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Evaluation Report 219

Prasco Super Seeder Model 75-55 Pneumatic Applicator

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

PRASCO SUPER SEEDER MODEL 75-55 PNEUMATIC APPLICATOR

MANUFACTURER AND DISTRIBUTOR:

Prasco Super Seeder Ltd.
200 - 280 Smith Street
Winnipeg, Manitoba
R3C 1K2

RETAIL PRICE: (January, 1981, f.o.b. Lethbridge)

(a) Prasco Super Seeder Model 75-55 pneumatic applicator complete with seed boots and distribution system to feed 35 shanks, with closed centre hydraulic fan drive $20,864.00
(b) John Deere 1610 10.7 m (35 ft) heavy duty cultivator complete with attached harrows $16,300.00
(c) Prasco spiral packers complete with mounting arms and brackets -- six, 1.6 m (5 ft) sections $3,200.00
(d) Hitch for John Deere 1610 heavy duty cultivator $1,268.00

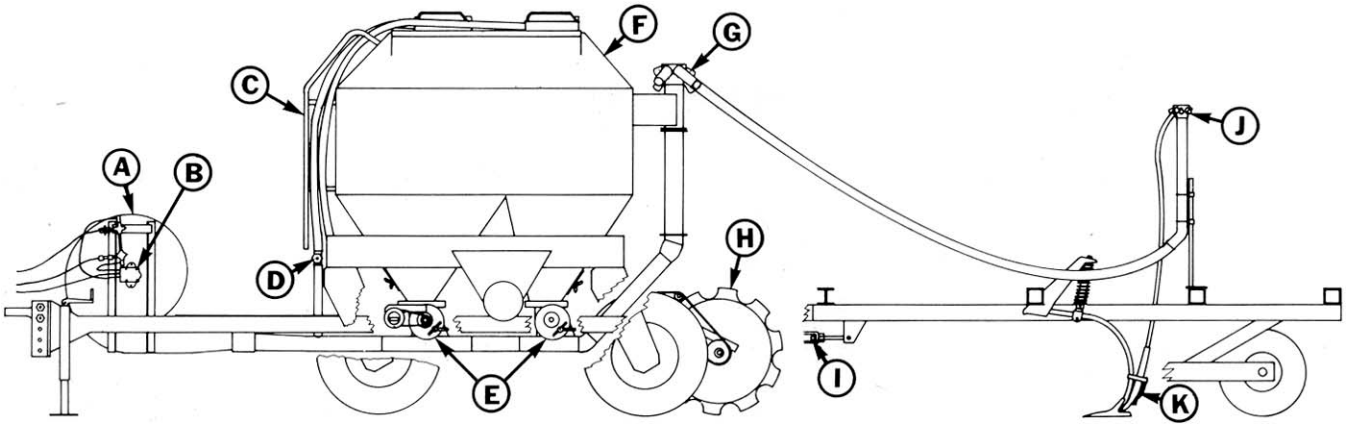

FIGURE 1. Prasco 75-55 Pneumatic Applicator: (A) Fan, (B) Fan Drive, (C) Ladder, (D) Tank Pressure Valves, (E) Metering System, (F) Tanks, (G) Primary Header, (H) Meter Drive Wheel, (I) Hitch Adjustment Turnbuckle, (J) Secondary Header, (K) Seed Boot.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Prasco 75-55 pneumatic applicator was good in all seeding conditions. Performance was good when banding fertilizer. When operated with the 10.7 m (35 ft) John Deere 1610 heavy duty cultivator, the Prasco 75-55 was suitable for seeding both in primary and secondary field conditions. The Prasco was also suitable for banding fertilizer at application rates up to 280 kg/ha (250 lb/ac).

Seed placement was good in most conditions. Variation in seed depth was slightly higher than with a conventional hoe drill when measured in the same fields under the same seeding conditions. The 60 to 90 mm (2.5 to 3.5 in) seed band width behind each seed boot was wide enough to provide stubble support for windrows, providing light crops were not laid parallel to seeding rows. Maintaining good cultivator frame levelling and ensuring a seed depth of at least 50 mm (2 in) were critical in ensuring good emergence.

The manufacturer's metering system calibrations were fairly accurate in wheat, oats, rapeseed and fertilizer. No calibration was provided for barley. The Prasco 75-55 gave acceptable uniform seed distribution across the seeding width in wheat, barley and oats at normal application rates. Distribution in rapeseed and fertilizer was unacceptable at all application rates. To accommodate the 35 outlet requirement of the 10.7 m (35 ft) John Deere 1610 heavy duty cultivator, five of the available 40 ports on the secondary distribution headers were blocked. Significant improvements in distribution occurred when all 40 secondary header ports were used.

Level of material in the tanks, field bounce and ground speed variation had litte effect on metering rates. A field sideslope of 15 degrees resulted in a 7% decrease in seeding rate and a 4% decrease in the fertilizer rate. Seeding down a 15 degree slope caused a 10% decrease in seeding rate and a 7% decrease in fertilizing rates. Seeding up a hill had little effect on the metering rates. Distribution uniformity was only slightly affected by field slopes.

Seeding rate was easily adjusted. Tank and meter cleanout was inconvenient. Tank filling required the use of a drill fill or auger. Thirty-two grease firings on the applicator required greasing.

The Prasco 75-55 and packers, with John Deere 1610 heavy duty cultivator, could be placed in transport position in less than five minutes.

Rate of work usually ranged from 8.6 to 10.7 ha/hr (21 to 27 ac/hr). About 40 ha (100 ac) could be seeded before refilling both tanks when seeding wheat at a normal seeding rate.

Tractor size depended on soil conditions, seeding depth, cultivator width and soil finishing attachments. In light primary tillage, at a 75 mm (3 in) depth and 8 km/h (5 mph), a 132 kW (175 hp) tractor was needed to operate the applicator-cultivator-packer combination. In heavy primary tillage, at the same depth and speed, a 152 kW (200 hp) tractor was needed.

The centre frame cultivator tires were overloaded in transport when equipped with Prasco mounted packers. Care had to be exercised when using the tank access ladder.

The operator's manual contained useful information on safety, adjustment, maintenance and operation.

A number of minor mechanical problems occurred during evaluation.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying calibration information for badey.
2. Modifying the metering system to improve metering characteristics with rapeseed.
3. Supplying secondary headers with correct outlet numbers to suit various cultivator widths without having to block secondary header ports.
4. Providing a material flow monitoring system as optional equipment.
5. Supplying meter calibrations and land area measurement in SI units.
6. Specifying lubrication service intervals for all fittings in the operator's manual.
7. Improving the upper access ladder area for increased safety.
8. Improving durability of both seed and fertilizer shank boots,

Chief Engineer: E. O. Nyborg
Senior Engineer: E. H. Wiens
Project Engineer: R. K. Allam

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A calibratiqn chart for barley is under consideration and will be made available.
2. It is recommended that the fan speed not exceed 3000 rpm when seeding rapeseed. A rapeseed calibration chart with the modified seed cup deflector plate is under consideration.
3. Secondary headers with the correct number of outlets to match the number of openings needed for various cultivator widths are being considered.
4. A monitoring system is now available as an option.
5. Supplying meters in SI units of measurement is under consideration.
6. Lubrication intervals for all grease fittings will be included in the operator's manual when it is updated.
7. The upper portion of the ladder design is under consideration.
8. It is recommended that the fertilizer boots be positioned just below the top bott in most soil conditions and that they be adjusted as the spikes wear. A soil deflector to prevent the boot from making direct contact with the soil is being considered.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX III.

