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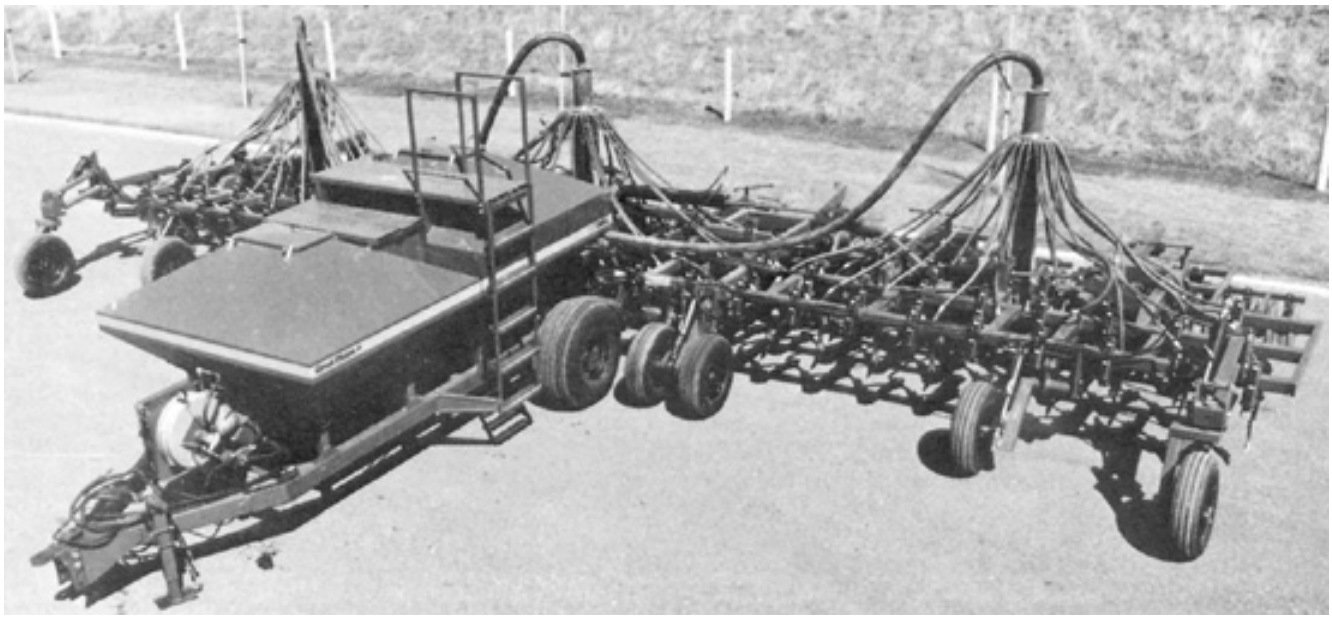

Great Plains Model ADC-0285-71 Air Drill

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

GREAT PLAINS MODEL ADC-0285-71 AIR DRILL

MANUFACTURER:

Great Plains Manufacturing Inc.
P.O. Box 218
Assaria, Kansas
67416

DISTRIBUTOR:

Crawfords of Alberta
Box 1720
Camrose, Alberta
T4V 1X6

RETAIL PRICE:

$79,200.00 (September, 1986, f.o.b. Lethbridge, Alberta).

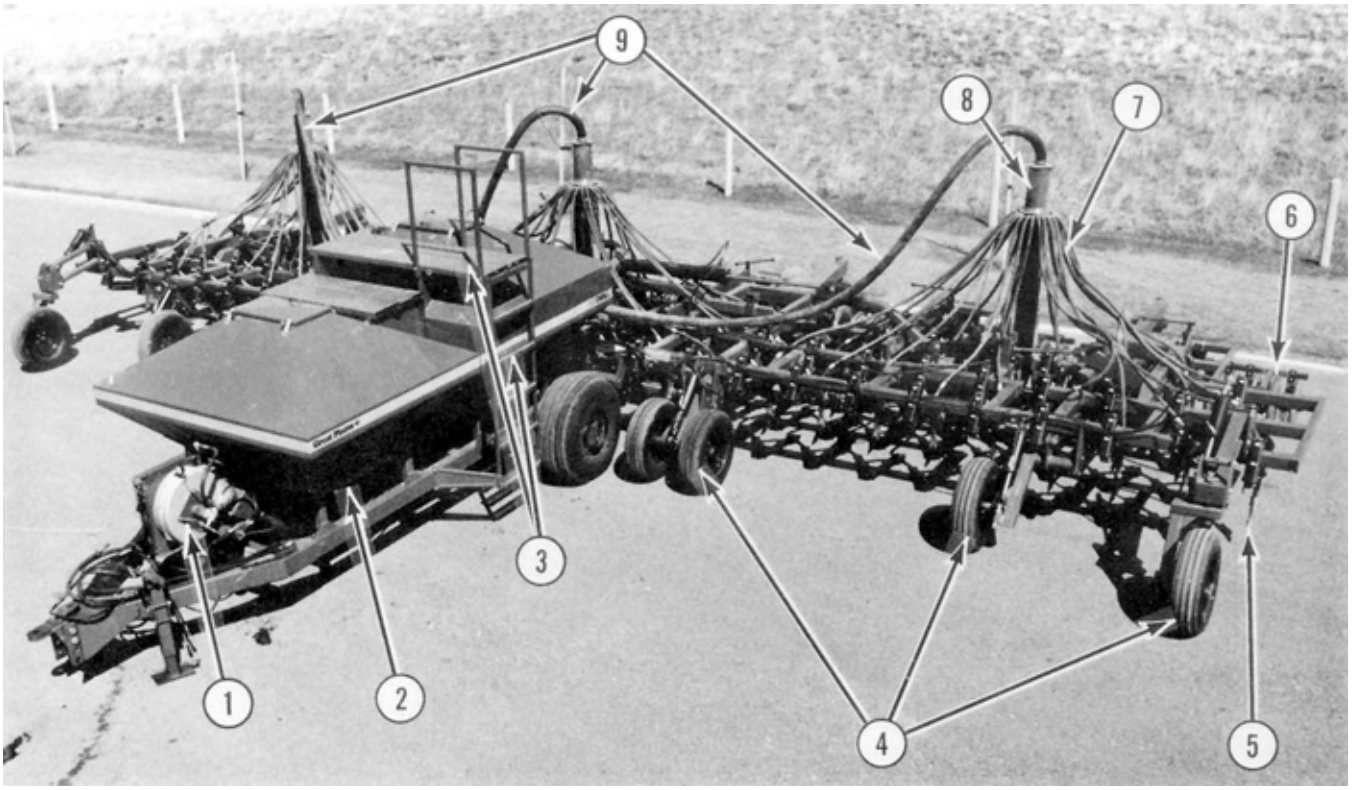

FIGURE 1. Great Plains Model ADC-0285-71 Air Drill: (1) Hydraulic Fan, (2) Metering System, (3) Ladder and Platform, (4) Gauge Wheels, (5) Openers, (6) Steel Press Wheels, (7) Secondary Hose, (8) Spinning Disc Tower, (9) Primary Hose.

