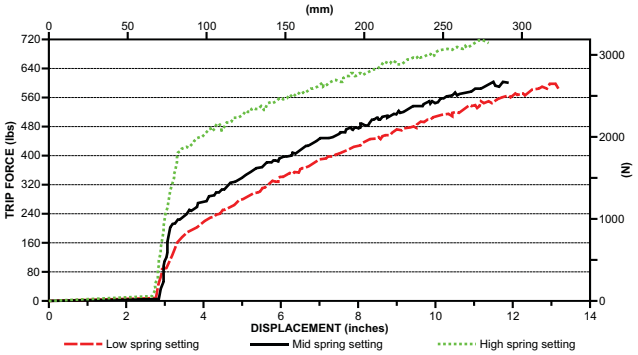

Figure 3. Disk Trip Forces.

The packer wheel had an independent spring for packing pressure. Force on the packer wheel varied from 0 to 210 lb (0 to 935 N) depending on the initial spring tension and the vertical packer displacement.

The weight of the drill frame and opener systems must be enough to overcome the upward forces exerted by the soil. The vertical forces exerted by the soil, were created from a combination of the disk and packer wheel springs and the soil compaction. The springs were operated at their maximum settings in the field so the vertical forces were measured at the same spring settings. The soil exerted an upward force on the seeding unit in all conditions. The force ranged from 284 lb (1264 N) at a 1 in (25 mm) depth to 313 lb (1393 N) at a 2.3 in (58 mm) depth. The soil exerted up to 70 lb (334 N) of lateral force on the seeding unit when the opener was not mounted straight. The side forces may cause skewing in hilly operating conditions if adjacent openers have similar side forces. It is recommended the manufacturer install guides to eliminate play with the opener mount bracket.

EASE OF INSTALLATION AND ADJUSTMENT

Ease of installing the seeding unit was good. One person could mount the unit but due to the weight of 110 lb (50 kg), two people were advised. The opener mounted on a 4 x 4 in (102 x 102 mm) frame with two U-bolts. Other mount sizes were available.

Ease of adjustment of the seeding unit was good. The operating depth was set by the toolbar frame height, disk arm spring tension and the packer spring tension. Setting the spring tensions was time consuming. The disk arm and packer spring tensions were adjusted by turning nuts on threaded rods connected to the end of the springs. No installation or operation instructions were supplied, but the manufacturer does offer an operators and parts manual in hard copy and on their website.

SPECIFICATIONS

Mounting:	
-Type	U-bolt
-Number of bolts	Two
-Size	0.63 x 4 x 4 in (16 x 102 x 102 mm)
Disk and Material Delivery System:	
-Type	Offset Double Steel Disks
-Disk diameter	16 in (406 mm)
-Disk thickness	0.19 in (4.8 mm)
-Angle between disks	6.5 degrees
-Disk offset	0.75 in (19 mm)
-Material delivery tube	One 1 in (25 mm) ID at inlet, tapered at end
Packer:	
-Type	Semi-pneumatic rubber tire
-Width and Diameter	2 x 12.5 in (51 x 317 mm)
Dimensions: (mounted position)	
-Width	8 in (203 mm)
-Height	29.5 in (749 mm)
-Length	47 in (1194 mm)
-Depth below frame in transport position	29.5 in (749 mm)
Weight:	
-Total	110 lb (50 kg)
Options Available:	
-Various packer wheel sizes	
-Disk mud scrapers	
-A 17 in (432 mm) disk set	
-Residue managers	

K-HART 2612 DOUBLE DISK OPENER WITH RESIDUE MANAGER

MANUFACTURER:

K-Hart Industries
Box 520
Elrose, Saskatchewan, Canada
S0L 0Z0
Phone: (306) 378-2258
Fax: (306) 378-2926
Email: sales@khartindustries.com
Website: www.khartindustries.com

RETAIL PRICE: (April 1, 2006)

($875.00 Canadian for complete opener)
($32.00 Canadian for replacement disks)

Figure 1. K-Hart Model 2612 Double Disk Direct Seeding Unit.

GENERAL DESCRIPTION

The K-Hart Model 2612 double disk opener is a single shoot double disk type tool bar mounted seed opener and packer (**Figure 1**). The unit mounts to the bottom and back of a frame with one U-bolt. The opener consists of an offset double disk opener followed by a packer. A parallel linkage allows the disk to move vertically. An adjustable tension spring in the parallel linkage supplies downward force to the double disks. The packer wheel is mounted on a pivot arm that is connected to the rear of the main disk mount. The packer wheel is a semi-pneumatic rubber tire that is spring loaded on the pivot arm to gauge packing pressure. The K-Hart Model 2612 unit was equipped with an optional residue manager. The residue manager is a spring loaded angled metal notched disk attached to an arm extended out ahead of the disks.

RESULTS AND DISCUSSION

QUALITY OF WORK:

The average seed and fertilizer placement is listed in **Table 1** and shown in **Figure 2**. Seed and fertilizer placement at shallower depths than listed, resulted in a narrower furrow width at the soil surface and a slightly narrower seed/fertilizer band. The following data was acquired with the disk and packer tension springs at the mid settings.

Table 1. Average Seed and Fertilizer Placement.

Variable	in	mm
Disk Penetration Depth	2.20	56
Seed/Fert. Depth Range (soil cover)	1.00	25
Seed/Fert. Band Width	0.60	15
Furrow Width at Soil Surface	2.25	57

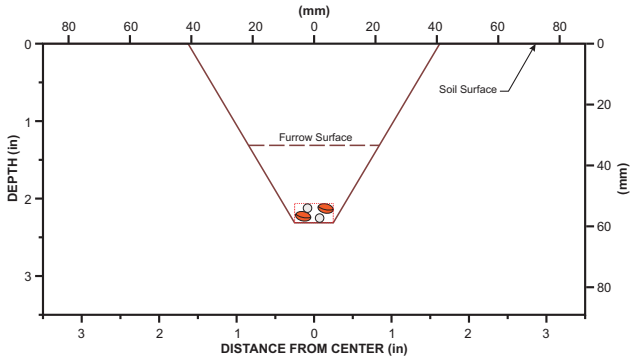

Figure 2. Average Seed and Fertilizer Placement.

