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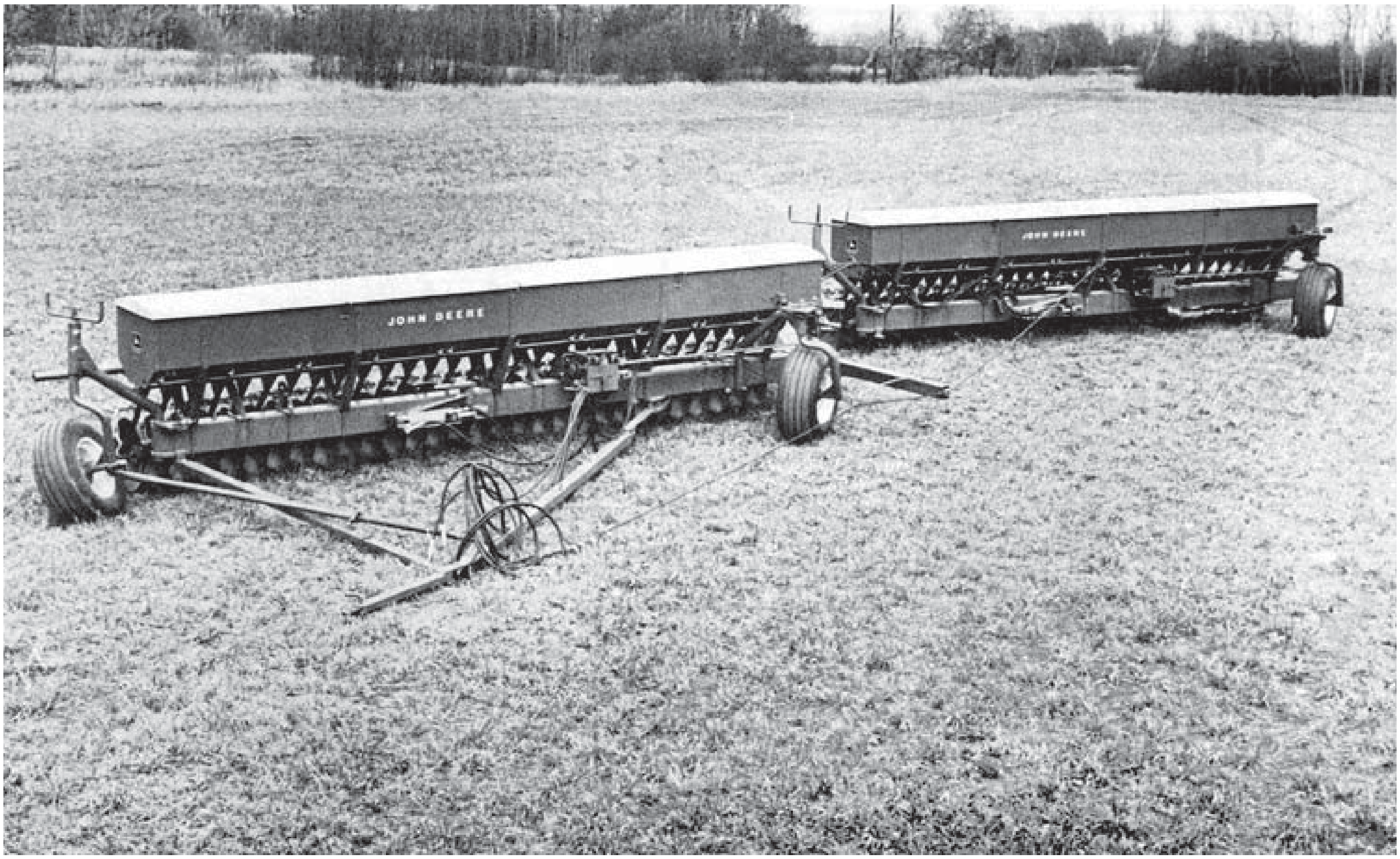


John Deere 1900 Seeding Tiller

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

JOHN DEERE 1900 SEEDING TILLER

MANUFACTURER:
John Deere Welland Works
Canal Bank Road
Welland, Ontario
L3B 3N3

DISTRIBUTOR:
John Deere Limited
455 Park Street
Regina, Saskatchewan
S4P 3L8

RETAIL PRICE:
$20,345.00 (December, 1981, f.o.b. Humboldt. Two 4.6 m wide piggyback hitched units with 6 rear frame weights, disk scraper attachment and rear stabilizing coulter.)