SUMMARY

Quality of Work: Performance of the Great Plains Model ADC-0285-71 air drill was good for seeding and fertilizer banding in secondary and light primary field conditions. Deep banding fertilizer in heavy primary field conditions was not recommended due to the inability of the air drill to maintain penetration. The Great Plains air drill was suitable for deep banding fertilizer in secondary and light primary field conditions at application rates up to 300 lb/ac (340 kg/ha) at 5.5 mph (9.0 km/h).

Meter Calibrations: The manufacturer's metering system calibration charts were accurate in wheat, barley and canola and were acceptable for fertilizer for both meters.

Distribution Uniformity: Distribution uniformity across the seeding width was acceptable in wheat, barley and fertilizer but was unacceptable in canola.

Effect of Field Variables: Field bounce and ground speed had only a small effect on metering rates, while field slope had a noticeable effect on metering rate. Distribution uniformity was only slightly affected by field slope.

Grain Damage: Grain damage by the metering and distribution system was within acceptable limits for cereals and unacceptable for canola at normal fan speeds.

Seed Placement: Seed placement was good in most conditions. Variation in seed depth was similar to conventional hoe drill when measured in the same fields under the same seeding conditions. With properly adjusted openers, seed and fertilizer were normally placed in a 1.5 in (38 mm) wide band, with most seeds within 0.5 in (13 mm) of the average seed depth in uniform soil conditions. Each press wheel followed behind an opener, exerting a packing force of 141 lb (627 N), which effectively packed the soil around the seed. Seeding into moist sticky fields resulted in soil build-up on the steel press wheels.

Ease of Adjustment and Operation: Seeding rate was easy and simple to adjust. Tank and meter cleanout convenience was very good. Tank filling required the use of a drill fill or auger. A total of 144 grease zerks on the air till drill required greasing at intervals indicated in the manual.

Since the applicator towed in between the tractor and air drill, visibility of the middle section was obstructed by the tanks.

The Great Plains air drill could be placed into transport position in less than five minutes.

Rate of Work: The rate of work usually ranged from 24.5 to 30 ac/hr (9.9 to 12.1 ha/hr). About 140 ac (56.7 ha) could be seeded before refilling both tanks when seeding wheat at a normal seeding rate. Using only the larger rear tank, 80 ac (32 ha) could be seeded before refilling.

Power Requirements: Tractor size depended on soil conditions, seeding depth, ground speed and soil finishing attachments. In light soil, seeding at a normal seeding depth and 5.5 mph (9 km/h), a 214 hp (160 kW) tractor was needed to operate the Great Plains 45 ft (13.7 m) air drill. In heavier soil conditons, at the same depth and speed, a 227 hp (170 kW) tractor was needed.

Safety: The Great Plains 45 ft (13.7 m) air drill was safe to operate provided normal safety procedures were observed.

Operator's Manual: The operator's manual was good, containing useful information on adjustment, maintenance and operations. A detailed parts list was also included.

Mechanical Problems: A few mechanical problems occurred during the evaluation. The right cart wheel hub failed twice during the evaluation and an opener was bent and replaced.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to improve distribution uniformity in canola.
2. Providing a suggested setting for fan pressure to reduce crackage when seeding canola.
3. Modifications to ensure that the press wheels do not interfere with the nut and bolt assembly holding the gangs in place.
4. Supplying a slow moving vehicle sign as standard equipment.
5. Supplying meter calibration charts in SI (metric) units.

Project Manager: R. P. Atkins
Project Technologist: G. A. Magyar

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Great Plains 1987 model air drills will have a metering box divider that greatly improves distribution uniformity in canola. This divider will retrofit pre-1987 models and will be offered to owners of air drills at no charge.
2. As a result of the PAMI findings, Great Plains now suggests running the fan pressure at 10.5 oz/in^2 and running the tower spinners at 400 RPM to prevent crackage of canola and for best results in low volume (0-10 lb/acre; 0-11 kg/hectare) seeding.
3. New (1986 & newer) 7" spacing drills have a center press wheel bearing at this location preventing the press wheel gang from flexing up and hitting the bolt. A bolt-in center bearing is also available for pre-1986 model air drills.
4. 1987 model air drills will have a slow moving vehicle sign as standard equipment.
5. 1987 model air drills will have seed rate calibration charts in both English and metric units.

ADDITIONAL COMMENTS

1. A 34 ft. (10.4 m) wide air drill is now available.
2. The cart wheel hubs had been previously made out of gray cast iron and are now made out of high strength ductile iron.
3. A spring cushioned press wheel gang is now available for improved performance in rocky conditions.

GENERAL DESCRIPTION

The Great Plains Model ADC-0285-71 air system is a pneumatic seed and fertilizer applicator designed for use with the Great Plains Model 345 750785 113261 drill.

The drill is attached to the rear of the applicator by two cart link pivot arms. The applicator is supported by two wheels, each on single axles.

Seed and fertilizer are pneumatically distributed from the two tanks through a network of tubes to the spring reset hoe openers. The air drill can be used for seeding or for combined seed and fertilizer application.

Seed and fertilizer are metered by star-shaped rollers mounted below each tank. The meters are driven by. variable speed gear boxes which are driven off of the right applicator wheel. A clutch between the gear box and drive wheel is hydraulically actuated when lowering the unit into the ground. A hydraulic driven fan forces the metered material through the distribution system. The distribution system consists of three primary tubes passing through the metering box at the bottom of each tank, which in turn feed one of three secondary headers mounted on the air drill. Tubes from the secondary headers connect to the hoe openers.

The Great Plains air drill is a 45 ft (13.7 m) wide drill consisting of six 7.5 ft (2.3 m) sections. It was equipped with 75 spring reset hoe openers, spaced at 7 in (178 mm) arranged in three rows. The air drill is supported at the front by eight gauge wheels and at the rear by six gangs of press wheels.

A tractor with three remote hydraulic controls was required to operate the Great Plains model ADC-0285-71 air system with the Great Plains model 345 750785 113261 drill.

Detailed specifications for the applicator and air drill are given in APPENDIX I, while FIGURE 1 shows the location of major components.

SCOPE OF TEST

The Great Plains air drill was operated in loam, silt loam and sandy soils in the field conditions shown in TABLE 1 for approximately 119 hours while processing about 2560 ac (1037 ha). It was evaluated for quality of work, power requirements, and safety and suitability of the operator's manual.

TABLE 1. Operating Conditions.

CROP	FIELD TILLAGE CONDITIONS	STONE CONDITIONS	FIELD AREA ac	(ha)	HOURS
Barley on Stubble	Primary	Occasional Stones	160	(65)	8
Neepawa Wheat on Stubble	Primary	Occasional Stones	200	(81)	10
Neepawa Wheat on Summerfallow	Secondary	Stone free	1050	(425)	51
Neepawa Wheat on Plowed Under Winter Wheat	Secondary	Stone Free	400	(162)	20
Winter Wheat on Stubble	Primary	Stone Free	390	(158)	15
Winter Wheat on Summerfallow	Secondary	Stone Free	240	(97)	9
Banding Fertilizer on Summerfallow	Secondary	Occasional Stones	120	(49)	6
TOTAL			2560	(1037)	119

RESULTS AND DISCUSSION

QUALITY OF WORK

Metering Accuracy: The grain and fertilizer metering system was calibrated in the laboratory and compared with the manufacturer's calibration. Since actual seeding rates for certain settings depended on things such as seed size, density and moisture content, it is not possible for a manufacturer to present charts to include all the varieties of seed. Field calibration checks may be necessary for seed with properties differing from those used in establishing the manufacturer's charts. Research has, however, shown that small variations in seeding rates will not significantly affect grain crop yields.