GENERAL DESCRIPTION

The Prasco Super Seeder Model 75-55 is a pneumatic seed and fertilizer applicator designed for use with varying makes and models of light, medium and heavy duty cultivators. For optimum depth control the manufacturer recommends that a cultivator with tandem walking beam axles be used with the Prasco Super Seeder.

The cultivator is attached to the rear of the applicator by substituting the Prasco supplied hitch members for the regular cultivator hitch. The Prasco hitch enables hook-up of the cultivator to the applicator by insertion of three pins. The applicator is supported by four castor wheels mounted on tandem walking beam axles.

Seed and fertilizer are pneumatically distributed from two tanks, through a network of tubes to seed boots attached to the rear of each cultivator shank. The applicator can be used for seeding, for combined seed and fertilizer application, and for fertilizer banding.

Seed and fertilizer are metered through two adjustable fluted rolls mounted below the tanks, while a hydraulically powered fan forces the metered material through the distribution system. The tanks are pressurized for positive metering of material. The distribution system consists of a six-port primary header mounted on the applicator, feeding four, 10-port secondary headers mounted on the cultivator. Tubes from the secondary headers connect to the seed boots. Fan speed is indicated by an electronic monitor.

The test machine was used with a John Deere 1610 heavy duty cultivator. This cultivator was 10.7 m (35 ft) wide with a 4.0 m (13.1 ft) centre frame and two 3.3 m (10.8 ft) wing sections. It was equipped with 35 spring cushioned shanks, spaced at 305 mm (12 in), arranged in three rows. To accommodate the 35 shanks, two of the six primary header ports were blocked. In addition, three of the secondary headers each had one port blocked, while the fourth secondary header had two pods blocked. The cultivator was equipped with six sections of Prasco frame mounted spiral packers. A tractor with four remote hydraulic controls was required to operate the Prasco 75-55 with the John Deere 1610 cultivator.

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

SCOPE OF TEST

The Prasco 75-55 was operated in loam and light loam soils in the field conditions shown in TABLE 1 for 160 hours while processing about 870 ha (2150 ac). It was evaluated for quality and rate of work, ease of operation and adjustment, power requirements, safety and suitability of the operator's manual.

TABLE 1. Operating Conditions.

CROP	FIELD TILLAGE CONDITIONS	STONE CONDITIONS	FIELD AREA (ha)	HOURS
Barley on stubble	Secondary	Occasional stones to very stony	380	70
Barley on stubble	Primary	Stone free	50	9
Spring wheat on sod	Secondary	Occasional stones	45	8
Rapeseed on summerfallow	Primary	Stone free	5	1
Winter wheat on summerfallow	Secondary	Occasional stones	20	4
Winter wheat on stubble	Primary	Occasional stones	110	21
Fall rye on summerfallow	Secondary	Occasional stones	110	22
Banding fertilizer	Primary	Occasional stones	150	25
TOTAL			870	160

RESULTS AND DISCUSSION

QUALITY OF WORK

Metering Accuracy: The grain and fertilizer metering system was calibrated in the laboratory[1] 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 indicated in the manufacturer's charts. Research has, however, shown that small variations in seeding rates will not significantly affect grain crop yields.

The original meters supplied by the manufacturer contained plastic fluted feed rolls. Due to excessive wearing of the plastic feed rolls when metering fertilizer, the manufacturer provided stainless steel feed rolls in a changeover kit. Since calibration with the two types of feed rolls differed, all calibration information presented is with the new stainless steel fluted feed rolls.

The recommended fan speed ranged from 3500 to 4250 rpm. Tests, using cereal grains, indicated that fan speed within this range has little effect on calibration providing tank pressure was adjusted according to the operator's manual procedure. The PAMI calibration curves for wheat, barley and oats given in FIGURES 2 to 4 were obtained at a fan speed of 3500 rpm. At a seeding rate of 80 kg/ha (70 lb/ac), actual rates were about 7 to 16% higher than indicated in wheat and from 25 to 40% higher than indicated in oats. No manufacturer's calibration curves were supplied for barley. It is recommended that the manufacturer provide a calibration for barley.

A low range sprocket drive for metering small seeds such as rapeseed was available for the front tank only. Varying the meter adjustment by 0.5 on the indicator scale, changed rapeseed application rate by 5.4 kg/ha (4.8 lb/ac). For the low rates commonly required with rapeseed, these large scale increments created difficulty in obtaining precise application rates.

The calibration with rapeseed was very dependent on fan speed. For example, at a meter setting of 2, when operating the fan at the recommended 4250 rpm, no rapeseed was metered due to inadequate air pressure within the tank. Further reductions in fan speed to 3500 and 2500 rpm resulted in application rates of 4.8 and 11.6 kg/ha (4.3 and 10.3 lb/ac), respectively. A manufacturer's modification to the seed cup deflector plate reduced the variability of metering rates With fan speed. For example, at a setting of 2, the application rates were 6.0 and 8.4 kg/ha (5.3 and 7.5 lb/ac) at 4250 and 2500 rpm, respectively.

The rapeseed calibration curve (FIGURE 5), with the modified seed cup deflector plate, was obtained at a fan speed of 2500 rpm. This fan speed was used since fan speeds much in excess of 2500 rpm, resulted in excessive rapeseed crackin'g. No manufacturer's calibration was available with the modified seed cup deflector plate.

Fan speed was easily varied with the hydraulically driven fan supplied with the test machine. However, reducing fan speed to

[1]PAMI T773, "Detailed Test Procedures for Grain Drills".

2500 rpm to minimize rapeseed damage with power take-off driven models would seriously limit operation since tractor engine speed would have to be reduced accordingly.

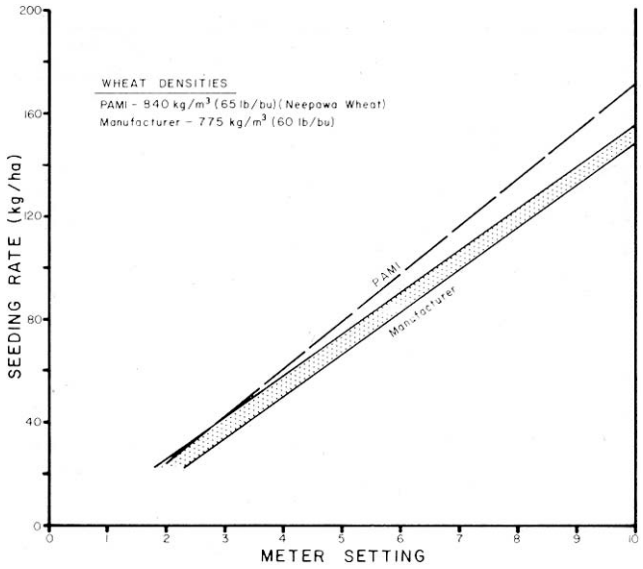

FIGURE 2. Metering Accuracy in Wheat at a Fan Speed of 3500 rpm.

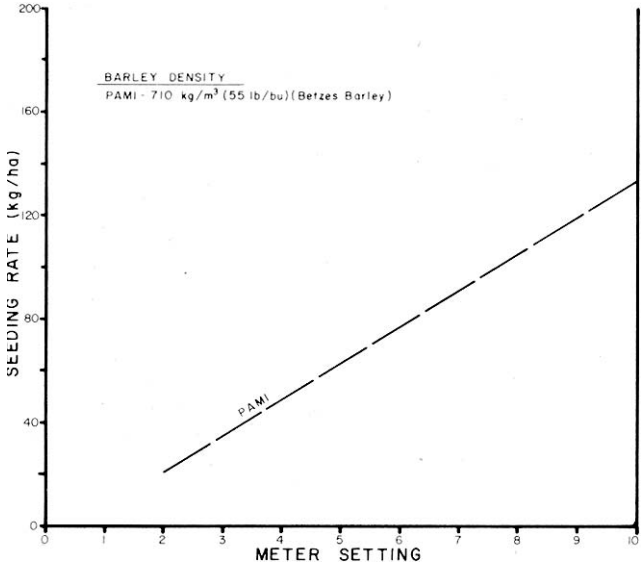

FIGURE 3. Metering Accuracy in Barley at a Fan Speed of 3500 rpm.