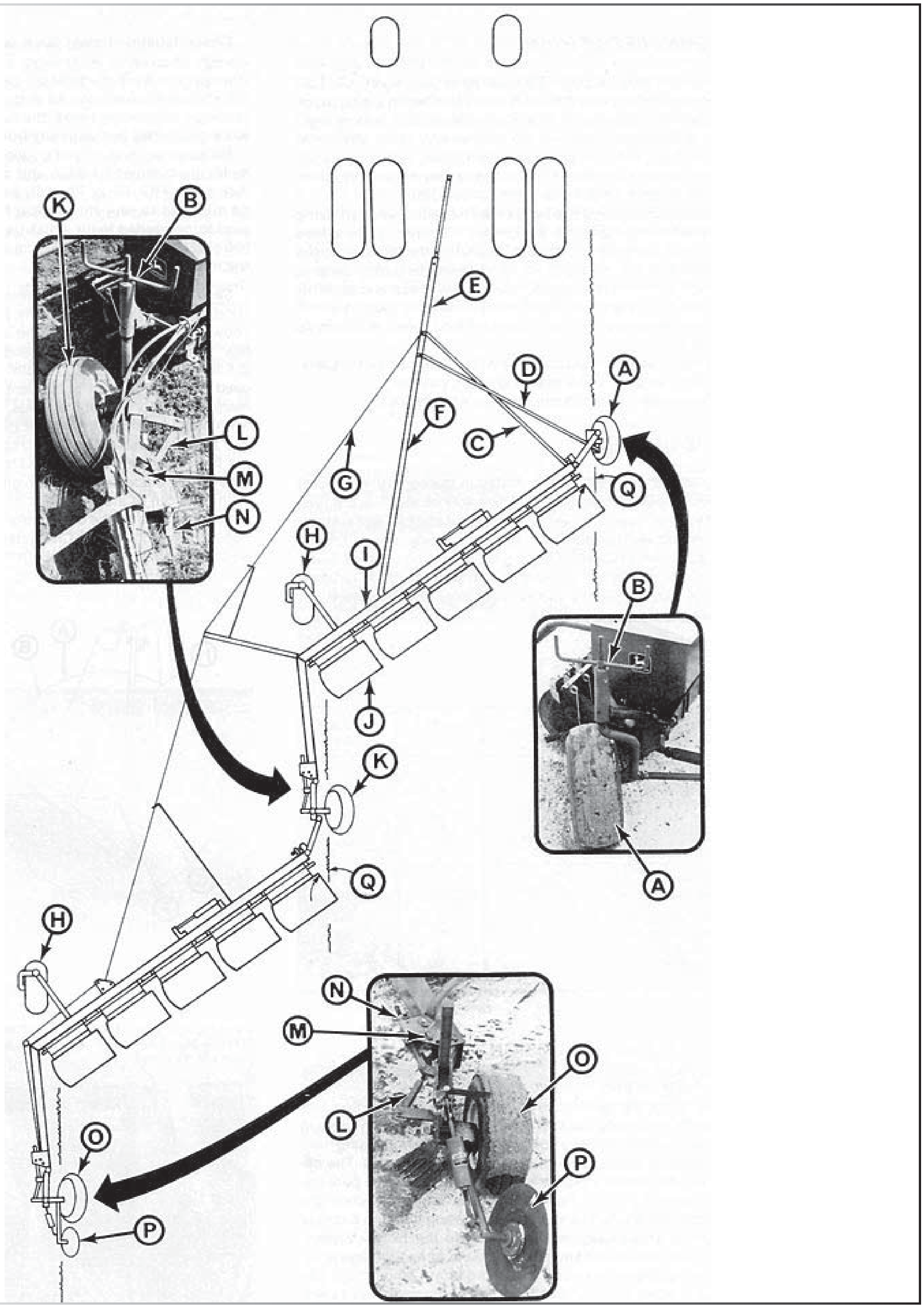


FIGURE 1. John Deere 1900 (A) Front. Furrow Wheel, (B) Frame Levelling Screws, (C) Hitch Brace, (D) Steering Link, (E) Front Hitch, (F) Main Hitch, (G) Hitch Cable, (H) Land Wheel, (I) Main Frame, (J) Disk Gangs, (K) Centre Furrow Wheel, (L) Lead Adjustment, (M) Wheel Lock, (N) Width of Cut Adjustment, (O) Rear Furrow Wheel, (P) Stabilizing Coulter Disk, (Q) Disk Angle.

SUMMARY AND CONCLUSIONS

Overall functional performance of the John Deere 1900 seeding tiller was good. Penetration was very good when seeding into summerfallow or moist stubble and fair when seeding into dry compacted stubble. Ability to cut through surface trash was good in firm soils and fair in soft soils. Heavy surface trash prevented proper penetration in all fields and lead to plugging in soft, moist fields.

Seed placement and seed coverage were good. In stony fields, rocks occasionally lodged between disks. The gangs rode smoothly over buried rocks and obstructions. The optional disk scrapers reduced the amount of soil clinging to the disks, but did not prevent plugging in wet clay soils. Stability was very good in rolling hills provided the six optional rear frame weights were used and the rear land wheel locked. Stability was slightly affected by changes in ground speed, soil hardness and tillage depth.

The accuracy of the seed metering system was very good in wheat, oats and barley and good in rapeseed. The variation in seeding rates among seed runs was very low in wheat, oats and barley, and was acceptable in rapeseed. Seeding rates were not affected by field roughness, field slope, ground speed or depth of grain in the seed box.

Overall performance of the fertilizer attachment was good. Variation of the application rates among runs was very low and the application rate was not affected by field roughness, ground speed or level of fertilizer in the fertilizer box. However, the application rate decreased significantly when seeding down slopes greater than 10 degrees.

Both the seed and fertilizer rates were easy to adjust. The seed and fertilizer boxes were convenient to refill, but difficult to clean. The boxes were adequately sealed to prevent moisture from entering in heavy rains. Daily lubrication took from 5 to 10 minutes. All lubrication points were readily accessible.

The John Deere 1900 could be placed into full transport position in 20 minutes and into semi-transport position in 10 minutes. Overall width in full or semi-transport was suitable for safe transport on all secondary roads. The JD 1900 towed well at speeds up to 32 km/h (20 mph). The JD 1900 should not be transported at road speeds with full grain and fertilizer boxes, as the front and centre furrow wheel and front land wheel exceeded the Tire and Rim Association's maximum ratings by 14%, 80% and 14% respectively. With the boxes empty, only the centre furrow wheel was slightly overloaded.

Average draft for the 9.2 m (30 ft) wide test machine, in primary tillage, at 8 km/h (5 mph) varied from 20.2 kN (4450 lb) at 50 mm (2 in) depth to 32.2 kN (7100 lb) at 90 mm (3.5 in) depth.

In primary tillage, at 8 km/h (5 mph) and 75 mm (3 in) depth, a tractor with 97 kW (130 hp) maximum power takeoff rating will have sufficient power reserve to operate the 9.2 m (30 ft) wide John Deere 1900.

The operator's manual was very well written and illustrated. Several pressure grease fittings and recommended chain servicing were not included in the lubrication section. The John Deere 1900 was safe to operate if normal safety procedures were followed.

Several mechanical problems occurred during functional testing.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying a jack for the main hitch.
2. Including in the operator's manual all pressure grease fittings and recommended servicing of the drive chains.
3. Modifying the disk gang frames to prevent twisting in stony fields.

Senior Engineer: G.E. Frehlich

Project Technologist: W.F. Stock

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A lift jack is currently available and maybe ordered with the machine as an optional attachment.
2. The additional information required on location of grease fittings and servicing of drive chains will be included in the next revision of the operator's manual.
3. Twisting of the gang frame arms during operation in stony fields will be investigated. The cause of yielding will be determined from parts returned and corrective measures will be taken on future production machines.

MANUFACTURER'S ADDITIONAL COMMENTS

1. Revisions have been made to the barley and rapeseed calibration settings on seed charts provided on 1982 machines. This new chart also provides allowances in settings for variations in machine width of cut.
2. A larger wheel with a 12.5L x 16 12-ply implement tire was adopted in 1981 for the middle furrow wheel position. This tire will eliminate overload in field operations with full grain and fertilizer boxes.

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

GENERAL DESCRIPTION

The John Deere 1900 is a 9.2 m (30 ft) wide one-way disk harrow consisting of two 4.6 m (15 ft) units hitched in a piggyback configuration. Each unit has five independent disk gangs, each containing six 508 mm (20 in) diameter disks spaced at 178 mm (7 in). Disk penetration is controlled with a hydraulic cylinder on each unit and a torsion bar on each gang. Width of cut is adjustable from 7.3 to 9.2 m (24 to 30 ft).

The John Deere 1900 is equipped with seeding and fertilizing attachments as standard equipment. The two grain boxes have a total capacity of 2060 L (57 bu) while the fertilizer boxes hold about 1010 kg (2225 lb) of granular fertilizer. Seed is metered by internally fluted, single run feed cups and fertilizer is metered by externally ridged traction wheels. Seed and fertilizer are delivered through common drop tubes adjacent to each disk.

