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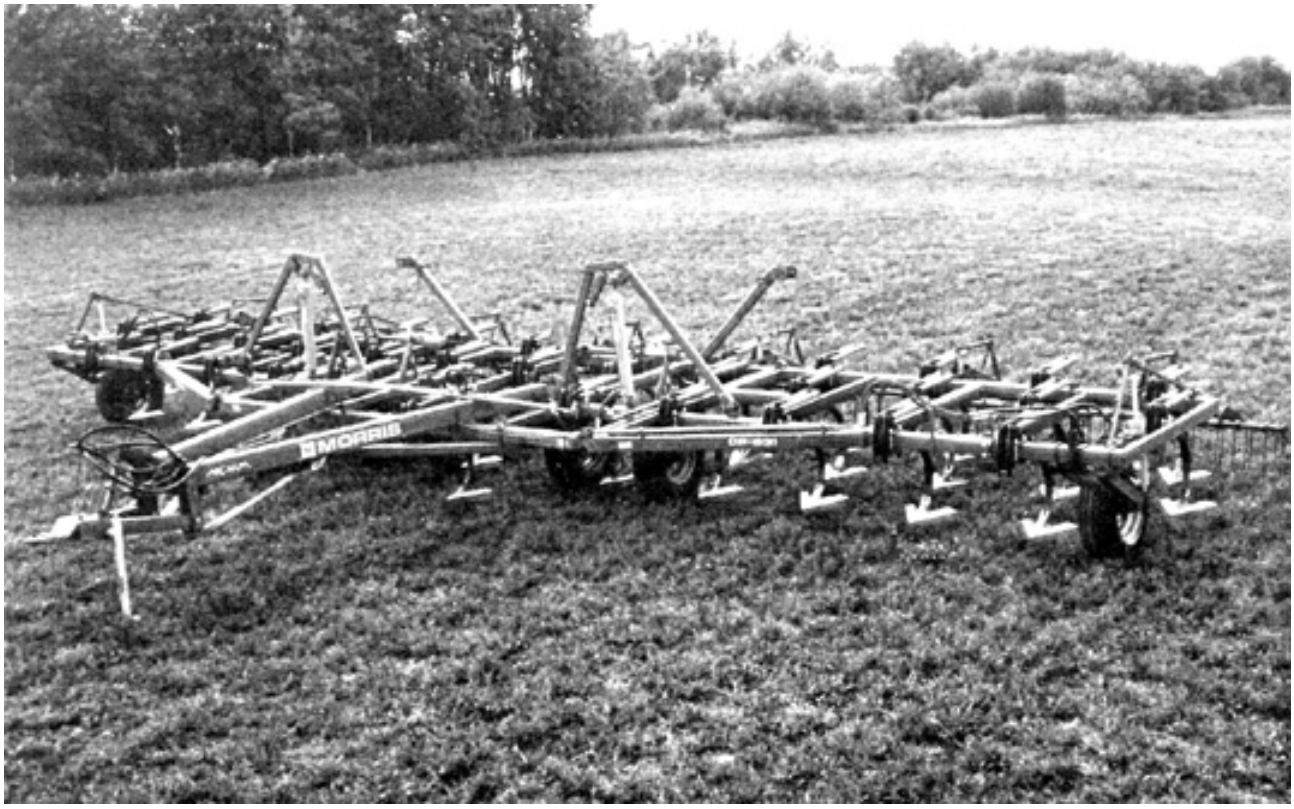
Evaluation Report 195



Morris CP-631 (11.3 m) Chisel Plow

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

MORRIS CP-631 CHISEL PLOW

MANUFACTURER AND DISTRIBUTOR:

Morris Rod-Weeder Co. Ltd.
85 York Road
Yorkton, Saskatchewan
S3N 2X2

RETAIL PRICE:

$12,275.00 (June 1980, f.o.b. Humboldt, 11.3 m width, with optional hitch jack and finishing harrows).

