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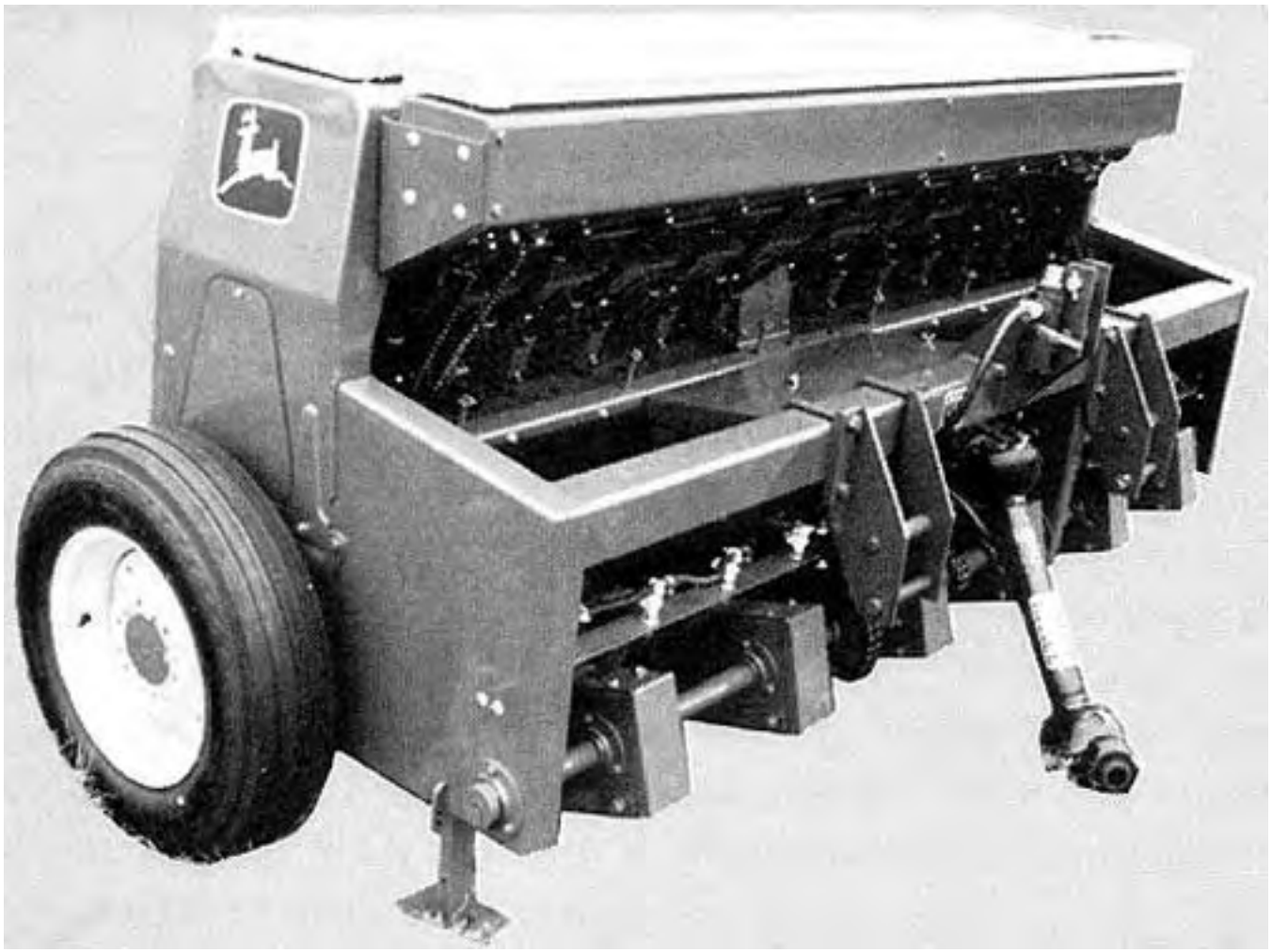
Evaluation Report 102



John Deere 1500 Powr-Till Seeder

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

JOHN DEERE 1500 POWR-TILL SEEDER

MANUFACTURER:
John Deere Des Moines Works
Des Moines, Iowa 50306
U.S.A.

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

RETAIL PRICE:
$7,250.00 (May, 1978, f.o.b. Portage la Prairie, grain model, with grass seeding attachment and herbicide spraying attachment).