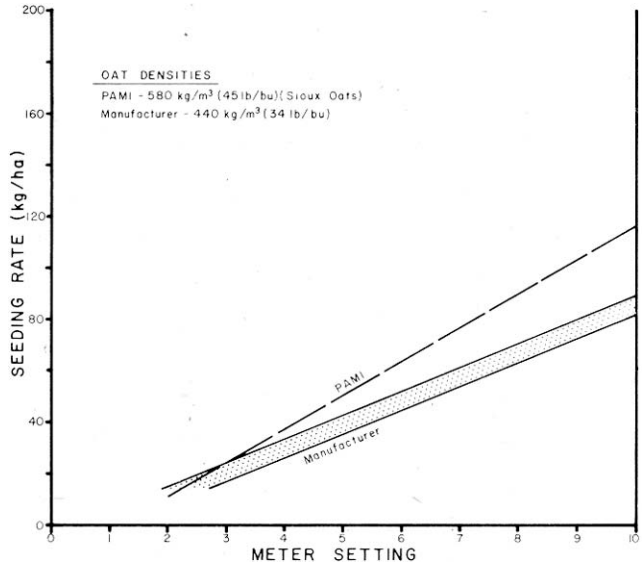

FIGURE 4. Metering Accuracy in Oats at a Fan Speed of 3500 rpm.

As is shown in FIGURE 6, metering of fertilizer was accurate throughout the full range of application rates.

Level of grain or fertilizer in the tanks, forward speed and field roughness had little effect on application rate. Seeding on sideslopes caused the application rate to decrease by 2 and 7% on 10 and 15 degree sideslopes, respectively. Seeding up a hill had little effect on application rate. However, seeding down a 10 degree hill decreased the application rate by 5% while seeding down a 15 degree hill decreased the application rate by 10%. A 15 degree sideslope reduced 11-51-00 fertilizer application rate by 4%, while travelling down a 15 degree hill reduced 11-51-00 application rate by 7%. No meter ground drive wheel slippage occurred in soft fields.

It is recommended that the manufacturer consider modifications to the metering system to improve metering characteristics with rapeseed.

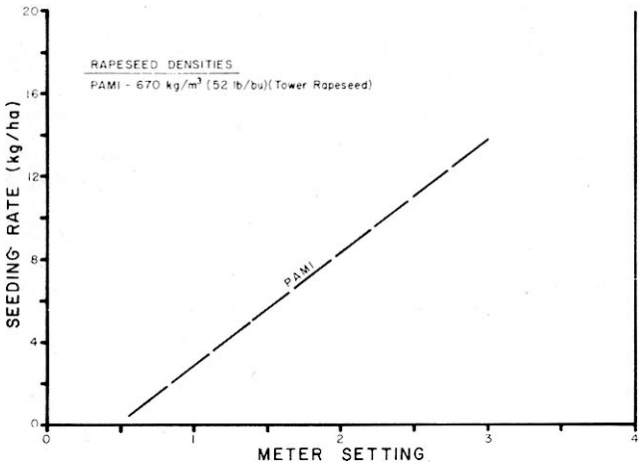

FIGURE 5. Metering Accuracy in Rapeseed at a Fan Speed of 2500 rpm.

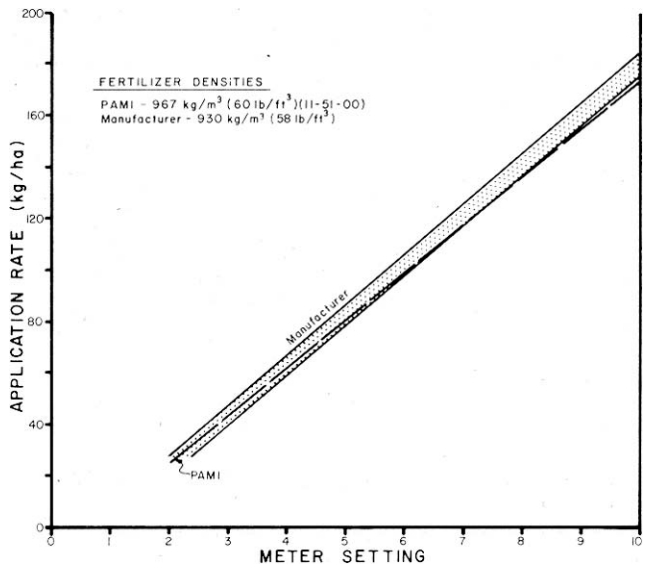

FIGURE 6. Metering Accuracy in Fertilizer at a Fan Speed of 3500 rpm.

Distribution Uniformity: The pneumatic distribution system distributed cereal grain uniformly from the metering system to the individual shank boots. FIGURE 7 gives seeding distribution uniformity for the Prasco 75-55 in wheat, barley and oats. Distribution was uniform over the full range of seeding rates. For example, at a seeding rate of 80 kg/ha (70 lb/ac) the coefficient of variation[2] (CV) was 10.3% in wheat, 12.4% in barley, and 11.0% in oats. Changes in distribution pattern uniformity could occur at different forward speeds or for different machine widths due to different volumes of seed being introduced into the constant volume of air supplied by the fan. Seeding or fertilizing up or down a 15 degree slope or on a 15 degree sideslope decreased distribution uniformity (CV) by up to 4%.

[2]The coefficient of variation (CV) is the standard deviation of seeding rates from individual shanks expressed as a per cent 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.

The Prasco primary header had six ports while the four secondary headers each had 10 ports. To accommodate the 35 shanks on the 10.7 m (35 ft) John Deere 1610, two of the primary header ports were blocked. Also, one port on each of three secondary headers were blocked while a fourth secondary header had two ports blocked.

Blocking the two primary header ports opposite each other did not greatly decrease overall distribution uniformity since it resulted in a symmetrical pattern with each open port being adjacent to a blocked port. Blocking the secondary header ports, however, significantly reduced distribution uniformity. FIGURE 6 shows distribution uniformity in Tower rapeseed when all 10 ports were used on each secondary header, as would be the case with a 40 shank cultivator, and when five of the secondary header ports were blocked, as was done with the 35 shank test machine. With the five ports blocked, the distribution was non-uniform and the CV varied from 17.5 to 19.2%. When all secondary header ports were used, application was uniform with the CV varying from 8.5 to 9.5%.

Similarly, the distribution uniformity in 11-51-00 fertilizer (FIGURE 9) with five of the secondary header ports blocked, resulted in a CV varying from 18.3 to 26.3%. When using all secondary ports, the CV varied from 10 to 15%.

It is recommended that the manufacturer consider supplying secondary headers with the correct number of ports to suit varying widths of cultivators, eliminating the need for blocking unused ports.

