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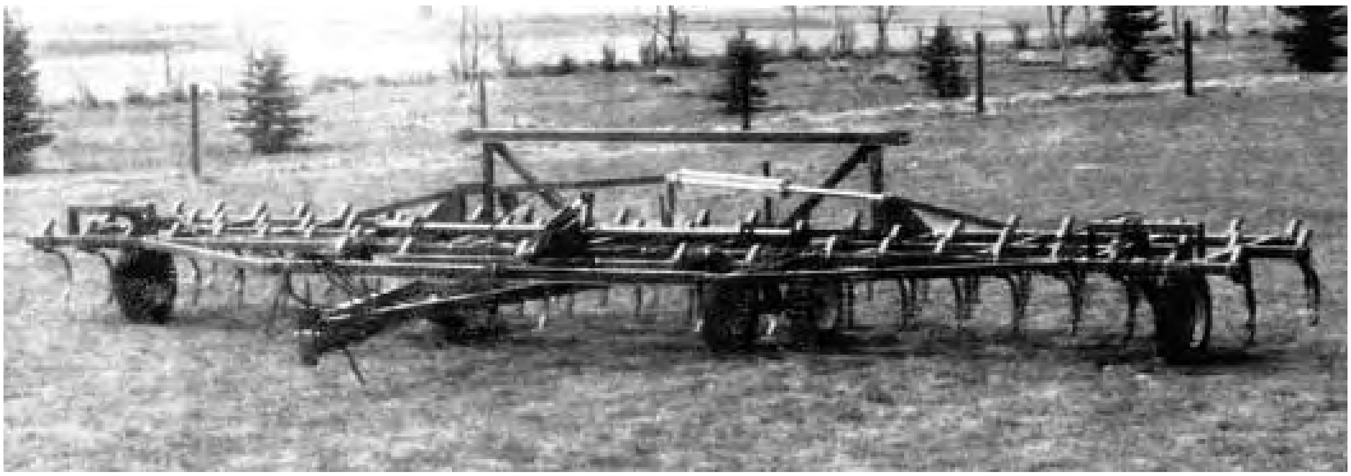
Evaluation Report 58



John Deere Series 1000 (11.4 m) Field Cultivator

A Co-operative Program Between

JOHN DEERE SERIES 1000 FIELD CULTIVATOR

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:
$8,929.39 (April, 1979, f.o.b. Lethbridge, 11.4 m width, with optional finishing harrows).

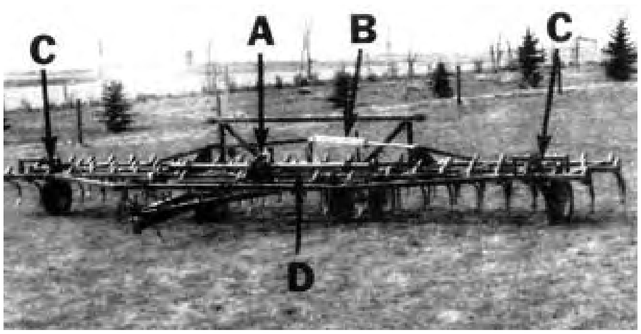


FIGURE 1. John Deere 1000: (A) Master Hydraulic Cylinder. (B) Wing Lift Cylinder,(C) Slave Cylinders. (D) Rockshaft.

SUMMARY AND CONCLUSIONS

Overall functional performance of the John Deere Series 1000 field cultivator was very good for seedbed preparation and herbicide incorporation, providing mounted finishing harrows were used. Its performance for second operation summerfallow was good with acceptable weed kill if 203 mm (8 in) sweeps, or larger, were used. As with most light duty field cultivators, the John Deere 1000 was unsuitable for first operation summerfallow or in moderate to heavy trash.

The spring cushioned shanks could lift 255 mm (10 in) to clear stones. As with most field cultivators, the shanks were very flexible. When equipped with recommended sweeps, having a 42 degree sweep stem angle, sweep pitch varied from 9 to 14 degrees over the range of normal secondary tillage draft, resulting in furrow bottom ridging. With 152 mm (6 in) shank spacing, shank cushioning spring preload was exceeded at drafts greater than 3.3 kN/m (230 lb/ft), occurring at the upper end of the secondary draft range. Penetration was adequate in previously tilled soil, but inadequate for harder soils. Plugging was a problem in moderately heavy trash. The John Deere 1000 buried less trash than most heavy duty cultivators. The sweep pattern was symmetrical and sideways skewing was not a problem in normal field conditions. Slight skewing occurred on hillsides. Weed kill in summerfallow was good as long as sweeps with adequate overlap were used.