The metering rate was varied by adjusting a variable speed gear box to the correct setting as determined from the calibration charts provided. By switching the gears on the agitator and meter shafts a low or high range drive was available.

Calibration curves for wheat, barley, canola and fertilizer are given in FIGURES 2 to 5. PAMI's calibration curves are compared to curves based on the manufacturer's calibration charts. Providing the scales on the front and rear meters were properly adjusted, there was very little difference between the manufacturer's and PAMI's calibration curves for wheat, barley and canola. A difference was observed in fertilizer rates. For example, at an application rate of 60 lb/ac (67 kg/ha), PAMI's measured rates in 11-51-00 fertilizer were 13% lower for both meters and at an application rate of 170 lb/ac (193.2 kg/ha) the measured rates was 12.6% lower for the front meter and 21% lower for the rear meter. The differences between the curves is probably due to the variation in the size and density of fertilizer used in the two calibrations. The density of the fertilizer used in the manufacturer's calibration was not indicated in the operator's manual.

Operating on 10 degree uphill slopes, the metering rate increased by up to 8%, while operating on downhill slopes decreased the metering rate by 14%. Operating on side hills, variations in ground speed, fan speed and field bounce had little effect on metering rates.

Distribution Uniformity: FIGURE 6 gives seeding distribution uniformity for the Great Plains air drill in wheat and barley. Distribution was uniform over the full range of seeding rates at a fan pressure reading of 12 oz/in^2. For example, at a seeding rate of 71.5 lb/ac (81.3 kg/ha), the coefficient of variation[1] (CV) was 9.5% for wheat, and at a seeding rate of 78 lb/ac (88.5 kg/ha) the coefficient of variation was 7.7% for barley. FIGURE 7 shows a typical seeding distribution pattern obtained in wheat at a seeding rate of 71.5 lb/ac (81.3 kg/ha). The seeding rate from each hoe opener across the width of the air drill varied from 53.6 to 87.4 lb/ac (60.9 to 99.3 kg/ha). This resulted in acceptable distribution uniformity with a CV of 9.5%.

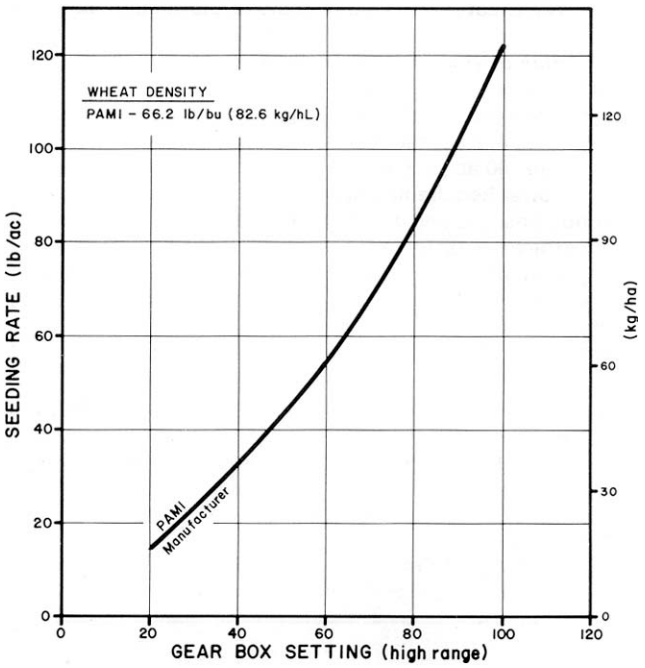

FIGURE 2. Metering Accuracy in Wheat.

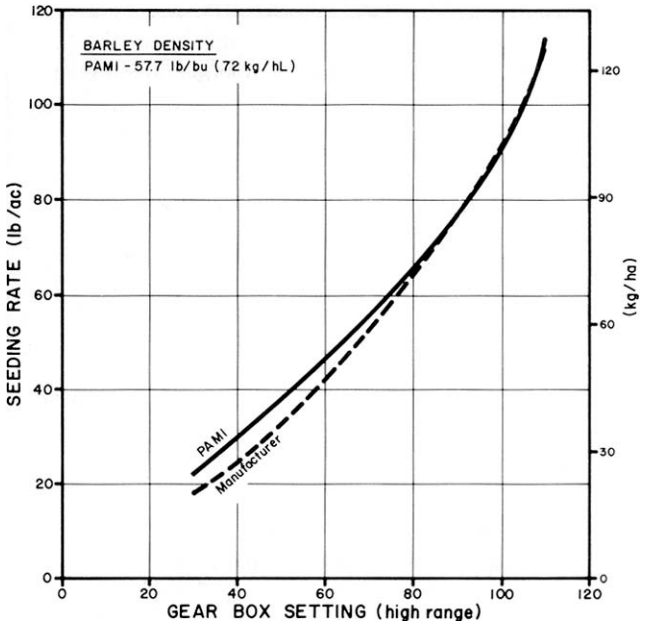

FIGURE 3. Metering Accuracy in Barley.

FIGURE 8 shows a typical distribution pattern obtained in canola at a seeding rate of 6.8 lb/ac (7.7 kg/ha), which resulted in unacceptable distribution uniformity with a CV of 23.6%. Distribution uniformity was unacceptable over the full range of canola seeding rates with CV's ranging from 20.1 to 27.6% (FIGURE 9). It is recommended that the manufacturer consider modiciations to improve distribution uniformity in canola.

Distribution uniformity in 11-51-00 fertilizer was acceptable over the full range of application rates with a CV ranging from 7.4 to 15% (FIGURE 10). Maximum application rate of 300 lb/ac (341 kg/ha) was possible with both meters at the highest setting.

[1] The coefficient of variation (CV) is the standard deviation of seeding rates from individual shanks expressed as a percent of the average seeding rate. An accepted variation for seeding grain or applying fertilizer is a CV value not greater than 15%. If the CV is less than 15%, distribution is acceptably uniform, whereas if the CV is greater than 15%, the variation in application rate among individual shanks is excessive.

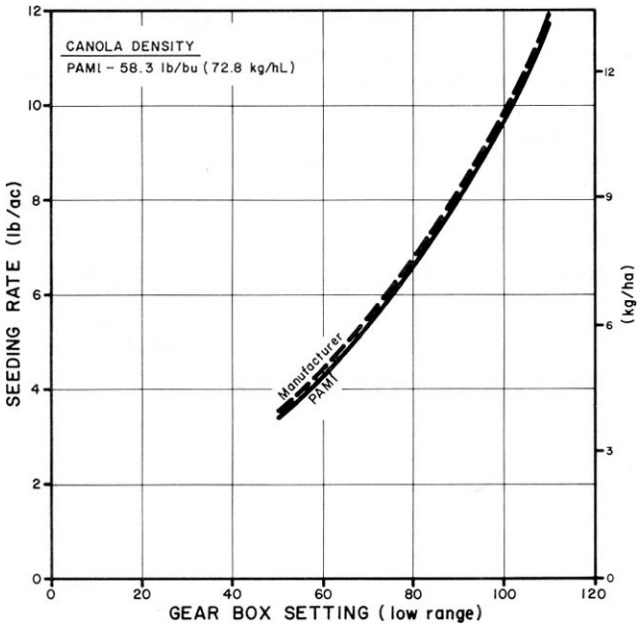

FIGURE 4. Metering Accuracy in Canola.