The test machine was equipped with optional disk scrapers, rear frame weights and a rear stabilizing coulter. Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The John Deere 1900 was operated in the conditions shown in TABLE 1 for 85 hours while tilling 400 ha (1000 ac). It was evaluated for quality of work, ease of operation, ease of adjustment, power requirements, operator safety and suitability of the operator's manual. Of the total operating time, 42 hours were spent seeding. In addition, the seed and fertilizer systems were calibrated in the laboratory. Packers were not used during the seeding trials.

TABLE 1. Operating Conditions

Field Condition	Hours	Field Area ha
Soil Type		
- silty clay loam	46	258
- light loam	10	42
- loam	29	100
Total	65	400
Stony Phase		
- stone free	22	107
- occasional stones	31	178
- moderately stony	27	95
- very stony	5	20
Total	85	400

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was very good when seeding into summerfallow or into moist stubble and was fair when seeding into dry stubble. Penetration was poor when seeding into heavy trash or dry stubble that had been compacted. The optional six rear frame weights were needed to provide penetration in hard dry soils. Penetration was improved when the grain and fertilizer boxes were full and when calcium chloride solution or wheel weights were added to the furrow wheels. Penetration decreased slightly as ground speed increased.

The disks effectively cut through moderate amounts of surface trash when tilling firm soils. In soft soils, trash was turned without being cut. In very heavy trash, disk penetration was non-uniform regardless of the soil conditions. Penetration in trashy fields was improved by sharpening the disks and by increasing the disk angle.

Characteristic of most large disk harrows, penetration was uneven in rough, undulating fields. The long frame and triangular wheel configuration caused irregular penetration at the bottom of steep ravines or gullies. To improve penetration in rough, undulating fields, the depth setting of each unit had to be controlled hydraulically from the tractor.

Penetration and seeding depth were controlled by one hydraulic cylinder for each unit and by a torsion bar on each disk gang (FIGURE 2). The fully enclosed torsion bar could not be adjusted to vary the vertical force on each gang. The vertical force needed to lift a disk gang out of the soil varied from 955 N (210 lb) to 3636 N (800 lb) depending on the position of the hydraulic cylinder.

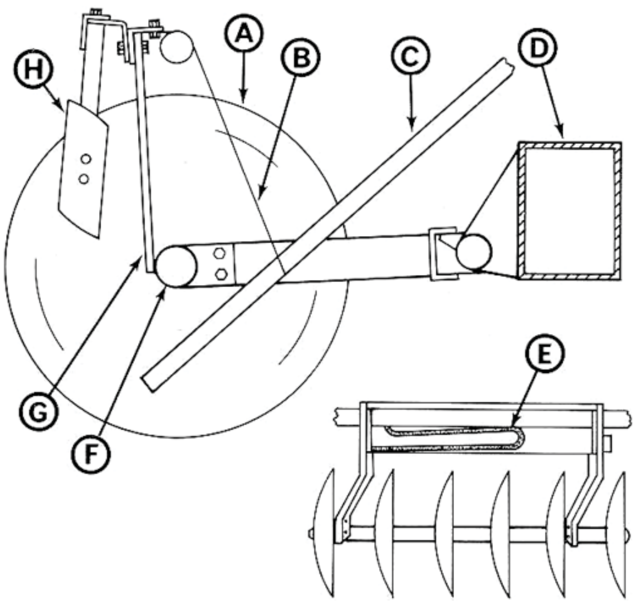


FIGURE 2. Disk Gang: (A) Disk, (B) Seed Tube Holder, (C) Seed and Fertilizer Drop Tube, (D) Main Frame, (E) Torsion Bar, (F) Gang Bearing, (G) Rock Deflector and Trash Bar, (H) Scraper.

Seed Placement: Seed placement was good in most field conditions. The seed tubes were positioned behind the disk as shown in FIGURE 3 to place the seed at the bottom of the furrow. At 8 km/h (5 mph) most seeds were placed within 12 mm (0.5 in) of the average seed depth. Higher speeds caused some seed scattering. Seed placement was slightly better in summerfallow than in stubble fields. In very trashy fields, seeds were placed amidst the trash if the disks failed to cut through it. If the trash was cut by the disks, the seeds were placed near the furrow bottom, and covered by a loose mixture of soil and trash. Seed placement in rough undulating fields was variable. In the bottom of steep ravines or gullies, seed was placed on the soil surface as the disks were unable to follow sharp variations in ground contour. Characteristic of all disk harrows, soil was not compacted firmly about the seeds. It is important that packers be used after seeding, especially in dry, loose or trashy soils, to aid seed germination and plant growth.

Stability: All one-way disk harrows have a characteristically large side draft which varies with changing field conditions. As a result, some sideways movement relative to the tractor, and changes in the disk angle or width of cut occur in non-uniform or undulating fields.

Stability of the John Deere 1900 was very good in most field conditions, provided the optional six rear frame weights were used and the rear land wheel was locked. Stability was poor when the rear frame weights were not used. Locking the rear unit land wheel to eliminate castoring, significantly improved stability. When the rear stabilizing coulter was used, weight was transferred from the rear furrow wheel to the coulter, thereby reducing the effectiveness of the furrow wheel. The stabilizing coulter improved stability only when the rear frame weights were added. Stability can also be improved by adding calcium chloride or wheel weights to the furrow wheels or rear unit land wheel, by operating at reduced speeds, by reducing the tillage depth and by increasing the disk angle. Extra weight is most effective when added to the rear furrow wheels.

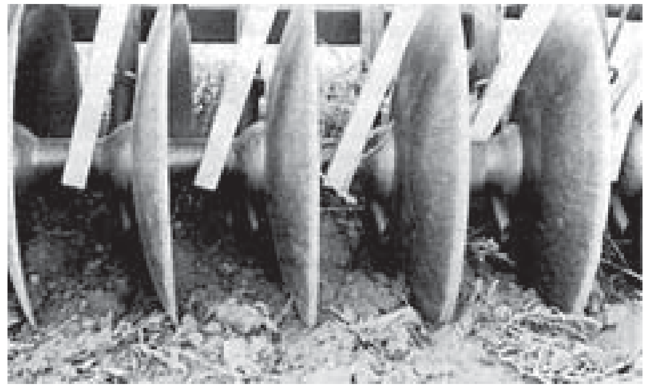
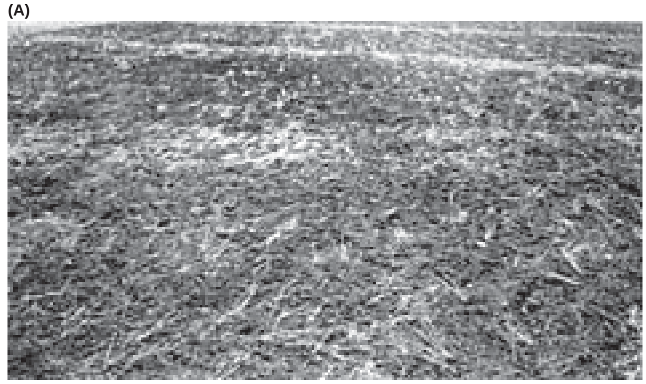


FIGURE 3. Seed Tube Position.