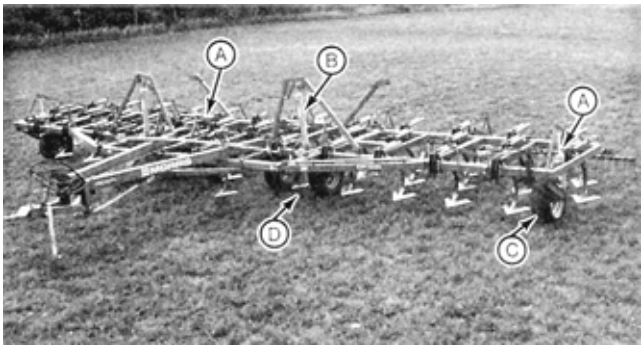


FIGURE 1. Morris CP-631 (A) Depth Control Cylinders, (B) Wing Lift Cylinders, (C) Wing Wheels, (D) Dual Centre Wheels.

SUMMARY AND CONCLUSIONS

The overall functional performance of the Morris CP-631 heavy duty cultivator was very good. Performance was reduced by uneven penetration in hard soils.

The spring trip shanks could lift 182 mm (7.2 in) to clear stones. When equipped with sweeps having a 43 degree stem angle as supplied by the manufacturer, sweep pitch varied from minus 1 degree to 2.5 degrees over the full draft range normally experienced by heavy duty cultivators. With 305 mm (12 in) spacing, shank trip spring preload was exceeded at drafts greater than 10.4 kN/m (710 lb/ft). This is well beyond the range of normal primary tillage drafts.

The Morris CP-631 had good penetration in normal conditions. Depth of penetration was uniform in normal conditions. In hard soils, the wing tips penetrated up to 50 mm (2 in) deeper than the centre section, due to non-uniform forces on the cultivator frame. Wing frame twisting also caused non-uniform fore-and-aft penetration in hard soils. The Morris CP-631 was very stable, no weed misses occurred because of skewing on moderate hillsides or in non-unif0rm soil. Weed kill was very good on level uniform soil. The Morris CP-631 followed the contour of rolling land very well. Trash clearance was excellent, and only in very heavy trash did plugging occur. Mounted finishing harrows were used during the test. They were able to distribute trash in ideal conditions, but were not aggressive enough in lumpy soils or in heavy trash. Furrow bottom ridging was only slight with 43 degree sweeps.

The Morris CP-631 could be conveniently placed into transport position in less than five minutes. The 200 mm (8 in) sweep to ground clearance, was ample for normal transport. The transport wheel tread of 2.1 m (7 ft) allowed safe transport on most slopes and rough terrain.

The Morris CP-631 towed well at normal transport speeds when equipped with mounted harrows. The weight on the wheels of the centre section, exceeded the maximum load recommended by the Tire and Rim Association for the tire size supplied.

The 11.3 m (37 ft) test machine had a transport height of 4.7 m (15.4 ft) which is greater than minimum power line heights in the three prairie provinces.

The hitch jack and rigid hitch link made one man hitching easy. Adequate adjustment was provided for both lateral and fore-aft frame leveling.

Average draft for the 11.3 m (37 ft) wide test machine in light primary tillage at 8 km/h (5 mph) varied from 19.4 kN (4360 lb) at 50 mm (2 in) depth to 42.2 kN (9470 lb) at 125 mm (5 in) depth. In heavy primary tillage at 8 km/h (5 mph), average draft varied from 20.5 kN (4600 lb) at 50 mm (2 in) to 74.1 kN (16,630 lb) at 125 mm (5 in).

In light primary tillage, at 10 km/h (6.2 mph) and 75 mm (3 in) depth, a tractor with 137 kW (184 hp) maximum power take-off rating will have sufficient power reserve to operate the 11.3 m (37 ft) wide Morris CP-631. In heavy primary tillage at the same depth and speed, a 167 kW (224 hp) tractor is needed.

The Morris CP-631 was equipped with locks for depth control wheels and raised wings, for safe towing. A slow moving vehicle sign with a mounting bracket was provided. The operator's manual was concise and well illustrated.