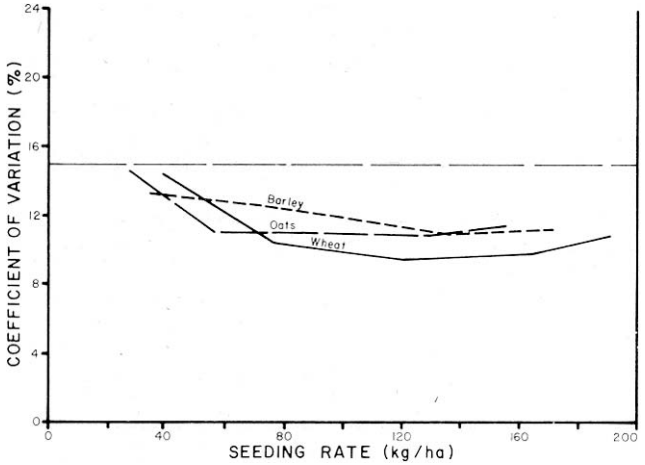

FIGURE 7. Seeding Uniformity in Cereal Grains at 10 km/h (Five Secondary Header Outlets Blocked).

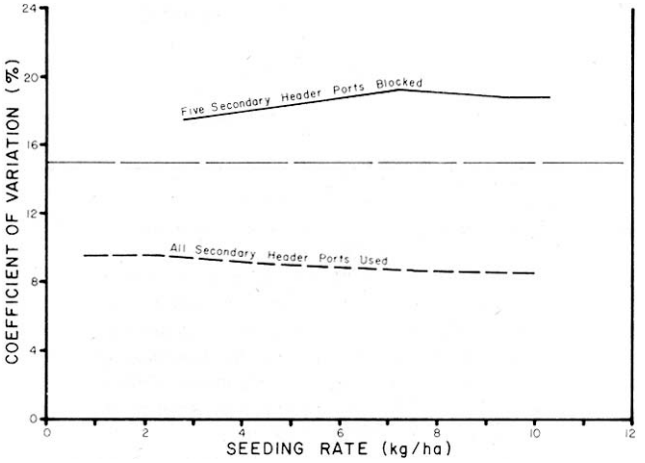

FIGURE 8. Distribution Uniformity in Tower Rapeseed at 10 km/h.

Grain Damage: Grain damage by the metering and distribution system was well within acceptable limits for cereal grains at fan speeds below 3500 rpm. For example, in dry Neepawa wheat at 10.5% moisture content and a fan speed of 3500 rpm, only 0.2% crackage occurred. Wheat crackage at the same moisture content increased to 5% at a fan speed of 4250 rpm. In dry rapeseed with a moisture content of 6%, crackage at a fan speed of 4250 rpm was 34%. Reducing the fan speed to 3000 rpm reduced rapeseed crackage to 0.5% and at 2500 rpm no cracking occurred. Due to excessive grain damage at 4250 rpm, it is suggested that maximum fan speeds of 3500 and 3000 rpm be recommended for cereal grains and rapeseed, respectively.

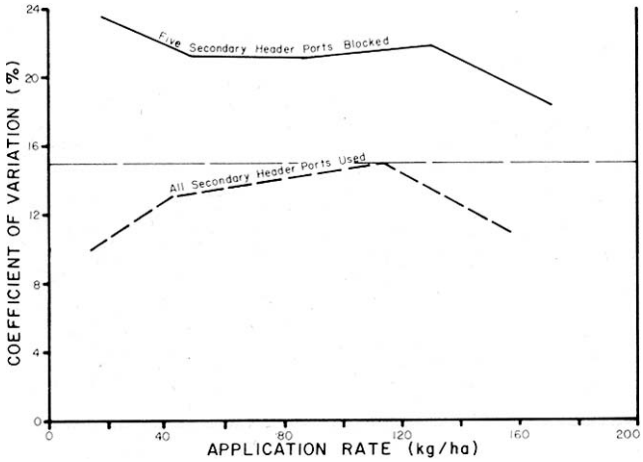

FIGURE 9. Distribution Uniformity in 11-51-00 Fertilizer at 10 km/h.

Seed Placement: The Prasco seed boot (FIGURE 10) provided limited spreading behind the cultivator sweep. Plants emerged in relatively distinct rows in band widths ranging from 60 to 90 mm (2.5 to 3.5 in) (FIGURE 11). With the 305 mm (12 in) cultivator shank spacing, distances between rows varied from 215 to 240 mm (8.5 to 9.5 in). This row spacing was found to provide adequate windrow support providing light crops were laid across the rows rather than parallel to them (FIGURE 11).

On level and gently rolling fields, vertical seed distribution resulted in most of the seeds being placed within 22 mm (0.9 in) of the working depth of the bottom of the cultivator sweeps. This compares to a vertical variation of from 12 to 15 mm (0.45 to 0.6 in) for a hoe drill in similar conditions. In fields with sharp hill crests or gullies, seed depth variation became much greater than for a hoe drill, due to the greater distances between shank rows on a heavy duty cultivator than on a hoe drill.

Vertical seed distribution was not adversely affected by field tillage conditions. The shanks on the John Deere 1610 cultivator were sufficiently rigid to maintain a fairly uniform sweep pitch (FIGURE 14), with resultant uniform tillage depth, over a wide range of soil conditions.

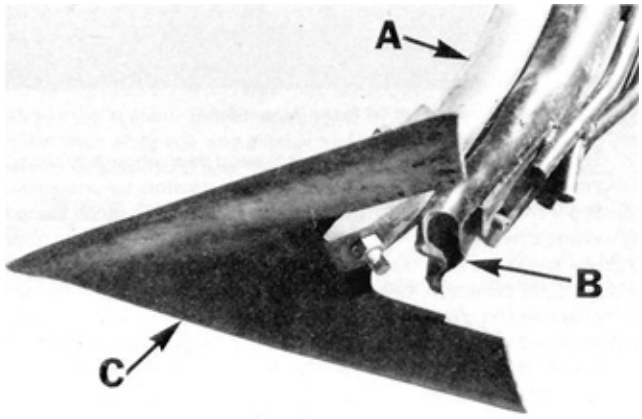

FIGURE 10. Prasco Seed Boot: (A) Shank, (B) Seed Boot (C) Sweep.

Plant Emergence: As with most seeding implements, time and uniformity of plant emergence depended on seedbed preparation, soil moisture and seed placement. The Prasco was used to seed in a number of fields with different types of seedbed preparation. In all instances, uniform emergence resulted as long as the seed was placed in moist soil and the soil was packed after seeding. FIGURE 11 shows good barley emergence when barley was seeded into a pre-worked stubble field.

Careful cultivator frame levelling was important in obtaining uniform emergence across the cultivator width. Due to the rigidity of

heavy duty cultivator frames, improper sideways levelling and fore-and-aft levelling can both result in shanks operating at different depths. FIGURE 12 shows how improper cultivator fore-and-aft levelling caused uneven fall rye emergence. Seeds placed by the front shanks were placed deeper than those by the rear shanks. This resulted in later emergence of the seeds placed by the front shanks.

FIGURE 11. Barley Emergence on Stubble (Upper: 20 Days after Seeding, Lower: at Harvest).

FIGURE 12. Uneven Emergence in Fall Rye on Summerfallow.

Seeding Depth: It is very important to seed deep enough to obtain uniform seed coverage. Correct cultivator adjustments for pneumatic seeding were best obtained by comparing the depth of seeds placed by several shanks across the cultivator width and from both the front and rear shank rows. This permitted accurate frame levelling to obtain uniform seed coverage. Seeding shallower than 50 mm (2 in) is not recommended for a heavy duty cultivator, due to poor seed coverage and generally poor cultivator performance at shallow tillage depths.

Frame levelling had to be checked and appropriate depth adjustments made when changing fields to ensure adequate, uniform seed coverage. The Prasco cultivator hitch was equipped with a threaded turnbuckle for cultivator hitch height adjustment. Due to the relatively short Prasco hitch, the cultivator followed the land contours very well.

