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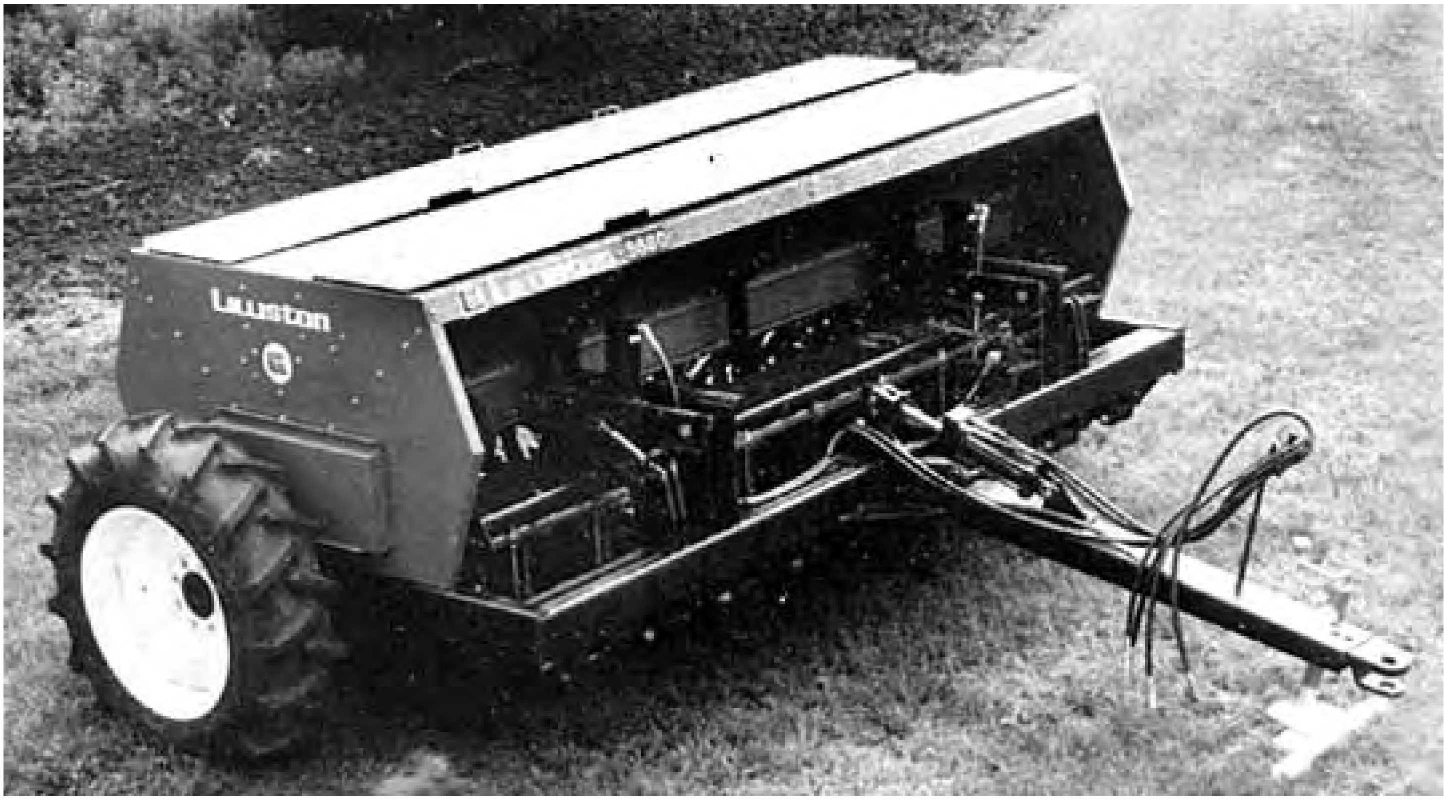
# EVALUATION REPORT 420




# Lilliston 9680 No-Till Grain Drill

A Co-operative Program Between
ALBERTA FARM MACHINERY RESEARCH CENTRE
PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

## LILLISTON 9680 NO-TILL GRAIN DRILL

**MANUFACTURER AND DISTRIBUTOR**
Lilliston Corporation
Box 3930
Albany, Georgia

**RETAIL PRICE:**
$21,693 (May, 1985 f.o.b. Portage la Prairie, Manitoba) 11 ft (3.4 m), combination grain/fertilizer model.