Some mechanical problems occurred during the 164 hours of field operation. Two shanks bent and five sweeps broke. Five shank pivot pins broke. Four shank holders cracked slightly. Two extension frame bolts failed.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Supplying tires on the centre section which comply with the Tire and Rim Association load rating.
2. Modifying the mounted harrows to provide more aggressive action.
3. Providing an alternate hitch jack location at the rear of the cultivator for use when mounted harrows are attached.
4. Specifying a lower spring-trip setting for shank and sweep protection in stony soils.
5. Installing lock washers on the sweep bolts to reduce loosening.
6. Modifying the shank pivot pins to reduce breakage.
7. Modifying the shank holders to reduce breakage.
8. Working with the agricultural equipment industry to standardize hydraulic quick couplers and hydraulic hose fitting threads.
9. 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 -- J. D. MacAuley
Project Engineer -- D. E. Gullacher

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. We try to meet all manufacturer's requirements on purchased components. On the model C.P.631, centre section tires become overloaded when the cultivator is extended from 31 to 37 ft. For cultivators which have been extended to 37 ft, using four 8-ply tires will provide adequate load carrying capacity. These tires will be available on request.
2. A new mounted harrow carrier arm, which provides increased downward pressure and more aggressive action, is under development. A four bar harrow is also available.
3. We do not feel that this is needed as we have had no complaints or requests for an alternate jack location, from dealers or farmers.
4. On our new series of cultivators, the trip has been redesigned to handle increased loads and higher tripping forces. Sweep bolt strength has also been increased by changing from Grade 5 to Grade 8 bolts.
5. We have found that loosening of the sweep bolts was due to stretching of the Grade 5 bolts previously used. The use of grade 8 sweep bolts has corrected this problem.
6. This problem has been corrected on the redesigned trip for our new series of cultivators. A longer pivot pin is also now being used to correct the problem on trips for our old series of cultivators.
7. This problem has been corrected on the redesigned shank holder for our new series of cultivators. On the old series of cultivators, it is important that the shank clamping U-bolts be kept tight to prevent the shanks from twisting within the castings, causing casting breakage.

8&9. We are working to obtain suitable agriculture equipment standards. There are already several standards for hydraulic hose fittings and lines and for stem and sweep angles and fasteners. From a manufacturer's point of view, we would like to work to only one standard. This is a complex problem as it does not only affect us in the prairies, but also involves machines we market in the rest of the world. Getting everyone to agree on one standard will take time.

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

GENERAL DESCRIPTION

The Morris CP-631 is a trailing, flexible, three-section heavy duty cultivator suitable for medium and heavy primary tillage operations. It is available in 4 widths ranging from 9.4 to 11.3 m (31 to 37 ft). The test machine was an 11.3 m (37 ft) model, with a 4.1 m (13.5 ft) centre frame and two 3.6 m (12 ft) wings. It was equipped with 37 spring-trip shanks, laterally spaced at 305 mm (12 in) and arranged in three rows, with one shank mounted on an extension row on the centre section.

The centre frame is carried on two dual wheels sets, while each wing is supported by a single wheel. Four hydraulic cylinders, connected in series, control tillage depth. The wings fold into the upright position with two hydraulic cylinders connected in parallel. A tractor with dual hydraulic controls and pressure capability of 11,400 kPa (1650 psi) was needed to operate the test machine.

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

SCOPE OF TEST

The Morris CP-631 was operated in the field conditions shown in TABLE 1, for 164 hours, while cultivating about 1400 ha (3500 ac). It was evaluated for quality of work, ease of operation and adjustment, power requirements, safety, and suitability of the operator's manual.

Optional attached finishing harrows were used during the test.

RESULTS AND DISCUSSION

QUALITY 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 trip spring preload, may become excessive on some cultivators in normal tillage. A slightly positive sweep pitch results in uniform tillage depth and a smooth furrow bottom while excessive sweep pitch causes furrow bottom ridging, rapid sweep tip wear, and increased draft. Shanks which maintain a low, relatively constant sweep pitch, over the normal range of tillage forces, are desirable.

The Morris CP-631 was equipped with spring-trip shank holders. Tripping force was adjustable. During the test, the Morris CP-631 was used with 406 mm (16 in) wide Nicols sweeps with 43 degree stem angle. This gave a no load sweep pitch of minus 1 degree.