The openers had good penetration in average soil conditions. Dry or hard packed soil conditions were not encountered. The use of the disk unit without the residue manager resulted in very low soil disturbance. Use of the residue manager resulted in more soil disturbance, but also increased disk penetration. Soil sticking to the disks in wet conditions caused high disturbance. This resulted in deeper seed placement depths. Seed and fertilizer placement was very good with proper disk to soil penetration. Stubble clearance was very good. The packer wheel created sufficient soil packing over the seed and could be adjusted from light to firm.

POWER REQUIREMENTS

Draft: Average draft (drawbar pull) ranged between 86 to 172 lb (383 to 765 N) at disk penetration depths from 1 to 3 in (25 to 76 mm). A higher tension spring setting increased draft due to better disk penetration. The residue manager slightly increased draft by an average of 2 lb (9 N), due to light tillage. For comparison, a 12 in (305 mm) wide sweep opener ranged from 215 to 280 lbs (957 to 1246 N) over a 3 to 3.5 in (76 to 89 mm) tillage depth.

The drawbar power needed to operate each disk opener at 5 mph (8 km/h) varied from 1.1 to 2.3 hp (.8 to 1.7 kW). For comparison, the drawbar power needed to operate a 12 in (305 mm) wide sweep opener varied between 2.9 to 3.7 hp (2.2 to 2.8 kW). Increasing ground speed will increase power requirements.

The residue manager did remove light and loose stubble from the path of the opener. The manager did not remove stubble piles, lodged or anchored plant material. The manager loosened the soil in front of the opener for more consistant penetration and seed placement.

Vertical, Side and Residue Manager Forces: The following results are based on soil bin and in-shop trip force test results only. The disks on the K-Hart 2612 unit tripped vertically and the force was adjustable by changing the spring tension in the parallel linkage. Force exerted on the disks ranged from 185 to 820 lb (823 to 3649 N) depending on the spring setting and disk displacement. The disks had a total displacement of 8.2 in (208 mm) for tripping over obstacles during operation. **Figure 3** summarizes the disk forces.

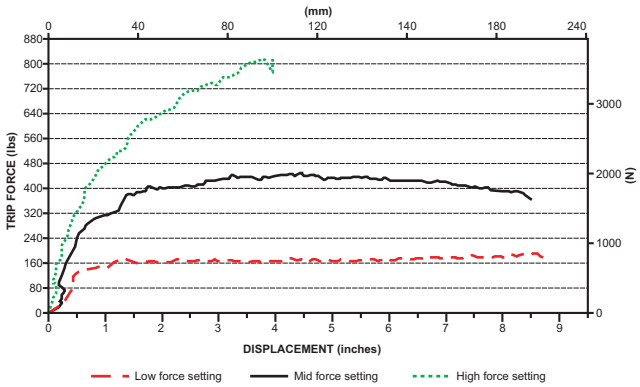

Figure 3. Disk Trip Forces.

The packer wheel had an independent spring with various adjustments for applying pressure. Force on the packer wheel varied from 40 to 140 lb (200 to 623 N) depending on the initial spring tension and the vertical packer displacement. The packer had a displacement from 0 to 5.4 in (0 to 137 mm) depending on the packer stop position.

When the packer stop was contacted, the disk tension spring then applied pressure to the packer wheel and at this point the disk and packer tripped together (significantly increasing the packing pressure).

The weight of the drill frame and seeding units must be enough to overcome the upward forces exerted by the soil. The vertical forces exerted by the soil were created from a combination of the disk and packer wheel springs and the soil compaction. The soil exerted an upward force on the seeding unit in all conditions. The force ranged from 210 to 330 lb (934 to 1470 N) depending on the disk and packer spring settings and the disk depth. The disk depth range used was 0.5 to 3 in (13 to 76 mm). The soil exerted up to 40 lb (178 N) of lateral force on the seeding unit. The side forces may cause skewing in hilly operating conditions if adjacent openers have similar side forces.

The wheel on the residue manager tripped vertically and the force was adjustable by changing the torsion spring tension. The force exerted on the wheel ranged from 40 to 70 lb (178 to 311 N) depending on the spring tension and vertical displacement. The wheel had a total displacement of 6.3 in (160 mm) for tripping over obstacles during operation.

EASE OF INSTALLATION AND ADJUSTMENT

Ease of installing the seeding unit was good. One person could mount the unit, but due to the weight of 155 lb (70 kg), two people were advised. The opener mounted on a 4 x 6 in (102 x 152 mm) frame with one U-bolt. Other mount sizes were available.

Ease of adjustment for the seeding unit was good. The operating depth was set by the tool bar frame height, disk arm spring tension and the packer spring tension. Setting the spring tensions was simple and quick. Positioning pins in a series of holes between two plates set the spring tensions. A plate with another pin limited the tripping of the packer. There were nine different settings for the limit stop. The residue manager was adjusted for angle, height and alignment with the disks. The adjustments were easy, but time consuming. The residue wheel trip force was adjusted by moving a plastic shim, located at one end of the torsion spring, to vary the tension. No installation or operation instructions were supplied, but the manufacturer does offer an operators and parts manual in hard copy and on their website.