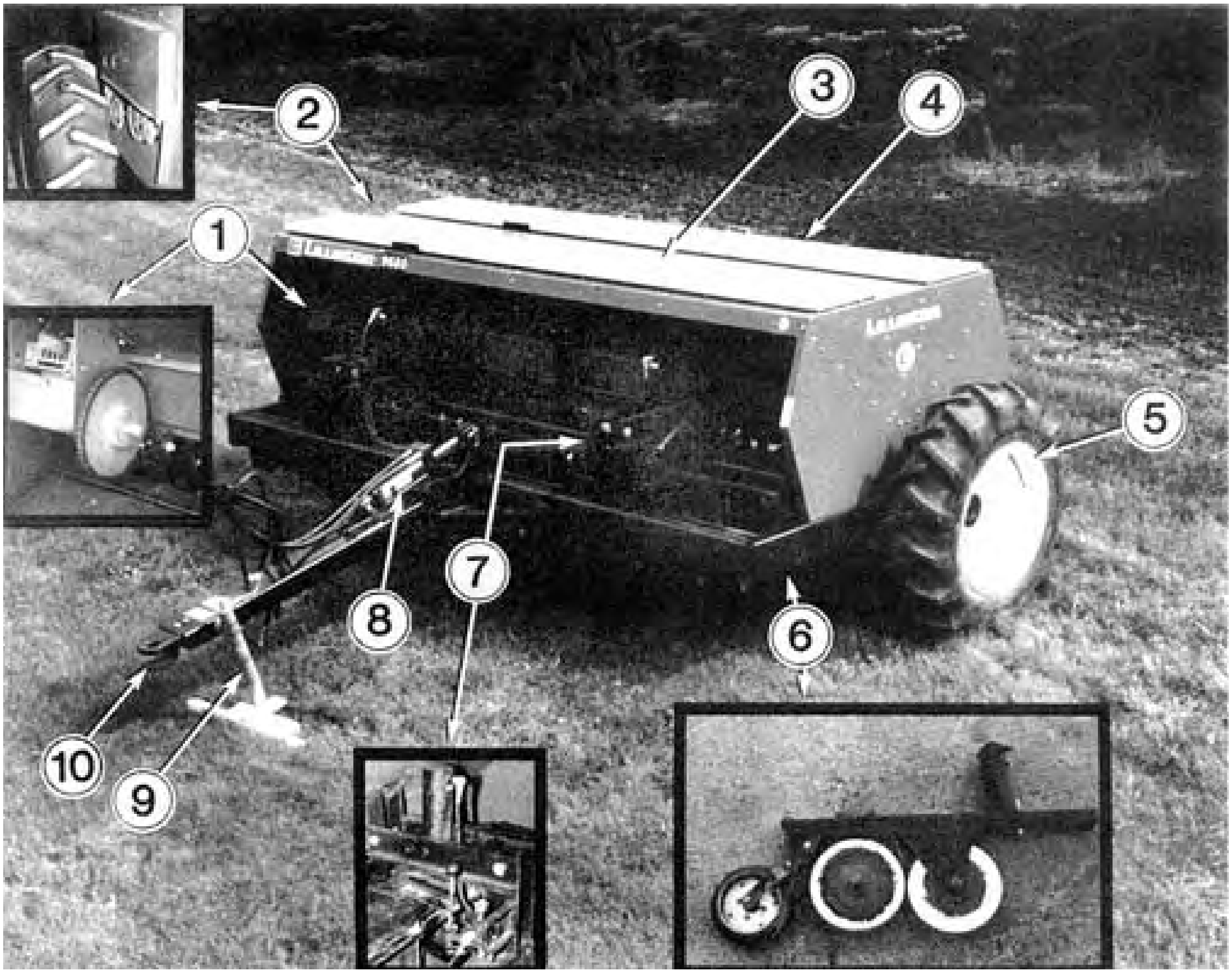



**FIGURE 1.** Lilliston 9680 No-Till Grain Drill: (1) Fertilizer Drive Transmission, (2) Final Drive Gears, (3) Fertilizer Box, (4) Grain Box, (5) End Wheel, (6) Opener Assembly, (7) Hydraulic Actuator, (8) Hitch Cylinder, (9) Jack, (10) Hitch.


### SUMMARY

**Quality of Work:** Penetration was very good when seeding directly into moist stubble fields and good when seeding into dry stubble fields and pastureland. The ability of the triple disk opener to cut through surface residue was good in firm soils and fair in soft moist soils. In very heavy trash seed placement was poor. Failure of the openers to cut through the surface residue results in seed being placed either in the residue or on the soil surface. The gauge press wheels provided adequate compaction in most soils encountered.

The accuracy of the seed metering system was very good in wheat and rapeseed. The minimum seeding rate in rapeseed was 3.5 lb/ac (3.9 kg/ha). The variation in seeding rates between seed runs was insignificant. The seeding rates of all crops were relatively unaffected by field roughness, ground speed or level of grain in the grain box. The seeding rate of wheat increased by as much as 15% when traveling up a 15° slope.

The accuracy of the fertilizer metering device was good. Variation in application rates between runs was insignificant. Application rates were not affected by field roughness, ground speed or level of fertilizer in the fertilizer box. The rate decreased by as much as 28% when travelling down a 15° slope.

A grass seeding attachment was made available as an option for the Lilliston 9680. The accuracy of the metering device was very good for small seeds such as alfalfa and good for large light seed such as rye grass.

**Ease of Operation:** Wet field conditions caused a buildup of mud on the outside of the openers and around the press wheels, eventually causing plugging. Exterior disk scrapers were not provided. Small rocks occasionally wedged between adjacent openers in stony fields. Reversible lids made filling of the grain and fertilizer boxes convenient especially if a drill fill was used. Installation of the grass seeding attachment directly over the rear walkway made filling of the grain box awkward. The fertilizer box was very easy to clean but leaked a small amount of moisture in heavy rains. The drill was very easy to transport, however limited ground clearance resulted in dragging of the disks on high crowned roadways.

**Ease of Adjustment:** One grease fitting on the hitch required lubrication. Both the seed and fertilizer rates were easy to change. The depth adjustment was quick and simple, but there was no calibrated scale for reference.

**Power Requirements:** A 100 hp (75 kW) tractor should have sufficient power reserve to operate one section of the 11 ft (3.4 m) drill in all field conditions and speeds.

**Operator Safety:** The Lilliston 9680 was safe to operate if

normal safety precautions were observed.

**Operator's Manual:** The operator's manual was very well written and clearly illustrated. It contained detailed information on safety, operation, service, assembly and warranty.

**Mechanical History:** One fertilizer metering gear broke early in testing and a cylinder lug broke after 83 hours of field operation. Other mechanical problems occurred but were considered minor.

## RECOMMENDATIONS:

It is recommended that the manufacturer consider:

1. Modifications to the final drive shield to make removal and replacement easier.
2. Improving quality control regarding thread surfaces on adjustments.
3. Making corrections to metric conversions on the fertilizer calibration tables, both in the operator's manual and on the grain tank lid of the drill.
4. Improving quality control regarding welding on the hitch of the drill.