FIGURE 3 shows pitch characteristics of the Morris CP-631 shank assembly. The increase in pitch as draft is increased results from shank flexing. Sweep pitch varied 3.5 degrees over the full

TABLE 1. Operating Conditions

FIELD CONDITION	HOURS	FIELD AREA (ha)
Soil Type		
— light loam	35	299
— loam	89	760
— clay	40	341
TOTAL	164	1 400
Stony Phase		
— stone free	35	299
— occasional stones	74	631
— moderately stony	35	299
— very stony	20	171
TOTAL	164	1 400

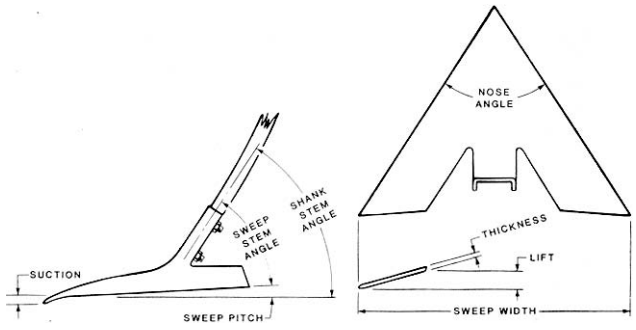


FIGURE 2. Shank and Sweep Terminology.

range of draft normally occurring in primary tillage. When equipped with 43 degree sweeps, as used during the test, sweep pitch varied from minus 1 to plus 2.5 degrees over this draft range. At the manufacturer's recommended setting, the shank trips began to release and shank force decreased at drafts greater than 10.4 kN/m (710 lb/ft), as shown on the graph. Tripping occurred well beyond the normal primary tillage draft range, indicating that the Morris CP-631 spring-trip shanks were well suited for heavy primary tillage.

FIGURE 4 shows the lifting pattern when shanks encounter stones or field obstructions. Maximum lift height was 182 mm (7 in). Two shanks bent and five sweeps broke during the 164 hour test period. These failures do not represent a serious problem, but indicate that the manufacturer's recommended spring-trip settings were too high for adequate shank and sweep protection in very stony conditions.

Penetration: Penetration of the Morris CP-631 was good in normal primary tillage conditions. In spite of negative no load sweep pitch recommended by the manufacturer, the cultivator mass of 334 kg/m was sufficient for proper penetration.

Penetration was uniform in normal primary tillage conditions provided the frame was properly leveled and depth control cylinders were kept synchronized. In heavy primary tillage, large soil forces on the cultivator limited penetration of the centre frame resulting in centre frame depths being about 50 mm (2 in) less than that of the wing tips. The depth control wheels were positioned so that each centre wheel supported about 17.5% of cultivator weight while each wing wheel supported about 15%. During operation, tillage forces redistributed load on the cultivator wheels so that each centre wheel supported about 15.5% of total weight while each wing wheel supported about 19%. For good flotation and uniform penetration across the cultivator width, is is desirable to have wheel sized and positioned so that each supports equivalent weight.

Depth differences between the front and rear rows of shanks were slight in normal soil conditions, once the frame had been properly leveled. In heavy primary tillage, twisting of the wing frames caused the outer front sweeps to penetrate about 50 mm (2 in) deeper than the outer rear sweeps.

The Morris CP-631 followed gently rolling field contours very well. The similar widths of the centre section and each hinged wing resulted in fairly uniform penetration across the cultivator width, in rolling fields. As with most wing cultivators, large variation in tillage depth could occur in fields with abrupt contour changes.

Plugging: Trash clearance was excellent. The Morris CP-631 was capable of clearing large amounts of trash in all conditions. Plugging occurred only in very heavy straw conditions.

Trash Burial and Field Surface: When operating at a 75 mm (3 in) tillage depth and fitted with 43° sweeps, the Morris CP-631 left most stubble standing upright, when travelling at speeds below 6 km/h (4 mph). Soil pulverization and trash burial increased appreciably at speeds above 8 km/h (5 mph). In normal conditions, sufficient trash was usually buried in first operation summerfallow to allow the use of a field cultivator for subsequent tillage.

Trash burial with chisel points in heavy crop residue was good (FIGURE 5). The action of the chisel points moved enough soil for adequate trash burial while leaving some standing stubble for snow retention.

In normal conditions, the Morris CP-631 gave good soil pulverization resulting in a uniform, field surface. As with most heavy duty cultivators, pulverization was reduced in compacted soils and a somewhat lumpy field surface resulted. The optional harrows were effective in smoothing small ridges, leaving a uniform, level field surface (FIGURE 6). The harrows were not effective in lumpy conditions or in breaking up and distributing heavy trash because of insufficient pressure by the harrow arm springs. It is recommended that the manufacturer increase the strength of the springs on the harrow arms for more aggressive harrow action.