The John Deere could be conveniently placed into transport position in leas than five minutes. The 108 mm (4.25 in) sweep-to-ground clearance, in transport position usually was adequate. Due to its large transport width and height, transporting on public roads had to be with extreme caution and the manufacturer's maximum recommended transport speed of 16 km/h (10 mph) should not be exceeded. The 11.4 m (37.4 ft) wide test machine had a transport height of 4.4 m (14.5 ft) permitting safe transport under power lines in the three prairie provinces. Transport height of the 13 m (42.5 ft) wide model of the John Deere 1000 is 5.4 m (17.7 ft) which is higher than minimum power line height in all three provinces.

When equipped with optional finishing harrows, hitch weight was negative, making hitching inconvenient. Adequate adjustment was provided for both lateral and fore-and-aft levelling. Tillage depth was uniform across the width of the cultivator as long as the centre frame and wing section hydraulic cylinders were kept synchronized.

Average draft for the 11.4 m (37.4 ft) wide test machine, in light secondary tillage, at 8 km/h (5 mph), varied from 9 kN (1980 lb) at 40 mm (1.5 in) depth to 23 kN (5080 lb) at 100 mm (4 in) depth. In heavy secondary tillage, at 8 km/h (5 mph), average draft varied from 16 kN (3520 lb) at 40 mm (1.5 in) to 34 kN (7480 lb) at 100 mm (4 in).

In light secondary tillage, at 10 km/h (6.2 mph) and 75 mm (3 in) depth, a tractor with 94 kW (126 hp) maximum power take-off rating will have sufficient power reserve to operate an 11.4 m (37.4 ft) wide John Deere 1000. In heavy secondary tillage at the same depth and speed, a 137 kW (184 hp) tractor is needed.

The John Deere 1000 was equipped with wing transport locks, a slow moving vehicle sign, and reflective tape at the frame ends, to aid in transport safety. The operator's manual was clear, concise and well illustrated.

Some minor mechanical problems occurred during the 185 hours of field operation: Two shanks bent in hard soil. Several finishing harrow mounting brackets bent or broke.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying mounted harrows that do not extend beyond the cultivator frame and modifying the harrow mounts to reduce lateral movement.
2. Supplying a transport lock for the centre frame depth control cylinder as standard equipment.
3. Providing an alternate location for the hitch jack for use at the rear of the cultivator to facilitate hitching when equipped with mounted harrows.
4. Providing some means of holding the hitch link in the horizontal position to facilitate one man hitching.
5. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.
6. Working with the agricultural equipment industry to standardize shank and sweep stem angles, and sweep fastener spacings and sizes.

Chief Engineer: E. O. Nyborg
Senior Engineer: E. H. Wiens

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We have changed ordering procedures for harrow attachments to enable dealers to buy them the same width as the cultivator on which they will be mounted. Lateral movement has not been a problem with harrow attachments. It could occur if the attachment is not mounted properly.
2. A hydraulic transport lock is provided by moving the depth control stop on the master cylinder rod against the stop r ed with the cylinder fully extended. On the smaller sizes where we do not supply the cylinder, a mechanical transport lock is made available.
3. An optional storage stand is available for use with harrow attachments to permit storage of the machine in the raised position. Alignment of the clevis with the drawbar is then easily done hydraulically using the depth control system.
4. There has not been adequate demand for a horizontal control of the freely pivoting hitch link to justify the added cost. Most customers used rigid nodular iron hitch links.
5. The standardization of hydraulic quick coupler design is the responsibility of all tractor manufacturers. This is presently under review by the International Standards Organization.
6. We will advise the ASAE Cultural Practices Equipment Committee of the need to standardize throughout the industry.

GENERAL DESCRIPTION

The John Deere 1000 is a trailing, flexible, three-section field cultivator suitable for light tillage such as seedbed preparation, herbicide incorporation and secondary summerfallow. It is available in 20 widths ranging from 6.6 to 13 m. The test machine was an 11.4 m model, with a 3.8 m centre frame and two 3.8 m wings. It was equipped with 75 spring cushioned shanks, laterally spaced at 152 mm, arranged in three rows on the wings and in four rows on the centre section.

The centre frame is carried on two tandem wheel sets, while each wing is supported by a single wheel. Tillage depth is set with a master hydraulic cylinder, controlling a rockshaft for the centre section wheels and slave cylinders for each wing wheel. The wings fold into upright transport position with a single hydraulic cylinder. A tractor with dual remote hydraulic controls is needed to operate the John Deere 1000.

Detailed specifications are given in APPENDIX I while FIGURE 1 shows the location of major components.

SCOPE OF TEST

The John Deem 1000 was operated in the field conditions shown in TABLE 1, for 185 hours, while cultivating about 1820 ha. It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety and suitability of the

Optional attached finishing harrows were used during most of the test.

