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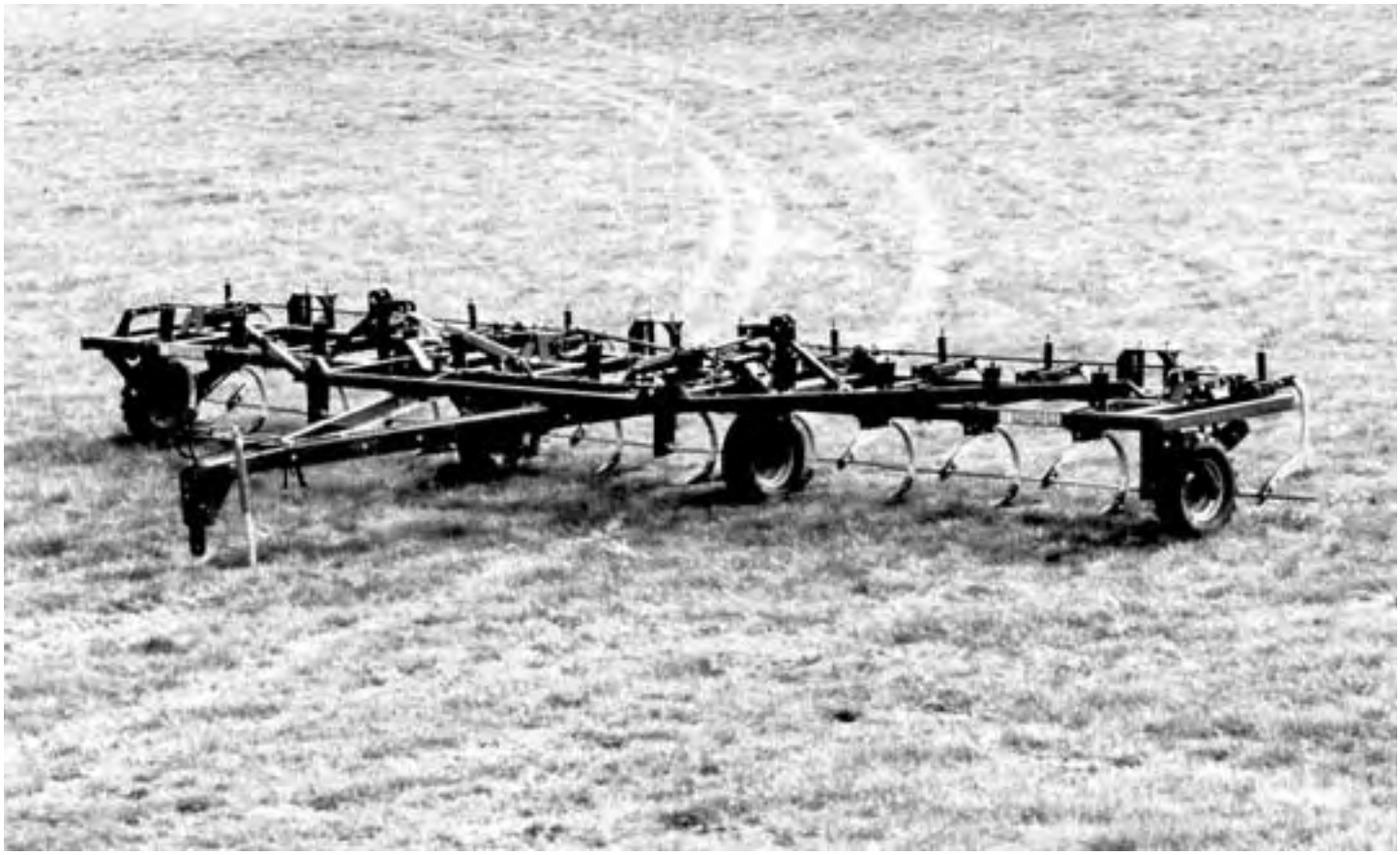
Evaluation Report 180



Edwards Model GN-R78-436 (11.1 m) Rod Weeder

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

EDWARDS MODEL GN-R78-436 ROD WEEDER

MANUFACTURER AND DISTRIBUTOR:

Edwards Rod Weeder Ltd.
P.O. Box 995
Lethbridge, Alberta
TIJ 4A2

RETAIL PRICE:

$7,221.00 (August, 1980, f.o.b. Lethbridge, 11.1 m width, with optional front row of cultivator shanks complete with sweeps).