Furrow Bottom Ridging: In most conditions, the spring-trip shanks of the Morris CP-631 held the sweeps at low pitch angles, resulting in a furrow bottom with ridges of less than 15 mm (0.6 in). In very compacted soils, increased sweep pitch caused greater furrow bottom ridging.

Skewing and Stability: The Morris CP-631 was very stable and did not skew sideways in normal field conditions. The sweep pattern (FIGURE 7) was symmetrical and did not impose any side forces on the cultivator during normal tillage. Slight skewing did

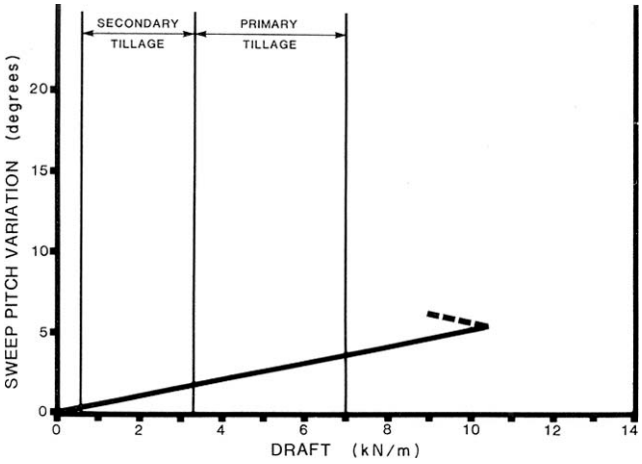


FIGURE 3. Sweep Pitch Variation over a Normal Range of Draft (305 mm shank spacing).

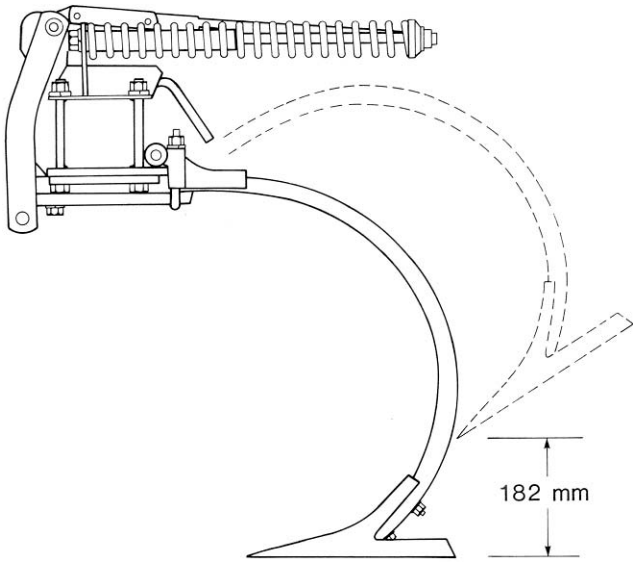


FIGURE 4. Shank Lifting Pattern.

FIGURE 5. Typical Trash Burial with Chisel Points.

occur in varying soil conditions, and on side hills. The cultivator, when equipped with 406 mm (16 in) sweeps, had to skew more than 2.3 degrees to miss weeds. Only steep hills provided enough side slope for weed misses due to skew.

Weed Kill: Weed kill was good in normal soil conditions when the cultivator was equipped with 406 mm (16 in) sweeps at a lateral spacing of 305 mm (12 in). Sweeps were located behind each depth control wheel to uproot weeds in the wheel tracks.

In favorable conditions, the finishing harrows were effective in uprooting and exposing weeds loosened by the cultivator. The harrows were not sufficiently aggressive for proper action in lumpy soils or in fields with heavy trash.

EASE OF OPERATION AND ADJUSTMENT

Transporting: The Morris CP-631 was easily placed in transport position (FIGURE 8) using the hydraulic wing lift system supplied as standard equipment. Transport locks were provided for both wings and for the depth control wheels of the centre section. Spacers are provided on the arms of the harrows on the centre section to raise the harrows for adequate transport clearance. One man could place the Morris CP-631 in transport position in about 5 minutes.

Transport width was 5.6 m (18.4 ft) while transport height was 4.7 m (15.4 ft). Care was needed when transporting on public roads, through gates, over bridges, and beneath power and telephone lines.