SPECIFICATIONS

Mounting:	
-Type	U-bolt
-Number of bolts	One
-Size	0.75 in (19 mm)
Disk and Material Delivery System:	
-Type	Offset double steel disks
-Diameter	16 in (406 mm)
-Thickness	0.19 in (4.8 mm)
-Angle between disks	6.5 degrees
-Disk offset	0.75 in (19 mm)
-Material delivery tube	1 in (25 mm) ID at inlet tapered at the end
Packer:	
-Type	Semi-pneumatic rubber tire
-Width and diameter	2 x 12.5 in (51 x 317 mm)
Dimensions: (mounted position)	
-Width	7.6 in (194 mm)
-Height	40 in (1016 mm)
-Length	48.25 in (1226 mm)
-Depth below frame in transport position	34 in (864 mm)
Weight:	
-Total	155 lbs (70 kg)
Options Available:	
-Various packer wheel sizes	
-Disk mud scrapers	
-A 17 in (432 mm) disk set	
-Residue managers	

DUTCH LOW DRAFT PAIRED ROW OPENER

MANUFACTURER:

Dutch Industries
P.O. Box 568
Portico Drive
Pilot Butte, Saskatchewan, Canada
S0G 3Z0
Phone: (306) 781-4820
Fax: (306) 781-4877
Toll Free: 1-800-663-8824
Email: sales@dutchind.com
Website: www.dutchind.com

RETAIL PRICE: (July 12, 2006)

1.5 in (38 mm)	Opener	$143.30
3.5 in (89 mm)	Opener	$154.60
5.5 in (140 mm)	Opener	$160.60
Opener Body		$75.00
1.5 in (38 mm)	Point	$68.30
3.5 in (89 mm)	Point	$80.20
5.5 in (140 mm)	Point	$86.20
Dry & liquid fertilizer tubes		$23.30

Figure 1. Dutch Low Draft Paired Row Opener.

GENERAL DESCRIPTION

The Dutch Low Draft Paired Row opener is a double shoot paired row knife type opener (**Figure 1**). The opener places the fertilizer at the same and slightly deeper depth than the seed and mounts on conventional C-shanks and Edge-On Morris or Concord shanks. The opener consists of a front point with wings and a spreader plate, main opener body and a fertilizer delivery tube. The front point has a small burr on the underside that creates a slight trench for the fertilizer to fall into, resulting in a slightly deeper depth than the seed. The opener body houses the seed delivery tube and shank mount bracket. The point spreader plate protrudes back across the outlet of the seed delivery tube to split the seed into two rows. The point wing tips create a wide soil furrow for the seed rows. The point utilizes carbide tips for extended wear. Two sizes of metal shims were provided to accommodate different degree C-shanks. Three opener point widths are available.

RESULTS AND DISCUSSION

QUALITY OF WORK:

A 1.5, 3.5 and 5.5 in (38, 89 and 140 mm) seed spread point is available for the opener. The different widths vary the seed band width and accommodate different packer wheel widths. Only the 3.5 in (89 mm) seed spread point was used during this test. The average seed and fertilizer placement measured in the loam soil of the soil bin, was as listed in **Table 1** and shown in **Figure 2**. Seed and fertilizer placement at shallower depths than listed, resulted in narrower furrow widths at the soil surface and opposite for deeper depths. The seed and fertilizer vertical separation, measured in a hard packed clay loam soil condition, had twice the separation as the results in **Figure 2**. The seed bands were also separated more in the clay loam soil condition. Less separation was attributed to higher soil fracturing in the mellow soil conditions of the soil bin. Seed and fertilizer placement was good, but there was some seed and fertilizer mixing. Seed and fertilizer placement tests were completed with different opener angles in the soil bin. Smaller opener angles than the manufacturers recommendation, resulted in less seed and fertilizer mixing. On average, 11% of the total seed distributed at 75 lb/ac (13.8 kg/ha) seed rate, were found in the fertilizer band and 17% of the total fertilizer granules at 80 lb/ac (14.7 kg/ha) fertilizer rate, were mixed into the seed bands. The opener wings created a wide furrow allowing the seed and fertilizer to spread in a large band. This limited the amount of direct contact between the seed and fertilizer to reduce the chance of seed burn. The paired seed rows were distinct, but some seeds were consistently distributed between the main seed bands. This resulted in one wide seed band. Wider points will improve the seed and fertilizer separation because the seed rows are spread further out from the fertilizer row. However, wider points require higher power requirements.

The openers had good penetration in all soil conditions, provided the drill frame was heavy enough to hold the opener in the ground. The double shoot opener created medium soil disturbance. Stubble clearance was very good.

Table 1. Average Seed and Fertilizer Placement.

Variable	in	mm
Opener Penetration Depth	2.00	51
Seed Depth Range (soil cover)	0.75 - 1.25	19 - 32
Fertilizer Depth Range (soil cover)	0.85 - 1.50	22 - 38
Seed Band Width (both)	1.90	48
Fertilizer Band Width	1.50	38
Vertical Separation	0.25	6
Horizontal Separation	1.30	30

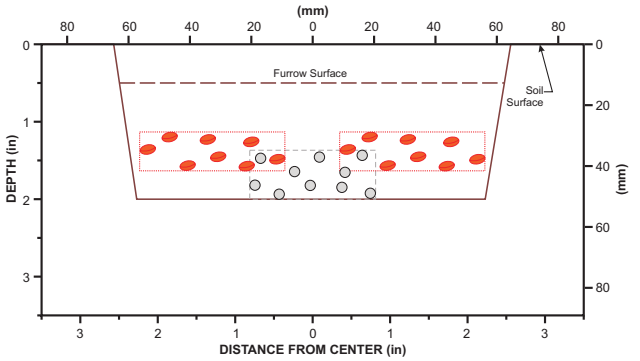

Figure 2. Average Seed and Fertilizer Placement.

POWER REQUIREMENTS

Draft: Average draft (drawbar pull) ranged between 139 to 355 lb (619 to 1580 N) at penetration depths from 1 to 3 in (25 to 76 mm). For comparison, a 12 in (305 mm) wide sweep opener ranged from 215 to 280 lb (957 to 1246 N) over a 3 to 3.5 in (76 to 89 mm) tillage depth.

The drawbar power needed to operate each opener at 5 mph (8 km/h) varied from 1.8 to 4.7 hp (1.3 to 3.5 kW) at tillage depths from 1 to 3 in (25 to 76 mm). For comparison, the drawbar power needed to operate a 12 in (305 mm) wide sweep opener varied between 2.9 to 3.7 hp (2.2 to 2.8 kW). Increased ground speed resulted in increased power requirements.