*Station Manager: G.M. Omichinski*

*Project Engineer: D.J. May*

## THE MANUFACTURER STATES THAT

With regard to the recommendation:

1. A new model, available in the fall of 1985, has an improved drive shield.
2. Quality Control has been advised of the thread quality problem so that they can monitor future production.
3. The fertilizer calibration charts in the Operator's Manual and on the grain tank lid have been corrected.
4. No other similar failures have been reported. However, Quality Control has been advised of the reported weld failure.

**Manufacturer's additional comments:**

We do not recommend the 9680 be used for conventional seeding. The stiff spring system required for minimum-no-till conditions applies too much pressure to the opener in fresh tilled soils, resulting in uneven seed depth placement.

The 9680 can be purchased as an all grain or as a combination grain/fertilizer model. We do not recommend field conversion, since the tank must be completely disassembled to make the required changes.

The Lilliston has an optional attachment to mount a Rich-way foam marker on the 9680 Drill.

## GENERAL DESCRIPTION

The Lilliston 9680 (FIGURE 1) is an 11 ft (3.4 m) grain drill designed for no-till and minimum till seeding. It is equipped with 18 double disk openers spaced 7 in (180 mm) apart in two ranks and each preceded by a single disk cutting coulter. Seeding depth and opener force are controlled by two hydraulic cylinders. The divider in the combination grain and fertilizer box may be installed in two positions giving filled capacities of 29.4 bu (1.06 m$^3$) of grain and 1540 lb (700 kg) of fertilizer, or 19.4 bu (0.70 m$^3$) of grain and 2340 lb (1060 kg) of fertilizer, or removed to give a capacity of 48.8 bu (1.76 m$^3$) of grain.

Seed and fertilizer are metered by exterior diagonally fluted feed wheels. One of four sizes of feed wheels was used to meter large or small seeds. Nine speed transmissions with three sets of final drive gears provided the varying speeds to the feed shafts.

Flexible rubber hoses separately deliver the seed and fertilizer to the openers. The test machine was equipped with gauge-press wheels and interior double disk scrapers. A grass seeding attachment was provided as optional equipment.

Detailed specifications are given in APPENDIX I.

## SCOPE OF TEST

The Lilliston 9680 was operated under field conditions as shown in TABLE 1 for 130 hours, while seeding 780 ac (315 ha). It was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

**TABLE 1.** Operating Conditions

| Field Condition | Operating Hours | Equivalent Field Area | |
|---|---|---|---|
| | | ac | ha |
| Soil Type: | | | |
| sand | 38 | 230 | 93 |
| sandy loam | 23 | 140 | 57 |
| loam | 16 | 95 | 38 |
| clay loam | 53 | 315 | 127 |
| TOTAL | 130 | 780 | 315 |
| Crop: | | | |
| winter wheat | 62 | 370 | 150 |
| spring wheat | 7 | 40 | 16 |
| barley | 5 | 30 | 12 |
| rye | 13 | 80 | 32 |
| rapeseed | 3 | 20 | 8 |
| flax | 6 | 35 | 14 |
| grass seedand alfalfa | 34 | 205 | 83 |
| TOTAL | 130 | 780 | 315 |
| Land: | | | |
| stubble | 93 | 560 | 226 |
| stubble mulch | 4 | 25 | 10 |
| pasture | 33 | 195 | 79 |
| TOTAL: | 130 | 760 | 315 |

During the test small to large stones were encountered in 70 ac (28 ha). The drill was transported over 250 m (420 km) on paved roads and 250 m (420 km) on gravelled roads.

## RESULTS AND DISCUSSION

### QUALITY OF WORK

**Penetration:** The drilling of seeds directly into stubble or pastureland in a no-till planting operation requires an opener that will cut through heavy surface trash, penetrate dry compacted soils and produce a minimum amount of soil disturbance. Excessive soil disturbance promotes weed growth and loss of soil moisture.

The Lilliston 9680 was equipped with double disk furrow openers preceded by single disk cutting coulters (FIGURE 2). Each set of openers had an individual trailing gauge-press wheel. Penetration of the openers was very good when seeding directly into moist stubble fields and good when seeding into dry stubble fields and pastureland. In hard soils it was necessary to add ballast to the drill tires and rear frame. A total of 1400 lb (640 kg) was adequate to provide the required opener force in most soil conditions, and to prevent the end ground drive wheel from lifting off the ground.

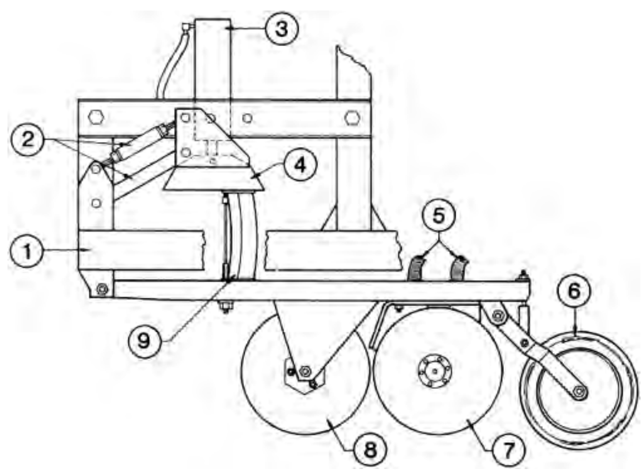



**FIGURE 2.** Triple Disk Opener: (1) Main Frame, (2) Parallel Linkage, (3) Hydraulic Cylinder, (4) Pressure Beam, (5) Delivery Tubes, (6) Gauge-Press Wheel, (7) Double Disk Opener, (8) Cutting Coulter, (9) Rubber Buffer.