The Morris CP-631 towed well without sway at normal transport speeds. Sweep-to-ground clearance of 200 mm (8 in) and a wheel tread of 2.1 m (6.9 ft) gave good transport ground clearance.

Hitching: The hitch jack and rigid hitch tongue of the Morris CP-631 made one man hitching fairly easy. The hitch jack worked well with the cultivator in transport and field positions when no mounted cultivator harrows were attached. The jack also worked well when in transport position with mounted harrows. Hitch weight of the harrow equipped cultivator in field position was however, negative, making hitching difficult without use of the tractor hydraulics. It is recommended that an alternate location for the hitch jack be provided at the rear of the cultivator to simplify hitching when equipped with mounted harrows.

FIGURE 6. Typical Field Surface when using Optional Mounted Harrows.

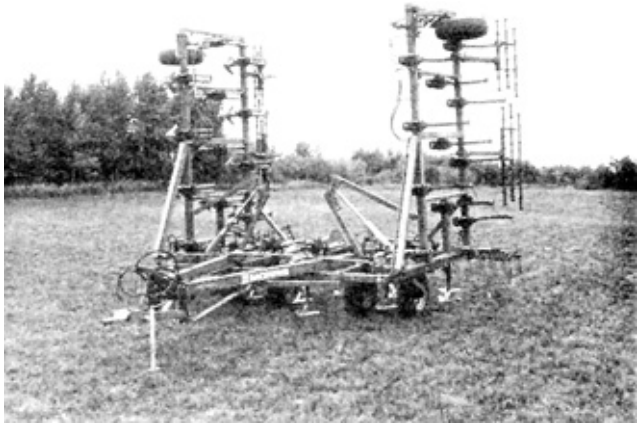


FIGURE 8. Transport Position.