TABLE 1. Operating Conditions

FIELD CONDITIONS	HOURS	FIELD AREA (ha)
Soil Type - loam - clay loam - clay	 59 102 24	 560 1004 236
TOTAL	185	1820
Stoney Phase - stone free - occasional stones - moderately stony - vey stony	 84 74 27 0	 626 728 266 0
TOTAL	185	1820

RESULTS AND DISCUSSION

QUAUTY OF WORK

Shank Characteristics: There is a large variation in shank and sweep stem angles (FIGURE 2) on cultivators from different manufacturers. Sweeps and shanks must be matched to obtain sufficient sweep pitch to achieve and maintain penetration. Usually manufacturers recommend sweeps with a stem angle from 0 to 5 degrees less than the shank stem angle to result in a slightly positive no-load sweep pitch.

Sweep pitch increases in proportion to draft due to shank flexing, and depending on shank stiffness and cushioning spring preload, may become excessive in normal tillage, on some cultivators. A slightly positive sweep pitch results in uniform tillage depth and a smooth furrow bottom while excessive sweep pitch causes furrow bottom ridging and rapid sweep tip wear. Shanks, which maintain a relatively constant sweep pitch, over the normal range of tillage forces, are desirable.

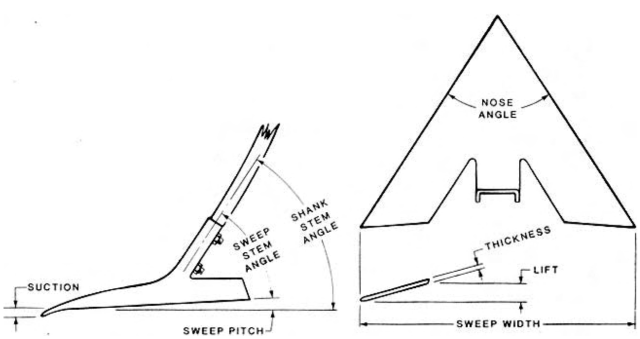


FIGURE 2. Shank and Sweep Terminology.

The John Deere 1000 was equipped with adjustable, spring cushioned shank holders. The spring clamps could be set in two positions to suit soil conditions. The normal position was recommended for mellow soils in typical secondary tillage, while the alternate position was intended to aid penetration in harder soils. During most of the test, the John Deere 1000 was used with 228 mm wide John Deere sweeps with a sweep stem angle of 47 degrees, giving a no load sweep pitch of 9 degrees.

FIGURE 3 shows pitch characteristics of the John Deere 1000 shank assembly. The Iow end of the pitch curve results from shank flexing, while the steeper upper part of the curve occurs when draft is large enough to overcome cushioning spring preload. Sweep pitch varied 5 degrees over the full range of draft normally occurring in secondary tillage. When equipped with 47 degree sweeps, as used during the test, sweep pitch varied from 9 to 14 degrees over this draft range. Cushioning spring preload was exceeded at drafts greater than 3.3 kN/m, occurring at the upper end of the normal secondary tillage draft range. This shows that the John Deere 1000 is well suited for most secondary tillage but is not intended for primary tillage. Setting the spring clamp in the alternate position, as recommended for harder soils, was of little benefit since it did not appreciably increase the force to overcome cushioning spring preload.

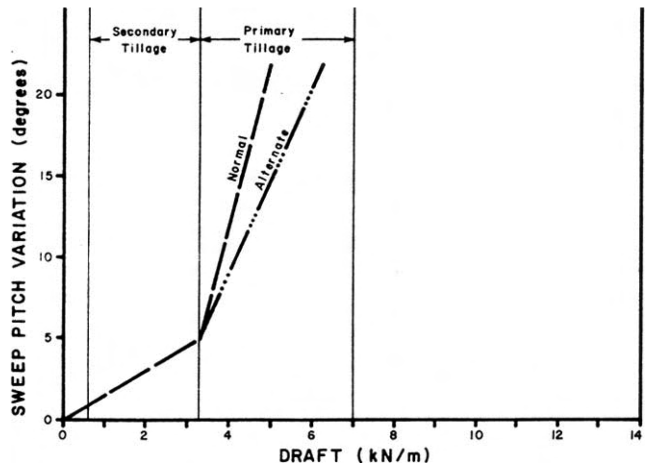


FIGURE 3. Sweep Pitch Variation over a Normal Range of Draft (152 mm shank spacing).

FIGURE 4 shows the lifting pattern when shanks encounter stones or field obstructions. Maximum lift height was 255 mm with the spring clamp in normal position and 220 mm with the clamp in the alternate position. Two shanks bent during the 185 hour test.