The ability of the triple disk opener to cut through surface residue was good in firm soils and fair in soft, moist soils. Straw was pushed into the furrow bottom without being cut when operating in soft, moist soils (FIGURE 3). Extremely heavy surface residue prevented proper opener penetration regardless of soil conditions. Straw and chaff should be spread evenly before seeding.

The force on the openers and the opener depth were controlled with two hydraulic cylinders. The cylinders raised and lowered the pressure beam that transferred the force through rubber buffers to the two rows of openers (FIGURE 2).

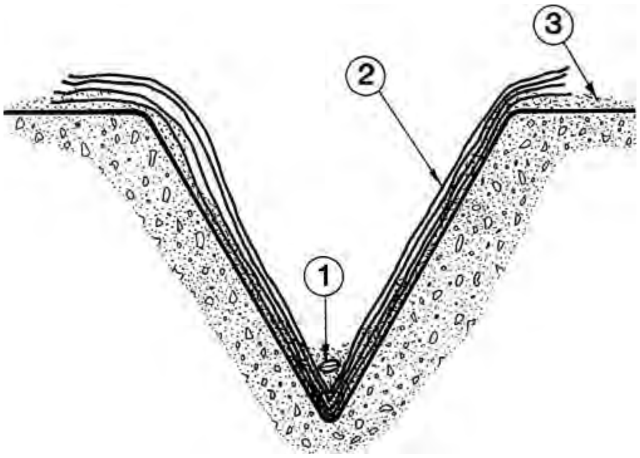



**FIGURE 3.** Schematic Representation of Hairpinning in Soft Moist Conditions: (1) Seed, (2) Uncut Straw, (3) Chaff.

Individual depth adjustment of the openers travelling in the tractor wheel tracks was possible. The front cutting coulter depth could be varied by changing the hitch angle with the hydraulic cylinder. In very soft or very moist conditions it was necessary to lift the cutting coulters almost out of the ground to keep the seed disks turning and to avoid plugging. This did not pose a penetration problem since there was still adequate opener force.

The downward force on each opener could increase from 0 to over 690 lb (0 to 3000 N) as the rubber buffers compressed. The maximum average force with grain and fertilizer boxes empty and the machine loaded with 1400 lb (640 kg) of ballast was 360 lb (1610 N) per opener.

**Seed Placement:** The basic rules for the conventional seeding of cereal and oilseed crops also apply to the direct drilling of these crops into stubble. The seed is ideally placed when it is in moist soil on a firm seedbed 0.8 to 2 in (20 to 50 mm) from the soil surface with the soil packed tightly about the seed for optimum moisture contact and minimum soil drying.

In very heavy trash, seed placement was poor. Failure of the openers to cut through the surface residue resulted in seed being placed either in the residue or on the soil surface (FIGURE 4). In lighter trash conditions and in softer soil the trash was pushed to the bottom of the furrow without being cut. The seed was then placed on the trash and covered with a small amount of trash and soil. This reduced the contact between the seed and the soil that is necessary for good germination. Seed placement was good in fields with evenly spread surface residue.

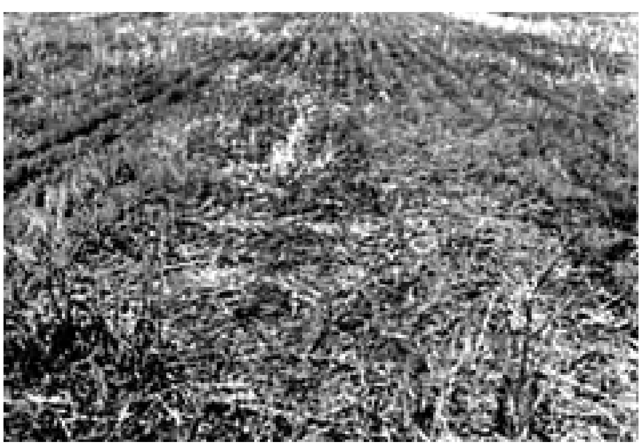


**FIGURE 4.** Poor Emergence After Seeding into Excessive Trash.

Seeding depth was very uniform with slight variations resulting from field or seedbed irregularities. Measurements of seeding depth when seeding wheat at 4 mph (6 km/h) in stubble, showed that at least 68% of the seeds were within 0.23 in (6 mm) of the average seeding depth.[1] Higher speeds caused more seed scatter. Seed coverage was good and only slightly affected by ground speed. Seed coverage was reduced in hard packed ground and in trashy conditions. Seed and fertilizer were placed together in a narrow band.

Seed placement when renovating dry pastureland was fair. The triple disc opener penetrated well into root bound soil. The Lilliston 9680 could be used for seeding conventionally into a prepared seedbed without requiring machine modifications.

**Soil/Stubble Disturbance:** Minimizing soil disturbance is important under dry conditions in that it lessens moisture loss and reduces germination of some annual weeds. The angle between the two seed disks of the Lilliston is about 9 degrees. This angle was small enough to keep soil disturbance minimal in most field conditions.

Retaining stubble is also important since it helps trap snow to insulate winter wheat and provide moisture in the spring, and guards against soil erosion. The small angle between the seed disks minimized the amount of stubble knockdown in most field conditions, and resulted in very good snow catch (FIGURE 5).