Soil Finishing: Evaluations were conducted with both John Deere optional three-row mounted harrows and with Prasco optional frame mounted spiral packers. The John Deere harrows were effective in smoothing the soil surface and in breaking soil lumps when adjusted for maximum ground pressure. The harrows also increased weed kill by loosening weeds. The Prasco packers, when substituted for the mounted harrows, were effective in compacting the soil and levelling the surface, leaving packer ridges from 25 to 35 mm (1.0 to 1.4 in). FIGURE 13 shows a typical seedbed after seeding into summerfallow. The single row of spring tine harrows located in front of the packer coil were less effective than the three-row mounted harrows. The harrows were adjustable for height and tine angle. Packer ground pressure could be increased by about 10% by adjusting for maximum force on the spring linkage.

FIGURE 13. Typical Seedbed after First Operation Seeding in Summerfallow.

Shank Characteristics: The John Deere 1610 cultivator was equipped with adjustable spring cushioned shank holders. During the evaluation, it was used with 406 mm (16 in) wide Edwards sweeps with a 50 degree stem angle, giving a no-load sweep pitch of 2 degrees. These shanks were very suitable for seeding since sweep pitch (FIGURE 14) varied only 3 degrees over the full range of draft normally expected for a heavy duty cultivator. This resulted in uniform tillage depth and a smooth furrow bottom over a wide range of soil conditions.

Cushioning spring preload, with new shanks, was exceeded at drafts greater than 7.3 kN/m (500 lb/ft), occurring just beyond the normal draft range, indicating the John Deere 1610 was suited for heavy primary tillage.

The shanks performed well in stony fields; one shank holder required welding throughout the evaluation period. Maximum lift height to clear obstructions was 210 mm (8.3 in).

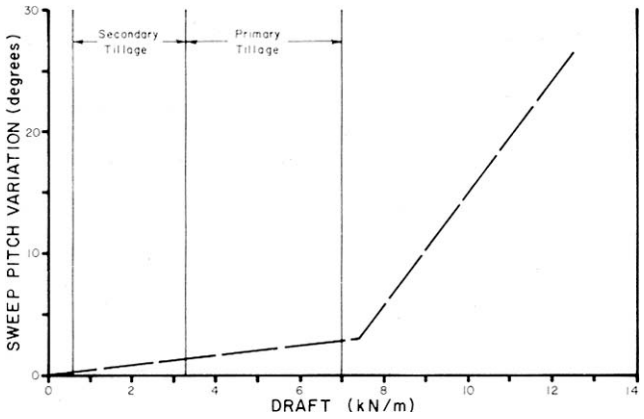

FIGURE 14. Sweep Pitch Variation over a Normal Range of Draft (305 mm Shank Spacing).

Penetration: When equipped with 50 degree, 406 mm (16 in) sweeps, penetration was good in nearly all field conditions and it was easy to obtain correct seeding depth. Correct seeding depth could not be obtained in hard conditions such as dry, baked slough bottoms or in fields with abnormally hard furrow bottoms. Penetration was uniform across the cultivator width provided all depth control linkages and hitch height were kept properly adjusted.

The cultivator wheels were positioned so that each centre wheel supported about 16% of the total cultivator weight while each wing wheel supported about 9%. In addition, each center wheel supported about 13% of the total suction force while each wing wheel supported about 12%. Cultivator or pneumatic seeder sinking was not a problem in moderately soft soils. Since the pneumatic seeder was not supported by the cultivator wheels, but was carried on its own wheels, it did not contribute to cultivator sinking in soft soils.

Trash Clearance: The John Deere 1610 cultivator had excellent trash clearance. The John Deere mounted harrows or the Prasco

single row packer harrows had to be raised to clear heavy loose trash.

With the harrows properly adjusted it was possible to operate in fields with a heavier trash cover than was possible with a conventional hoe drill.

Skewing and Stability: The John Deere 1610 cultivator, equipped with the Prasco 75-55 applicator, was very stable and sideways skewing occurred only in very hilly conditions. The cultivator shank pattern was symmetrical and did not impose any side forces on the cultivator during normal tillage. When equipped with 406 mm (16 in) sweeps the cultivator had to skew more than 3 degrees to miss weeds. Throughout the evaluation period, skewing was never serious enough to cause weeds to be missed.

Weed Kill: Weed kill was very good when equipped with 406 mm (16 in) sweeps. The 305 mm (12 in) shank spacing resulted in 100 mm (4 in) sweep overlap. Considerab!e sweep wear could occur before weeds were missed. When sweeps wore to about 330 mm (13 in), larger weeds could work their way between the sweeps and be missed.

Fertilizer Banding: The Prasco 75-55 could be used for two types of fertilizer applications. It could be used for normal fertilizer application at seeding time by metering fertilizer from one tank and grain from the other and applying both through the same seed boots. When equipped with chisel points, and alternate banding boots (FIGURE 15), it could also be used for fertilizer banding.

Banding is a relatively new method of fertilizer application on the Prairies. Experimental results suggest that placing fertilizer in compact bands, from 35 mm (1.5 in) below seed depth to twice seeding depth is desireable for fall fertilizer application. This requires the use of chisel points to obtain sufficient depth and minimize soil disturbance and special boots to minimize fertilizer spreading. The Prasco 75-55 worked well for fertilizer banding. Fertilizer granules were placed in a band about 25 mm (1 in) wide. Vertical fertilizer distribution generally ranged from chisel tip depth to 13 mm (0.5 in) above chisel tip depth.

The fan did not provide adequate air to allow both meters to be fully opened while distributing 11-51-00 fertilizer. When using both tanks, the air supply, at a maximum fan speed of 4250 rpm, was adequate to apply 280 kg/ha (250 lb/ac) with the 10.7 m (35 ft) cultivator at 10 km/h (6 mph). When using a single tank, fertilizer application rates up to 175 kg/ha (155 lb/ac) were possible with the Prasco 75-55. Fertilizer banding rates in excess of 260 kg/ha (250 lb/ac) are commonly recommended.

The meters and fluted metering rolls were made of stainless steel for corrosion protection. The metering system should be checked after rainfall for any caking of fertilizer as this will cause errors in application rates. When applying fertilizer, all unprotected metal surfaces such as the meter adjustment threads should be cleaned and oiled periodically to prevent corrosion.

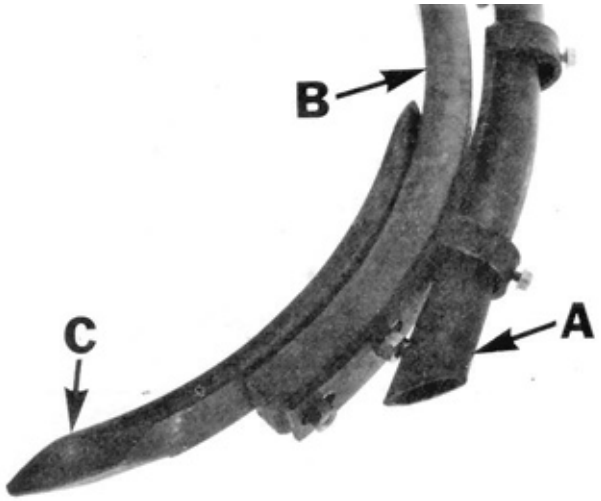

FIGURE 15. Prasco Fertilizer Banding Boot: (A) Banding Boot, (B) Cultivator Shank, (C) Chisel Point.

EASE OF OPERATION

Dual Purpose Operation: The Prasco 75-55 could be detached from the John Deere cultivator by two men in about four hours. The procedure included the removal of the Prasco cultivator hitch assembly, removal of the secondary header stands and hoses from the cultivator, shortening the cultivator hydraulic hoses and installation of the original cultivator hitch. This allowed the cultivator to be used as a dual purpose machine, both for seeding and seasonal tillage.