The width of cut was only slightly affected by changing ground speeds. The width of cut varied up to 305 mm (12 in) due to variations in soil hardness. When operating on side slopes up to 10% the width of cut varied up to 457 mm (18 in). When operating down slopes greater than 10°, the rear furrow wheel left the furrow. The disk harrow was more stable when tilling uphill or on a hillside sloping down to the right than when tilling downhill or on a hillside sloping down to the left.

Ridging: The John Deere 1900 usually produced an even seedbed with a uniform soil surface (FIGURE 4) provided it was properly adjusted and the tractor driven at a steady speed and consistent distance from the furrow. Untilled strips between the front and rear units occurred on steep hillsides or when operating at a width of cut greater than 9.2 m (30 ft) (FIGURE 5). Slight furrow bottom ridging occurred on hillsides and gradual left turns as the width of cut increased. Furrow bottom ridging decreased with narrower widths of cut. A width of cut 10% less than the nominal width of cut is recommended for seeding to obtain a good weed kill and to provide a uniform furrow bottom for seed placement. At speeds above 9.6 km/h (6 mph), bouncing of the disk harrow produced an uneven seedbed. Slight soil surface ridging occurred when making gradual right turns. In dry soils, a smoother surface with fewer lumps was obtained at higher ground speeds.

(A)



(B)

FIGURE 4. Soil Surface after Seeding into Stubble: (A) Heavy Trash Cover, (B) Light Trash Cover.

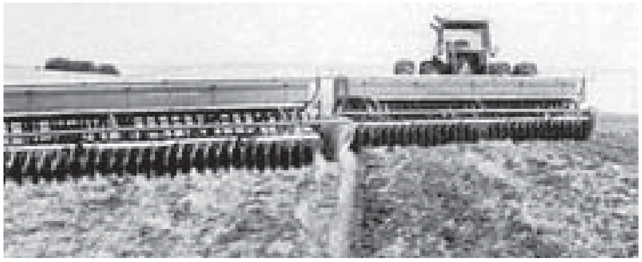


FIGURE 5. Centre Furrow Wheel Leaving the Furrow when Width of Cut Exceeds 9.2 m.

Seed Emergence: Seed emergence was uniform (FIGURE 6) in all fields with sufficient moisture and nutrient reserves. Emergence was delayed in hard soils or heavy trash areas of dry stubble fields (FIGURE 7).

FIGURE 6. Neepawa Wheat 37 Days after Seeding into Summerfallow. Moisture Conditions Slightly Below Average.

FIGURE 7. Patchy Emergence of Neepawa Wheat 42 Days after Seeding Directly into Hard Stubble with Rows of Heavy Trash. Moisture Conditions Below Average.

Metering Accuracy: The grain and fertilizer metering systems (FIGURE 8) were calibrated in the laboratory, using a standard procedure[1] and were compared with the manufacturer's calibrations.

Since the actual application rates for certain settings depend on factors such as the size, density, moisture content of seeds and fertilizer particles, and on the width of cut, it is not practical for a manufacturer to present charts to include all possible variations. Research has shown, however, that small variations in seed or fertilizer application rates will not significantly affect grain crop yields.

Seed Metering System: Large seeds such as wheat, oats and barley are metered through the seed cup with the feed gate up and the drive chain on the standard sprocket. Rapeseed and flax are metered through the seed cup with the feed gate down and the drive chain on the rapeseed or slow speed sprocket.

Seed metering system accuracy was very good in wheat, barley and oats and good in rapeseed. The manufacturer's calibration charts for wheat and oats were the same as the Machinery Institute's calibrations when using the same density seed. Some differences were obtained between the manufacturer's calibrations and the Machinery Institute's calibration for barley and rapeseed (FIGURES 9 and 10). The manufacturer's barley calibration was calculated using the volume seeding rates from the operator's manual and the density of grain used for the Machinery Institute calibration. The manufacturer's rapeseed calibration was obtained using the mass seeding rates indicated in the operator's manual. The manufacturer's rapeseed density was not given. Differences in seeding rates will occur when using seed of different size, density and moisture content or when operating at different widths of cut. To obtain exact seeding rates, it is important to adjust for different seed properties and widths of cut.

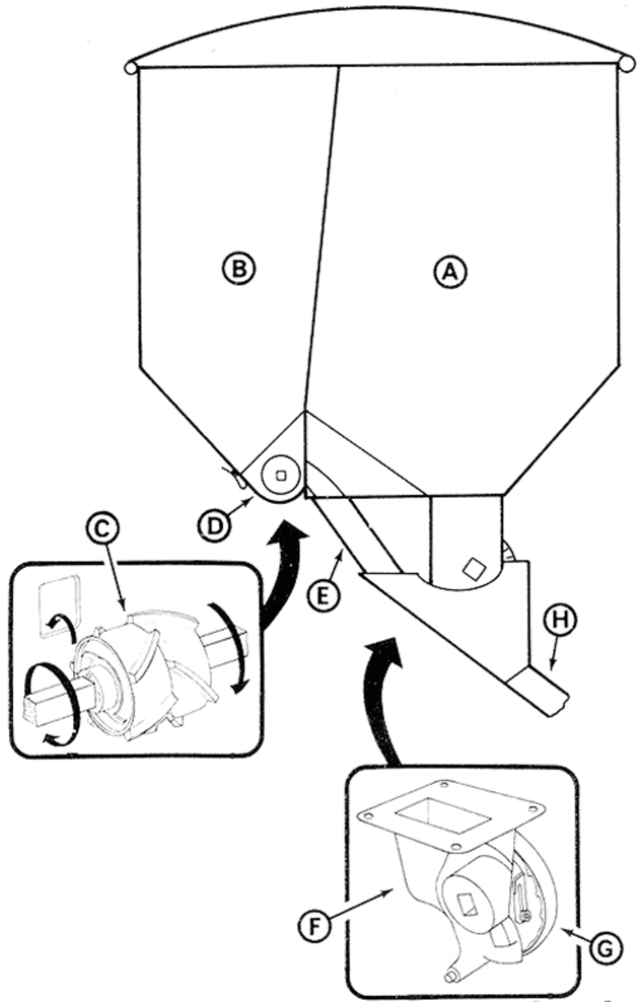


FIGURE 8. Seed and Fertilizer Metering System: (A) Grain Box, (B) Fertilizer Box, (C) Externally Ridged Traction Wheel, (D) Fertilizer Cleanout Panel, (E) Fertilizer Spout, (F) Internally Fluted Single Run Feed Cup, (G) Adjustable Feed Gate, (H) Grain and Fertilizer Drop Tube.