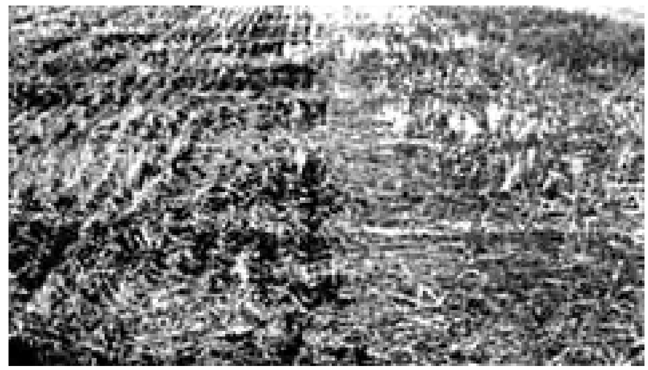


**FIGURE 5.** Soil Disturbance and Stubble Knockdown with Lilliston 9680.

**Soil Compaction:** The ribbed semi-pneumatic gauge-press wheels followed directly behind each opener, effectively pressing the soil about the seeds. The press wheels provided adequate compaction in most soils encountered. In moist clay, soil would pack around the wheels and sometimes churn up between the wheels causing plugging.

In hard packed soil, the seed would sometimes be left with little or no covering soil to be packed around it.

Average packing force exerted by each press wheel was 390 lb (1730 N).

**Plant Emergence:** In general, the crops seeded directly into stubble or conventionally into a prepared seedbed, germinated well and emerged evenly if adequate moisture was present (FIGURE 6). In dry fields, complete emergence occurred only after rain. Seed emergence in heavy trash ranged from fair to poor as the trash prevented proper opener penetration. Emergence in the renovated pastureland was fair with too much competition from existing growth. Better pasture renovation techniques would remove the existing growth in 6 in (150 mm) wide strips with a chemical defoliant and place seed in the centre of these strips.

**FIGURE 6.** Emergence of Wheat Drilled Directly into Flax Stubble with Average Moisture Conditions.

[1]*Seeding depth was determined by measuring the seedling root length to the ground surface. Ungerminated seeds either on the surface or below the soil surface were not considered.*

**Metering Accuracy:** The grain and fertilizer metering systems (FIGURE 7) were calibrated in the laboratory and compared with the manufacturer's calibration. Since the actual application rates for certain settings depend on factors such as size, density, and moisture content of seed and fertilizer, it is not possible for a manufacturer to prepare charts which include all the variations of seed and fertilizer used. Small variations in seed or fertilizer application rates will not significantly affect grain crop yields.

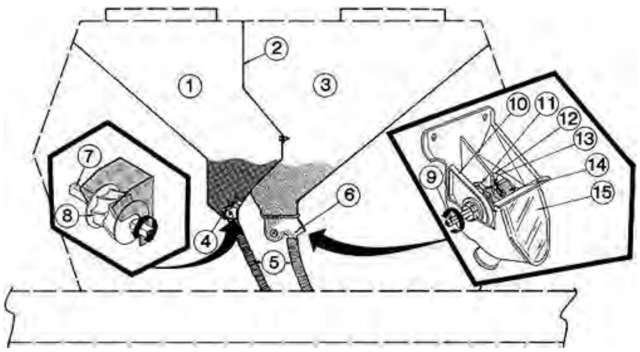


**FIGURE 7.** Seed and Fertilizer Metering Systems: (1) Fertilizer Box, (2) Removable Partition, (3) Seed Box, (4) Feedshaft Baffles, (5) Delivery Tubes, (6) Seed Cup, (7) Fertilizer Feedshaft, (8) Fertilizer Feedwheel, (9) Grain Feedshaft, (10) Intermediate Feedwheel Spacer, (11) Intermediate Feedwheel, (12) Medium Feedwheel Spacer, (13) Medium Feedwheel, (14) Feedcup Seals, (15) Seed Cup Window. Not shown: Fine and Coarse Feedwheels.

**Seed Metering System:** The accuracy of the seed metering system on the Lilliston 9680 in wheat and rapeseed was very good. Differences between the actual seeding rate and the manufacturer's calibration charts were probably due to differences in the seed densities. Since seed densities were not stated in the operator's manual, actual rates should be checked by the operator.

Field roughness, level of seed in the grain box and variation in speed did not significantly affect the seeding rate for either large or small seeds. Variation in field slope had some effect on the seeding rate as shown in FIGURE 9. When travelling up a 15° hill the seeding rate of wheat increased by as much as 15%.

The coefficient variation (CV) can be used to describe the variation of application rates among individual seed cups. If the CV is less than 15%, seeding is acceptable whereas if the CV is much greater than 15%, the variation among individual seed or fertilizer cups is excessive. When seeding rapeseed at 8.9 lb/ac (10.0 kg/ha) the CV was 7.0% indicating very uniform seeding.

**Fertilizer Metering System:** FIGURE 8 shows PAMI calibration results in comparison with the manufacturer's calibrations. The small difference between the two calibrations is probably due to the difference in density of fertilizer.

The variation in fertilizing rates from one run to another was very low. When distributing 11-51-00 fertilizer at a rate of 63.1 lb/ac (70.7 kg/ha), the CV among individual seed cups was 1.7%. The fertilizer application rate was not significantly affected by the level of fertilizer in the box, ground speed or field vibrations. Variations in field slope did have an effect on the fertilizing rate as shown in FIGURE 9. When travelling down a 15° slope, the fertilizing rate decreased by as much as 29%.