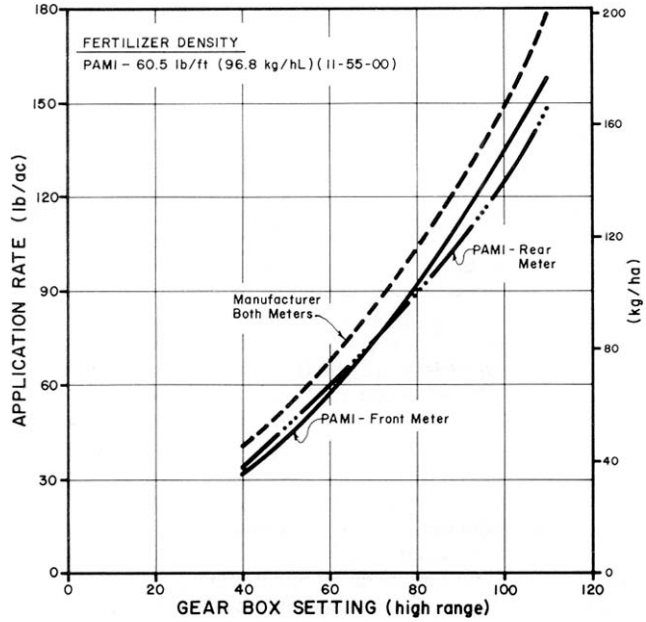

FIGURE 5. Metering Accuracy in Fertilizer.

Changes in distribution pattern uniformity could occur at different forward speeds due to different volumes of material being introduced into the constant volume of air supplied by the fan.

Changes in fan speed had little effect on distribution uniformity. Operating in hilly terrain caused the distribution uniformiry to become worse.

Grain Damage: Grain damage by the metering and distribution system was within acceptable limits for cereal grains at a fan pressure of 12 oz/in². For example, in dry Neepawa wheat, at an 11% moisture content and at a fan pressure of 12 oz/in² only 1.0% grain crackage occurred. Grain crackage in canola was slightly higher than in cereal grains. For example, in dry canola at a moisture content of 6.8%, crackage at fan pressure of 12 oz/in² was 5.0%. Reducing fan pressure to 10.5 oz/in² reduced canola damage to 1.0%. Due to canola damage at recommended fan pressures, it is recommended that the manufacturer consider providing a suggested setting for fan pressure to reduce crackage when seeding canola.

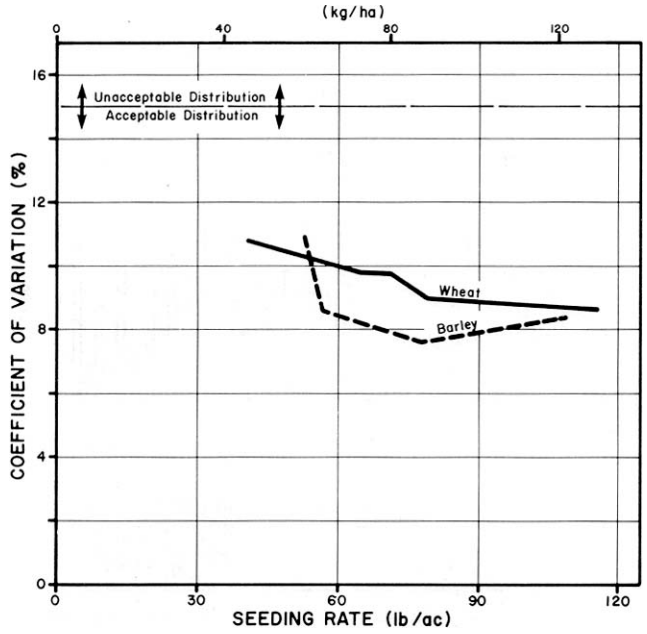

FIGURE 6. Distribution Uniformity in Cereal Grains over a Range of Seeding Rates at 5.5 mph (9 km/h) and a Fan Pressure of 12 oz/in².

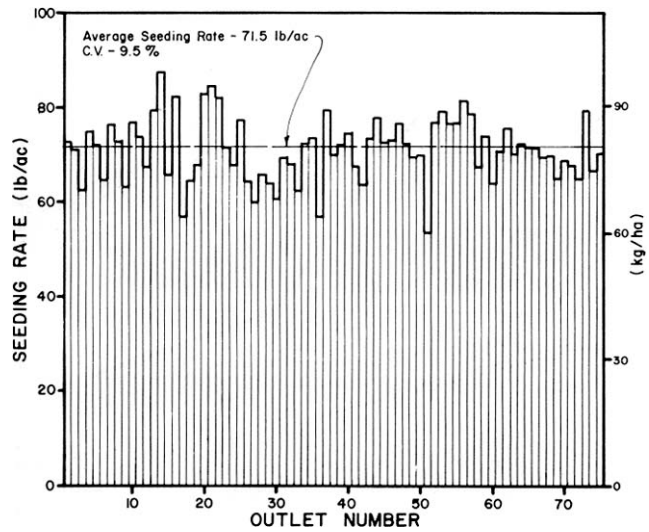

FIGURE 7. Distribution Uniformity Pattern in Wheat at 71.5 lb/ac (81.3 kg/ha) at a Fan Pressure of 12 oz/in².

Seed Placement: In normal prairie conditions, grain is seeded into moist soil on a firm seedbed from 1 to 2 in (25 to 50 mm) deep within the soil packed tightly around the seed for optimum moisture contact and minimum soil drying.

The Great Plains air drill normally placed seed and fertilizer within a 1.5 in (38 mm) wide band. When seeding in pre-tilled uniform soil conditions, variation in seed depth was quite uniform. For example, at an average seeding depth of 2.1 in (53 mm), seeding depth across the width of the machine varied from 1.2 to 3.3 in (30 to 85 mm), most of the seeds were placed within 0.5 in (13 mm) of the average seed depth.

Each hoe opener was equipped with Acra Plant points (FIGURE 11). Plants emerged in distinct 7 in (178 mm) rows (FIGURE 12). This row spacing provided adequate windrow support provid-lng light crops were laid across the rows rather than parallel to them.

In fields with sharp hill crests or gullies, seed depth variation was similar to a hoe drill.

In heavy primary tillage conditions, care had to be taken to ensure proper penetration of the hoe openers was possible due to the increased soil forces, especially behind the wheel tracks.