Hitching: The Prasco 75-55 applicator was easily hitched to a tractor. Hitching convenience was increased by the fact that the hitch link remained horizontal when unhitched from the tractor. Hitching also required hook-up of eight hydraulic lines with quick couplers and an electrical connector for the fan speed monitor. A tractor with four remote hydraulic outlets was required to operate the hydraulically driven fan, depth and transport cylinders and meter drive wheel lift cylinder.

Packers: Attaching the Prasco packers on the John Deere 1610 heavy duty cultivator required removal of the John Deere mounted harrows. It was also necessary to relocate two mainframe shank holders about 25 mm (1 in) outwards along the cultivator frame to eliminate interference between the shank holders and packer attaching arms. Both height and tine angle were adjustable on the single row of spring tine harrows supplied with the Prasco packers. Changing the harrow height was inconvenient and required wrenches. Packer ground pressure could be altered slightly by adjusting, the compression springs.

Filling: A drill fill or grain auger was needed to fill the applicator tanks. Because the filler openings were located 2.4 m (8 ft) above the ground, hand filling was difficult as it necessitated carrying the grain or fertilizer up the access ladder. To reduce spilling when filling with an auger, the relatively small 240 mm (9.5 in) diameter openings required the use of a directional spout. The filler lids were hinged and were latched by a simple hinged friction lock. The lids were equipped with a rubber gasket for an airtight and moisture tight seal.

The front tank held 2605 L (74 bu) while the rear tank held 1905 L (54 bu).

Visibility: Visibility of the cultivator mainframe section was obstructed by the applicator. Care had to be observed when operating with the applicator to detect possible problems such as mainframe plugging.

Monitoring: The test machine was equipped with an electronic fan speed monitor, allowing the operator to monitor fan speed from the tractor cab. It was necessary to dismount from the tractor to adjust the speed of the hydraulically powered fan with the flow control valve located on the fan housing.

The Prasco 75-55 was not equipped with a material flow monitoring system. Because plugging of the distribution system or meter drive stoppage was difficult to detect from the tractor seat, it is recommended that a flow monitoring system be made available.

Cleaning: Access to the meter flutes required emptying of the tanks. Each tank was equipped with a cleanout door. However, the reduced clearance due to the location of the main distribution tube directly below the cleanout doors made collection of material difficult. It was more convenient to empty the tanks directly onto the ground. As the cleanout door was located about 125 mm (5 in) above the meters, a vacuum cleaner was needed for thorough cleaning of both tanks. Access into the tanks was possible by removal of the tank filler cover assembly.

Area Meter: The Prasco 75-55 was equipped with an area meter, calibrated in acres. The area meter was accurate and recorded the nearest tenth acre up to one million acres. It is recommended that the area meter be calibrated in SI units.

Transporting: A distinct advantage of cultivator mounted pneumatic seeders over conventional drills, is the ease with which relatively wide machines can be transported. The Prasco applicator and packers with John Deere cultivator were easily placed in transport position (FIGURE 16) in less than five minutes. Dual hydraulic cylinders raised the cultivator wings to the upright position. The packers were conveniently transported since they were directly mounted to the cultivator frame. The meter drive wheel was

conveniently raised and lowered hydraulically from the tractor seat.

The assembly towed well in transport position when applicator tanks were partially filled. With tanks empty, the applicator castors would shimmy, making the unit unstable to tow at speeds greater than 16 km/h (10 mph).

Overall transport width was 6.2 m (20.3 ft), requiring care when travelling on public roads.

FIGURE 16. Transport Position.

EASE OF ADJUSTMENT

Lubrication: Lubrication was convenient with good access to all grease fittings. Thirty-two fittings on the applicator, seven on the cultivator and four on each packer section required servicing. Four wheels on the applicator and eight on the cultivator required servicing. A servicing schedule was provided for only eight of the 32 fittings on the applicator. It is recommended that service intervals for all fittings be specified in the operator's manual.

Hydraulic Fan Drive: Fan speed was adjusted by operating a flow control valve located on the fan housing. This adjustment could not be made from the tractor seat.

Optional hydraulic kits were available to suit the requirements of hydraulic systems on various makes and models of tractors. Kits were available to suit tractors with either open or closed hydraulic systems. Oil coolers and proportionators were also available for tractors requiring these options.

Tank Pressure: Tank pressure was adjusted by means of a valve for each tank located behind the access ladder. Proper tank pressure was established with the meter drive stationary and by opening valves as fully as possible, without material being blown into the distribution system. Changing meter settings or fan speeds required readjustment of tank pressure.

Application Rate: Application rate was easily changed by a threaded adjusting screw on each meter (FIGURE 17). The meter scale was adjustable from 0 to 10 in increments of 0.5. Calibration charts included in the operator's manual showed application rates for each scale reading, in pounds per acre. A low range setting with alternate sprockets, available for the front tank only, was used for metering fine seeds such as rapeseed.

Adjusting for precise seeding rates was difficult due to the relatively large scale divisions. For example, in Tower rapeseed, each 0.5 scale increment changed the seeding rate by 5.4 kg/ha (4.8 lb/ac).

ALen Digney tube for checking metering rates was supplied with the Prasco 75-55. At normal cereal grain seeding rates, the Len Digney tube was accurate to within 10% if samples from several seed boots were averaged.

Depth Adjustment: Seeding depth was conveniently adjusted with dual mainframe cylinders connected in series to a cylinder on each wing in a master-slave arrangement. All four tandem wheel sets were on walking beam axles, a feature which was considered desireable for keeping the frame level in the fore and aft direction. An adjustable sleeve on one of the dual mainframe depth cylinders could be used to set maximum depth. A wrench was needed to position the depth stop. As is common with series hydraulic systems, to maintain the centre and wing frame at the same height, periodic synchronization of the cylinders, by completely extending them to the fully raised position, was necessary.

The Prasco cultivator hitch was conveniently levelled with the turnbuckle provided. This adjustment was provided for accurate fore-and-aft levelling in all conditions encountered. The applicator hitch height could be adjusted by placing the hitch link in one of four positions. Cultivator wing levelling was accomplished, using two wrenches, by turning threaded connectors on each wing ,depth cylindei'.

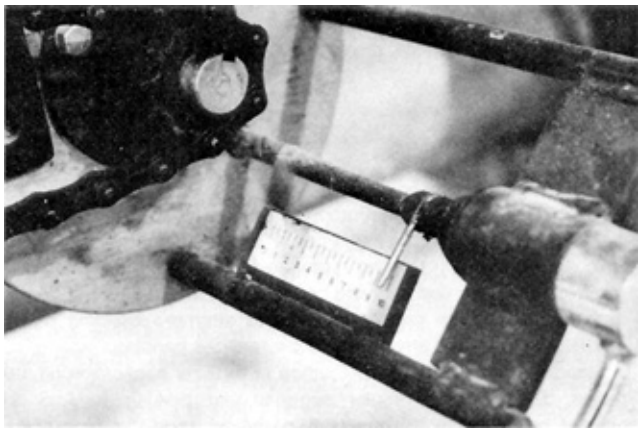

FIGURE 17. Application Rate Adjustment.

RATE OF WORK

The Prasco 75-55 was operated at speeds of 5 to 10 km/h (3 to 6 mph). Overall best performance, in terms of weed kill and seed placement, was obtained at speeds of 8 to 10 km/h (5 to 6 mph), resulting in field work rates for the 10.7 m (35 ft) unit, ranging from 8.6 to 10.7 ha/hr (21 to 27 ac/hr). Using both tanks, when seeding wheat at a rate of 85 kg/ha (75 lb/ac), about 40 ha (100 ac) could be seeded before refilling. Using only the larger tank, about 23 ha (58 ac) could be seeded before refilling. This compares to 15 to 25 ha (40 to 60 ac) between refills for most conventional drills of similar widths.