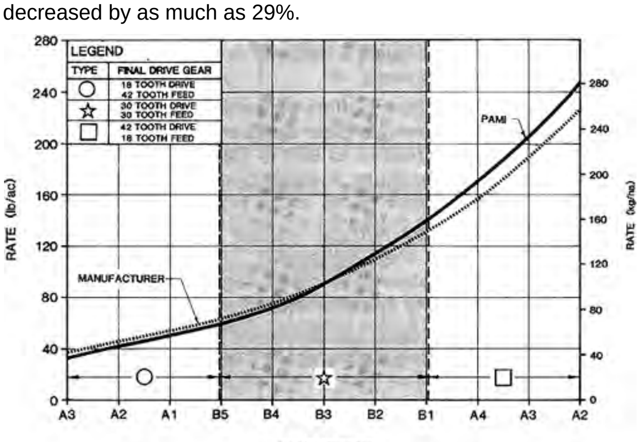



**FIGURE 8.** PAMI Calibrations in Comparison to Manufacturer's Calibration (11-51-00 Fertilizer).

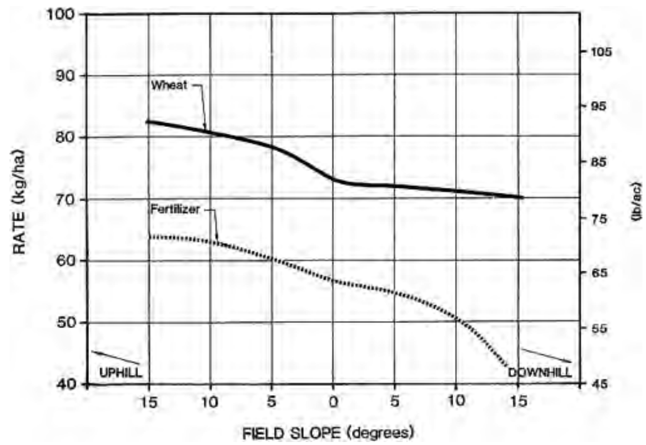



**FIGURE 9.** Variation in Seed and Fertilizer Application Rate with Change in Field Slope while Seeding Wheat and 11-51-00 Fertilizer.

**Grass Seeding Attachment:** A grass seeding attachment was installed as optional equipment on the Lilliston 9680. The accuracy of the metering device was very good for small seeds such as alfalfa and good for large, light seeds such as ryegrass. Some field vibration was required to prevent bridging of large light seeds in the grass seeding attachment.

The metering device supplied with the seeding attachment was different from that shown in the operator's manual. Updated calibration charts for some seed types were supplied with the new grass seeding attachment. TABLE 2 shows PAMI calibrations for ryegrass and alfalfa.

**TABLE 2.** Ryegrass and Alfalfa Calibration with Grass Seeding Attachment (PAMI)

| Lever Setting | Ryegrass | | Alfalfa | |
|---|---|---|---|---|
| | lb/ac | kg/ha | lb/ac | kg/ha |
| 2 | 0 | 0 | 0.4 | 0.5 |
| 4 | 0.3 | 0.3 | 0.9 | 1.0 |
| 6 | 0.9 | 1.0 | 2.7 | 3.0 |
| 8 | 1.6 | 1.8 | 5.4 | 6.0 |
| 10 | 2.4 | 2.7 | 9.8 | 11 |
| 12 | 3.0 | 3.4 | 13 | 15 |
| 14 | 3.3 | 3.7 | 18 | 20 |
| 16 | 3.4 | 3.8 | 22 | 25 |
| 18 | 3.5 | 3.9 | 25 | 28 |
| 20 | 3.6 | 4.0 | 29 | 32 |

## EASE OF OPERATION

**Wet Fields:** Excessive mud buildup on the single disk cutting coulters and the double disk openers caused plugging when operating in wet clay or clay loam soils. This problem could usually be overcome by simply tilting the frame of the drill backwards using the hydraulic cylinder located on the hitch. The interior double disk scrapers were spring loaded and maintained good contact with the inside surface of the disk throughout the test. Exterior scrapers were not provided on the Lilliston 9680.

**Stony Fields:** Small rocks occasionally wedged between adjacent openers in stony fields. A hammer or metal bar was usually required to remove the rocks.

Compressing the rubber buffers permitted the openers to lift a maximum of 8 in (200 mm) to clear rocks and other obstructions. The opener force increased to 850 lb (3800 N) as the buffers compressed to the maximum. Average opener force during normal operation varied from 100 to 350 lb (450 to 1600 N).

**Trashy Fields:** Heavy surface residue caused poor opener penetration and poor seed placement. The addition of ballast only solved this problem to a small degree. Surface residue should be spread evenly before attempting to seed through it.

**Filling:** The Lilliston 9680 was equipped with reversible lids on the grain and fertilizer boxes and an 11 in (280 mm) wide rear walkway.

The grain box had a capacity of 29.4 bu (1.06 $m^3$) and the fertilizer box had a capacity of 1540 lb (700 kg) of fertilizer with a density of 62.4 lb/$ft^3$ (1000 kg/$m^3$). The drill was not equipped with grain and fertilizer level indicators.

**Moisture:** The grain and fertilizer boxes were adequately sealed to prevent leakage into the box in light rains, but small amounts of moisture entered during heavy rains. The fertilizer shaft should be checked before operation to ensure that it is free to rotate and that the fertilizer has not caked.

**Cleaning:** The grain and fertilizer boxes could be easily cleaned with a vacuum cleaner. The grass seeding attachment was located directly over the rear walkway (FIGURE 10) making cleaning of the grain box awkward. The fertilizer box could also be cleaned by removing the baffles and cleanout bottoms.

**FIGURE 10.** Seed Box Directly Over Rear Walkway.

**Acremeter:** The Lilliston 9680 was equipped with one continuous non-resettable acremeter. It read to the nearest tenth of an acre to a maximum of 1,000,000 acres and was accurate to within 1%.

**Transportability:** The Lilliston 9680 trailed well and rode smoothly behind a tractor or light truck at speeds up to 19 mph (30 km/h) provided grain and fertilizer boxes were empty. Speeds in excess of this are not recommended. The overall width of the machine was 14 ft (4.3 m), which permitted easy travel down most roadways.

The limited ground clearance of 5 in (125 mm) frequently resulted in the openers dragging on high crowned roadways. Mechanical locks were provided to hold the openers in a raised position and the frame at a slightly backward angle for transport.