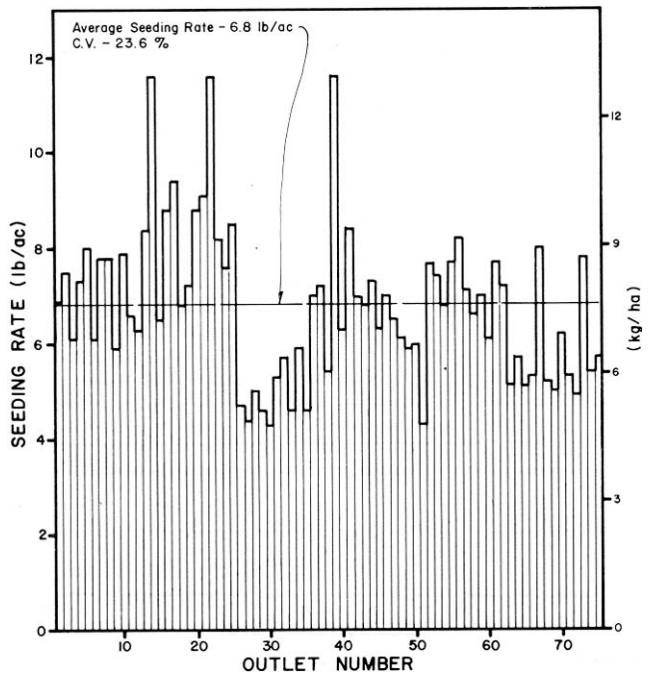

FIGURE 8. Distribution Uniformity Pattern in Canola at 6.8 lb/ac (7.7 kg/ha) at a Fan Pressure of 10.5 oz/in².

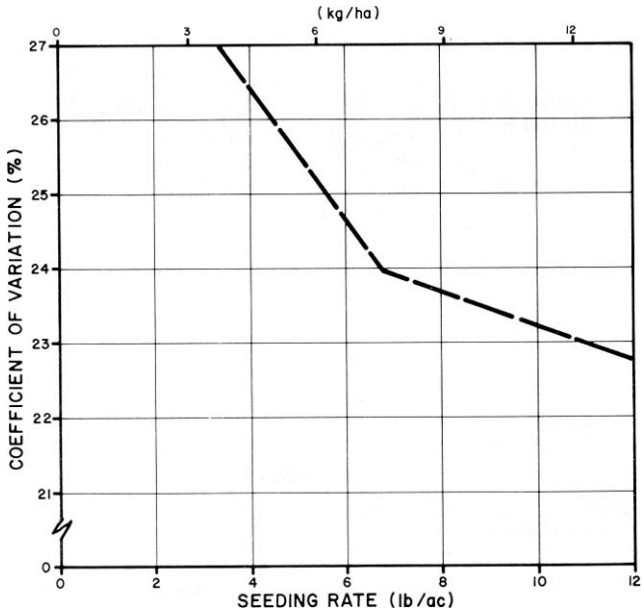

FIGURE 9. Distribution Uniformity in Canola over a Range of Seeding Rates at 5.5 mph (9 km/h) and a Fan Pressure of 12 oz/in².

Plant Emergence: As with most seeding implements, time and uniformity of plant emergence depended on seedbed preparation, soil moisture and seed placement. Uniform emergence resulted as long as machine settings were carefully adjusted to place seed in moist soil at the correct depth and providing loose seedbeds were packed after seeding. FIGURE 12 shows good wheat emergence when wheat was seeded directly into summerfallow as the first spring operation.

Careful air drill frame levelling was important in obtaining uniform emergence across the drill width. Improper levelling can result in openers operating at different depths.

Soil Finishing: The Great Plains air drill was equipped with steel press wheels. The steel press wheels followed directly behind the openers, effectively pressing the soil about the seeds. Average packing force exerted by each press wheel was 141 lb (627 N). Press wheel furrow depth ranged from 1.2 to 2 in (30 to 50 mm), depending on soil conditions. FIGURE 13 shows a typical seedbed after seeding into stubble. Seeding into moist, sticky fields resulted in soil build-up on the steel press wheels, which caused the nut and bolt assembly on the gang pivot point to become worn (FIGURE 14). It is recommended that the manufacturer consider modifications to ensure that the press wheels do not interfere with the nut and bolt assembly holding the gang in place.

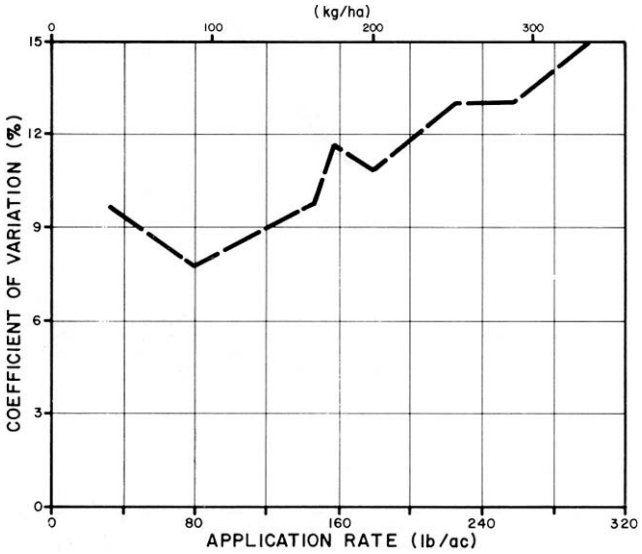

FIGURE 10. Distribution Uniformity in Fertilizer over a Range of Application Rates at 5.5 mph (9 km/h).

Penetration: Penetration was good in a wide variety of field conditions provided the openers (FIGURE 11) were properly adjusted and adequate pre-seeding tillage had been performed. Penetration was good when seeding directly into stubble fields provided the soil contained adequate moisture.

Penetration was uniform across the air drill provided all gauge wheels were levelled, the back row of openers were set to the same depth as the front row and openers behind tire tracks were set deeper to compensate for the added compaction. The openers were set deeper by adjusting the depth adjustment setting and the down-pressure adjustment. Each opener had three down pressure adjustment settings, four depth adjustment settings and an angle trunion bolt to maintain a constant seed boot pitch at the various seeding depths. Lowering the openers while the air drill was stationary could result in plugging the delivery boots. The spring reset opener was effective in providing opener protection in stony conditions.

Trash Clearance: The Great Plains air drill had very good trash clearance due to the 28 in (711 mm) ground to frame clearance, the shape of the hoe opener shank, and the 28 in (711 mm) row spacing. It was possible to operate in fields with a heavier trash cover than was possible with a conventional hoe drill.

Skewing and Stability: The Great Plains air drill was very stable and sideways skewing occurred only in very hilly conditions. The opener shank pattern was symmetrical and did not impose any side forces on the drill during normal tillage.

Reasonable care had to be observed on steep hillsides due to the high centre of gravity of the air seeder, especially with full grain and fertilizer tanks.

Fertilizer Banding: It is not recommended that the Great Plains air drill be used for deep banding fertilizer in primary conditions. When banding fertilizer in pre-worked conditions, fertilizer granules were placed in a band about 1.0 in (25 mm) wide, with fertilizer depth ranging from near opener tip depth to 0.60 in (15 mm) above opener tip depth. The fertilizer band width and thickness was affected by the amount of point wear.

When using the front or rear meter only, fertilizer application rates of 147 lb/ac (167 kg/ha) were possible. When using

When using the front or rear meter only, fertilizer application rates of 147 lb/ac (167 kg/ha) were possible. When using both tanks, a maximum application rate of 300 lb/ac (341 kg/ha) was possible at a ground speed of 5.5 mph (9 km/h).

The tanks and metering systems were sealed against moisture entry and no problem was encountered with fertilizer caking. To prevent corrosion, all unprotected components should be cleaned and oiled periodically when applying fertilizer.