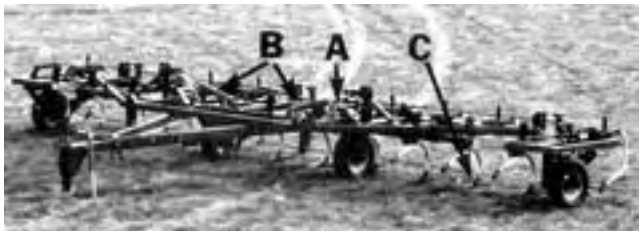


FIGURE 1. Edwards GN-R78-436: (A) Master Cylinder, (B) Wing Lift Cylinders, (C) Cultivator Shanks.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Edwards GN-R78-436 rod weeder was good for light tillage operations such as seedbed preparation and light secondary summerfallow. Performance in hard soil was reduced due to insufficient penetration.

The spring cushioned rod shanks could lift 100 mm (4.0 in) to clear stones. This height was insufficient as rod and shank damage occurred. The front row of spring cushioned cultivator shanks could only lift 100 mm (4 in) to clear stones. No shank damage occurred.

Penetration was very good in soft soil and good in moderately firm to hard soils. In very hard soils, penetration was inadequate due to skidding of the drive wheels. Plugging occurred in heavy or damp trash. The Edwards GN-R78-436 buried less trash than most heavyduty cultivators, but buried slightly more than most blade cultivators. Sideways skewing was evident only in very hilly conditions. Weed kill was good but depended on tillage depth and soil moisture conditions.

The Edwards GN-R78-436 could be placed in transport position in about 5 minutes. The 180 mm (7.1 in) rod to ground clearance, in transport position, was adequate. The Edwards GN-R78-436 towed well at transport speeds up to 32 km/h (20 mph). However, this was unsafe, as the tire loads in transport position exceeded the Tire and Rim Association maximum rating by 30%. Caution had to be observed when towing on public roads due to large transport width and height. The 11.1 m (36.3 ft) wide test machine had a transport height of 4.9 m (16.1 ft), which was high enough for contact with many power lines in the three prairie provinces.

A hitch jack was provided for convenient hitching. Adequate adjustment was provided for both lateral and fore and aft levelling. Tillage depth was uniform when the depth control linkages were properly adjusted.

Average draft for the 11.1 m (36.3 ft) wide test machine in secondary tillage, at 8 km/h (5 mph), varied from 22.2 kN (4880 lbs) at 25 mm (1 in) depth to 32.2 kN (7080 lbs) at 75 mm (3 in) depth. in secondary tillage with the cultivator shanks removed, at 8 km/h (5 mph), average draft varied from 15.5 kN (3410 lbs) at 25 mm (1 in) depth to 21.1 kN (4 640 lbs) at 75 mm (3 in) depth.

In secondary tillage, at 8 km/h (5 mph) and 50 mm (2 in) depth, a tractor with 104 kW (140 hp) maximum power take-off rating will have sufficient power reserve to operate the 11.1 m (36.3 ft) wide Edwards GN-R78-436. In secondary tillage with the cultivator shanks removed, at the same depth and speed, a 70 kW (94 hp) tractor is needed.

The Edwards GN-R78-436 was equipped with transport lock pins for safe towing. No slow moving vehicle sign was provided. The operator's manual was clear, concise and well illustrated.

Some mechanical problems occurred during the 160 hours of field operation. The rods and several rod shank holders bent and the centre section axle assemblies deformed. The centre drive assembly broke and several rod drive shank chain guards were replaced. The depth control pivot arms bent and the hitch link cotter pin sheared.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the rod shank holders to provide greater lift height.
2. Providing a slow moving vehicle sign as standard equipment.
3. Equipping the rod weeder with tires that comply with the Tire and Rim Association load rating.
4. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.

5. Chief Engineer: E. O. Nyborg
Senior Engineer: E. H. Wiens
Project Engineer: M. V. Eliason

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The rod shank holders have been modified and strengthened to provide almost double the previous lift height and also provide a softer cushioning effect to decrease the amount of rod bending in rocky soils.
2. Slow moving vehicle signs are optional equipment, as many farmers do not require them.
3. Unnecessary weight has been eliminated on all current models to conform to recommended tire and rim ratings. All 48 and 60-foot models are equipped with floating duals on the centre section to accommodate the extra weight.
4. We will continue to work with the agricultural industry toward standardizing hydraulic quick couplers and hose fittings. This has been a concern of ours for some time.