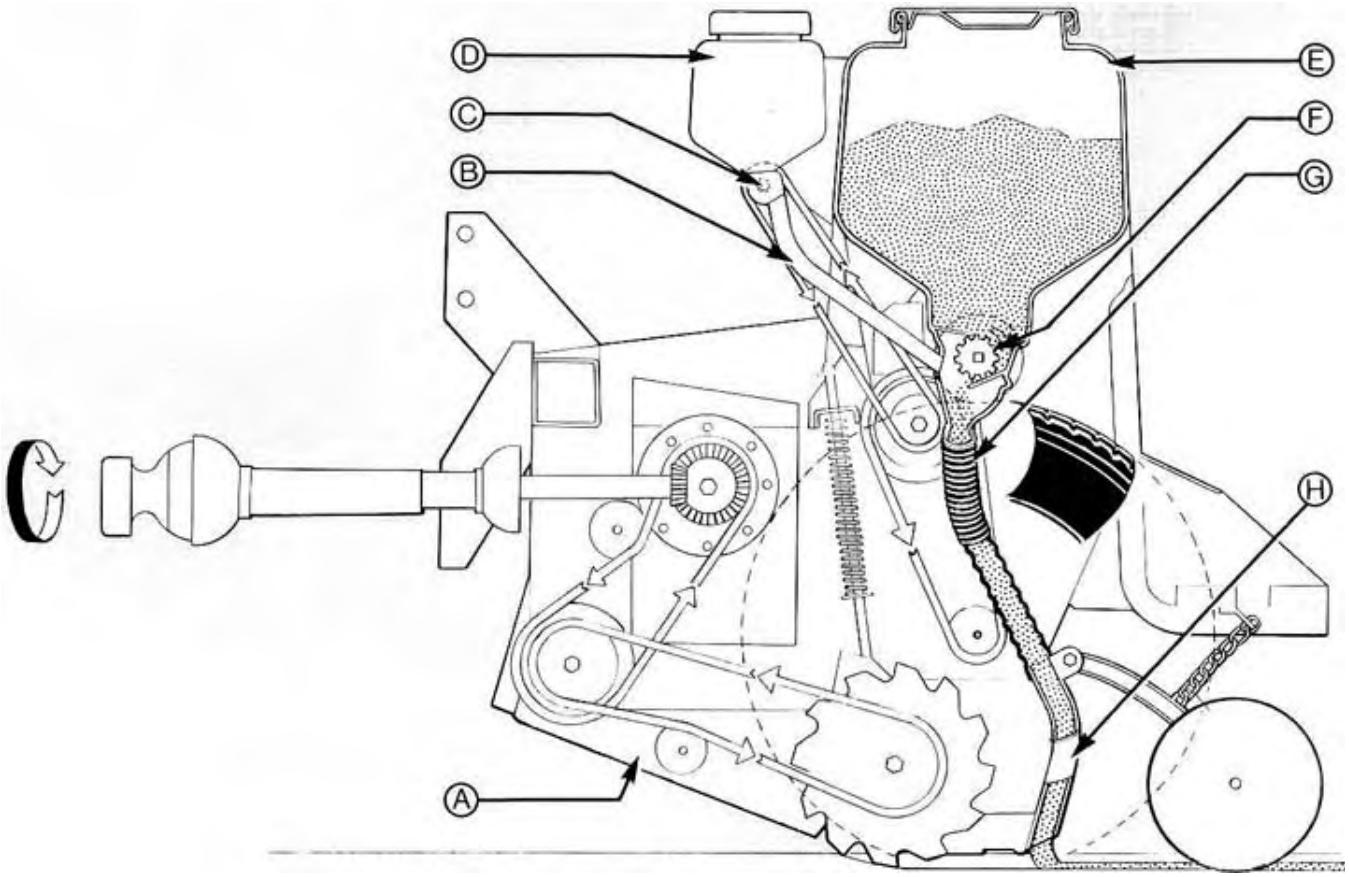


FIGURE 1. Grain and Optional Grass Seed Metering Systems: A) Cutter Wheel Unit, B) Grass Seed Tube, C) Externally Fluted Grass Feed Roll, D) Grass Seed Box, E) Grain Box, F) Externally Fluted Grain Feed Roll, G) Seed Tube, H) Seed Boot.

SUMMARY AND CONCLUSIONS

Overall functional performance of the John Deere 1500 Powr-Till seeder was very good. Its performance in rough, stony native rangeland was also very good.

Performance of the defoliant spraying attachment was not evaluated[1].

Nominal power requirements ranged from 30 to 40 kW (40 to 53 hp) when seeding at a speed of 10 km/h (6 mph).

Cutter wheel performance was very good in all soils provided that the existing crop was closely grazed or clipped before seeding. When attempting to seed in unclipped fields, wrapping of grass around the cutter wheels was a problem.

Firming wheel performance was very good. The firming wheels effectively placed a shallow layer of soil over the seed in most field conditions.

Accuracy of the grain metering system was good in barley, wheat and oats, but was fair for seeding small seeds such as alfalfa. When seeding small seeds with the grain box, seeding accuracy was affected by field roughness. Bouncing of the drill caused the feed rolls to move on the seed shaft.

This did not cause significant variations among seed runs but did result in significant reductions in overall seeding rates. Variations in seeding rates among seed runs was negligible when seeding larger grains such as wheat, oats or barley.

Seeding rates, in all crops were not significantly affected by field slope, ground speed or the level of grain in the grain box.

Performance with the grass seeding attachment was good when seeding small seeds such as alfalfa, timothy or reed canary grass. As is common with such attachments, it was not suited for large light seeds such as bromegrass, orchard grass or Russian wild ryegrass. An agitator attachment (not evaluated) is available for seeding such crops through the grain box.

Both grain and grass seeding systems were convenient to adjust. Servicing was convenient. Drive unit chain tension was difficult to check. Planting depth was fairly easy to adjust.

The operator's manual was very good. It contained comprehensive instructions on adjustment, repair, maintenance and safety. The John Deere 1500 was safe to operate if normal safety procedures were followed.

Few mechanical problems occurred despite the fact that the seeder was operated predominantly in rough native pastures, which were often too stony for other agricultural use, for much of the evaluation. The cutter wheel teeth wore quickly in abrasive sandy soils.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the jack stand locking pins to improve ease of use.