EASE OF OPERATION

Hitching: The Great Plains air drill was easily hitched to a tractor. Hitching convenience was increased by the fact that the clevis shaped hitch link was always in the horizontal position. Hitching also required the hook-up of five hydraulic lines with quick couplers and the plumbing in or the quick hookup of one hydraulic return line.

Filling: A drill fill or grain auger was needed to fill the applicator tanks. Because the filler openings were located at 7.1 ft (2.2 m) above ground level, hand filling was impractical as it necessitated carrying the grain and fertilizer up the access l adder. The large 14.0 x 26 in (335 x 660 mm) front and rear tank openings gave ample room for auger filling.

The filler lids were .hinged and were latched by a simple over centre catch. A chain connected from the screen to the lid prevented the lid from opening completely but still allowed for easy filling and closing.

The front tank held 70 bu (2548 L), while the rear tank held 95 bu (3458 L).

Visibility: Visibility of the centre sections of the air drill was obstructed by the tanks. Care had to be observed when operating the Great Plains air drill to detect possible plugging problems in the center sections. It was very difficult to determine if the meters were turning due to the poor visibility of the meters (FIGURE 15) from the tractor cab. An optional monitor system is available but was not supplied with the machine.

FIGURE 11. Opener Assembly.

FIGURE 12. Uniform Wheat Emergence in Summerfallow After 30 Days.

FIGURE 13. Seedbed After Seeding Directly into Stubble.

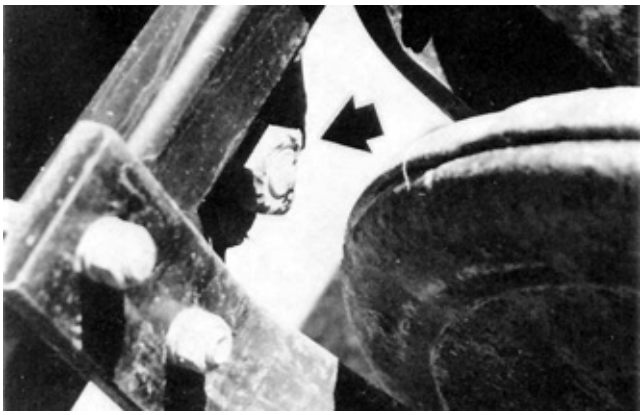

FIGURE 14. Bolt Wear on Gang Pivot Point.

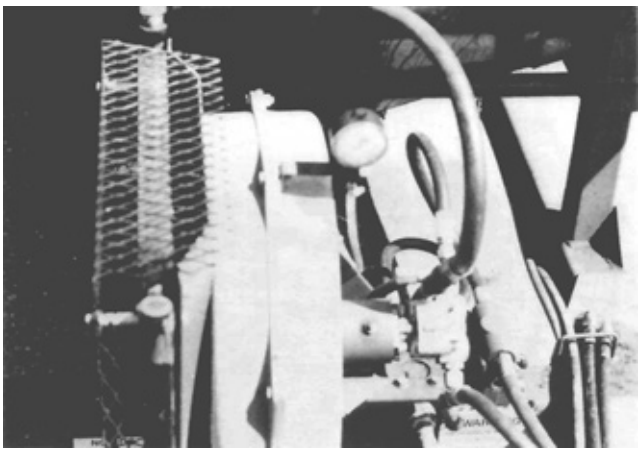

FIGURE 15. Poor Visibility of Meters from Tractor Cab.

Manueverability: With the applicator being connected to the air drill by two cart link pivot arms, the unit was very easy to maneuver while backing up.

M**onitoring:** A metered flow monitoring system is available as optional equipment but was not supplied with the test machine.

Seed and Fertilizer Boots: The occasional seed boot plugged with wet soil while seeding in moist conditions.

Cleaning: It was necessary to empty the tanks to get access to the star-shaped rollers. Complete removal of the meter

took one man approximately half an hour. Each tank was equipped with a cleanout flap which allowed easy cleaning of the tanks (FIGURE 16). Access to the tanks was possible through the tank filler openings by removal of the hopper basket. The basket could be removed without tools.

Area Meter: The Great Plains air drill was equipped with a meter drive shaft revolution counter for area measurement. The meter recorded area to the nearest tenth and was found to be accurate.

Transporting: The Great Plains air drill was easily placed in transport position in less than five minutes (FIGURE 17). Four hydraulic cylinders raised the four wing sections to transport position. The drive chain was disconnected when transporting long distances.

The assembly towed well in transport position. Overall transport height and width were 14.75 ft (4.5 m) and 19.5 ft (5.9 m) respectively, requiring care when travelling on public roads.

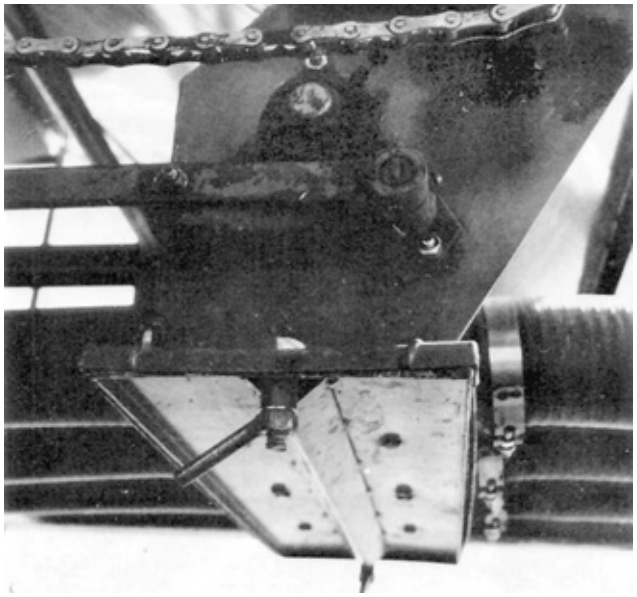

FIGURE 16. Clean Out Flap and Handle.

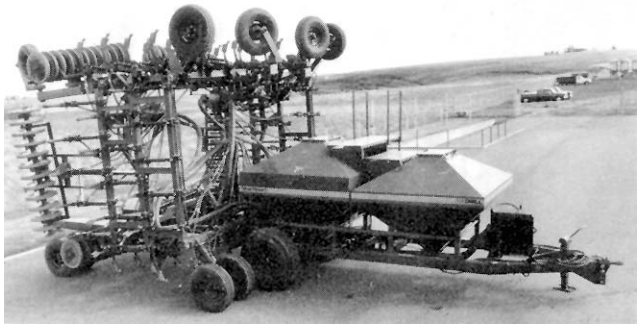

FIGURE 17. Transport Position.

EASE OF ADJUSTMENT

Lubrication: Lubrication of the pivot points joining the six sections together was inconvenient due to poor access to the grease fittings. Eleven grease fittings on the cart and one hundred thirty-three on the air drill took one man approximately one hour to be serviced. The two gear boxes required checking every season. A service schedule was supplied in the operator's manual.

Application Rate: The application rate was changed by turning the hand crank on each meter gear box to the desired setting. This setting determined the speed of the meter. Depending on the application rate, there were two gear combinations available. For the high range, the 54-tooth gear drives the 17-tooth, while the 17-tooth gear drives the 54-tooth gear for low range aplications.