Manufacturer's Additional Comments

Our complete line of rod weeders now have triple sealed bearings in the leg assembly to provide the farmer with less down-time and eliminate skidding of the wheel that was encountered in some conditions. Metal shields are available for the tumble drives to eliminate wrapping of weeds and provide better trash clearance. A second pin has been added on the hitch tongue so it can be used as either a stiff hitch or a loose hitch.

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

GENERAL DESCRIPTION

The Edwards GN-R78-436 is a trailing, flexible, three-section rod weeder suitable for light tillage such as seedbed preparation and secondary summerfallow. It is available in eight widths ranging from 3.6 to 22.8 m (12 to 75 ft). The test machine is an 11.1 m (36.3 ft) model, with a 3.5 m (11.3 ft) centre frame and two 3.8 m (12.5 ft) wings. The square, ground driven rod is in three sections, supported by 12 spring-cushioned shanks. Each rod section consists of three rods coupled by universal joints. The 11 optional spring cushioned cultivator shanks are spaced at 1 m (3.3 ft) in a single row across the front of the machine.

The centre frame is carried on two wheels, while each wing is supported by a single wheel. Tillage depth is controlled by a master cylinder, through chains and connector linkages to each wheel. Two hydraulic cylinders connected in parallel fold the wings into an upright position. A tractor with dual remote hydraulic controls is needed to operate the Edwards GN-R78-436.

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

SCOPE OF TEST

The Edwards GN-R78-436 was operated in the field conditions shown in TABLE 1, for 160 hours, while cultivating about 1152 ha

(2845 ac). It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety .and suitability of the operator's manual.

The optional cultivator shank assemblies were used during most of the test.

TABLE 1. Operating Conditions

Field Condition	Hours	Area (ha)
Soil Type		
sand	27	194
sandy loam	11	79
loam	103	742
clay loam	13	94
clay	6	43
Total	160	1152
Stony Phase		
stone free	110	792
occasional stones	47	338
moderately stony	3	22
Total	160	1152

RESULTS AND DISCUSSION

QUALITY OF WORK

Shank Characteristics: The Edwards GN-R78-436 was equipped with adjustable spring cushioned .rod shank holders. FIGURE 2 shows the lifting pattern of the shanks when stones or field obstructions were encountered. Lift height depended on the cushioned spring preload. Maximum lift height was 100 mm (4 in). This was insufficient as field obstructions resulted in bent rods and shank holder damage. It is recommended that the manufacturer modify the rod shank holders to provide greater rod lift height.

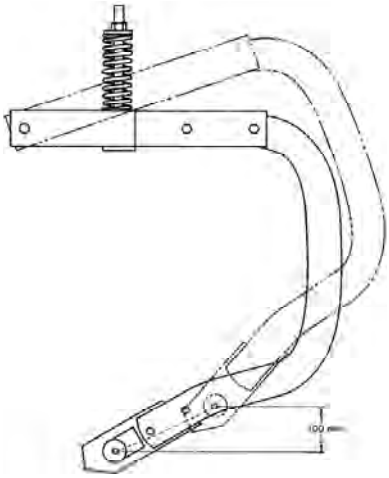


FIGURE 2. Rod Shank Lifting Pattern.

The cultivator shanks were also equipped with adjustable cushioning springs. FIGURE 3 shows the lifting pattern when the cultivator shanks encountered stones or field obstructions. Although the shank assemblies performed well, with no shank damage during the test, the maximum lift height of only 100 mm (4 in) resulted in many stones being pulled out or the frame having to lift to clear stones.

Penetration: Penetration was good in most light tillage operations such as seedbed preparation and secondary summerfallow.

The optional cultivator shanks aided penetration in hard soils. In very hard soils, however, the 1 m (3.3 ft) shank spacing was insufficient, resulting in skidding of the drive wheels and stoppage of rod rotation.

Penetration was uniform across the rod weeder width provided all the depth control linkages were properly set. The wheels were positioned so that each centre section wheel supported about 34% of the total rod weeder weight while each wing wheel supported about 16%. In addition, each centre section wheel supported about 29% of the total tillage suction force while each wing wheel supported about 21%. For good flotation and uniform tillage depth across the width, it is desirable to have wheels sized and positioned so that each supports an equivalent weight and a similar tillage suction force.

Depth differences between the front row of shanks and the rod were slight if the frame was properly levelled. In normal secondary tillage, the frame remained level with little twisting of the wing frames.