[1]Proper establishment of a new crop when interseeded into existing grassland is dependent upon controlling competition from existing grass crops, either by chemical means or pre-seeding tillage. Techniques may vary considerably dependent on local conditions and are too involved to comment upon in a machinery evaluation report.

2. Providing locking devices on the cutter wheel drive unit bearing retainer bolts and housing assembly bolts.
3. Providing instructions in the operator's manual on procedures for removal of the cutting wheel retaining nuts.
4. Providing an access hole in the side of the cutter wheel drive unit to facilitate inspection and servicing.
5. Providing information in' the operator's manual on recommended methods of resurfacing cutter wheel teeth.
6. Including information in the operator's manual on recommended grain box feed gate settings and seed densities used in preparing the calibration tables.

Chief Engineer -- E.O. Nyborg
Senior Engineer -- J.G. Thauberger
Project Engineer -- R.R. Hochstein

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We will consider design improvements, which will improve the ease of use of the jack stand locking pin.
2. The redesigned version of this machine provides locking devices on the cutter wheel drive unit bearing retainer bolts as suggested.
3. Operator's Manuals for the new model provide procedures for removal of the cutter wheel retaining nut. Easier removal procedures are being developed.
4. The redesigned machine provides an access hole in the side of the cutter wheel drive unit to facilitate inspection and service.
5. We will consider providing information in the Operator Manual as tested and proven methods of resurfacing cutter wheel teeth become known.
6. Additional calibration information relating grass seeding rates to grain box feed gate settings is being developed.

GENERAL DESCRIPTION

The John Deere 1500 is a 2440 mm (8 ft) power take-off driven seed drill, with 200 mm (8 in) row spacing, designed for pasture and rangeland rejuvenation by interseeding grasses, grains or legumes. It is adaptable to either a category II or III three-point hitch. The test machine was equipped with optional grass seeding and herbicide spraying attachments.

Twelve power take-off driven cutter wheels, which rotate in the direction of travel, cut 13 mm (0.5 in) wide furrows for each seed run. Seed is dropped into the furrows through steel seed boots and then covered by the firming wheels. Twelve cutters and firming wheels are mounted in pairs on six drive units, which pivot about a main drive shaft. Seeding depth is controlled by adjustable skid plates and compression springs on each drive unit.

It is available with a grain seeding box or an optional grass seeding attachment. Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The John Deere 1500 was mounted on a David Brown 990 tractor and operated in the conditions shown in TABLES 1 and 2 for 94 hours while seeding about 85 ha (208 ac). It was evaluated for quality of work, ease of operation, ease of adjustment, rate of work, power requirements, operator safety and suitability of the operator's manual. In addition, the grain metering system and the grass seed attachment were calibrated in the laboratory.

TABLE 1. Operating Conditions

Field Condition	Soil Texture	Ground Speed		Op. Time	Field Area	
		km/h	mph	hours	ha	ac
Brome Grass Sod	Sand	5	3	14	5	11
Lightly Pre-tilled	Sandy Clay Loam	5	3	30	30	73
Kentucky Blue Grass Sod	Sandy Clay Loam	8	5	22	22	56
Alfalfa Sod	Sandy Silt	10	6	11	9	21
Native Rangeland	Clay Loam	10	6	12	16	40
Clover Sod	Clay	5	3	3	1	2
Native Rangeland	Peat	10	6	2	2	4
Total				94	85	208

TABLE 2. Operation in Stony Conditions

Stony Conditions	Operating Time	Field Area	
	hours	ha	ac
Stone Free	23	14	35
Occasional Stones	16	12	29
Moderately Stony	25	29	71
Very Stony	30	30	73
Total	94	85	208

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was excellent in all field conditions. Furrow depth was controlled by lowering or raising the skid plates on the individual cutter wheel units (FIGURE 2). The downward force on the cutter wheels was controlled by adjusting the push rod springs. The range of adjustment was ample. Maximum spring force had to be used in heavy soils and soils with trash cover. In loose soils spring force had to be reduced to minimize dragging and bunching ahead of the skid plates.

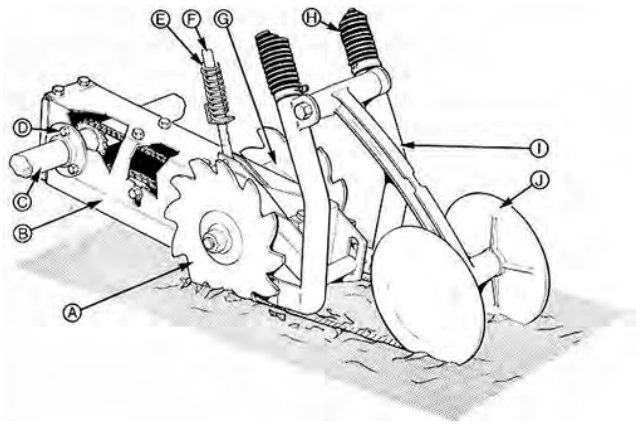


FIGURE 2. Cutter Wheel Unit: (A) Cutter Wheel, (B) Drive Unit Housing, (C) Drive Shaft, (D) Bearing Retainer, (E) Spring, (F) Push Rod, (G) Skid Plate, (H) Seed Tube, (I) Seed Boot, (J) Firming Wheel.