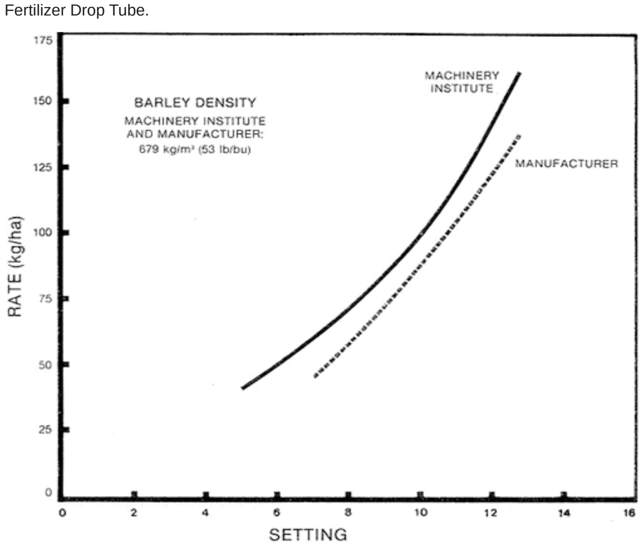


FIGURE 9. Barley Calibration.

[1]*Machinery Institute T792-R79, Detailed Test Procedures for Disker Seeders.*

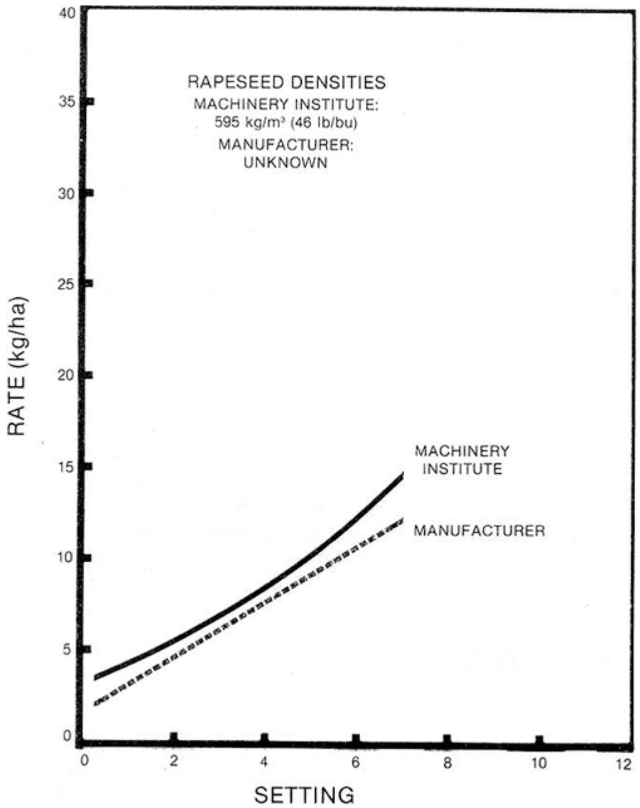


FIGURE 10. Rapeseed Calibration.

Field roughness, depth of seed in the grain box, variation in field slope or ground speed did not affect the seeding rate for either large or small seeds.

The coefficient of variation[2] (CV) is commonly used to describe the variation of the application rate among individual seed cups. An accepted variation for grain or fertilizer application is a CV value not greater than 15%. If the CV is less than 15%, seeding is acceptable, whereas if the CV is much greater than 15%, the variation among individual seed cups is excessive.

For wheat, oats and barley, seeding was very uniform. For example, when seeding wheat at 85 kg/ha (75 lb/ac), the CV was only 2%. When seeding rapeseed at a rate of 7.2 kg/ha (6.4 lb/ac), the CV was 11%.

Fertilizer Metering System: Fertilizer metering accuracy was good. Comparison of the manufacturer's calibration with the actual application rate for 11-51-0 fertilizer having a density of 853 kg/m³ (53 lb/ft³) showed actual application rates 33% higher than indicated. Differences in fertilizing rates will occur when using fertilizer of different size, density and moisture content or when operating at different widths of cut. To obtain exact fertilizing rates, it is important to adjust for different fertilizer properties and widths of cut. The density of fertilizer used by the manufacturer was not indicated in the operator's manual.

The variation in the fertilizing rate from one run to another was very good. For example, when distributing 11-51-0 fertilizer at a rate of 58 kg/ha (52 lb/ac), the coefficient of variation among individual feed cups was only 3%.

The fertilizer application rate was not significantly affected by level of fertilizer in the box, field roughness, ground speed or machine side slope. It was, however, significantly affected by downhill slopes. FIGURE 11 shows the variation in application rates obtained when fertilizing uphill, downhill and on level ground. The application rate quickly dropped to zero as the downhill slope exceeded 10°.

Grass Seeding: FIGURE 12 presents the Machinery Institute calibration for alfalfa, obtained by seeding with the feed gate down and the drive chain on the rapeseed sprocket. The graph is presented for operator information only, since this calibration was not given in the operator's manual.

Large light seeds such as bromegrass and ryegrass bridged over the seed cup openings and prevented the seed from being metered. Large light seeds can usually be metered by mixing the seed with heavier material such as cracked grain or fertilizer.

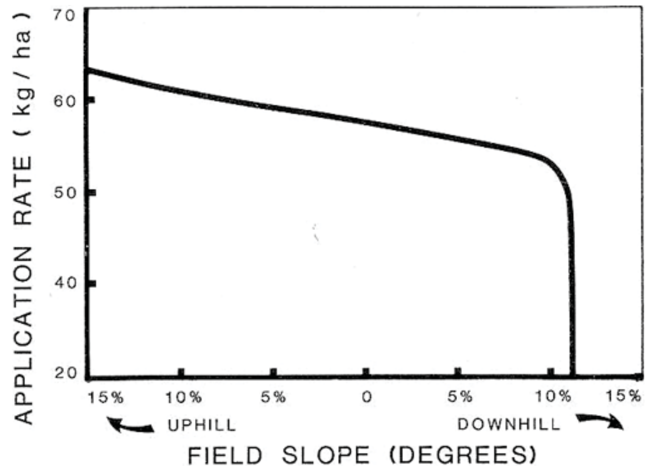


FIGURE 11. Variation in Fertilizer Application Rate with Change in Fore-and-aft Slope While Applying 11-51-0 Fertilizer at the 3-3/4 Setting.