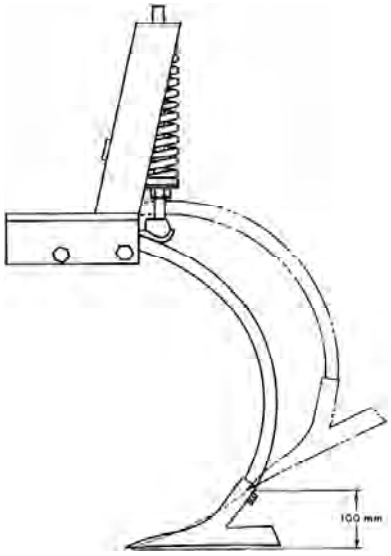


FIGURE 3. Cultivator Shank Lifting Pattern.

The Edwards GN-R78-436 followed gently rolling field contours well, maintaining uniform depth across its width. All sections were about the same width. As with most wing tillage implements, large variations in tillage depth occurred in fields with abrupt contour changes.

Plugging: The Edwards GN-R78-436 cleared trash well in medium to heavy straw conditions. Occasional plugging at the wing section drive shafts (FIGURE 4), occurred due to reduced rod to drive shaft clearance when damp trash and weeds wrapped around the rod shanks and drive shafts.

FIGURE 4. Plugging at the Wing Section Drive Shafts.

Trash Burial and Surface Condition: The Edwards GN-R78-436 buried less trash than most heavy duty cultivators and slightly more than most blade cultivators (FIGURE 5). In secondary tillage the Edwards GN-R78-436 left a smooth, even, unridged soil surface.

FIGURE 5. Trash Burial with Blade Cultivator (left) and Edwards GN-R78-436 (right).