The hand crank scale was calibrated in increments of 5.0 from 0 to 110 (FIGURE 18). Calibration charts, shown in pounds per acre, were shown in the operator's manual along with being located on the large tank.

The metering scale allowed relatively precise seeding rate adjustment. For example, changing the meter setting by 5.0 in Tower canola, changed seeding rate by only 0.40 lb/ac (0.45 kg/ha).

Depth Adjustment: Seeding depth was conveniently adjusted by first setting the front row of openers to the desired depth and then by either raising or lower the packer gangs to adjust the second and third row of openers to the front rows depth. Additional depth adjustment could be done on the openrs separately (FIGURE 11).

The unit was equipped with rephasing type hydraulic lift cylinders and it was necessary to make sure that the implement was completely raised and held in this position for a few seconds to ensure the cylinders had time to rephase. If this is not done periodically, the openers will not penetrate to the same depth from section to section.

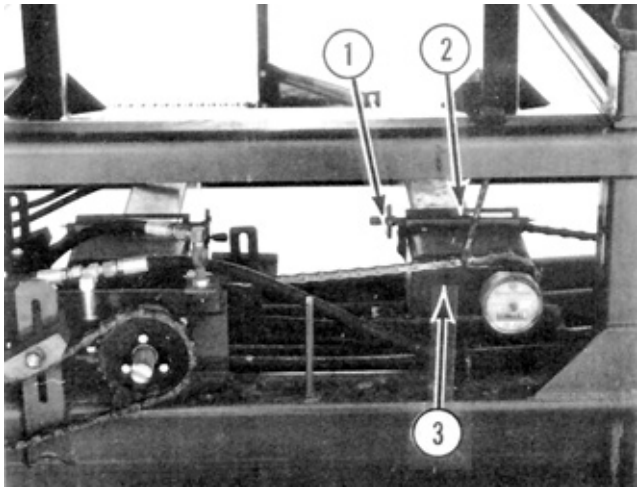

FIGURE 18. Application Rate Adjustment: (1) Hand Crank, (2) Scale, (3) Gear Box.

RATE OF WORK

The Great Plains air drill was operated at speeds ranging from 4 to 6 mph (6.4 to 10 km/h). Overall best performance in terms of seed placement was obtained at speeds of 4.5 to 5.5 mph (7 to 9 km/h). This resulted in field work rates for the 45 ft (13.7 m) unit ranging from 24.5 to 30 ac/hr (9.9 to 12.1 ha/hr). Using both tanks when seeding wheat at a rate of 75 lb/ac (85 kg/ha), about 140 ac (56.7 ha) could be seeded before refilling. Using only the rear tank, about 80 ac (32 ha) could be seeded before refilling. This compares to 50 to 79 ac (20.2 to 32 ha) between refills for most conventional drills of similar widths.

POWER REQUIREMENTS

Draft Characteristics: Attempting to compare draft (drawbar pull) requirements of different tillage units is usually unrealistic. Draft requirements for the same implement, in the same field, may vary by as much as 30 percent in two different years, due to changes in soil conditions. Variations in soil conditions affect draft much more than variation in machine make, usually

making it impossible to measure any significant draft difference betwee makes of implements. Average draft at a normal seeding depth and at 5.5 mph (9 km/h), with fully loaded seed and fertilizer tanks ranged from 8450 lb (37,603 N) to 8950 lb (39,828 N) in silt loam and loam conditions for the 45 ft (13.7 m) air drill.

Tractor Size: Tractor size needed to pull the 45 ft (13.7 m) Great Plains air drill varied from 214 to 227 hp (160 to 170 kw) in silt loam and loam conditions. Tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80 percent of the maximum power tank-off ratings as determined by Nebraska tests or as presented by the tractor manufacturer. Selected tractor sizes given will have ample power reserve to operate in the stated conditions.

OPERATOR SAFETY

The Great Plains access ladder and platform was convenient and safe. A safety handrail was provided at the edge of the platform.

Extreme caution is needed when transporting folding implements to avoid contacting power lines. Minimum power line heights vary in the three prairie provinces. In Saskatchewan the energized line may be as low as 17 ft (5.2 m) over farmland or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 15.7 ft (4.8 m) over farmland. In all three provinces, power lines in farmyards may be as low as 15 ft (4.6 m).

Transport height of the 45 ft (13.7 m) wide test machines was 14.75 ft (4.5 m), permitting safe transport under prairie power lines. The legal responsibility for safe passage under utility lines rests with the machinery operator and not with the power regulations governing maximum permissible equipment heights on various public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The Great Plains air till drill was 19.5 ft (5.9 m) wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates.

A slow moving vehicle sign was not provided on the rear of the air drill for transport. It is recommended that the manufacturer consider supplying a slow moving vehicle sign as standard equipment. Pins were provided to lock the wings in transport position. Gauge wheel locks were supplied to keep the air drill in the raised position for transport.

The Great Plains fan was located at the front of the applicator. The operator noise level in most modern tractor cabs was virtually unaffected by the fan.

OPERATOR'S MANUAL

The operator's manual for the Great Plains air drill contained useful information on safety, assembly, adjustment, specifications, maintenance and operation. A detailed parts list was also included. Calibration charts, calibrated in pounds per acre, were included in the operator's manual. A conversion chart in SI (metric) units was not included. It is recommended that the manufacturer consider supplying meter calibration charts in SI (metric) units.

MECHANICAL HISTORY

TABLE 2 outlines the mechanical history of the Great Plains air drill during 119 hours of operation while processing about 2560 ac (1037 ha). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

Manufacturer's Modifications to Air Drill: A new fan outlet transition coupler (FIGURE 19) was installed at the end of the test. This greatly improved the distribution uniformity pattern in wheat, barley and fertilizer.

TABLE 2. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA ac	(ha)
- jack would not work at and was fixed at	5 end of test		
- right cart wheel hub failed and was replaced at	15, 30	375, 810	(152, 328)
- sprocket drive assembly was repaired at	15, 30	375, 810	(152, 328)
- drive chain was replaced at	15, 30	375, 810	(152, 328)
- spring reset opener was bent and replaced at	45	1215	(492)
- cotter pin on front meter was sheared and replaced at	51	1326	(537)
- acre meter was supplied at	51	1326	(537)
- all hoe tips were replaced at	65	1755	(710)
- five hoses were damaged and replaced at	end of test		
- fan outlet transition coupler was modified at	end of test		

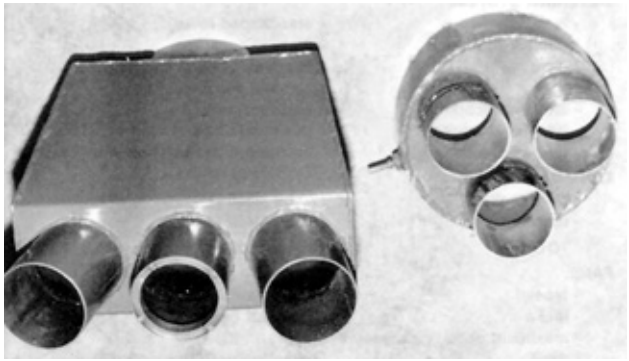

FIGURE 19. (Left) New Transition Coupler, (Right) Old Transition Coupler.

Cart Wheel Hub: The hub on the right side of the cart failed twice during the evaluation (FIGURE 20). After the second failure, a redesigned hub was installed and no further failures occurred.