Field Conditions: The cutter wheels performed best in clipped or well-grazed fields. If established grass was too high, it wrapped around the cutter wheel hubs causing binding. FIGURE 3 shows grass accumulation on the cutter wheels when seeding in 200 mm (8 in) native prairie wool. The operator's manual advised against operating in unclipped fields.

FIGURE 3. Grass Wrapping on Cutter Wheels when Operating in 200 mm (8 in) Prairie Wool.

The John Deere 1500 performed well in wet conditions. Some seeding was carried out during light rain with no noticeable effect on machine performance. Plugging of the seed boots was not a problem.

Most of the evaluation was conducted in native rangeland and

pasture, much of which was too stony for other agricultural use. Field surfaces, in many cases were very rough. Performance was very good in such conditions. The individual cutter wheel units were capable of clearing surface stones up to 150 mm (6 in) while the three-point hitch provided clearance for larger obstacles. The drill followed irregular ground contours well.

Seed Placement: Depth of seed placement was determined by the amount of soil falling back into the furrows behind the cutter wheels. In firm heavy soils, seed was placed at the furrow bottom whereas in loose or sandy soils, it was usually placed at a shallower depth. In most cases, all seed was metered in a narrow band directly into the furrow.

Soil Firming: The firming wheels effectively covered the seed with a shallow soil layer in most field conditions. Soil and surface conditions had little effect on firming wheel performance.

Crop Emergence: An assessment of crop emergence and subsequent survival was not made. Research[2] has shown that for interseeding of tame grasses into established grass stands, it is necessary to reduce competition from existing grass during initial growing stages. The optional spray attachment covers a 100 mm (4 in) wide strip directly ahead of each cutter wheel and is intended for use with defoliants such as paraquat. This leaves alternate 100 mm (4 in) wide spaces of intact grass, among the defoliated strips. FIGURE 4 shows a field of native grassland immediately after seeding. Examination after 75 days showed virtually no emergence, however, no defoliant spray was used in this field. FIGURE 5 shows emergence after 75 days in a similar field where native grass competition had been reduced by disking before seeding.

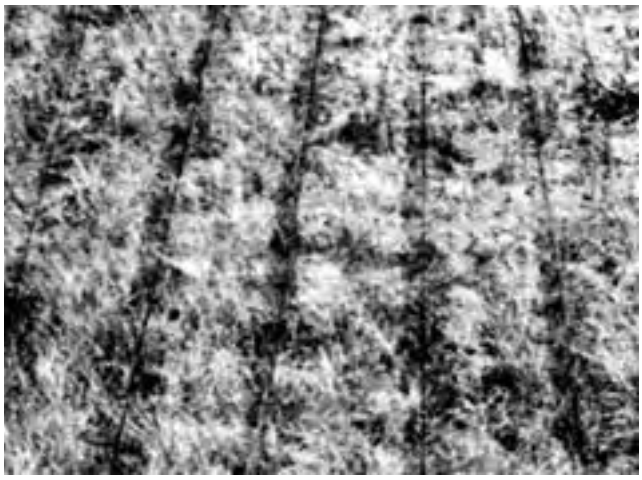


FIGURE 4. A Field of Native Grassland Immediately After Seeding.

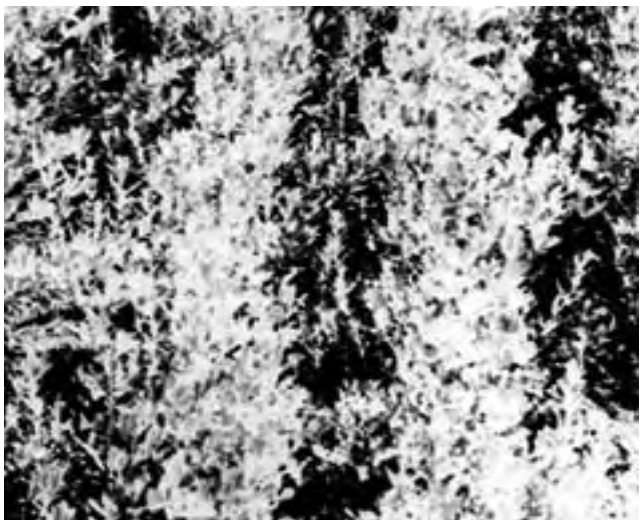


FIGURE 5. Emergence After 75 Days in a Field of Native Grassland, Which Had Been Disked Before Seeding.

Metering Accuracy: The grain and optional grass seed metering system (FIGURE 1) were calibrated in the laboratory[3] and compared with the manufacturer's calibrations. Since actual application rates depend on many factors such as seed size, density and moisture content, it is not possible for a manufacturer to present calibration tables which suit all variations for a certain variety of seed. Field calibration checks are necessary for seed with properties, which differ from those in the manufacturer's calibration tables. Research indicates that small variations in seeding rates will not significantly affect yields.

Grain Metering System: FIGURES 6 to 9 show calibration curves for the John Deere 1500 in wheat, barley, oats and alfalfa, when using the slow speed grain drive adjusted according to the manufacturer's calibrations. The seed densities (bushel weights) used in the PAMI calibrations are indicated. The seed densities used in the manufacturer's calibration tables were not provided in the operator's manual. Differences between the calibration curves may be due to different seed densities. It is recommended that the manufacturer include a table of seed densities used in the calibration contained in the operator's manual. This would allow an operator to determine when field calibration checks are necessary.