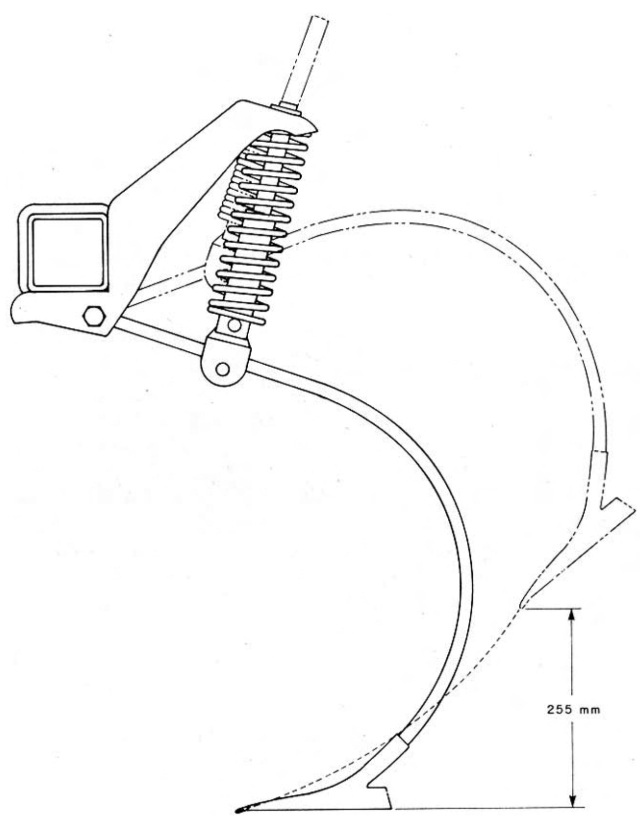


FIGURE 4. Shank Lifting Position (Spring Clamp in Normal Position).

Penetration: Penetration was good in light tillage, such as seedbed preparation, herbicide incorporation and secondary summerfallow. Penetration was inadequate in most primary tillage operations. As with most field cultivators, the John Deere 1000 was not intended for primary tillage.

In most conditions, penetration was uniform across the cultivator width. In soft, sandy soils, the wing wheels sometimes sank more than the centre wheels, causing slightly deeper penetration at the wings. Tires were adequately sized to provide good flotation in most. soil conditions. The wheels were positioned so that each centre section wheel supported about 18% of the cultivator weight while each wing wheel supported about 14%. In addition, each centre section wheel supported about 13.5% of the total tillage suction force while each wing wheel supported about 23%. For good flotation, it is desirable to have wheels sized and positioned so that each supports equivalent weight and similar tillage suction force.

Depth differences between the front and rear rows of shanks were slight, once the frame had been properly levelled. In normal secondary tillage, the frame remained relatively level with little twisting of the wing frames.

The John Deere 1000 followed gently rolling field contours very well, maintaining quite uniform depth across its width. All sections were about the same width. As with most wing cultivators, large variations in tillage depth occurred in fields with abrupt contour changes.

Plugging: The 152 mm lateral shank spacing was suitable only for light trash and light weed growth. In moderately heavy, damp straw, in secondary tillage, in primary stubble tillage, or in moderately heavy weed growth, plugging occurred across the entire cultivator width. Plugging usually began next to the rear centre section wheels. Plugging was not a problem in those light secondary tillage operations for which the cultivator was intended. The shank pattern of the John Deere 1000 could be rearranged to achieve a 230 mm lateral shank spacing. This spacing, which was not assessed during the test, could be beneficial in trashy fields. Increasing the shank spacing would, however, reduce the draft level at which shank cushioning spring preload was exceeded.

The optional mounted finishing harrows contributed to plugging in loose heavy trash. If trash was not well anchored, the harrows bunched, leading to plugging. In anchored, moderately heavy trash, the harrows cleared trash reasonably well.

Trash Burial and Field Surface: The John Deere 1000 buried less trash than most heavy duty cultivators. In light, secondary tillage, the resulting soil surface was smooth, even and unridged. The optional mounted finishing harrows also aided in smoothing the soil surface resulting in very uniform seedbed preparation (FIGURE 5).

FIGURE 5. Typical Seedbed Preparation.

In firm, dry, lumpy soil and in very trashy fields, the finishing harrows did not have the desired levelling effect since they were not heavy enough to level the cultivator ridges. There was also much sideways harrow movement due to flexibility of the harrow attaching brackets.

Furrow Bottom Ridging: In soft, previously filled fields, furrow bottom ridging was less than 10 mm. In fields with a hard subsoil layer, ridging was severe due to excessive sweep pitch (FIGURE 3) at high draft.

Skewing and Stability: The John Deere 1000 was very stable and did not skew sideways in normal field conditions. The shank pattern (FIGURE 6) was symmetrical and did not impose any side forces on the cultivator during normal tillage. As with most field cultivators slight skewing occurred on hillsides. When equipped with 228 mm sweeps, weeds were missed if the cultivator skewed more than 3 degrees (FIGURE 6). With 152 mm sweeps, there was no sweep overlap and weeds were missed with only slight skewing.