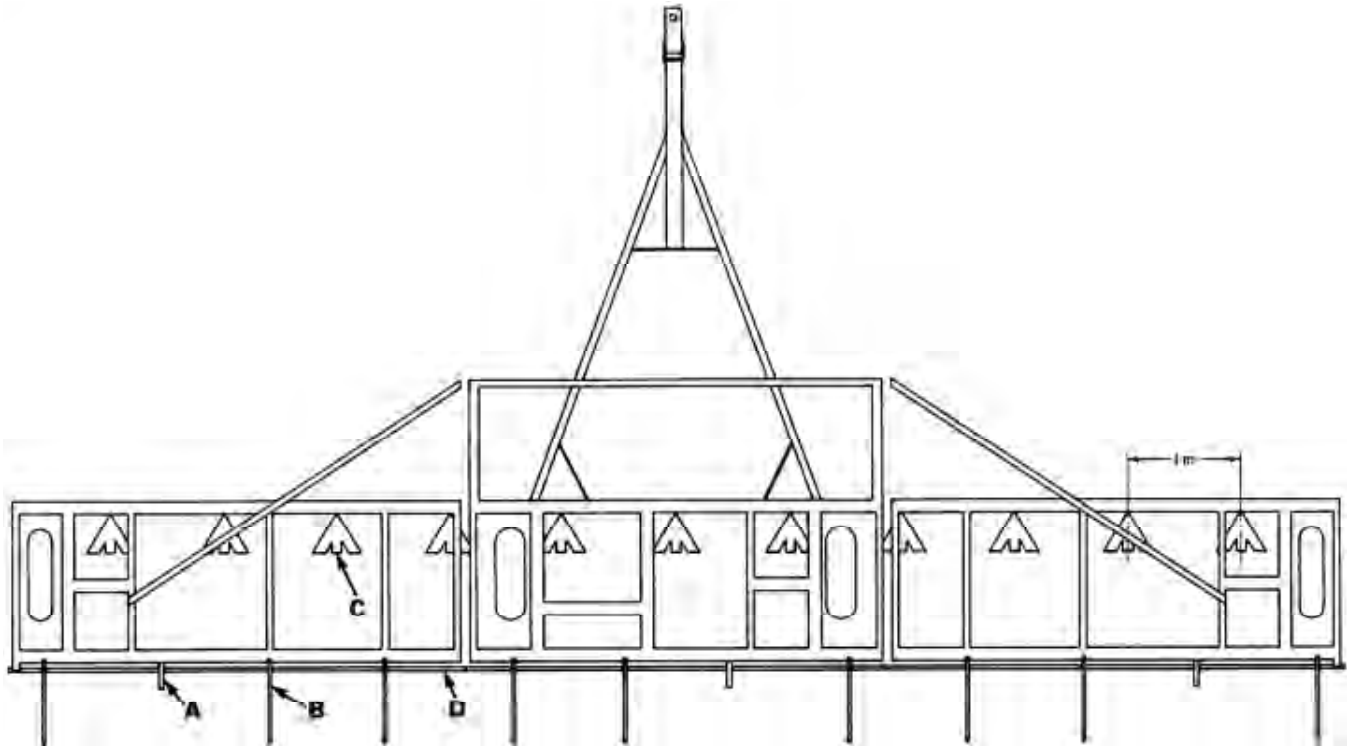


FIGURE 6. Shank Pattern: (A) Rod Drives, (B) Rod Support Shanks, (C) Cultivator Shanks, (D) Rod.

Skewing and Stability: The Edwards GN-R78-436 was stable and sideways skewing occurred only in very hilly conditions. The location of the rod drives, rod support shanks and cultivator shanks (FIGURE 6) did not impose any side forces on the rod weeder during normal tillage.

Weed Kill: Weed kill was very good. Exceptions occurred in moist conditions when small weeds were present. Small weeds were able to pass over the rod with minimal root disturbance, allowing continued growth. Shallow tillage depth increased soil disturbance and produced a better weed kill.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Edwards GN-R78-436 was easily placed in transport position (FIGURE 7) using the wing lift system supplied as standard equipment. Two pins, which had to be inserted by hand, were provided to lock the wings during transport. A mechanical transport lock was also supplied for the depth control cylinder. Raising or lowering, which depended on the tractor hydraulic system, took one man less than five minutes.

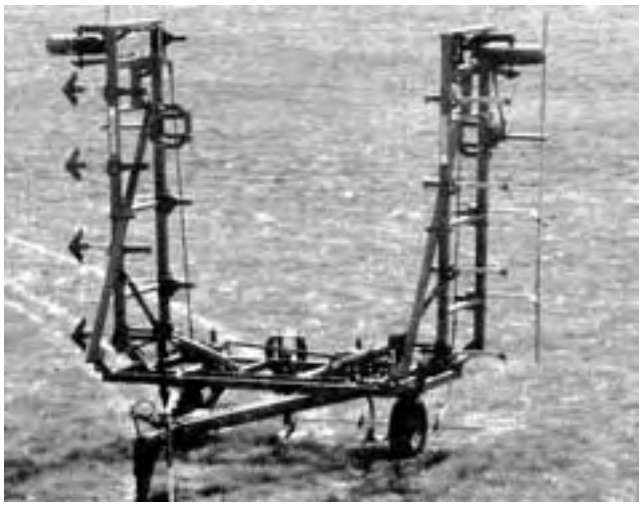


FIGURE 7. Transport Position.

For high transport speeds or long transport distances, removal of the centre drive assembly (FIGURE 8) was recommended. Disengaging the assembly was inconvenient as the operator had to climb over the rod weeder frame. Pins were provided to lock the assembly for both field and transport positions.

Transport width was 5.6 m (18.3 ft) while transport height was 4.9 m (16.1 ft). Extreme care was needed when transporting on public roads, through gates, over bridges and beneath power and telephone lines.

The hitch weight, in transport position, was 123 kg (270 lb) making the Edwards GN-R78-436 very stable while towing. It towed well at transport speeds up to 32 km/h (20 mph). Sweep-to-ground clearance during transport was 180 mm (7.1 in), while transport wheel tread was 2.7 m (8.7 ft). This provided ample ground clearance.

FIGURE 8. Centre Drive Assembly in Transport Position.

Hitching: The Edwards GN-R78-436 was equipped with a suitable hitch jack, which permitted easy hitching.

The hitch link swivelled downward when not hitched to a tractor (FIGURE 9). One man hitching would have been greatly facilitated if the hitch link remained horizontal.

The hitch height could be easily adjusted 305 mm (12 in) in five increments by removing one pin. This range was adequate to allow fore-and-aft frame levelling with all tractors used during the test.

Frame Levelling: Adequate lateral levelling adjustments were provided for the centre and wing sections. The center and wing sections were levelled with a threaded adjustment on each wheel.

Depth of Tillage: Tillage depth was controlled by one hydraulic cylinder linked to each wheel by rod and chain connector linkages. Uniform tillage depth across the rod weeder could usually be obtained with the tractor hydraulics, without using the depth control

stop collar.