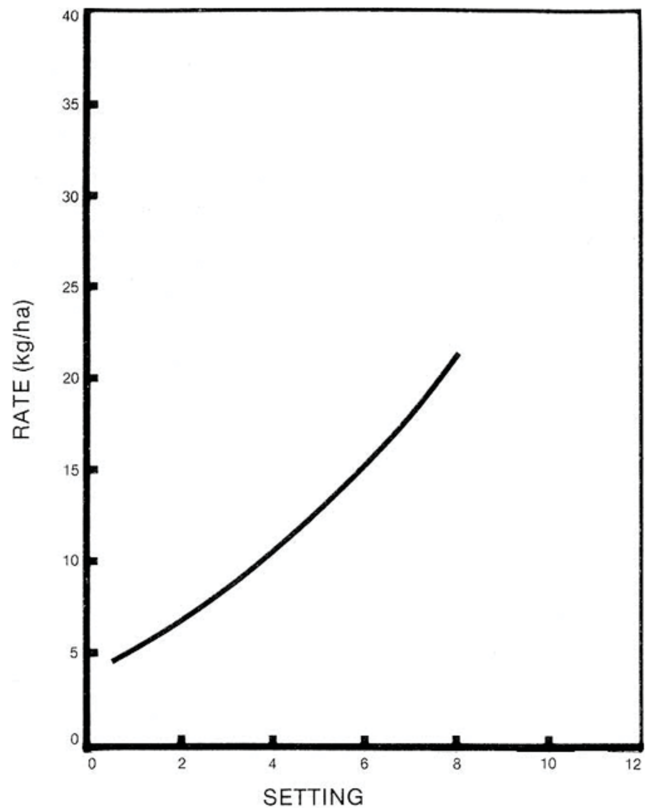


FIGURE 12. Alfalfa Calibration using the Rapeseed Drive with the Feed Gates Down. Grain Density - 721 kg/m³ (56 lb/bu).

EASE OF OPERATION

Wet Fields: Mud buildup on the disks and loose trash occasionally caused disk plugging in wet fields. Plugging occurred more readily in heavy trash areas where bunched straw was pushed ahead of the gangs.

The rock deflectors reduced the buildup of trash, but did not prevent mud from clinging to the disks. Optional disk scrapers reduced the mud buildup in moist soils, but occasionally mud and straw collected between the scraper and the disk to cause plugging (FIGURE 13). As is common with most one-way disk harrows, plugging occurred more readily at reduced widths of cut and at increased working depths.

Stony Fields: Small 180 to 230 mm (7 to 9 in) diameter rocks sometimes lodged between adjacent disks in stony fields. The rock deflectors eliminated lodging of most rocks except those that wedged tightly between the disks, and jammed against the rock deflectors to stop gang rotation. Occasionally, larger surface rocks

[2]The coefficient of variation is the standard deviation of application rates from individual seed cups expressed as a percent of the mean application rate.

were pushed ahead by the disks until plugging occurred.

FIGURE 13. Trash and Mud Buildup Between the Scrapers and Disks.

The torsion bar disk gangs could lift a maximum of 320 mm (12.5 in) to clear rocks and other obstructions. Disk gang force at maximum trip clearance was about 3640 N (800 lb). Under normal operating conditions, the disks rode smoothly over rocks and other obstructions.

Trashy Fields: Heavy surface trash caused poor disk penetration, poor seed placement and occasional plugging. Plugging occurred when loose clumps of straw and trash were pushed ahead of the disk gangs. Plugging due to trash was more frequent in wet fields than in firm, dry fields. In dry fields, trash built up between the scrapers and the disks, but did not cause plugging. In moist fields, mud collected on the trash buildup and occasionally caused plugging. Trash buildup did not occur when only rock deflectors were used.

Changing Disks: Disks gangs were easily removed by removing four bolts from the disk gang frame. Two lock nuts tightened the disks on the disk gang arbor bolt. Once removed, the disks were easily replaced. New disks should be installed at the rear of the disk gang to maintain uniform penetration.

Filling: Two lids for each unit covered both the grain and fertilizer compartments. Interior fertilizer covers prevented the grain and fertilizer from being mixed when filling. The boxes could be filled only from the front since the lids could not be reversed. No walkway was provided and the hitches and land wheel interfered with filling. The John Deere 1900 was capable of carrying 2060 L (57 bu) of grain and 1010 kg (2225 lb) of fertilizer. Grain and fertilizer level indicators were not provided.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent leakage into the boxes, even in heavy rains. However, if the disk harrow was allowed to stand out in the rain, the fertilizer shafts should be checked before operation to ensure that they rotate freely and that the fertilizer has not caked.

Cleaning: The grain box lid opened wide permitting easy access with a 20 L (5 gal) pail. The flat bottom was easily cleaned with a brush or vacuum cleaner, but was difficult to reach while standing on the ground. The tapered fertilizer boxes were easily cleaned by removing bottom drop out panels, which were equipped with quick release latches. About 10 kg (22 lb) of fertilizer could not be metered from the fertilizer box. Visibility and access into the fertilizer box were very good.

Acremetre: The John Deere 1900 was equipped with an acremetre that recorded the nearest tenth acre up to 1000 acres. The accuracy of the acremetre depended upon the width of cut. A metric counter was not available.

Turning: Left 90° turns were easily made. Sharp left turns greater than 90° caused excessive skidding of the rear land wheel if it was locked to prevent castoring (FIGURE 14). Skidding became more severe when the rear stabilizing coulter was used. Tilled corners were smooth and could easily be covered by two passes when finishing the field. Sharp right turns had to be made with caution due to interference between the tractor tire and front unit. When making right turns, it was important that the gangs be raised to reduce draft and prevent possible disk damage in stony fields.

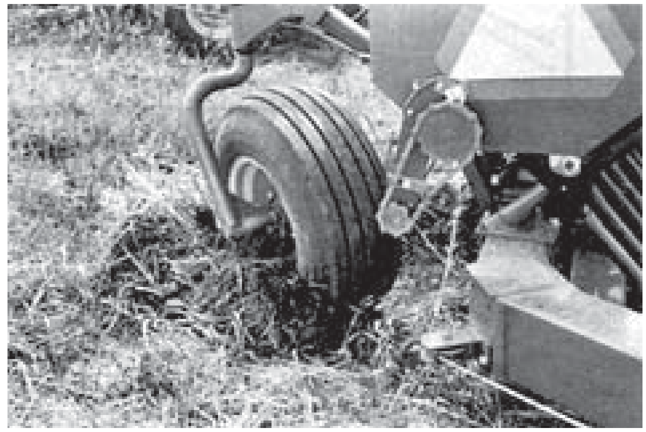


FIGURE 14. Skidding of the Locked Rear Land Wheel when Making Left Turns Greater than 90°.

Transporting: The John Deere 1900 could be safely transported at speeds up to 34 km/h (21 mph) when in full transport position, providing the seed and fertilizer boxes were empty. It could be put into or taken out of full transport position by one man in about 20 minutes. Wheel lead adjustments were not required when changing to or from transport position. A jack was needed for adjusting the hitch and for hitching to the tractor. It is recommended that the manufacturer supply a jack for the main hitch. A lock on the hydraulic cylinder prevented the disk gangs from being lowered while transporting. Damage could not occur when the hydraulics were activated with the lock engaged. Transport width was narrow enough to allow most vehicles to pass on secondary roads (FIGURE 15).