Weed Kill: Weed kill was good with 228 mm sweeps and 152 mm shank spacing. With 152 mm sweeps, weed kill was poor, especially if the weeds were large and well rooted, since there was no sweep overlap. As the sweeps wore, unfilled rows were left, resulting in a further weed kill reduction. New 152 mm sweeps were adequate for seedbed preparation, with finishing harrows, but for weed killing, at least 203 mm sweeps had to be used.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The John Deere 1000 was easily placed in transport position (FIGURE 7) using the hydraulic wing lift system supplied as standard equipment. Two pins, which had to be inserted by hand, were provided to lock the wings during transport. Raising

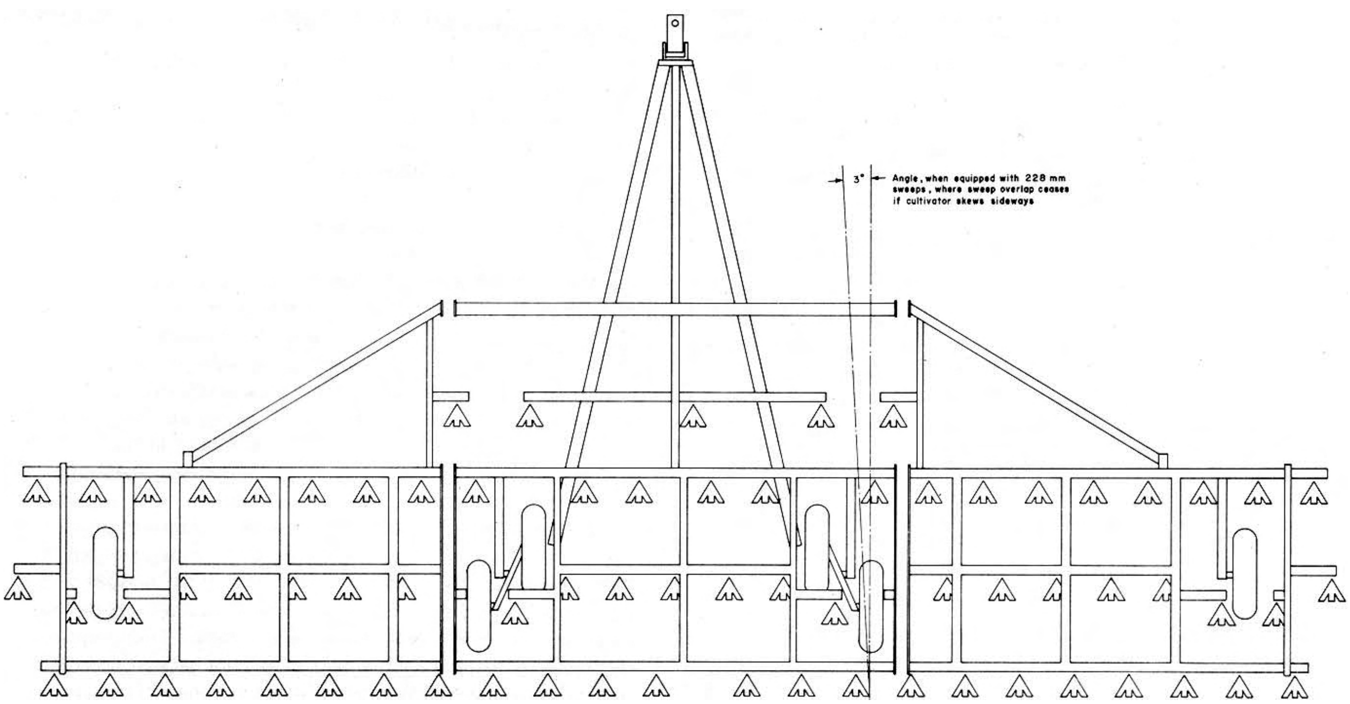


FIGURE 6. Sweep Pattern (152 mm shank spacing).

and lowering time depended on the tractor hydraulic system as well as hose and orifice restrictor sizes. With properly matched components, it took one man less than five minutes to raise or lower the wings. No transport lock was provided for the hydraulic depth control cylinder, although a lock is available as optional equipment. It is recommended that the transport lock be supplied as standard equipment, to aid in transport safety.

Transport width was 5.7 m while transport height was 4.4 m. Extreme cars was needed when transporting on public roads, through gates, over bridges and beneath power or telephone lines.

Hitch weight, without finishing harrows, was about 135 kg, while with attached finishing harrows, the hitch weight was minus 95 kg. Negative hitch weight caused cultivator swaying at transport speeds greater than 40 km/h. Swaying did not occur when transporting at the manufacturer's maximum recommended speed of 16 km/h. If a farm truck is used to transport the cultivator, sufficient weight should be added to the truck to compensate for the negative hitch weight.

Sweep to ground clearance during transport was 180 mm, while transport wheel tread was 3 m. This usually provided ample ground clearance.