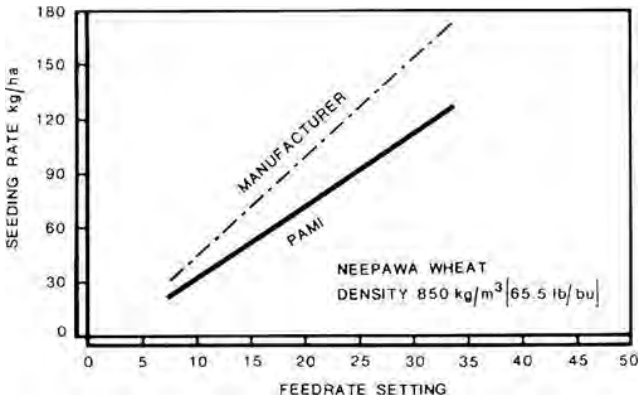


FIGURE 6. Wheat Calibration.

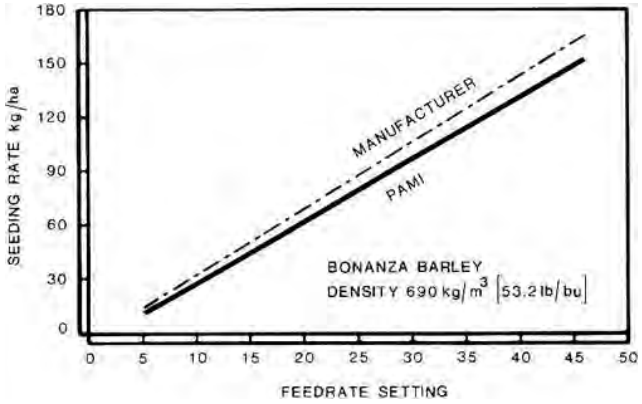


FIGURE 7. Barley Calibration.

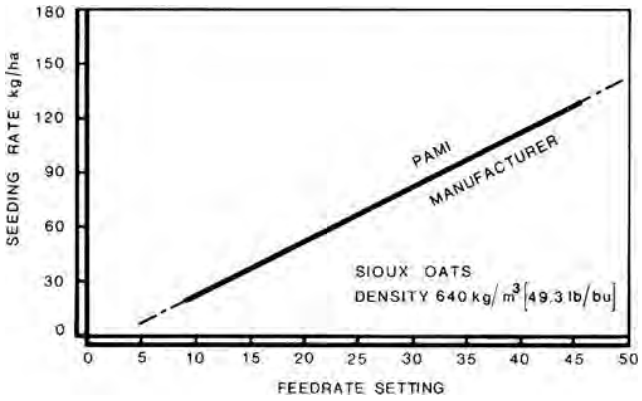


FIGURE 8. Oats Calibration.

[2]*Lindwall. C W, and Anderson, D. T., EFFECTS OF DIFFERENT SEEDING MACHINES ON SPRING WHEAT PRODUCTION UNDER VARIOUS CONDITIONS OF STUBBLE RESIDUE AND SOIL COMPACTION IN NO-TILL ROTATION 1976 Agriculture Canada, Canadian Journal o! Soil Science, Vol 57, No 2, p 81- 91.*

[3]*PAMI T773 Detailed Test Procedure for Grain Drills*

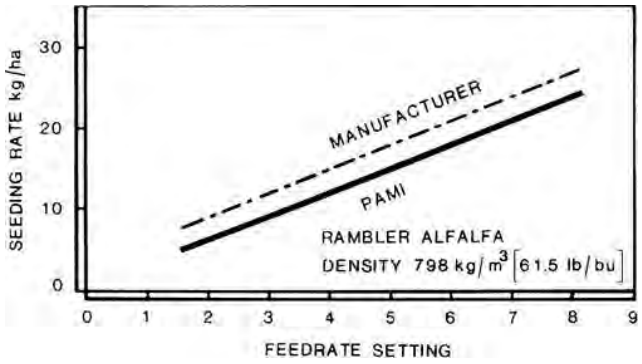


FIGURE 9. Calibration for Seeding Alfalfa through the Grain Box.

Level of seed in the grain box and variations in field slope or ground speed did not appreciably affect the seeding rates for either large or small seeds. Field roughness did not appreciably affect the seeding rate for large seeds such as wheat, oats, or barley but did affect the seeding rate for alfalfa.

The coefficient of variation (CV)[4] is commonly used to describe the variation in seeding rates among individual seed cups. It is accepted that for drills, the CV should not be greater than 15%. If the CV is less than 15%, seeding is uniform whereas if the CV is much greater than 15%, the variation among seed cups is excessive.

For barley, seeding was very uniform. When seeding wheat at 85 kg/ha (75 lb/ac) the CV was only 3%. When applying small seeds, such as alfalfa, with the grain box at setting 3, the mean seeding rate was 10 kg/ha (9 lb/ac) with a CV of 15% immediately after setting the drill. When the drill was bounced, corresponding to normal field operation, the feed rolls moved toward the closed position reducing the mean seeding rate by 13%. The CV did not change appreciably. FIGURE 10 shows alfalfa seeding uniformity immediately after the drill was set while FIGURE 11 shows uniformity of seeding after the feed rolls had moved on the seed shaft due to field vibration.