POWER REQUIREMENTS

Fan: The power requirement of the Prasco 75-55 fan, operating at the maximum manufacturer's recommended speed of 4250 rpm, was 10.7 kW (14.3 hp). This rating was determined for normal operating conditions and has been adjusted to include a tractor hydraulic system operating at 90% efficiency.

Draft Characteristics: Attempting to compare draft requirements of different makes of heavy duty cultivators usually is unrealistic. Draft requirements for the same cultivator, in the same field, may vary by as much as 30% 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 between makes of heavy duty cultivators. The power requirements given in TABLES 2 and 3 are based on average draft requirements of 10 makes of heavy duty cultivators in 40 different field conditions. Additional draft due to the Prasco applicator with full tanks and packers, as well as hydraulic fan power requirements has been included.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the Prasco 75-55 Applicator, Hydraulic Fan and Packers with 10.7 m John Deere 1610 Cultivator in Light Primary Tillage.

DEPTH	SPEED (km/h)					
(mm)	7	8	9	10	11	12
50	90	105	121	138	156	175
75	114	132	152	172	194	216
100	138	160	183	207	232	257
125	162	188	214	241	270	299

TABLE 3. Tractor Size (Maximum Power Take-off Rating kW) to Operate the Prasco 75-55 Applicator, Hydraulic Fan and Packers with 10.7 m John Deere 1610 Cultivator in Heavy Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	83	97	111	127	143	160
75	131	152	174	196	219	243
100	180	208	236	266	296	327
125	229	263	299	335	372	410

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the Prasco 75-55 applicator with hydraulic fan, packers and John Deere 1610 heavy duty cultivator, in light and heavy primary tillage. Tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80% of maximum power on a level field. The sizes presented in the tables are the maximum power take-off rating as determined by Nebraska tests or as presented by the tractor manufacturer. Selected tractor sizes will have ample power reserve to operate in the stated conditions.

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in light primary tillage at 75 mm (3 in) depth and 8 km/h (5 mph), a 132 kW (175 hp) tractor is required to operate the seeding unit. In heavy tillage, at the same depth and speed, a 152 kW (200 hp) tractor is needed.

OPERATOR SAFETY

Although the ladder provided convenient access to the tank openings, caution had to be used. When stepping to and from the ladder at the top of the applicator tanks, a secure handhold was not readily available (FIGURE 18). Convenient, safe access to the base of the ladder was provided. It is recommended that the manufacturer consider modificatons to the upper area of the ladder to improve safety.

Extreme caution is needed in transporting most folding cultivators 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 5.2 m (17 ft) over farm land or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m (15.7 ft) over farm land. In all three provinces, feeder lines in farmyards may be as low as 4.6 m (15 ft).

The Prasco 75-55 applicator with John Deere 10.7 m (35 ft) cultivator was 4.5 m (14.8 ft) high in transport position, permitting safe transport under prairie power lines. On the other hand, transport height with the 11.9 m (39 ft) wide model of the same cultivator is 4.9 m (16.2 ft) which is high enough for contact with many prairie power lines. The legal responsibility for safe passage under utility lines rests with the machinery operator and not with the power utility or the machinery manufacturer. All provinces have 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 Prasco 75-55 with John Deere 1610 cultivator was 6.2 m (20.3 ft) wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates.

No slow moving vehicle sign was provided on the applicator.

No mechanical lock-up was provided to hold the drive wheel in the raised position for transport. Pins were provided to lock the cultivator wings in transport position. The depth cylinder could be locked in the raised position with the depth adjusting sleeve.

The Prasco 75-55 applicator, with John Deere 1610 cultivator, towed well at speeds up to 28 km/h (17 mph) with the tanks partially filled. With tanks empty, applicator castor wheels shimmied at speeds greater than about 16 km/h (10 mph). The castors could be pinned to prevent the problem but this resulted in the castor wheels skidding sideways when turning sharp corners.

Centre section tire loads on the cultivator in transport position, exceeded the Tire and Rim Association maximum load rating for 7.60 x 15, 6-ply tires by 36% with the mounted packers. This tire load could be unsafe at high transport speeds and appropriate caution should be used when transporting on public roads.

FIGURE 18. Tank Access Ladder.

OPERATOR'S MANUAL

The operator's manual supplied with the Prasco 75-55 applicator contained useful information on safety, adjustments, maintenance and operation. The lubrication service intervals were not given for all lubrication points. All calibration charts for the Prasco 75-55 were based on a 12.2 m (40 ft) wide machine, requiring a calculation for all other widths. A metric calibration chart was not included. It is recommended that the manufacturer consider providing metric meter calibrations.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Prasco 75-55 applicator, Prasco packers and the John Deere 1610 cultivator during 160 hours of field operation while seeding about 870 ha (2150 ac). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA (ha)
APPLICATOR		
-- The seed boot hoses pulled out of the boot connection	throughout the test	
-- The seed boot clamps bent	throughout the test	
-- The main air distribution tube connectors slipped out of place at	21. 38	115, 205
-- The secondary manifold plugged at	32, 73	175, 400
-- The fan tach meter failed at	50, 125	270, 680
-- The acre meter chain fell off at	60	325
-- The rear meter drive sprocket was realigned and tightened at	68	370
-- Castor wheels were sticking and were heavily lubricated at	73	400
-- The meter drive wheel support arms bent and were straightened at	100	540
-- The plastic flutes in both meters were replaced with stainless steel flutes at	i07	580
-- The seedcup deflector plate was modified at .	16o	2150
-- Chisel points and fertilizer banding boots were installed at	135	720
-- Fertilizer banding boot tubes bent rearward and cracked	throughout the banding use period	
-- Chisel points were worn out and inverted at	155	840
CULTIVATOR		
-- Axle grease caps were knocked off by rocks at	20, 35, 60	110, 190, 325
-- All sweeps were replaced at	107	580
-- A seal in one hydraulic cylinder was replaced at	145	790
-- A shank holder bracket cracked and was welded at	150	815
PACKERS		
-- A packer axle weld failed and was rewelded at	107	580
-- A packer axle weld and packer coil weld failed and both were rewelded at	145	790
-- Packer axle bearing grease fittings were damaged by rocks	throughout the test	
-- The mounted harrow bars shifted sideways	throughout the test	

DISCUSSION OF MECHANICAL PROBLEMS

APPLICATOR

Seed Boots: Although the distribution hoses were securely placed into the seed boot connectors during assembly, the hoses pulled out frequently throughout the evaluation. Screws were threaded through both the tubes and seed boot to eliminate the problem, but this resulted in damaged hoses after continued use.

The upper seed boot clamps were twisted by rocks and soil forces throughout the evaluation (FIGURE 19). It is recommended that the manufacturer consider an alternate distribution hose connection at the seed boot and consider improving the durability of the upper seed boot clamps.

FIGURE 19. Damaged Seed Boot Clamps.

Manifold Plugging: Secondary manifold plugging occurred when straw entered the distribution system through the fan air inlet. An air intake deflector was supplied by the manufacturer to eliminate this problem.

Fan Speed Monitor: The fan speed monitor failed after 50 hours of field operation and was replaced with a new unit. After a further 75 hours of operation, one of the digital readout lights ceased functioning and was replaced.

Meter Drive Wheel Support Arms: The meter drive wheel support arms were bent due to side forces while cornering with the drive wheel down. The support arms were straightened and reinforced (FIGURE 20) and no further problems were encountered. To prevent support arm failure, the meter drive wheel should be raised when turning sharp corners.