Vertical and Lateral Forces: The following forces were based on soil bin test results only. The soil exerted an average upward force range of 26 to 51 lb (116 to 227 N) on the opener at tillage depths from 1 to 3 in (25 to 76 mm). The weight of the drill frame and shank openers must overcome these upward forces. For comparison, the soil exerted an average downward or suction force of 50 lb (223 N) on a 12 in (305 mm) wide sweep opener over a 3 to 3.5 in (76 to 89 mm) tillage depth. There was an average force of 7 lb (31 N) to either side of the opener at the same tillage depths.

EASE OF INSTALLATION AND ADJUSTMENT

Ease of installing the opener on a shank was good. The fertilizer delivery tube bolted to the rear of the opener. The fertilizer tube inlet ridge was flared to secure a delivery hose clamp. The

seed tube inlet ridge had two vertical tabs to secure a delivery hose clamp. The manufacturer recommended the point be 0.25 in (6 mm) lower than the wing tip when mounted to ensure proper soil flow, penetration and product placement. This angle difference was accomplished by using supplied shims placed between the opener and shank with the top opener mount bolt. A very detailed installation and operation instruction manual was supplied.

SPECIFICATIONS

Mounting:	
-Type	Plow bolt
-Number	Two
-Size	0.5 x 2 in (13 x 51 mm)
-Bolt spacing	2.5 in (63 mm)
-Shims (2 thicknesses)	0.12 and 0.19 in (3 and 5 mm)
Point:	
-Type	Narrow knife with carbide tip
-Width	0.75 in (19 mm)
-Wing tips	4.4 in (112 mm) total width with carbide tips
Mounting:	0.25 in (6 mm) rollpin
Material Delivery System:	
-Fertilizer tube	1.1 in (28 mm) ID tapered at the end
Mounting:	
-Type	Hexagon head bolts
-Number	Two
-Size	0.25 in (6 mm) dia x 0.75 in (19 mm) long
-Seed tube	1.25 in (32 mm) ID
Dimensions: (mounted position)	
-Width	4.4 in (112 mm)
-Height	10 in (254 mm)
-Length	14.25 in (362 mm)
-Depth below shank	5 in (127 mm)
Weight:	
-Total	9.3 lbs (4.2 kg)
Options Available:	
-Different opener points	1.5 in (38 mm) 3.5 in (89 mm) 5.5 in (140 mm)

DUTCH PAIRED ROW OPENER

MANUFACTURER:

Dutch Industries
P.O. Box 568
Portico Drive
Pilot Butte, Saskatchewan, Canada
S0G 3Z0
Phone: (306) 781-4820
Fax: (306) 781-4877
Toll Free: 1-800-663-8824
Email: sales@dutchind.com
Website: www.dutchind.com

RETAIL PRICE: (July 12, 2006)

Paired Row Opener	$178.60
Side Band Opener	$171.60
¾ in (19 mm) Super eagle point	$32.60
Paired row sealer plates	$45.30
Side Band sealer plate	$38.10
Opener body	$75.00
Paired Row seed tube	$28.00
Side Band seed tube	$26.50
NH_3 Insulator kit	$30.90

Figure 1. Dutch Paired Row Opener.

GENERAL DESCRIPTION

The Dutch Paired Row opener is a double shoot paired row knife type opener (**Figure 1**). The opener places the fertilizer below and between the paired seed rows and mounts on conventional C-shanks and Edge-On Morris or Concord shanks. The opener consists of a front point, main opener body, seed furrow sealer plate and split seed delivery tube. The main opener body houses the fertilizer delivery tube and shank mount bracket. The sealer plate wings taper back and outward. The point utilizes carbide tips for extended wear. Two sizes of metal shims were provided to accommodate different degree shanks. The sealer plate determines the seed band width and there are four sealer plate widths available. A single seed row side band sealer plate is also available.

RESULTS AND DISCUSSION

QUALITY OF WORK:

A 3.5, 4.5, 5.5 and 6.5 in (89, 114, 140 and 165 mm) wide sealer plate is available with this opener. The different widths vary the seed band width and accommodate different packer wheel widths. Only the 4.5 in (114 mm) wide opener was used during this test. The average seed and fertilizer placement is listed in **Table 1** and shown in **Figure 2**. Seed and fertilizer placement at deeper depths than listed, resulted in a wider furrow width at the soil surface and opposite for shallower depths. The seed and fertilizer vertical separation measured in the soil bin was half of the result in field conditions. This resulted in the seed placed just above the fertilizer in the soil bin. The smaller separation was attributed to higher soil fracturing in the soil bin, which left less of a ridge for the seed rows. Seed and fertilizer separation was excellent, but the seed bands were not completely separated. A third small band of seed was located just above the fertilizer and below and between the two main seed bands. This third small band was seed that fell off the seed furrow ledges and down the opener point furrow wall. Seed and fertilizer placement

tests were completed with different opener angles (different mounting shims) in the soil bin. There was no seed and fertilizer placement difference or mixing with different mounting angles. As the seed furrow widens with wider sealer plates, the seed and fertilizer separation is better because the seed is spread further out from the fertilizer row. However, the wider sealer plates require higher power requirements.

Table 1. Average Seed and Fertilizer Placement.

Variable	in	mm
Opener Penetration Depth	2.50	63
Seed Depth Range (soil cover)	0.25 - 0.75	6 - 19
Fertilizer Depth Range (soil cover)	1.50	38
Seed Band Width (both)	2.20	56
Fertilizer Band Width	1.10	28
Vertical Separation	1.10	28
Horizontal Separation	1.40	35

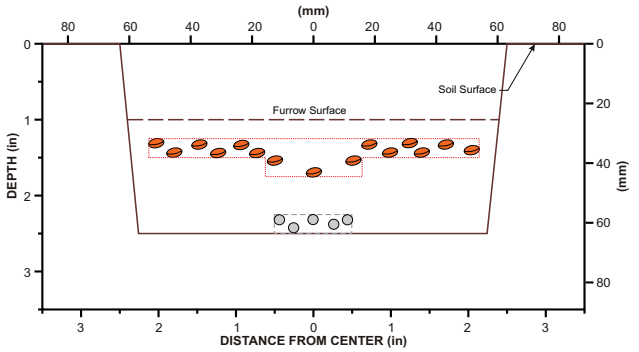

Figure 2. Average Seed and Fertilizer Placement.