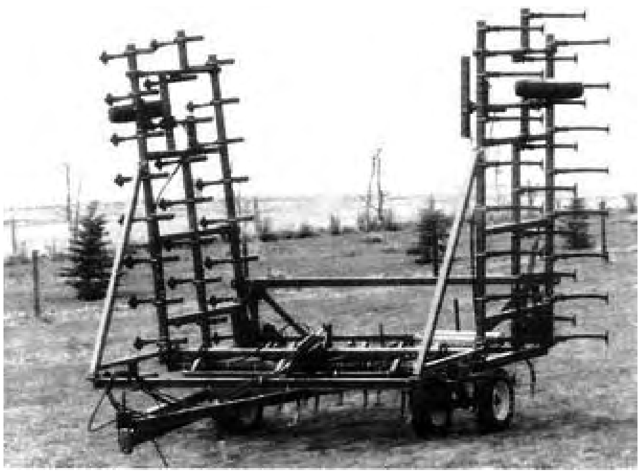


FIGURE 7. Transport Position.

Hitching: The John Deere 1000 was equipped with an optional hitch jack. The jack permitted easy hitching, only if the cultivator was not equipped with finishing harrows. When finishing harrows were attached, the resulting negative hitch weight made it difficult for one man to hitch the cultivator to a tractor. Optional jack stands were available for the rear of the cultivator to limit backward tipping, however, since these were not adjustable, they did not necessarily set the hitch at a suitable hitching height. It is recommended that an alternate location for the adjustable hitch jack be provided at the rear of the cultivator to facilitate hitching when equipped with finishing harrows.

The hitch clevis swivelled downward when not hitched to a tractor (FIGURE 8). One-man hitching would have been greatly facilitated if the clevis remained horizontal. Optional rigid hitch links were available to eliminate this problem.

Hitch height could be adjusted 245 mm in four increments by removing one bolt. This range was adequate to allow fore-and-aft cultivator frame levelling with all tractors used during testing.

Frame Levelling: Adequate lateral levelling adjustments were provided for both the centre and wing sections. The centre frame was levelled by loosening the rockshaft bearing support bolts and adjusting the rockshaft height. Adjustment was provided on the wing cylinder eye bolts to level the wing sections in relation to the centre frame.

Depth of Tillage: Tillage depth is controlled with three hydraulic cylinders connected in series. The depth of the centre frame section is controlled by the master cylinder which attaches to the main frame rockshaft. The wing slave cylinders set wing depth by controlling the height of the wing section wheels. As is common with series hydraulic systems, to maintain the centre and wing frames at the same height, periodic synchronization of the cylinders, by completely extending them to the fully raised position, was necessary.

Sweep Installation: It took one man about four hours to remove and replace the 75 sweeps on the John Deere 1000. The sweep bolts were short enough to have their ends completely covered by the retaining nuts, preventing thread damage to the sweep bolts during tillage.

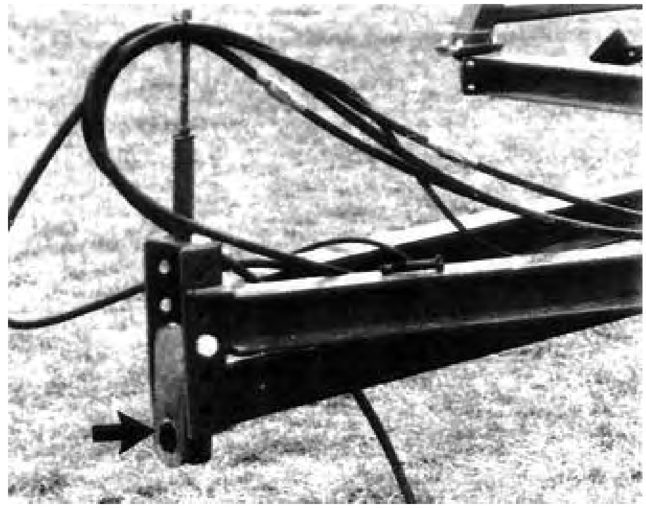


FIGURE 8. Hitch Clevis in Vertical Position.

Shank Installation: Shanks could be easily replaced by removing the shank clamp bolt and the pivot bolt. A shank could be replaced in less than five minutes.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 9 shows draft requirements for field-cultivators in typical secondary tillage, at a speed of 8 km/h. This figure gives average requirements based on tests of six makes of field cultivators in two seasons and 12 different field conditions.

Attempting to compare draft requirements of different makes of field cultivators usually is unrealistic. Draft requirements for the same cultivator, in the same field, may vary by as much as 30% in two different years, due to changes in soil conditions. 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 field cultivators.