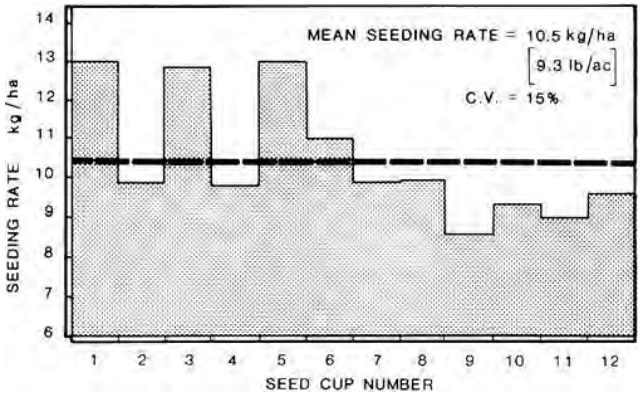


FIGURE 10. Variation in Alfalfa Seeding Rates Among Individual Seed Cups Immediately after Setting the Grain Box Seed Shaft at Number 3.

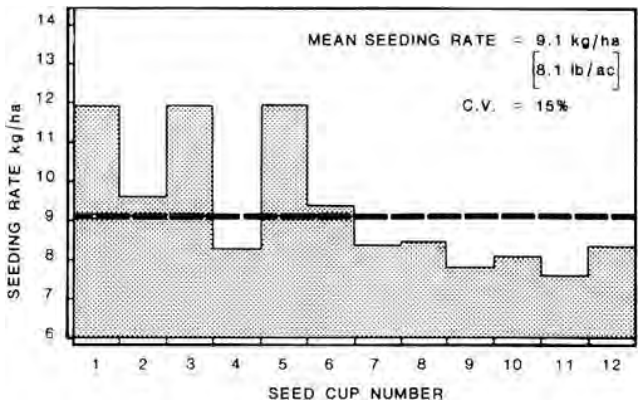


FIGURE 11. Variation in Alfalfa Seeding Rates Among Individual Seed Cups, with the Grain Box Seed Shaft Set at Number 3, after Shifting of the Feed Rolls due to Field Vibration.

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

Grass Seed Attachment: As is common with most drills, the grass seed attachment is designed only for small seeds. It is not intended for large light seeds such as bromegrass, orchard grass, or Russian wild ryegrass. Such grasses may be seeded through the grain box with the addition of the grain agitator attachment or by mixing the seed with heavier material such as cracked grain.

FIGURES 12 to 14 show calibration results for alfalfa, reed canary grass and timothy. Seeding rates with the grass seed attachment were not significantly affected by ground speed or field vibration. The seed box had dividers to prevent the seed from shifting in the box. The grass seed attachment was more suitable for seeding small seed than was the grain box. For these seeds, the accuracy of the grass seed attachment was higher at normal seeding rates and the adjustment of seeding rate was not nearly as sensitive. When set at number 4, the coefficient of variation was 7% in alfalfa and reed canary grass and 10% in timothy which are all well within acceptable limits.

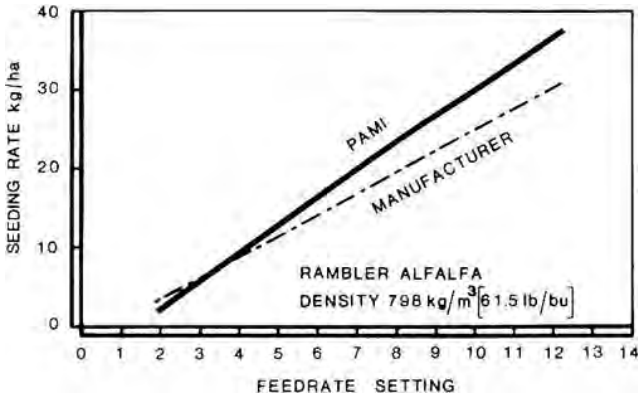


FIGURE 12. Calibration of Grass Seed Attachment in Alfalfa.

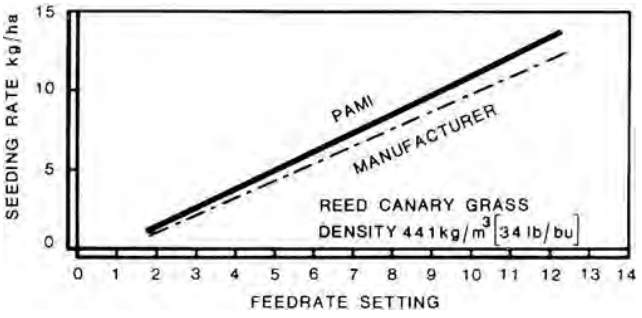


FIGURE 13. Calibration of Grass Seed Attachment in Reed Canary Grass.

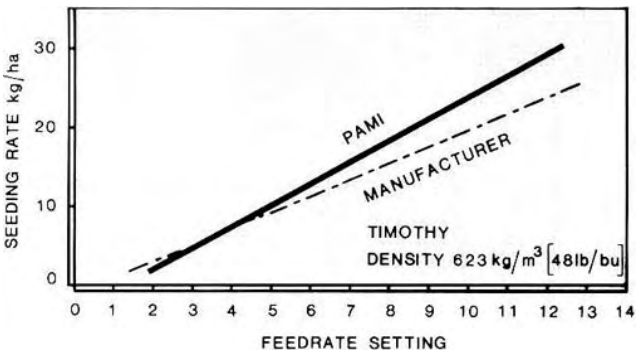


FIGURE 14. Calibration of Grass Seed Attachment in Timothy.