FIGURE 9. Hitch Link in Vertical Position.

Sweep and Rod Support Bracket Installation: It took one man about one-half hour to remove and replace the 11 cultivator sweeps on the Edwards GN-R78-436. The sweep bolts were short enough to have their ends protected by the nuts, thereby preventing thread damage during tillage. High frame clearance permitted easy movement underneath the rod weeder.

When using 406 mm (16 in) sweeps, the right sweep on the outer frame had to have one wing cut off (FIGURE 10) to prevent centre rod drive assembly interference. This was inconvenient since an acetylene torch was needed when changing sweeps.

The rod support brackets were symmetrical and could be reversed after one end was worn. It took one man about one hour to remove and reverse the 9 rod support brackets.

FIGURE 10. Sweep Wing Cut Off to Prevent Centre Rod Drive Assembly Interference.

Shank Installation: A cultivator shank could be replaced, without removing the complete shank holder assembly from the frame, in less than 10 minutes.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 11 shows draft requirements for rod weeders in typical secondary tillage, at a speed of 8 km/h (5 mph). This figure gives average requirements based on tests in several different field conditions. Attempting to compare draft requirements of different makes of rod weeders is usually unrealistic. Draft requirements for the same rod weeder, in the same field, may vary significantly 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 difference between different makes of rod weeders.

In secondary tillage when equipped with a single row of spring cushioned cultivator shanks laterally spaced at 1 m (3.3 ft), average draft per metre width, at 8 km/h (5 mph), varied from 2.0 kN (440 lb) at 25 mm (1 in) depth to 2.9 kN (640 lb) at 75 mm (3 in) depth. For the 11.1 m (36.3 ft) wide test machine, this corresponds to a total draft ranging from about 22.2 to 32.2 kN (4880 to 7080 lb).

In secondary tillage with the spring cushioned cultivator shanks removed, the average draft per metre width, at 8 km/h (5 mph), varied from 1.4 kN (310 lb) at 25 mm (1 in) depth to 1.9 kN (420 lb) at 75 mm (3 in) depth. For the 11.1 m (36.3 ft) wide test machine this corresponds to a total draft ranging from about 15.5 to 21.1 kN (3410 to 4640 lb).

Increasing speed by 1 km/h (0.6 mph) increased draft by about 60 N (13 lb) per metre of width. For the 11.1 m (36.3 ft) wide test machine this represents a draft increase of about 670 N (150 lb) for a 1 km/h (0.6 mph) speed increase.

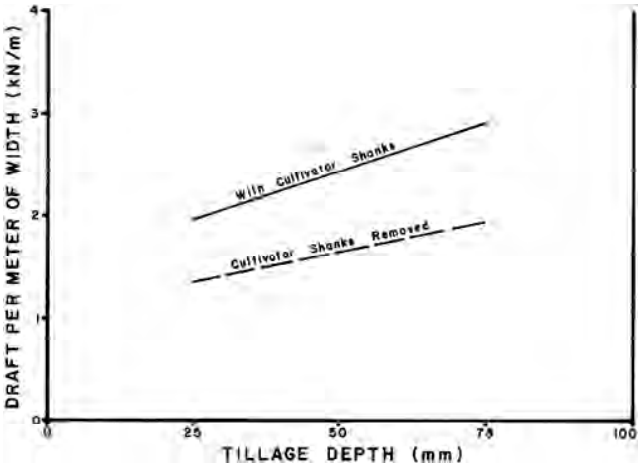


FIGURE 11. Average Draft Requirements for Rod Weeders in Secondary Tillage at 8 km/h.

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the 11.1 m (36.3 ft) Edwards GN-R78-436 in secondary tillage with and without cultivator shanks, respectively. Tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80% of maximum power on a level field. The sizes presented in the tables are the maximum power take-off rating, as determined by Nebraska tests or as presented by the tractor manufacturer. Selected tractor sizes will have ample power reserve to operate the Edwards GN-R78-436 in the stated conditions.

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example, in secondary tillage at 50 mm (2 in) depth and 8 km/h (5 mph) a 104 kW (140 hp) tractor is needed to operate the Edwards GN-R78-436. In secondary tillage with the cultivator shanks removed, at the same depth and speed, a 70 kW (94 hp) tractor is needed.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.1 m Wide Edwards GN-R78-436 in Secondary Tillage.