Bent Opener: The one opener was bent due to contact with large stones in the field. The opener was replaced and no other opener failures occurred.

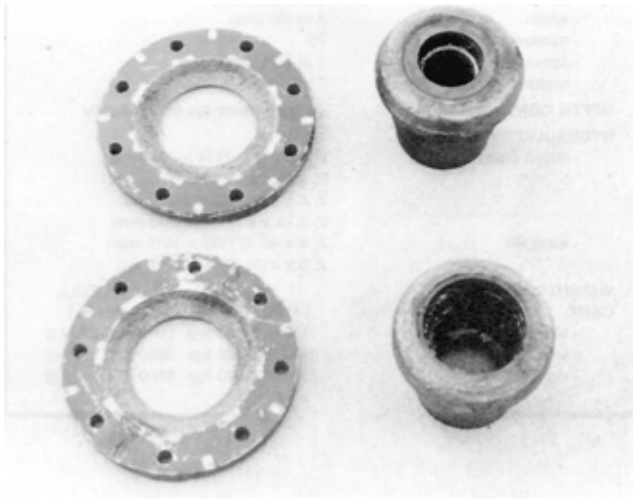

FIGURE 20. Hub Failure.

APPENDIX I

SPECIFICATIONS

(A) AIR TILL DRILL

MAKE:	Great Plains
MODEL:	ADC-0285-71 (Cart)
	345-750785 113261 (Air Drill)
SERIAL NUMBER:	1047 k (Cart)
MANUFACTURER:	Great Plains Manufacturing Inc. P.O. Box 218 Assaria, Kansas 67416

DIMENSIONS:	**FIELD POSITION**	**TRANSPORT POSITION**
- width	45 ft (13.7 m)	19.5 ft (5.8 m)
- length	31.6 ft (9.6 m)	31.6 ft (9.6 m)
- height	10.2 ft (3.0 m)	14.9 ft (4.3 m)
- maximum ground clearance	5.25 in (133 mm)	5.25 in (133 mm)
- wheel tread (Cart)	8.2 ft (2.5 m)	
- effective seeding width	43.75 ft (13.3 m)	

METERING SYSTEM:	
- type	- star-shaped roller
- number of meters	- 2
- drive	- chain off of right cart wheel to variable speed gear box
- airstream loading	- pressurized tank
- transfer to openers	- pneumatic conveyance to spinning disc towers and hoses
TANK CAPACITIES:	
- front tank	70 bu (2548 L)
- rear tank	95 bu (3458 L)
TOTAL	165 bu (6006 L)
FAN:	
- type	centrifugal
- make	Cincinnati Fan
- maximum operating pressure	1 psi (6.9 kPa)
- drive	hydraulic drive from tractor remote
CART HITCH	
- vertical adjustment range	11 in (279 mm) in 6 positions
WHEELS:	
- cart	2, 16.5 - 16.1L, 10 ply
- drill	12, 9.5 - 15.5L, 8 ply
NUMBER OF LUBRICATION POINTS:	144 grease fittings 14 wheel bearings
OPENERS:	
- type	spring reset opener
- point	Acra Plant
- number of runs	75
- run spacing	7 in (178 mm)
- number of rows	3
- distance between rows	28 in (711 mm)
PRESS WHEELS:	
- type	formed steel
- diameter	21 in (533 mm)
- width	2 in (50 mm)
- number	75
- spacing	7 in (178 mm)
- number of gangs	6
DEPTH CONTROL:	gauge wheels set hydraulically
HYDRAULIC CYLINDERS:	
- depth control	2, 4.5 x 8 in (114 x 203 mm) 2, 4.25 x 8 in (108 x 203 mm) 2, 4 x 8 in (102 x 203 mm) 2, 3.75 x 8 in (95 x 203 mm)
- wing lift	2, 4 x 40 in (102 x 1016 mm) 2, 3.5 x 20 (89 x 508 mm)

WEIGHTS: **CART:**	**TANKS EMPTY**	**TANKS FULL OF WHEAT**
- hitch	1150 lb (523 kg)	5000 lb (2270 kg)
- left wheel	2460 lb (1120 kg)	5860 lb (2660 kg)
- right wheel	2300 lb (1040 kg)	5600 lb (2540 kg)

DRILL:	**FIELD POSITION**	**TRANSPORT POSITION**
far left gauge wheel	940 lb (427 kg)	
near left gauge wheel	950 lb (431 kg)	
left center tandem wheels	1700 lb (772 kg)	3890 lb (1770 kg)
right center tandem wheels	1700 lb (772 kg)	3930 lb (1780 kg)
near right gauge wheel	1380 lb (627 kg)	
far right gauge wheel	840 lb (381 kg)	
left lift assist wheel	1780 lb (808 kg)	
left center lift assist wheel	2190 lb (994 kg)	3910 lb (1780 kg)
right center lift assist wheel	2120 lb (962 kg)	3790 lb (1720 kg)
right lift assist wheel	1920 lb (872 kg)	
TOTAL, TANKS EMPTY	21,430 lb (9730 kg	
TOTAL, TANKS FULL OF WHEAT		31,980 lb (14,520 kg)

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

- Excellent
- Very Good
- Good
- Fair
- Poor
- Unsatisfactory

APPENDIX III

CONVERSION TABLE

acres (ac) x 0.40	= hectares (ha)
miles/hour (mph) x 1.61	= kilometres/hour (km/h)
inches (in) x 25.4	= millimetres (mm)
feet (ft) x 0.305	= metres (m)
horsepower (hp) x 0.75	= kilowatts (kW)
pounds (lb) x 0.45	= kilograms (kg)
pounds force (lb) x 4.45	= newtons (N)
bushels (bu) x 36.4	= litres (L)
pounds/acre (lb/ac) x 1.12	= kilograms/hectare (kg/ha)
pounds/bushel (lb/bu) x 1.25	= kilograms/hectolitre (kg/hL)
pounds force/foot (lb/ft) x 0.015	= kilonewtons/metre (kN/m)

SUMMARY CHART
GREAT PLAINS AIR DRILL

RETAIL PRICE:	$79,200 (September, 1986 f.o.b. Lethbridge, Alberta)
QUALITY OF WORK:	
Metering Accuracy	**very good:** between tanks **very good:** wheat, barley and canola, field slope had significant effect on rates **fair:** no charts supplied for different densities of fertilizer
Distribution Uniformity	**good:** wheat, barley and fertilizer **poor:** canola at recommended fan pressures
Penetration	**very good:** secondary field conditions **good:** light primary field conditions
Trash Clearance	**very good**
EASE OF OPERATION:	
Filling	**good:** required use of drill fill or auger
Visibility	**fair:** tank blocked view of main section of air drill
Transportability	**very good:** care was required due to width of unit
EASE OF ADJUSTMENT:	
Application Rate	**good**
Depth Adjustment	**good:** hydraulic cylinders required periodical rephasing
POWER REQUIREMENTS:	227 hp (170 kw) tractor has sufficient reserve for all field conditions and speeds
OPERATOR SAFETY:	safe, if normal precaution observed
OPERATOR'S MANUAL:	**good;** metric (SI) metering charts were not supplied
MECHANICAL HISTORY:	right cart wheel hub failed twice

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