EASE OF OPERATION

Maneuverability: The three-point hitch mounting provided good maneuverability over large rocks and obstacles.

Filling: The 230 mm (9 in) wide wooden walkway at the rear provided safe and convenient operator footing for filling of both seed boxes. Grain level in the grain box was monitored from the tractor through the adequate windows provided, however, the grass seed attachment, when mounted, obscured the operator's view of the grain box windows. Flow of grain and grass seed were visible through the openings in front of the feed cups.

Feed Gates: The grain box seed cups were equipped with adjustable feed gates, which could be set in one of three operating

positions or in a fully open position for cleaning. The operator's manual did not indicate suggested feed gate settings for various seed sizes. It is recommended that suggested feed gate settings be included in the operator's manual.

Cleaning: The feed gates on each of the grain box seed cups could be opened to aid in cleaning. Access to the seed cups on the grass seed attachment was difficult.

Land Area Meter: The meter indicated the area processed in acres to an accuracy of 2% if the drill was operated at full seeding width. The counter recorded the nearest tenth acre up to 1000 acres. A metric counter was not available. Sufficient calibration adjustment was available to change the drive ratio so that the counter could be made to indicate the correct area in units of hectares.

Hitching: The John Deere 1500 was easily mounted to the tractor. Adjustable support stands at the front of the drill provided stability during hitching. A quick coupling device was used on the power shaft. When initially attaching the drill to a tractor, the three-point hitch and power take-off geometry should be checked to ensure that the power shaft is free to telescope over the entire lifting range.

EASE OF ADJUSTMENT

Maintenance: Lubrication of the nine grease fittings on the firming wheels and power shaft was easy. The power shaft had to be disconnected to lubricate the yokes. It was important to keep the telescoping portion of the drive shaft well lubricated, as the drive shaft was continually telescoping. The cutter wheel unit drive chains required periodic adjustment. Access to the chains, in order to check tension, was through the caps at the front of the drive unit housings. It was difficult to judge chain tension through these openings. Inspection ports on the side of each housing would have been more convenient. Periodic oiling of the main cutter wheel drive chain was required.

The cutter wheels had to be removed to clean grass and twine accumulation when operating in tall grass or in pastures used for winter feeding. The cutter wheels tightened during operation, far beyond the recommended installation torque of 112 N•m (80 ft•lb); removal was difficult. Two men were required, one preventing pivoting of the planting unit and the other requiring a wrench with an extension.

Seeding Rate: Grain and grass seeding rates were easily adjusted. It was important, when setting the seeding rates, to open the feed shaft past the desired setting and then bring the shifter back to the desired location.

Tilling Depth: Adjusting the planting depth was relatively easy. One man could reset the depth and adjust the cutting wheel pressure in about 30 minutes.

RATE OF WORK

Workrates in native grasslands depended primarily upon field roughness and stone population. Suitable speeds were about 10 km/h (6 mph) in relatively smooth fields and about 5 km/h (3 mph) in rough fields. In rough fields, ground speed was limited by the operator's ability to maneuver rather than by the performance of the drill. Workrates varied from 0.3 to 1.3 ha/h (0.75 to 3.2 ac/hr).

POWER REQUIREMENTS

At a speed of 10 km/h (6 mph) in clay loam sod, peak power requirements were 70 kW (90 hp) when seeding at a depth of 45 mm (1.8 in) and 40 kW (55 hp) when seeding at the more common depth of 25 mm (1 in). Power input was appreciably reduced in lighter soils or when seeding at slower speeds. The majority of field testing was conducted with a 40 kW (55 hp) tractor. This tractor had adequate power to seed under most conditions, at speeds up to 10 km/h (6 mph). In most cases, the entire power input was through the power take-off since the cutter wheels created a forward thrust resulting in negligible draft.

OPERATOR SAFETY

The John Deere 1500 was safe to operate if normal safety procedures were observed. All moving parts were adequately shielded. All shields were easy to remove and replace.

The jack stands were awkward to raise and lower. This could lead to failure to use them during servicing. A more convenient locking device on each jack stand would encourage their use.

The operator's manual contained a comprehensive and useful section on safety.

OPERATOR'S MANUAL

The operator's manual was simple, concise, and well illustrated, presenting much useful information on operation, maintenance and safety. The operator's manual did not include recommended seed gate settings for various grain sizes. It did not include the densities (bushel weights) for the grains presented in the calibration charts. It is recommended that both these items be included in the operator's manual to aid the operator in setting the seed metering mechanisms.

DURABILITY RESULTS

TABLE 3 outlines the mechanical history of the John Deere 1500 Powr-Till seeder during 94 hours of operation while seeding about 85 ha (208 ac). The intent of the test was evaluation of functional performance. The following failures represent those, which occurred during functional testing. An extended durability evaluation was not conducted. It should be noted that most of the operation was in native grassland and that more than half of the operation was in fields, which were too stony for any agricultural use other than pasture.