Depth (mm)	Speed (km/h)					
	7	8	9	10	11	12
25	71	84	98	112	127	143
50	89	104	120	137	155	173
75	106	124	143	162	182	203

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.1 m Wide Edwards GN-R78-436 in Secondary Tillage with the Cultivator Shanks Removed.

Depth (mm)	Speed (km/h)					
	7	8	9	10	11	12
25	49	58	67	77	87	98
50	60	70	81	92	104	118
75	71	83	95	108	121	135

OPERATOR SAFETY

`Extreme caution is needed in transporting most folding implements to avoid contacting power lines. Minimum power line heights vary in the three prairie provinces. In Saskatchewan, the energized line may be as low as 5.2 m (17 ft) over farmland or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m (15.8 ft) over farmland. In all three provinces, lines in farmyards may be as low as 4.6 m (15 ft).

Transport height of the 11.1 m (36.3 ft) wide test machine was 4.9 m (16.1 ft), which was high enough for contact with many prairie power lines. The legal responsibility for safe passage under utility lines rests with the machinery operator and not with the power utility or the machinery manufacturer. All provinces have regulations governing maximum permissible equipment heights on various types of public roads. If height limits are exceeded, the operator must contact power and telephone utilities before moving.

The Edwards GN-R78-436 was 5.6 m (18.3 ft) wide in transport position. This necessitated caution when towing on public roads, over bridges and through gates.

No slow moving vehicle sign or mounting bracket were provided.

It is recommended that a slow moving vehicle sign be supplied as standard equipment.

Pins were provided to lock both the centre frame lift cylinder and the wings in transport position.

The Edwards GN-R78-436 towed well at speeds up to 32 km/h (20 mph). Centre section tire loads, in transport position, exceeded the Tire and Rim Association maximum rating for 9.5L x 15, 6-ply tires by 30%. This tire overload was considered unsafe and hazardous, especially at high transport speeds. It is recommended that the rod weeder be equipped with tires having suitable load ratings.

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.

OPERATOR'S MANUAL

The operator's manual included 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 Edwards GN-R78-436 during 160 hours of field operation while tilling about 1152 ha (2845 ac). 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

Item	Operating Hours	Equivalent Field Area (ha)
Sweeps, Shanks and Rods:		
-The cultivator shank spring preload nuts loosened and required tightening at	32	230
-The welds failed and several rod shank holders bent at	37	266
-The rods bent and were straightened frequently	throughout the test	
-Several cultivator shank bracket bolts loosened and were tightened at	40	288
-All rod support brackets were worn and reversed at	67	482
-A rod shank holder bent, necessitating replacement at	101	727
-The weld on the locking bars on two rod shank swivels cracked and were rewelded at	115, 155	828, 1116
-The center section rod drive shank holder was bent at	end of test	
Frame:		
-The right telescoping drive shaft was too short and was replaced at	beginning of test	
-The depth control pivot arms bent at	10	72
-Interference of the depth control lock-up bracket and a rod shank holder was corrected at	12	86
-Interference between the centre and right depth control rods was corrected at	12	86
-The drive chains loosened and required tightening at	30	216
-The center drive chains, idler sprocket and axle drive broke and were repaired at	37	266
-The lower chain guard on the centre rod drive shank was worn and replaced at	37	266
-The axle assemblies on the center wheels bent and were replaced at	40	266
-The cotter pin on the hitch link pin sheared and was replaced at	90	648
-The right rod drive shank chain guard was lost and was replaced at	109	785
-The centre rod drive shank chain guard broke and was replaced at	159	1145
Wheels:		
-The left wing tire was mounted incorrectly and was remounted at	beginning of test	
-The right center wheel bolts loosened, damaging the rim, necessitating replacement at	92	662

DISCUSSION OF MECHANICAL PROBLEMS

SHANKS, SWEEPS AND RODS

Shanks: The weld failed and several rod shank holders bent (FIGURE 12) as a result of insufficient shank lift to clear field obstructions. Bending of the centre section rod drive shank holder (FIGURE 13) caused interference and wear of the overlapping right and centre section rod ends. The weld on two rod shank swivel locking bars cracked (FIGURE 14) and had to be rewelded.

Rods: Bent rods were a result of direct impact with field obstructions. Straightening was easily accomplished by one man using a jack.

The rod support brackets wore out and were reversed at 67 hours. Wear rate depends on the type and abrasiveness of the soil. Great variation can be expected.

FIGURE 12. Weld Failure and Bent Rod Shank Holder.