The John Deere 1900 could be safely transported at speeds up to 21 km/h (13 mph) when in semi-transport position (FIGURE 16). Semi-transport width was only 760 mm (30 in) wider than full transport width making transport on secondary roads safe and easy. The John Deere 1900 could be placed in or taken out of semi-transport by one person in about 10 minutes. Right or left turns were easily made in semi-transport.

FIGURE 15. Full Transport Position.

FIGURE 16. Semi-Transport Position.

EASE OF ADJUSTMENT

Width of Cut: The width of cut was adjustable from 7.3 to 9.2 m (24 to 30 ft) depending upon soil conditions, operating depth and ground speed. The width of cut was set by adjusting the angle between the main frame, and the centre and rear furrow wheel subframes. Large adjustments also required lengthening or shortening the hitch cable to make the two units parallel, setting the furrow wheel leads, and positioning the front furrow wheel. All adjustments were quickly and easily made and were adequate to provide the desired range of cutting widths.

Tillable Depth: The depth of tillage was determined by the position of the hydraulic cylinder on each unit. The hydraulic cylinders were easily adjusted from the tractor. An adjustable stop on the cylinder aided in setting the desired depth.

Individual unit frames were easily levelled with levelling screws at the front of each unit.

The front unit was equipped with an indicator showing the hydraulic cylinder position. The indicator was useful for initial cylinder setting, but was difficult to see from the tractor while operating in the field.

Lubrication: Forty-nine pressure grease fittings required greasing every 10 hours of operation and four required greasing every 100 hours of operation. The wheel bearings are to be cleaned and repacked with grease each season. Daily lubrication took about 5 to 10 minutes. All lubrication points were readily accessible. Several pressure grease fittings were not mentioned in the operator's manual.

Seeding and Fertilizing Rates: Seeding and fertilizing rates were easily adjusted. Two screws on the seed and fertilizer drives adjusted the stroke of a cam which varied the metering shaft speed. When, adjusting the screw with the wrench provided, the screw must be moved up and down to prevent damaging the cam. The metering shaft speed could be reduced for seeding rapeseed and other small seeds by pinning the rapeseed sprocket to the shaft and unpinning the standard sprocket. The feed gates were also moved down for seeding small seeds.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 17 shows draft requirements for one-way disk harrows in typical primary tillage at a speed of 8 km/h (5 mph). This figure gives average requirements based on tests of eleven machines in 36 different field conditions.

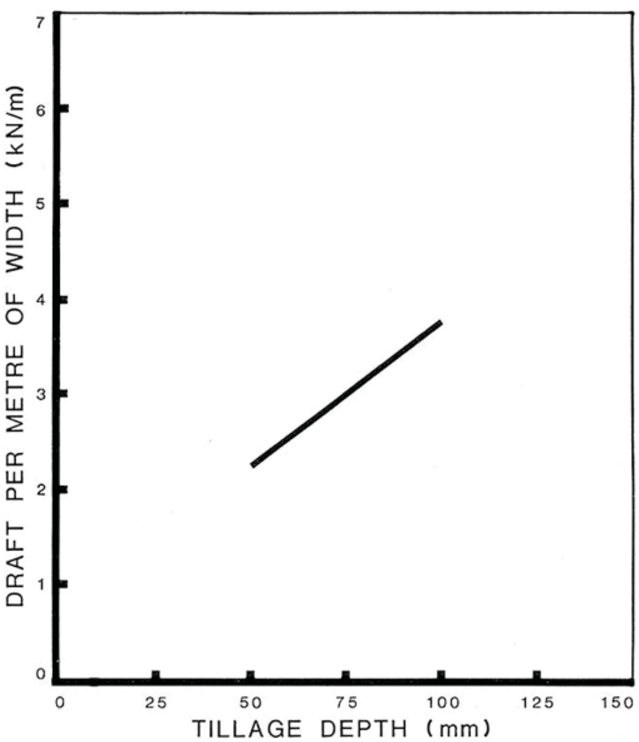


FIGURE 17. Average Draft Requirements for One-Way Disk Harrows at 8 km/h.

It is impossible to make meaningful comparisons of the draft requirements of different makes of one-way disk harrows. Draft requirements for the same one-way disk harrow, in the same field, may vary by as much as 30% in two different years due to changes in soil conditions. Variation in soil conditions affect draft much more than variation in machine make, usually making it impossible to measure any significant draft differences between different makes of one-way disk harrows. The difficulty in accurately measuring and controlling the depth of tillage, which directly affects draft requirements, further complicates direct draft comparisons.

In primary tillage, average draft at 8 km/h (5 mph), varied from 2.2 kN/m (147 lb/ft) of width at 50 mm (2 in) depth to 3.5 kN/m (235 lb/ft) of width at 90 mm (3.5 in) depth. This represents a total draft from 20.2 to 32.2 kN (4500 to 7000 lb) for the 9.2 m (30 ft) test machine.

Increasing speed by 1 km/h, increased draft by about 134 N/m of width (a draft increase of 14 lb/ft of width for a 1 mph speed increase). For the 9.2 m (30 ft) wide test machine, this represents a draft increase of 1.23 kN for a 1 km/h speed increase (430 lb for a 1 mph speed increase).

Tractor Size: TABLE 2 shows tractor power ratings needed to operate the 9.2 m (30 ft) wide John Deere 1900 in primary tillage. Tractor power requirements have been adjusted to include tractive efficiency and are based on the tractor operating at 80% of maximum power on a level field. The tractor sizes presented in the table are the maximum power takeoff rating, as determined by Nebraska tests or as presented by the tractor manufacturer. Tractors selected according to this table will have ample power reserve to operate the John Deere 1900 in primary tillage.

Tractor size may be determined from TABLE 2 by selecting the desired tillage depth and speed. For example, at a depth of 75 mm (3 in) and a speed of 8 km/h (5 mph), a 97 kW (130 hp) tractor is needed to operate the John Deere 1900.

TABLE 2. Tractor Size (Maximum Power Take-Off Rating, kW) to Operate the 9.2 m Wide John Deere 1900 in Primary Tillage

Depth	Speed					
mm	5	6	7	8	9	10
50	37	48	59	72	82	101
75	53	66	81	97	114	132
89	61	77	93	111	130	149
100	68	85	103	122	142	164

OPERATOR SAFETY

The John Deere 1900 was safe to operate if normal safety precautions were observed.

The centre furrow wheel exceeded the Tire and Rim Association maximum rating for 11L x 15, 8-ply implement tires by 53% when operating in the field with full grain and fertilizer boxes. No overload occurred with empty boxes. The front furrow wheel, centre furrow wheel and front land wheel were overloaded by 14%, 80% and 14% respectively, when transporting with full boxes at speeds above 16 km/h (10 mph). There was only slight overload on the centre furrow wheel when transporting with empty boxes.