TABLE 3. Mechanical History

Item	Operating Hours	Field Area ha	Field Area (ac)
Firming Wheels			
-3 firming wheels broke and were replaced at	35	21	(51)
-another 4 firming wheels broke and were replaced at	57	45	(112)
Cutter Wheels			
-all cutter wheels had worn substantially and were re-hard surfaced at	74	66	(163)
-all cutter wheels were replaced at	91	82	(202)
Drives			
-planting unit drive chains required tightening at	56, 90	44, 81	(109, 200)
-the telescoping drive shaft, spline failed, due to wear and was replaced at	85	75	(184)
Miscellaneous			
-the bearing retainer and housing assembly bolts on all cutter wheel drive units loosened and were retightened		many times	
-the push rod spring support frame had deformed at		end of test	

DISCUSSION OF MECHANICAL PROBLEMS

CUTTER WHEELS

Cutter wheel wear depended primarily on the soil texture and frequency of stones. Wear was significant in sandy soils and moderate in clay soils. The more severe operating condition consisted of 66 ha (162 ac) in abrasive sandy soils and 59 ha (145 ac) in fields, which were moderately to very stony. The original hard surfacing on the cutter wheels was adequate for 20 to 35 hours operation in abrasive soils while seeding from 30 to 40 ha (75 to 100 ac). FIGURE 15 shows wear after 75 hours of operation while seeding 80 ha (200 ac).

The operator's manual did not contain instructions on cutter wheel hard surfacing. It is recommended that such instructions be included in the operator's manual.

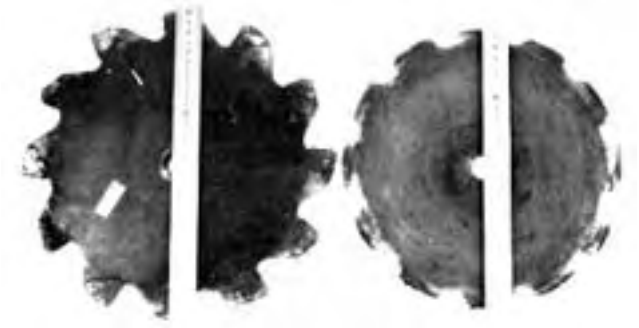


FIGURE 15. Cutter Wheel Wear: left, new; right, after 80 ha (200 ac).

FIRMING WHEELS

All firming wheel failures occurred in stony fields. The wheels usually split through the hub mounting holes (FIGURE 16). Air entrainment in the cast plastic wheels was usually evident along the

fracture lines.

FIGURE 16. Firming Wheel Failure.

POWER SHAFT

The telescoping portion of the power take-off drive shaft wore excessively during operation and failed after 85 hours. Failure may have been due to inadequate lubrication. During normal operation, especially on rough fields, there is constant vertical movement of the drill resulting in constant telescoping of the drive shaft. Frequent lubrication is required.

LOOSENING OF BOLTS

The bearing retainer bolts and drive unit housing bolts on all cutter wheel drive units loosened frequently. It is recommended that suitable locking devices be installed on these bolts.

APPENDIX I
SPECIFICATIONS

Make:	John Deere Powr-Till Seeder
Model:	1500 grain version
Serial No.:	000825
Overall Dimensions:	
-- height	1270 mm (50 in)
-- length	1346 mm (53 in)
-- width	3023 mm (119 in)
-- effective seeding width	2438 mm (96 in)
Grain Metering System:	
-- type	externally fluted feed rolls
-- drive	Chain and gear from end wheels
-- adjustment	lever controlling feed roll protrusion
-- transfer to openers	convoluted rubber tube
Grass Seed Attachment: (Optional)	
-- type	externally fluted feed rolls
-- drive	chain from end wheel
-- adjustment	lever controlling teed roll protrusion
-- seed transfer	rubber tubes to front of grain feed cups
Cutter Wheels:	
-- number	12
-- nominal diameter	305 mm (12 in)
-- thickness	6.4 mm (0.25 in)
-- spacing	200 mm (8 in)
-- speed	740 rpm (1000 rpm PTO)
Firming Wheels:	
-- number	12
-- material	plastic
-- diameter	255 mm (10 in)
-- thickness	6.4 mm (0.25 in)
-- spacing	200 mm (8 in)
Grain and Seed Capacities:	
-- grain box	350 L (10 bu)
-- grass seed attachment	90 L (2.5 bu)
Total Weight:	
-- with boxes empty	810 kg (1782 lb)
End Wheels:	
-- number	2
-- tire size	6.70 x 15, 4-ply
Number of Chain Drives:	9
Number of Lubrication Points:	9
Number of Sealed Bearings: (on cutter wheel drives)	28
Other Bearings:	6
Other Optional Attachments:	grain box agitator, defoliant spraying attachment

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports

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

APPENDIX III
METRIC UNITS

In keeping with the Canadian metric conversion program. This report has been prepared in SI units. For comparative purposes, the following conversions may be used.

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/h)	= 0.62 miles/hr (mph)
1 metre (m) = 1000 millimetres (mm)	= 39.27 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds (lb)
1 newton (N)	= 0.22 pounds force (lb)
1 litre (L)	= 0.028 bushels (bu)
1 kilogram/hectare (kg/ha)	= 0.9 pounds/acre (lb/ac)

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