**Marker:** A marker was not available for the Lilliston grain drill. When operating in tall stubble or dusty conditions it was very difficult to see the edge of the previous pass.

## EASE OF ADJUSTMENT

**Lubrication:** The Lilliston 9680 had one grease fitting, located on the hitch, which required greasing periodically. The drive gears and chains should also be oiled regularly.

**Seed and Fertilizer Rates:** The seed and fertilizer rates were adjusted in an identical manner. One of the nine gears was selected on each of the transmissions. Then one of three sets of final drive gears was selected to give a total of 27 possible seed or fertilizer rates. A low rate set of final drive gears was available as optional equipment for very small seeds such as rapeseed and grass seeds.

The drill sometimes had to be moved ahead a short distance with the openers down in order for the idler to completely engage both sets of gears in the transmission. The final drive gear shield, which held the gears in place, was difficult to remove and replace. It is recommended that the manufacturer consider modifications to the final drive shield to make removal and replacement easier.

**Depth:** All 18 triple disk openers were raised and lowered at the same time from the tractor seat with two hydraulic cylinders. The maximum depth was set by adjusting the depth adjustment rod shown in FIGURE 11. The rod activated a hydraulic cut-off valve. Fine tuning of the depth was accomplished by adjusting spacers on the gauge-press wheels.

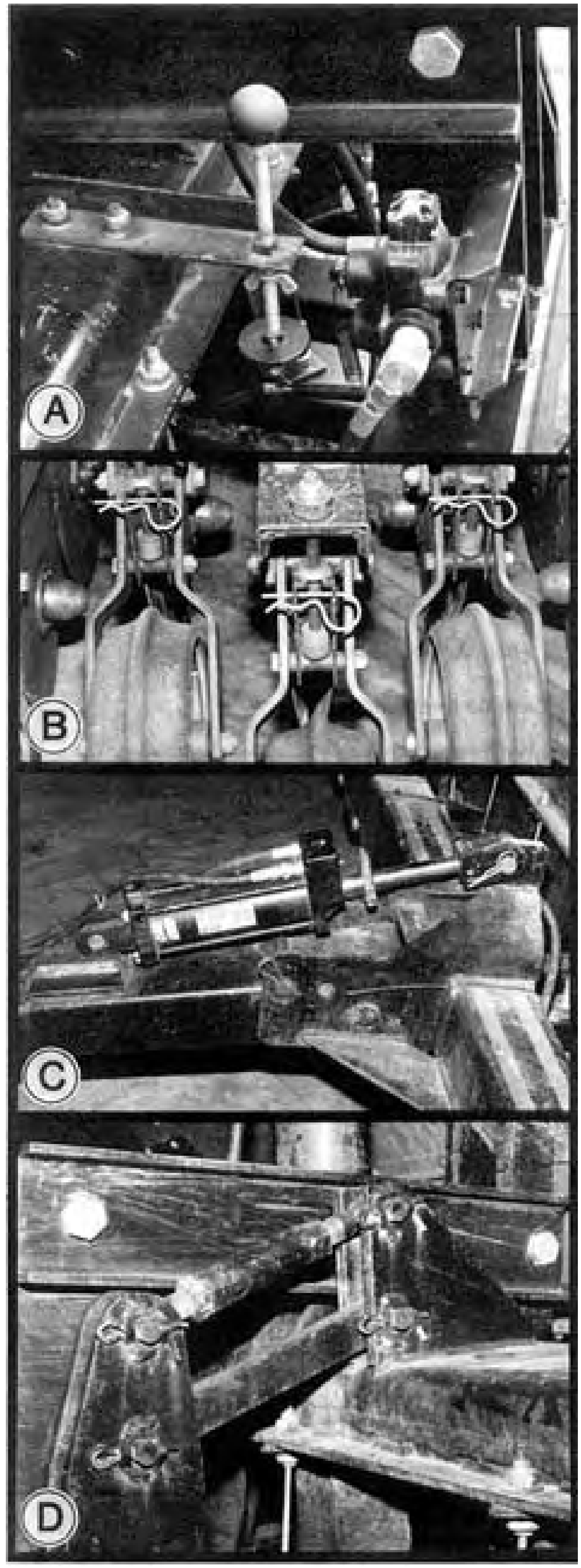



**FIGURE 11.** Depth Adjustments: (A) Pressure Adjustment Bolt, (B) Spacers for Gauge-Press Wheels, (C) Hitch Cylinder, (D) Parallel Linkage.

The front cutting coulters could be set deeper or shallower than the double disk openers by changing the hitch angle. The hitch angle was adjusted by actuating the hitch cylinder. When the cutting coulters were at the desired depth, the cylinder stop was adjusted to make contact with the cut-off button on the cylinder.

The front row of openers could be adjusted to operate deeper or shallower than the back row of openers by adjusting the length of the parallel linkages that connect the pressure beam to the main frame. This was a very infrequent adjustment. One of the parallel linkages was very difficult to adjust due to thread interference. It is recommended that the manufacturer consider improving quality control regarding thread surfaces on adjustments.

## POWER REQUIREMENTS

Maximum draft at 1.6 in (4 cm) depth with 1400 lb (640 kg) of ballast and full grain boxes on level fields with average soil moisture was about 4500 lb (20.0 kN), while average draft was about 2500 lb (11.0 kN). A 100 hp (75 kW) tractor should be adequate in all field conditions and field speeds.

## OPERATOR SAFETY

The Lilliston 9680 was safe to operate if normal safety precautions were observed. Pinch points and moving parts were adequately shielded. Warning decals were properly displayed on the drill. Care should be taken when inspecting feed cups as lids may fall shut if bumped.

The drill was not equipped with a slow moving vehicle sign.