The openers had good penetration in all soil conditions. The double shoot opener created medium soil disturbance. The sealer plate created a wide furrow for seed row separation but also created higher disturbance. Stubble clearance was very good.

POWER REQUIREMENTS

Draft: Average draft (drawbar pull) ranged between 174 to 526 lb (775 to 2341 N) at penetration depths from 2 to 5 in (51 to 127 mm). The average draft was 297 lb (1323 N) at a 3 in (76 mm) opener depth. Average seed depth placement was 2 in (51 mm) shallower than the opener penetration depth. For comparison, a 12 in (305 mm) wide sweep opener ranged from 215 to 280 lb (957 to 1246 N) over a 3 to 3.5 in (76 to 89 mm) tillage depth.

The drawbar power needed to operate each opener at 5 mph (8 km/h) varied from 2.3 to 7 hp (1.7 to 5.1 kW) at penetration depths from 2 to 5 in (51 to 127 mm). For comparison, the drawbar power needed to operate a 12 in (305 mm) wide sweep opener varied between 2.9 to 3.7 hp (2.2 to 2.8 kW). Increased ground speed resulted in increased power requirements. Different opener angles did not change the opener power requirments.

Vertical and Lateral Forces: The following forces were based on soil bin test results only. The soil exerted an average upward force range of 22 to 30 lb (98 to 133 N) on the opener at tillage depths from 2 to 3 in (51 to 76 mm). The weight of the drill frame and shank openers must overcome these upward forces. For comparison, the soil exerted an average downward or suction force of 50 lb (223 N) on a 12 in (305 mm) wide sweep opener over a 3 to 3.5 in (76 to 89 mm) tillage depth. There was an average force of 6 lbs (27 N) of force to either side of the opener at the same tillage depths.

EASE OF INSTALLATION AND ADJUSTMENT

Ease of installing the opener on a shank was good. The point was secured to a protruding tab at the opener body front. The manufacturer recommended the lowest part of the sealer plate be 0.12 to 0.25 in (3 to 6 mm) higher than the front of the plate when mounted. This setting should result in approximately 1.3 to 1.6 in (33 to 41 mm) seed and fertilizer depth separation. This angle was achieved by using supplied shims. The mounting shims provided by Dutch did not allow the recommended opener angle with the shanks used and special shims had to be fabricated. The seed delivery tube bolted to the rear of the seed furrow sealer plate and opener body. The seed tube inlet ridge was flared to secure a delivery hose clamp. The seed furrow sealer plate bolted to the rear of the opener body with the seed tube mount bolt and another bolt. The fertilizer tube was part of the opener body and mount bracket and had two vertical tabs at the inlet to secure a delivery hose clamp. A very detailed installation and operation instruction manual was supplied.

SPECIFICATIONS

Mounting:	
-Type	Plow bolt
-Number	Two
-Size	0.5 x 2 in (13 x 51 mm)
-Bolt spacing	2 in (51 mm)
-Shims (2 thicknesses)	0.12 and 0.19 in (3 and 5 mm)
Point:	
-Type	Super Eagle Beak knife with carbide tip
-Width	0.75 in (19 mm)
Mounting:	0.25 in (6 mm) roll-pin
Sealer plate:	4.375 in (112 mm) wide
Mounting:	
-Type	Hexagon head bolt
-Number	Two
-Size	0.5 x 2.5 in (13 x 63 mm)
Material Delivery System:	
-Seed tube	1.25 in (32 mm) ID round, split to two 0.75 in (19 mm) ID square tubes
Mounting:	
-Type	Hexagon head bolt
-Number	One
-Size	0.5 x 2.5 in (13 x 63 mm)
-Fertilizer tube	1.25 in (32 mm) ID round
Dimensions: (mounted position)	
-Width	4.375 in (111 mm)
-Height	10.625 in (270 mm)
-Length	16 in (406 mm)
-Depth below shank	5 in (127 mm)
Weight:	
-Total	11.35 lbs (5 kg)
Options Available:	
-Different paired row sealer plates	3.5 in (89 mm) width 4.5 in (114 mm) width 5.5 in (140 mm) width 6.5 in (165 mm) width
-Side band sealer plate	1.5 in (38 mm) width
-NH_3 insulator kit	

GEN 300 T2 OPENER

MANUFACTURER:

Gen Manufacturing Ltd.
P.O. Box 560
Coaldale, Alberta, Canada
T1M 1M5
Phone: (403) 345-3414
Fax: (403) 345-3413
Website: www.wearpoints.com

RETAIL PRICE: (April 1, 2006)
($99.75 without carbide on wings)
($25.00 for carbide on wings)
($44.50 for replacement points)

Figure 1. Gen 300 T2 Opener.

GENERAL DESCRIPTION

The Gen 300 T2 opener is a double shoot paired row knife type opener (**Figure 1**). The opener places the fertilizer at the same to slightly below the seed depth and mounts on a conventional C-shank. The opener consists of a front point with wings, a v-shaped tab and a main opener body. The main opener body is a complete cast unit with two tubes at the rear for seed and fertilizer delivery and a shank mount bracket at the front end of the body. A tab with a hole through the middle is located at the rear of the opener body to accommodate a liquid or anhydrous tube. A second tab is located below the other tab to protect the tube from damage and plugging and to help form a channel for the product. A square shaped divider at the back of the point protrudes across the seed delivery tube outlet to split the seed into two rows. The divider also creates a fertilizer furrow. The point wing tips are tapered back and outward and are hollowed out. The point utilizes carbide for extended wear. A cast metal shim was provided to accommodate different degree shanks. The latest model openers are molded to fit any 50° shank, not requiring a shim.