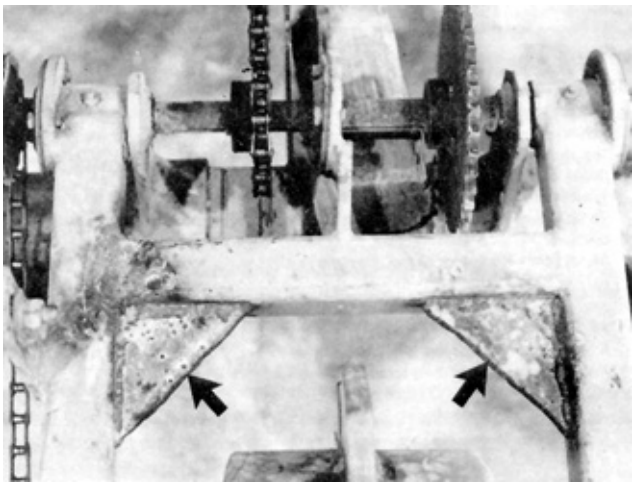

FIGURE 20. Meter Drive Wheel Support Arm Repair.

Meter Flute Change Over: The meters supplied with the Prasco 75-55 contained plastic fluted metering rolls. Considerable flute wear, causing a significant decrease in metering rates, was observed after 107 hours of operation. This wear was attributed to the metering of fertilizer with the seed from alternate tanks throughout most of the spring seeding period. Stainless steel fluted metering rolls were installed and no significant flute wear was evident at the conclusion of the evaluation period.

Fertilizer Boots: The fertilizer boot tubes were made of soft plastic and were pulled rearward by soil action around the shanks. Continued flexing eventually cracked the tubes. Sliding the tube upward within the tube support reduced tube damage. However, for optimum fertilizer placement the tubes should not be raised above the lower shovel bolt. It is recommended that the manufacturer improve the durability of the fertilizer banding boots.

APPENDIX I
SPECIFICATIONS

(A) PNEUMATIC APPLICATOR

MAKE:	Prasco Pneumatic Applicator
MODEL:	75-55
SERIAL NO.:	J 1064.2
MANUFACTURER:	Prasco Super Seeder Ltd. 200 - 280 Smith Street Winnipeg, Manitoba R3C 1K2
DIMENSIONS:	
- width	3660 mm
- length	4950 mm
- height	2553 mm
- maximum ground clearance	375 mm
- wheal tread	3213 mm
- wheel base	2095 mm
METERING SYSTEM:	
- type	externally fluted feed wheel, pressurized tank
- number of meters	2
- drive	chain drive from ground drive wheel
- adjustment	
high range	threaded adjustment for area of flute
(48 tooth sprocket)	exposure
iow range	threaded adjustment for area of flute
(24 tooth sprocket)	exposure
- transfer to openers	pneumatic conveyance through divider headers and plastic tubes
TANK CAPACITIES:	
- front	2605 L (74 bu)
- rear	1905 L (54 bu)
Total	4510 L (128 bu)
FAN:	
- type	straight blade centrifugal
- maximum operating speed	4250 rpm
- drive	hydraulic from tractor remote
WHEELS:	
- dual castor wheels	4, 11L x 15, 8-ply implement
- meter drive wheel	steel with traction lugs, 0 8 m diameter
NUMBER OF LUBRICATION POINTS:	32 grease fittings 4 wheel bearings
HITCH:	
- vertical adjustment range	
- applicator	215 mm in 4 positions
- cultivator	full range of adjustment with turnbuckle

OPTIONAL EQUIPMENT:

- chisel plow frame mounted packers*
- dual castor wheels
- liquid fertilizer system
- power take-off fan drive
- closed center hydraulic fan drive*
- open center hydraulic fan drive
- open center hydraulic fan drive with proportionator
- open center hydraulic fan drive with proportionator and oil cooler

* Supplied on test machine.

(B) CULTIVATOR

MAKE:	John Deere Heavy Duty Cultivator
MODEL:	1610
SERIAL NO.:	005242N
MANUFACTURER:	John Deere Des Moines Works Des Moines, Iowa 50306 U.S.A.
SHANKS:	
- number	35
- lateral spacing	305 mm
- trash clearance (sweep to frame)	735 mm
- number of shank rows	3
- distance between rows	840, 990 mm
- shank cross section	32 x 50 mm
- shank stem angle	52°
- sweep hole spacing	57 mm
- sweep bolt size	11 mm
DEPTH CONTROL:	hydraulic
FRAME:	
- cross section	100 mm square tubing, 6.4 mm thickness
TIRES:	8, 7.60L x 15, 6-ply implement
NUMBER OF LUBRICATION POINTS:	7, 10 hr service 8, 250 hr service
HYDRAULIC CYLINDERS:	
- main depth control	2, 108 x 203 mm
- wing depth control	1, 102 x 203 mm
	1, 95 x 203 mm
- wing lift	2, 102 x 813 mm

OPTIONAL EQUIPMENT:

- 13 width options ranging from 7.0 to 12.5 m
- frame mounted 3-row spring tine harrows

(C) PACKERS WITH SINGLE ROW SPRING TINE HARROWS

MAKE:	Prasco Frame Mounted Steel Coil Packers
MANUFACTURER:	Prasco Super Seeder Ltd. 200 - 280 Smith Street Winnipeg, Manitoba R3C 1K2
NUMBER OF SECTIONS:	6
OVERALL SECTION WIDTH:	1765 mm
EFFECTIVE SECTION PACKING WIDTH:	1540 mm
COIL DIAMETER:	460 mm
COIL PITCH:	142 mm
LUBRICATION POINTS:	4 grease fittings per section
OBSTRUCTION CLEARANCE:	335 mm*
WEIGHT:	200 kg per section
HARROW HEIGHT ADJUSTMENT:	172 mm in 3 settings

* Measured at cultivator working depth of 76 mm at maximum packer force setting.

(D) OVERALL SPECIFICATIONS FOR APPLICATOR-CULTIVATOR-PACKER ASSEMBLY

DIMENSIONS:	**FIELD POSITION**	**TRANSPORT POSITION**
- overall width	11,010 mm	6240 mm
- overall length	9840 mm	9840 mm
- overall height	2530 mm	4530 mm
- ground clearance	140 mm	140 mm
- wheel tread	8800 mm	3280 mm
- effective seeding width	10,670 mm	

WEIGHTS:	**TANKS EMPTY**	**TANKS FULL OF WHEAT**
APPLICATOR		
- hitch	250 kg	475 kg
- left front castor	525 kg	1475 kg
- left rear castor	450 kg	1255 kg
- right front castor	525 kg	1475 kg
- right rear castor	450 kg	1255 kg

CHISEL PLOW (WITH PACKERS)	**FIELD POSITION**	**TRANSPORT POSITION**
- left centre tandem wheels	1665 kg	2635 kg
- right centre tandem wheels	1735 kg	2635 kg
- left wing tandem wheels	930 kg	
- right wing tandem wheels	940 kg	
Total, Tanks Empty	7470 kg	
Total, Tanks Full of Wheat		11,205 kg

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evlauafion Reports:

(a) excellent
(b) very good
(c) good
(d) fair
(e) poor
(f) unsatisfactory

APPENDIX III

CONVERSTION TABLE

1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hbur (mph)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds (lb)
1 newton (N)	= 0,2 pounds force (lb)
1 litre (L)	= 0.03 bushels (bu)
1 kilogram/hectare (kg/ha)	= 0.9 pounds/acre (lb/ac)
1 kilogram/cubic metre (kg/m^3)	= 0.08 pounds/bushel (lb/bu)
1 kilonewton/metre (kN/m)	= 70 pounds force/foot (lb/ft)

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