## OPERATOR'S MANUAL

The operator's manual was very well written and clearly illustrated. It contained detailed information on safety, operation, service, assembly and warranty. The manual had Imperial and Metric units in the calibration charts however there were improper conversions in the fertilizer calibration charts. It is recommended that the manufacturer consider making corrections to metric conversions on the fertilizer calibration tables, both in the operator's manual and on the grain tank lid of the drill.

## MECHANICAL HISTORY

The Lilliston 9680 was operated for 130 hours while seeding 780 ac (315 ha). The intent of the test was an evaluation of functional performance and an extended durability evaluation was not conducted. TABLE 3 outlines the mechanical problems that occurred during the functional testing.

**TABLE 3.** Mechanical History

| Item | Operating Hours | Field Area ac | (ha) |
|---|---|---|---|
| -fertilizer drive gear broke and was replaced at | 5 | 30 | (12) |
| -rubber feed hose ripped and was replaced at | 53 | 315 | (127) |
| -packer wheel rim bent and was replaced at | 68 | 405 | (164) |
| -cylinder lug broke off and rewelded at | 83 | 500 | (202) |

## DISCUSSION OF MECHANICAL PROBLEMS

**Gear:** Fertilizer caked on the feedshaft and jammed it, due to moisture leakage after a heavy rainfall. This resulted in a broken drive gear, which was easily replaced.

**Packer Wheel:** The packer wheel rim was bent in stony field conditions and was easily replaced with a new rim.

**Cylinder Lug:** The cylinder lug, which anchors the hitch cylinder, broke off of the hitch due to faulty welding. It was rewelded in the field (FIGURE 12). It is recommended that the manufacturer consider improving quality control regarding welding on the hitch of the drill.

**FIGURE 12.** Rewelded Cylinder Lug.

## APPENDIX I
## SPECIFICATIONS

| | |
|---|---|
| **MAKE:** | Lilliston |
| **MODEL:** | 9680 No-till Grain Drill |
| **SERIAL NUMBER:** | 5587 |
| **DIMENSIONS:** | |
| -- height | 5.2 ft (1.57 m) |
| -- length | 12.5 ft (3.81 m) |
| -- width | 14.2 ft (4.32 m) |
| -- effective seeding width | 10.5 ft (3.20 m) |
| -- transport ground clearance | 5 in (127 mm) |
| **SEED METERING SYSTEM:** | |
| -- type | exterior diagonally fluted feed wheels |
| -- drive | nine speed transmission with three sets of final drive gears |
| -- adjustment | change speed of feed shaft by changing transmission or transferring final drive gears |
| -- transfer to openers | convoluted rubber hose |
| **FERTILIZER METERING SYSTEM:** | |
| -- type | externally ridged traction wheels |
| -- drive | nine speed transmission with three sets of final drive gears |
| -- adjustment | change speed of feed shaft by changing transmission or transferring final drive gears |
| -- transfer to openers | convoluted rubber hose |
| **OPENERS:** | |
| -- type | triple disk (single disk cutting coulter followed by double disk opener) |
| -- size (coulter & openers) 1 | 4 in (360 mm) |
| -- distance between coulter and double disks | 0.6 in (16 mm) |
| -- number of openers | 18 |
| -- number of rows | 2 |
| -- distance between row | 2.5 in (64 mm) |
| **GAUGE-PRESS WHEELS:** | |
| -- type | ribbed, semi-pneumatic |
| -- diameter | 12 in (300 mm) |
| -- width | 4 in (100 mm) |
| -- number | 18 |
| -- spacing | 7 in (180 mm) |
| **END WHEELS:** | |
| -- number | 2 |
| -- tire size | 12.4 x 24 |
| **GRAIN AND FERTILIZER BOX CAPACITIES:** | |
| -- grain box capacity | 29.4 bu (1.06 m³) |
| -- fertilizer box capacity | 1540 lb (700 kg) |

| **WEIGHT: (**Without ballast) | **Boxes Empty** | **Boxes Full** |
|---|---|---|
| -- on end wheels | 4820 lb (2190 kg) | 7370 lb (3350 kg) |
| -- on hitch | 700 lb (320 kg) | 920 lb (420 kg) |
| total weight | 5520 lb (2510 kg) | 8290 lb (3770 kg) |

**NUMBER OF CHAIN DRIVES:** 4

**NUMBER OF LUBRICATION POINTS:** 1

**NUMBER OF HYDRAULIC CYLINDERS:** 3

**NUMBER OF SEALED BEARINGS:** 146

## APPENDIX II
## MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

## SUMMARY CHART

# LILLISTON 9680 NO TILL GRAIN DRILL

| | |
|---|---|
| **RETAIL PRICE:** | $21,693 (May 1985, f.o.b. Portage la Prairie) |
| **QUALITY OF WORK:** | |
| Penetration | **Very good;** moist stubble fields<br>**Good;** dry stubble field and pastureland |
| Trash Cutting | **Good;** firm soils<br>**Fair;** soft moist soils |
| Accuracy of: | |
| Seed Metering Device | **Very good;** wheat and rapeseed |
| Fertilizer Metering Device | **Good;** 11-51-00 |
| **EASE OF OPERATION:** | |
| Wet Field Conditions | Some plugging |
| Filling | Easy, reversible lids |
| Transportability | Very easy, limited ground clearance |
| **EASE OF ADJUSTMENT:** | |
| Seed and Fertilizer Rates | Easy to change; simple transmission |
| Depth | Quick and simple; no scale |
| **POWER REQUIREMENTS:** | 100 hp (75 kW) tractor has sufficient reserve for all field conditions and speeds. |
| **OPERATOR SAFETY:** | Safe, if normal precautions observed |
| **OPERATOR'S MANUAL:** | Very well written and illustrated |
| **MECHANICAL HISTORY:** | Fertilizer metering gear broke and a cylinder lug broke. |

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