RESULTS AND DISCUSSION

QUALITY OF WORK:

The average seed and fertilizer placement is listed in **Table 1** and shown in **Figure 2**. Seed and fertilizer separation was excellent in all test conditions. There was less than 3% mixing of fertilizer into the seed bands at various seeding and fertilizing rates. The opener wings created a wide furrow for good seed and fertilizer separation. The point wings were hollowed out to contain and control the seed rows and resulted in precise placement.

Table 1. Average Seed and Fertilizer Placement.

Variable	in	mm
Opener Penetration Depth	2.50	63
Seed Depth Range (soil cover)	0.70 - 1.00	18 - 25
Fertilizer Depth Range (soil cover)	0.90 - 1.25	23 - 32
Seed Band Width (both)	0.75	19
Fertilizer Band Width	0.90	23
Vertical Separation	0.20	5
Horizontal Separation	1.60	40

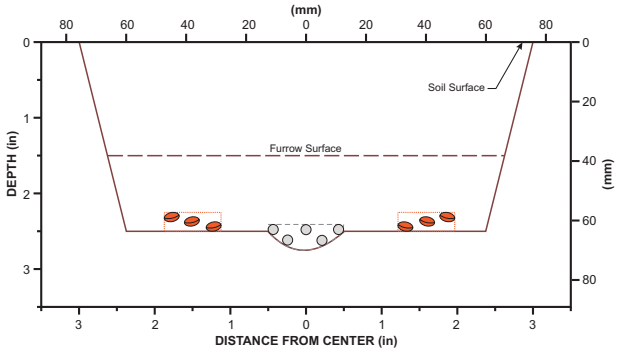

Figure 2. Average Seed and Fertilizer Placement.

The openers had good penetration in all soil conditions. The double shoot opener created medium soil disturbance. The wing tip design allowed for smooth soil flow over the opener. Stubble clearance was very good.

POWER REQUIREMENTS

Draft: Average draft (drawbar pull) ranged between 170 to 440 lb (756 to 1957 N) at penetration depths from 1 to 3 in (25 to 76 mm). For comparison, a 12 in (305 mm) wide sweep opener ranged from 215 to 280 lb (957 to 1246 N) over a 3 to 3.5 in (76 to 89 mm) tillage depth.

The drawbar power needed to operate each opener at 5 mph (8 km/h) varied from 2.3 to 5.8 hp (1.7 to 4.3 kW) at penetration depths from 1 to 3 in (25 to 76 mm). For comparison, the drawbar power needed to operate a 12 in (305 mm) wide sweep opener varied between 2.9 to 3.7 hp (2.2 to 2.8 kW). Increased ground speed resulted in increased power requirements.

Vertical and Lateral Forces: The following forces were based on soil bin test results only. The soil exerted an average upward force of 30 lb (133 N) on the opener at all tillage depths. The weight of the drill frame and shank openers must overcome these upward forces. For comparison, the soil exerted an average downward or suction force of 50 lb (223 N) on a 12 in (305 mm) wide sweep opener over a 3 to 3.5 in (76 to 89 mm) tillage depth. There was an average force of 1 lb (4 N) to either side of the opener at all tillage depths.

EASE OF INSTALLATION AND ADJUSTMENT

Ease of installing the opener on a shank was good. The point mounts to the opener body front. The seed and fertilizer delivery tubes each have a vertical cast tab at the inlet to secure a delivery hose clamp. The manufacturer recommended the front edge of the opener wings be 0.125 to 0.25 in (3 to 6 mm) higher than the front point tip when mounted to ensure proper soil flow, penetration and seed and fertilizer placement. The opener angle was set by placing a supplied shim between the top opener mount hole and shank. No shim is required on new models. No installation or operation instructions were supplied. An installation instruction manual is available from the manufacturer and is normally supplied with purchase.

SPECIFICATIONS

Mounting:	
-Type	Hexagon head bolt
-Number	Two
-Size	0.5 in x 2.75 in x 2.5 in (13 mm x 70 mm x 63 mm)
-Bolt spacing	2 in (51 mm)
-Shim	0.6 in (16 mm) tapered to 0.25 in (6 mm)
Point:	
-Type	Narrow knife with carbide tip and wings
-Width	0.75 in (19 mm)
-Mounting	0.3 in (8 mm) roll-pin
-Wing tips	5 in (127 mm) width
Material Delivery System:	
-Fertilizer and seed tubes	
Inlet	1.4 in (36 mm) ID round
Outlet	0.9 in (22 mm) ID width oval
Dimensions: (mounted position)	
-Width	5 in (127 mm)
-Height	0.75 in (273 mm)
-Length	6.5 in (419 mm)
-Depth below shank	6 in (152 mm)
Weight:	
-Total	18.45 lb (8.4 kg)

Options:
-Carbide tips for the wings

SEED MASTER OPENER

MANUFACTURER:

Straw Track Manufacturing Inc.
#1 South Plains Road West
Emerald Park, Saskatchewan, Canada
S4L 1C6
Phone: (306) 721-3001 or 1-888-721-3001
Fax: (306) 721-3002
Email:norbert@strawtrack.ca
Website: www.strawtrack.ca

RETAIL PRICE: (April 1, 2006)
($960.00 Canadian (retail) for complete opener)
($36.00 Canadian for replacement points)

Figure 1. Seed Master Opener.

GENERAL DESCRIPTION

The Seed Master opener is a double shoot, two-shank type opener that uses a hydraulic cylinder for the shank trip system (**Figure 1**). The opener consists of a main mounting arm assembly, two edge-on shanks, hydraulic ram and hoses and a packer wheel with mounting arm. The front fertilizer opener shank has a residue deflector, opener point and delivery tube. A hydraulic cylinder is connected between the front of the main mounting arm and the fertilizer shank. The rear seed opener shank has an opener point and delivery tube. There are nylon plates between the fertilizer and seed shank mounts and between the mounting bracket and main frame arm. The nylon plates allow ease of shank tripping and reduce metal fatigue. Both opener points are fitted with carbide tips for increased wear. The fertilizer point is vertically adjustable. The packer wheel arm is mounted behind the seed opener shank and extends out behind both shanks. The packer wheel is vertically adjustable to gauge depth.