Each unit was equipped with a slow moving vehicle decal that was readily visible when transporting.

OPERATOR'S MANUAL

The operator's manual was very well written and illustrated, and presented much useful information on operation and adjustments and the affects of adjustments. Both English and Metric calibration charts were included in the operator's manual along with a table to adjust the seeding rate for different widths of cut.

The operator's manual did not list all the pressure grease fittings or include recommended maintenance of drive chains. It is recommended that the operator's manual be revised to include all pressure grease fittings and recommended drive chain maintenance.

DURABILITY RESULTS

The John Deere 1900 was operated for 85 hours while tilling about 400 ha (1000 acre). The intent of the test was to evaluate the functional performance of the machine, 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	Hours	Field Area ha
-The lock nut on the disk gang axle was lost and replaced at	4	20
-The fertilizer rate adjusting cam was damaged when adjusting the fertilizer rate. It was repaired at	8	47
-The grain metering shaft twisted off when a bushing failed. Shaft and bushing were replaced at	45	190
-Four disk gang frames were slightly twisted	during the test	
-Six disks were bent and 3 disks were broken	during the test	

DISCUSSION OF MECHANICAL PROBLEMS

Metering System: Damage to the fertilizer metering cam occurred while turning the adjustment screw to set the fertilizer application rate. Damage occurred only if the adjustment screw was turned when the cam slot (FIGURE 18) was perpendicular to the screw. It is important that the screw be moved up and down in the cam slot as it is turned to prevent damaging the cam.

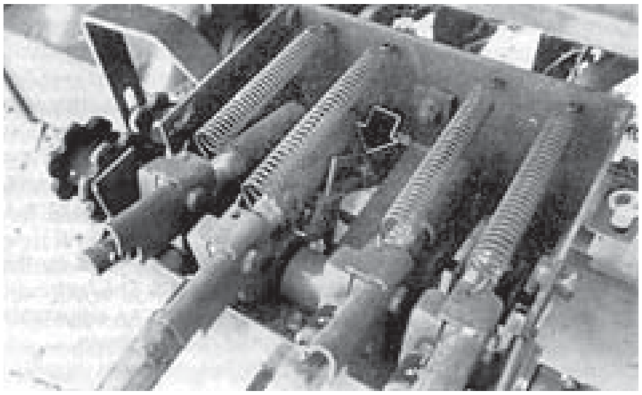


FIGURE 18. Metering System Adjustment.

Grain Shaft: A misaligned bushing on the grain metering shaft failed, causing the metering shaft to bind and twist off. Bushing failure was attributed to lack of grease and misalignment. The grain shaft, bushing, and bushing collar were replaced and then greased at regular intervals. No further problems occurred. It is recommended that the manufacturer include greasing of the bushings in the lubrication section of the operator's manual.

Disk Gangs: Four disk gang frames were slightly twisted when operating in stony fields (FIGURE 19). It is recommended that the manufacturer consider strengthening the disk gang frame to prevent twisting in stony fields.

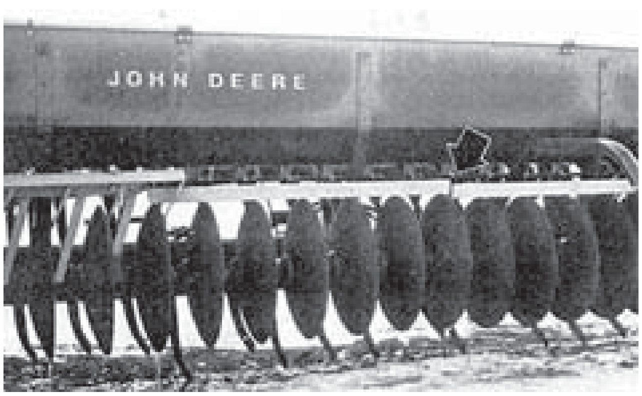


FIGURE 19. Twisting of the Disk Gang Frame.

Disks: Three disks were broken. Several disks were bent and nicked, with the majority still suitable for resharpening.

APPENDIX I
SPECIFICATIONS

MAKE:	John Deere Seeding Tiller		
MODEL:	1900		
SERIAL NUMBER:			
-- front unit	004218W		
-- rear unit	004219W		
HITCH CONFIGURATION:			
-- number of units	2		
-- hitch type	piggyback		
OVERALL DIMENSIONS:	**Field**	**Semi-Transport**	**Transport**
-- height	1375 mm	1800 mm	1800 mm
-- width	9350 mm	5390 mm	4630 mm
-- ground clearance	140 mm	140 mm	140 mm
-- nominal seeding width	9144 mm		
SEED METERING SYSTEM:			
-- type	internally fluted single run feed wheel		
-- drive	infinitely variable transmission driven from land wheel		
-- adjustment	turning metering screws on transmission varies output speed		
-- transfer to openers	formed rubber tubes		
FERTILIZER METERING SYSTEM:			
-- type	externally ridged traction wheel		
-- drive	infinitely variable transmission driven from land wheel		
-- adjustment	turning metering screws on transmission varies output speed		
-- transfer to openers	plastic cup to top of grain drop tube		
DISK GANGS:			
-- number of disks per unit	30		
-- number of gangs per unit	5		
-- number of disks per gang	6		
-- disk diameter	508 mm		
-- disk thickness	5.5 mm (5 gauge)		
-- disk concavity	65 mm		
-- disk spacing	178 mm		
TIRES:			
-- number	5		
-- size	11L x 15, 8 ply		
GRAIN AND FERTILIZER BOX CAPACITIES:			
-- grain box capacity	2060L		
-- fertilizer box capacity	1010 kg		
WEIGHT:	**Boxes Empty**	**Boxes Full**	
-- weight on front furrow wheel	757 kg	1293 kg	
-- weight on front land wheel	671 kg	1292 kg	
-- weight on centre furrow wheel	1266 kg	2033 kg	
-- weight on rear land wheel	381 kg	765 kg	
-- weight on rear furrow wheel	753 kg	1010 kg	
Total	3828 kg	6393 kg	
LUBRICATION POINTS:			
-- 10 h	49 pressure grease fittings		
-- 100 h	4 pressure grease fittings		
-- seasonal	wheel bearings		
NUMBER OF CHAIN DRIVES:	8		
NUMBER OF HYDRAULIC LIFTS:	2		
NUMBER OF SEALED BEARINGS:	28		

APPENDIX II
MACHINE RATINGS

The following rating scale is used in Machinery Institute Evaluation Reports:

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

APPENDIX III
CONVERSION TABLE

1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 hectare (ha)	= 2.5 acres (ac)
1 litre (L)	= 0.03 bushels (bu)
1 newton (N)	= 0.2 pounds force (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kilogram/hectare (kg/ha)	= 0.9 pounds/acre (lb/ac)

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:

P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080