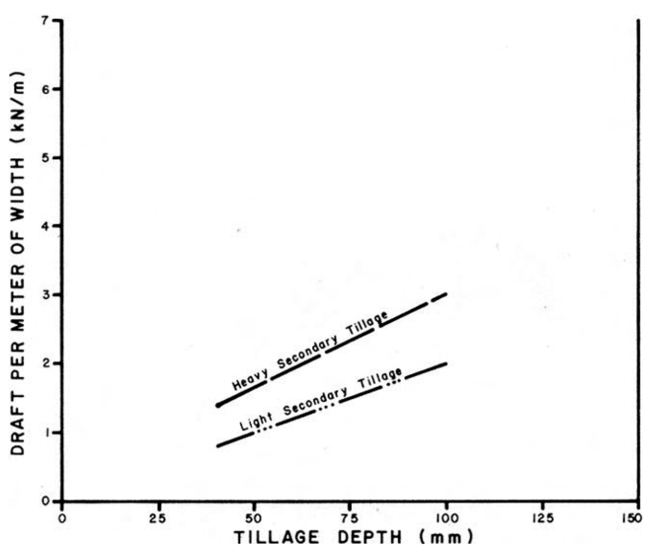


FIGURE 9. Average Draft Requirements for Field Cultivators at 8 km/h.

In light secondary tillage, such as herbicide incorporation or seedbed preparation, average draft per metre of width, at 8 km/h, varied from 0.8 kN at 40 mm depth to 2 kN at 100 mm depth. For the 11.4 m wide test machine, this corresponds to a total draft ranging from about 9 kN to 23 kN.

In heavy secondary tillage, such as firm summerfallow, average draft per metre of width, at 8 km/h, varied from 1.4 kN at 40 mm depth to 3 kN at 100 mm depth, corresponding to a total variation from about 16 to 34 kN for the 11.4 m test machine.

Increasing speed by 1 km/h, increased draft by about 90 N per metre of width. For the 11.4 m wide test machine this represents a draft increase of 1 kN for a 1 km/h speed increase.

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the 11.4 m wide John Deere 1000 in light and heavy secondary tillage. Tractor sizes have been adjusted to include tractive efficiency in loose soils and represent a tractor operating at 80%of maximum power on a level field. The sizes presented in the tables are the maximum power take-off rating, as determined by Nebraska tests or as presented by the tractor manufacturer. Selected tractor sizes will have ample power reserve to operate the John Deere 1000 in the stated conditions.

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in light secondary tillage at 75 mm depth and 10 km/h, a 94 kW tractor is needed to operate the John Deere 1000. In heavy secondary tillage at the same depth and speed, a 137 kW tractor is needed.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.4 m Wide John Deere 1000 in Light Secondary Tillage.

DEPTH mm	SPEED km/h					
	7	8	9	10	11	12
40	27	35	43	52	63	74
50	35	44	54	64	76	88
75	56	68	81	94	109	124
100	77	92	108	124	142	160

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.4 m Wide John Deere 1000 in Heavy Secondary Tillage

DEPTH mm	SPEED km/h					
	7	8	9	10	11	12
40	49	60	72	85	100	115
50	59	72	86	100	116	133
75	85	101	119	137	156	177
100	111	131	152	174	197	221

OPERATOR SAFETY

Extreme caution is needed in transporting most folding cultivators, to avoid contacting power lines. Minimum power line heights vary in the three prairie provinces. In Saskatchewan, the energized line may be as low as 5.2 m over farm land or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m over farm land. In all three provinces, feeder lines in farmyards may be as low as 4.6 m.

Transport height of the 11.4 m wide test machine was 4.4 m, permitting safe transport under prairie power lines. On the other hand, transport height of the 12.9 m wide model of the John Deere 1000 is 5.4 m, which is high enough for contact with many prairie power lines. The legal responsibility for safe passage under utility lines rests with the machinery operator and not with the power utility or the machinery manufacturer. All provinces have regulations governing maximum permissible equipment heights on public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The John Deere 1000 was 5.7 m wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates, The John Deere 1000 was equipped with a permanently attached slow moving vehicle sign as well as reflective tape at the front and rear frame ends. The manufacturer recommends that transport speed should not exceed 16 km/h.

Pins were provided to lock the wings in transport position. A lock was not provided for the centre frame lift cylinder as standard equipment. This was deemed a safety hazard and it is recommended the lift cylinder lock be supplied as standard equipment to provide for safer transport.

The four fires supporting the main frame were adequately sized for transporting the cultivator. Individual ‘tire loads did not exceed the Tire and Rim Association maximum rating for 7.60 x 15, 8-ply tires.

The operator’s manual clearly outlined all safety precautions.

STANDARDIZATION

Hydraulics: During the test, considerable difficulty was encountered due to differences in hydraulic couplers on various tractors. The difficulty was in the lack of standardization both in couplers and in hose threads. More standardization is needed in this area.

Sweep Bolt Holes: The bolt hole size and spacing on cultivator Sweeps and shanks, as well as stem angles, should similarly be standardized to provide some degree of interchangeability of sweeps.