Note: The Seed Master is normally sold as a complete air-drill system with frame. The air tank and material delivery system is sold separately as an option. For the following tests, a set of openers and hydraulic trip system was set-up on a non-commercial test air seeder unit. The drill frame height was adjusted during the testing. The Seed Master drill does not require a frame height adjustment, making the setup simpler.

RESULTS AND DISCUSSION

QUALITY OF WORK:

The average seed and fertilizer placement is shown in **Figure 2** and listed in **Table 1**. Seed and fertilizer separation and placement was very good.

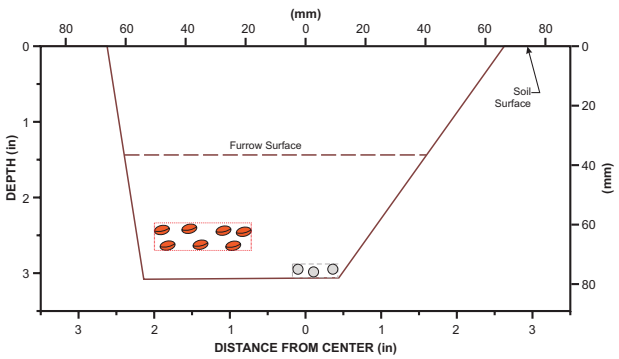

Figure 2. Average Seed and Fertilizer Placement.

Table 1. Average Seed and Fertilizer Placement

Variable	in	mm
Opener Penetration Depth	3.10	79
Seed Depth Range (soil cover)	0.90 - 1.25	23 - 32
Fertilizer Depth Range (soil cover)	1.40 - 1.60	35 - 40
Seed Band Width	1.25	32
Fertilizer Band Width	0.60	15
Vertical Separation	0.40	10
Horizontal Separation	1.50	38
Furrow Width at Soil Surface	5.30	135
Seeder Frame Height	34	864
Packer Adjustment (#)	5	
Hydraulic Cylinder Pressure - psi (kPa)	1100 (7583)	

Note: There are 9 packer adjustment settings with the #1 allowing the deepest opener depth.

The openers had very good penetration and created low soil disturbance. Stubble clearance was very good. The metal residue deflector did help prevent residue from accumulating around the shanks. A high hydraulic cylinder pressure allowed for maximum opener penetration, but increased the pressure on the packer wheel. Lowering the packer wheel to the maximum (position #9) allowed for very shallow seed placement. At this position the seed opener just scratches the soil surface. The opener would not normally be operated at this setting. To keep the openers in the ground at the shallow depths required higher hydraulic pressures because the packer wheel was able to ride on the soil surface at low pressures. Higher pressure sank the wheel into the soil and allowed more opener penetration. However in hard compact soil conditions at shallow seed depths, the packer wheel did not sink into the hard soil, even at high hydraulic pressure settings, which attributed to decreased opener penetration. In this circumstance, lower hydraulic pressure and a lower packer setting was necessary to allow opener penetration. There was sufficient soil flow for the packer wheel to pack over the seed and fertilizer. The openers worked independently from the seeder frame allowing them to follow varying land contours for consistent seed and fertilizer placement and packing pressure.

POWER REQUIREMENTS

Draft: Average draft (drawbar pull) ranged between 150 to 333 lb (667 to 1481 N) at tillage depths from 1.4 to 3.1 in (36 to 79 mm) and hydraulic cylinder pressure forces between300 to 1400 psi (2068 to 9651 kPa). For comparison, a 12 in (305 mm) wide sweep opener ranged from 215 to 280 lb (957 to 1246 N) over a 3 to 3.5 in (76 to 89 mm) tillage depth. Increasing cylinder pressure and lowering seed depth with the packer setting depth increased draft. For example, using a packer depth setting of #5 and a hydraulic trip pressure of 1300 psi (8961 kPa) caused a draft of 213 lbs (948 N) at the 3.1 in (79 mm) tillage depth. Setting the packer to the highest position #1 (deepest opener depth) with a cylinder pressure of 1500 psi (10,340 kPa), allowed the deepest fertilizer opener penetration depth of 3.5 in (89 mm) and resulted in a draft of 405 lbs (1800 N). A high hydraulic pressure and/or lowering the packer wheel caused high pressure on the packer wheel. Increased packing pressure increased the wheel rolling resistance and increased the power requirements.

The average drawbar power needed to operate each Seed Master opener at 5 mph (8 km/h) varied from 2 to 4.4 hp (1.5 to 3.3 kW). For comparison, the drawbar power needed to operate a 12 in (305 mm) wide sweep opener varied between 2.9 to 3.7 hp (2.2 to 2.8 kW). Increasing ground speed will increase power requirements.

Horizontal, Vertical and Side Forces: The following forces were based on in-shop trip tests and soil bin test results only. The Seed Master functioned with the packer tripping vertically and the shanks tripping vertically and horizontally. Both vertical and horizontal trip forces were adjustable by changing the hydraulic cylinder pressure. A hydraulic pressure setting of 300 psi (2068 kPa) created 120 lb (534 N) of vertical trip force on the packer wheel between the full displacement range. The horizontal seed shank trip force at the same pressure averaged 183 lb (814 N) and the fertilizer shank ranged between 130 to 210 lb (578 to 934 N) between the full displacement ranges. The seed shank and packer vertical displacements were the same with a total movement range from 0 to 21 in (533 mm). The fertilizer shank horizontal displacement range was from 0 to 13 in (330 mm). A hydraulic pressure setting of 900 psi (6204 kPa) created 240 lb (1068 N) of vertical trip force for the packer. The horizontal seed shank trip force at the same pressure averaged 303 lb (1348 N) and the fertilizer shank ranged between 260 to 440 lb (1157 to 1958 N). A hydraulic pressure setting of 1500 psi (10340 kPa) created 320 lb (1424 N) of vertical trip force for the packer. The horizontal seed shank trip force at the same psi averaged 430 lb (1913 N) and the fertilizer shank ranged between 415 to 610 lb (1847 to 2714 N). See **Figure 3** for the trip force measurements with the seed shank and **Figure 4** for the fertilizer shank.