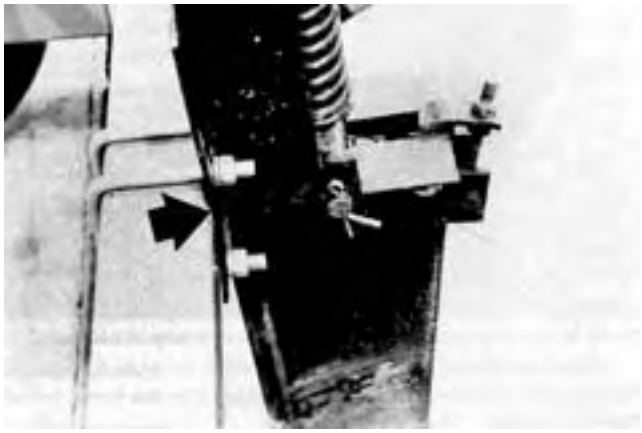


FIGURE 13. Bent Rod Drive Shank Holder.

FIGURE 14. Weld Failure on a Rod Shank Swivel Locking Bar.

FRAME

Axle Assemblies: The center section axle assemblies bent as a result of the high transport weight. The axles were replaced with strengthened assemblies provided by the manufacturer. No further problems were encountered.

Depth Control Pivot Arms: The depth control pivot arms bent (FIGURE 15) as a result of tillage depth adjustment during field operation. After initial bending no further problems were encountered. Depth control and adjustment were unaffected by the bent members.

FIGURE 15. Bent Depth Control Pivot Arm.

Chain Drives: The center section drive chains and assembly broke when the shank drive chain broke and jammed. All drive chains required periodic adjustment for proper tension.

Depth Control Rod Interference: Interference at the linkage

of the centre and right depth control rods did not allow the rod weeder to run level at all depths. Interference was eliminated by cutting off the corner of the right depth control rod clevis (FIGURE 16).

FIGURE 16. Corner of Right Depth Control Rod Clevis Cut Off.

APPENDIX I
SPECIFICATIONS

MAKE:	Edwards Rod Weeder	
MODEL:	GN-R78-436	
SERIAL NUMBER:	79-5-2686	
MANUFACTURER:	Edwards Rod Weeder Ltd. 3102 - 5 Avenue North Lethbridge, Alberta	
DIMENSIONS:	**Field Position**	**Transport Position**
-- width	5590 mm	11,060 mm
-- length	5770 mm	5770 mm
-- height	1480 mm	4900 mm
-- maximum ground clearance	185 mm	185 mm
-- wheel tread	10,240 mm	2650 mm
RODS:		
-- number of rods	3	
-- number of rods to each section	3	
-- rod size	22 mm square	
-- drive type	ground driven, chain drive	
SHANKS:		
Rod Shanks:		
-- number	12	
-- lateral spacing	915 mm	
-- trash clearance (frame to rod)	585 mm	
-- shank cross-section	18 x 76 mm	
Cultivator Shanks:		
-- number	11	
-- lateral spacing	915 mm	
-- trash clearance (frame to sweep tip)	620 mm	
-- shank cross-section	25 x 47 mm	
-- shank stem angle	56°	
-- sweep hole spacing	57 mm	
-- sweep bolt size	11 mm	
HITCH:		
-- vertical adjustment range	305 mm	
DEPTH CONTROL:	hydraulic	
FRAME:		
-- cross-section	102 mm square tubing	
TIRES:		
-- center section	2, 9.5L x 15, 6-ply implement tread	
-- wing	2, 7.60 x 15, 6-ply lug tread	
NUMBER OF LUBRICATION POINTS:	4 wheel bearings, annual service 25 grease fittings, 10 hour service	
HYDRAULIC CYLINDERS:		
-- wing lift	2, 102 x 610 mm	
-- main frame depth control	1, 102 x 203 mm (not supplied)	
WEIGHTS:	**Field Position**	**Transport Position**
-- right wheel	427 kg	
-- right center wheel	850 kg	1268 kg
-- left center wheel	872 kg	1295 kg
-- left wheel	423 kg	
-- hitch	114 kg	123 kg
TOTAL	2686 kg	2686 kg
OPTIONAL EQUIPMENT:		
-- 8 width options from 3.6 to 22.8 m		
-- cultivator shank assemblies*		
* supplied on test machine		

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
CONVERSION TABLE

1 hectare (ha)	= 2.5 acres (ac)
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 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 newton (N)	= 0.2 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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