OPERATOR’S MANUAL

The operator’s manual was very good, containing useful information on safety, operation, maintenance and assembly. It was clear, concise and well illustrated.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the John Deere 1000 during 185 hours of field operation while tilling about 1820 ha. The intent of the test was evaluation of functional performance. The following mechanical problems represent those which occurred during the functional testing. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

ITEMS	OPERATING HOURS	EQUIVALENT FIELD AREA ha
Sweeps and Shanks		
- The 152 mm, sweeps were replaced with 228 mm sweeps at	52	512
- A shank bent and was replaced at	121, 169	1192, 1665
Hitch		
- The hitch clevis bushing wore, requiring replacement at	53, 125	522, 1232
- The outer end harrow section mounting bolts broke, causing the harrow section to fall off at	20, 92	197, 906
Mounted Harrows		
- Several harrow tines were lost and replaced at	30	296
- The outer harrow section ends bent back and were straightened at	92	906
- The right end harrow support arm broke and was welded at	121	1192
- The right end harrow support arm bent and was straightened at	173	1705

DISCUSSION OF MECHANICAL PROBLEMS

Sweeps: The 152 mm sweeps, supplied with. the cultivator, were adequate only for seedbed preparation and chemical incorporation. For summerfallowing, these sweeps were replaced with 228 mm sweeps to provide sufficient overlap. The latter set of sweeps was used for 133 hours in relatively non-abrasive clay loam soils. They needed replacement at the end of the test. Sweep wear rate depends on the type and abrasiveness of the soil. Great variation can be expected.

Shanks: Two shanks bent, requiring replacement while working in hard, dry soil.

Mounted Harrows: The arms and brackets used to mount the finishing harrows were weak and inadequate, resulting in poor harrow trailing and much lateral movement, in addition to some failures. Failure of the end harrow section mounting bolts as well as bending and failure of the harrow support arm (FIGURE 10) were mainly due to the outer ends of the harrow extending 0.6 m beyond the cultivator frame. Harrow overhang could also result’ in interference with fence posts and other similar obstacles. It is recommended that mounted harrows not extend beyond the cultivator frame.

FIGURE 10. Harrow Support Arm Failure.

When making sharp turns, especially with four-wheel drive tractor, the harrow section at the inside of the turn was forced backwards. This resulted in bending of the harrow tine support bars.

APPENDIX I

SPECIFICATIONS

MAKE:	John Deere Field Cultivator
MODEL:	1000 (11.4 m size)
SERIAL NUMBER:	10728N

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

DIMENSIONS	**FIELD POSITION**	**TRANSPORT POSITION**
- width	11,400 mm	5700 mm
- length	5910 mm	5430 mm
- height	1400 mm	4430 mm
- maximum ground clearance	180 mm	180 mm
- wheel tread	9480 mm	3000 mm

SHANKS:	
- number	75
- lateral spacing	152 mm
- trash clearance (frame to sweep tip)	550 mm
- number of shank rows:	
- centre section	4
- wings	3
- distance between rows	810 mm
- shank cross section	13 x 44 mm
- shank stem angle	56°
- sweep hole spacing	45 mm
- sweep bolt size	9.5 mm

HITCH:
- vertical adjustment range: 245 mm

DEPTH CONTROL: hydraulic

FRAME:
- cross section76 mm square tubing

TIRES:
- centre section 4, 7.60 x 15, 8 ply
- wings 2, 7.60 x 15, 8 ply

NUMBER OF LUBRICATION POINTS: 2 grease fittings, 10 hour service; 6 wheel bearings, 250 hour service

HYDRAULIC CYLINDERS:	
- main frame, depth control master	1, 108 x 203 mm
- wings, depth control slaves	2, 102 x 203mm
- wing lift cylinder	1, 125 x 610 mm

WEIGHTS: (Without Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
- right wheel	358 kg	
- right centre wheels	788 kg	1152 kg
- left centre wheels	835 kg	1200 kg
- left wheel	358 kg	
- hitch	136 kg	123 kg
TOTAL	2930 kg	2475 kg

WEIGHTS: (With Mounted Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
- right wheel	418 kg	
- right centre wheels	1085 kg	1478 kg
- left centre wheels	1104 kg	1525 kg
- left wheel	418 kg	
- hitch	-95 kg	-73 kg
TOTAL	2930 kg	2930 kg

OPTIONAL EQUIPMENT:
20 width options from 6.6 to 13 m
adjustable hitch clevis
rigid hitch yoke
rear support stand
mounted finishing harrows*
hitch jack*

* supplied on test machine.

APPENDIX II

MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

(a) excellent	(b) very good
(c) good	(d) fair
(e) poor	(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 mile/hour (mph)
1000 millimetres (mm) = 1 metre (m)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.20 pounds mass (lb)
1 newton (N)	= 0.22 pounds force (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kilonewton/metre (kN/m)	= 70 pounds force/foot (lb/ft)

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