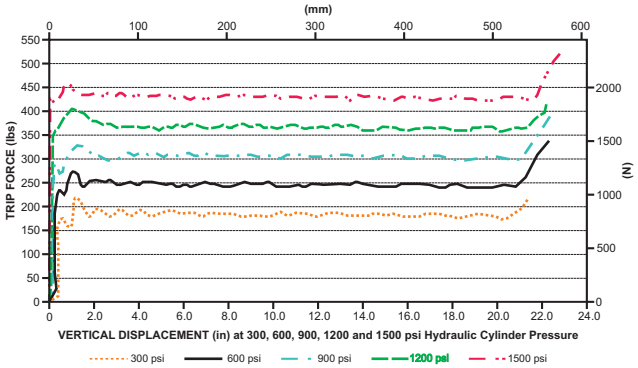

Figure 3. Seed Shank Trip Forces.

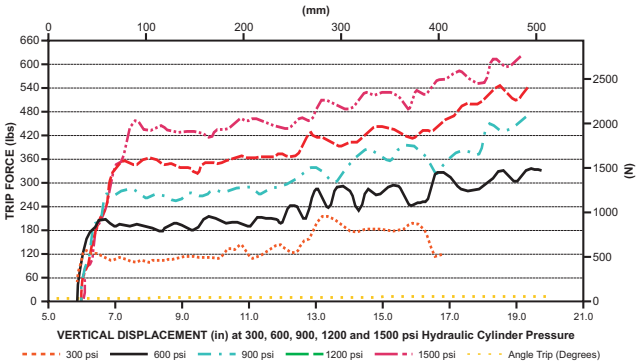

Figure 4. Fertilizer Shank Trip Forces.

The weight of the drill frame must be enough to overcome the upward forces exerted by the soil. The vertical force in operating conditions is mainly exerted on the packer wheel caused by the upward pressure from the soil, which also determines the material soil packing force. The upward forces measured varied with changes in depth, hydraulic cylinder trip pressure and packer wheel height. A tillage depth of 1.9 in (48 mm), hydraulic pressure of 300 psi (2068 kPa) and a packer wheel setting #5 (middle opener depth) created 120 lb (534 N) upward force on the packer wheel. A tillage depth of 2.4 in (61 mm), hydraulic pressure of 1050 psi (7238 kPa) and a packer wheel setting #5 created 189 lb (841 N) upward force on the packer wheel. A tillage depth of 2.1 in (53 mm), hydraulic pressure of 1400 psi (9651 kPa) and a packer wheel setting #9 created 258 lb (1148 N) upward force on the packer wheel. Lowering the packer wheel all the way caused a shallower tillage depth and high packing pressure.

There was anywhere from 5 to 39 lb (22 to 174 N) force of pull to the right side of the opener. These side forces may cause skewing under hilly operating conditions.

EASE OF INSTALLATION AND ADJUSTMENT

Note: Ease of installation of the opener would not be an issue because the system is normally sold completely setup. The following information is based on the test seeder set-up.

The opener mounted to the bottom of the frame and therefore did not need to be lifted entirely for mounting. One person could mount the unit, but due to the weight of 170 lb (77 kg) and awkwardness of the opener shape, two people were advised. Several hydraulic hoses were required with installation to supply oil to each opener

hydraulic cylinder. An instruction sheet was supplied for hydraulic line and regulator installation.

Operation and adjustment of the opener was simple. The frame height required for the opener was standard and was set by the operator with manufacturer recommendations. Seed depth could be adjusted by varying the frame height. The seed depth was also easily changed by either changing the packer height position (9 clearly marked positions) or by adjusting the hydraulic cylinder pressure. The packer wheel height was adjusted by loosening one bolt. The hydraulic pressure was adjusted with a flow control valve. The manufacturer recommended operating the hydraulic pressure initially at 950 psi (6549 kPa) and to adjust for varying conditions. Vertical seed and fertilizer separation and the packer wheel height was factory pre-set. The seed opener point was replaceable. The fertilizer point was replaceable and could be adjusted vertically to one of three positions. The residue deflector was mounted with the fertilizer point bolts. The openers were hydraulically raised or lowered for field work or transport. The shanks raised and pivoted 30 in (762 cm) higher than the field position during the transport transformation, allowing maximum ground clearance. In transport position, the shanks extended almost straight out from the frame. No other installation or operation instructions were supplied.

SPECIFICATIONS

Mounting:	
-Type	U-bolt
-Number of bolts	Two
-Size	0.63 x 4 x 4 in (16 x 102 x 102 mm)
Points:	
Seed point type	Narrow knife with carbide tip
-Width	0.62 in (16 mm)
Mounting:	
-Type	Hexagon head bolt
-Number	Two
-Size	0.3 x 1.25 in (8 x 32 mm)
Fertilizer point type	Narrow knife with carbide tip
-Width	0.56 in (14 mm)
Mounting:	
-Type	Hexagon head bolt
-Number	Two
-Size	0.3 x 1.5 in (8 x 38 mm)
Material Delivery System:	
-Fertilizer and seed tube	1 in (25 mm) OD
Packer:	
-Type	V-shaped rubber tire
-Width and diameter	4.5 x 16 in (114 x 406 mm)
Dimensions: (mounted position)	
-Width	11 in (279 mm)
-Height	40.5 in (1029 mm)
-Length	73 in (1854 mm)
-Depth below frame in transport position	10.5 in (267 mm)
-Depth below frame in field position	40.5 in (1029 mm)
Weight:	
-Total	170 lb (77 kg)

Agtech CENTRE
3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 328-5562
http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/eng6627