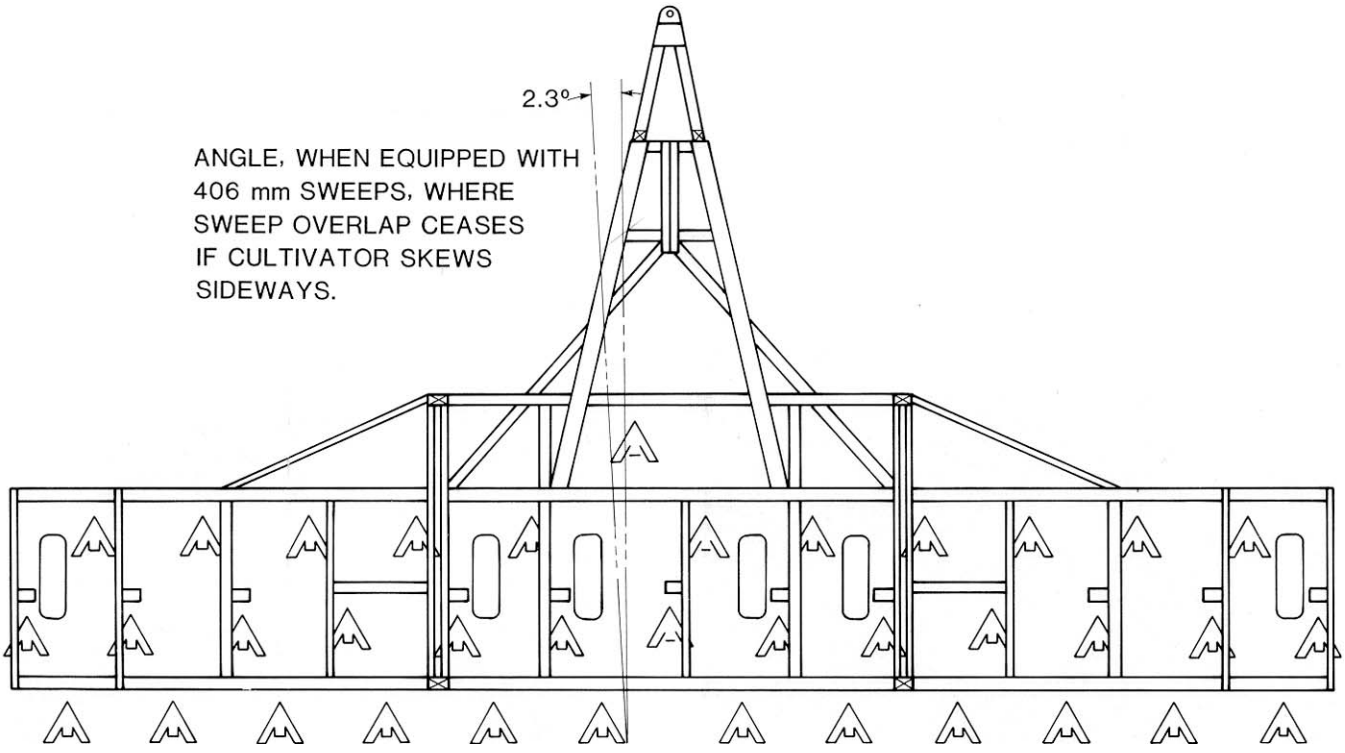


FIGURE 7. Sweep Pattern (305 mm Shank Spacing).

The swivel hitch (FIGURE 9) was shimmed to fit the drawpin very closely, thereby making precise tractor alignment necessary when hitching. An optional ring type clevis is available that does not require exact drawpin fit. This clevis makes hitching easier, but results in rapid wear of the drawpin.

Hitch height could be adjusted precisely over a 400 mm (16 in) range by use of the ratchet jack assembly (FIGURE 9). This range was adequate to allow fore-and-aft frame leveling with all tractors used during testing.

Maneuverability: The hitch pole of the Morris CP-631 was narrow, permitting normal turns without tractor wheel interference. The dual wheels of the centre section did not skid during turns.

The wing wheels were mounted very close to the ends of the wings. There was not sufficient wing overhang to allow moderate overlap without running a wing wheel on previously tilled ground. This reduces uniformity of cultivator penetration.

Frame Leveling: Adequate lateral leveling adjustment was provided for the depth control cylinders of the centre and wing sections. The threaded cylinder anchor rods could be adjusted at the rear of the cultivator to raise or lower the wheels. Spacers were provided for additional adjustment range.

Depth of Tillage: Tillage depth was adjusted with four hydraulic cylinders connected in series. A hydraulic stop valve on one cylinder controlled the tillage depth. As is common with series hydraulic systems, to maintain the centre and wing frames at the same depth, periodic synchronization of the cylinders, by completely extending them to fully raised position, was necessary.

Sweep Installation: It ook one man about two hours to change the 37 sweeps on the Morris CP-631. The sweep bolts were located high enough on the shank to avoid thread damage during tillage, making removal easy. The 200 mm (8 in) sweep ground clearance was adequate for easy sweep removal.

Shank Installation: Individual shanks could be easily replaced in less than 10 minutes by removing the U-bolt and one bolt.

POWER REQUIREMENTS

Draft Characteristics: FIGURE 10 shows draft requirements for heavy duty cultivators in typical primary tillage, at a speed of 8 km/h (5 mph). This figure gives average requirements based on tests of 10 makes of heavy duty cultivators in 40 different field conditions. Attempting to compare draft requirements of different makes of heavy duty 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 heavy duty cultivators.

In light primary tillage, average draft per metre of width, at 8 km/h (5 mph), varied from 1.7 kN (380 lb) at 50 mm (2 in) depth to 3.7 kN (830 lb) at 125 mm (5 in) depth. For the 11.3 m (37 ft) wide Morris CP-361, this corresponds to a total draft ranging from 19.4 to 42.2 kN (4350 to 9470 lb).

In heavy primary tillage, average draft per metre of width, at 8 km/h (5 mph), varied from 1.8 kN (380 lb/ft) at 50 mm (2 in) depth to 6.5 kN (1460 lb/ft) at 125 mm (5 in) depth, corresponding to a total draft from 20.5 to 74.1 kN (4600 to 16,600 lb) for the 11.3 m (37 ft) test machine.

Increasing speed by 1 km/h (0.6 mph), increased draft by about 90 N per metre of width (6 lb/ft). For the 11.3 m (37 ft) wide test machine, this represents a draft increase of 1.0 kN (225 lb) for a 1 km/h (0.6 mph) speed increase.

Tractor Size: TABLES 2 and 3 show tractor sizes needed to operate the 11.3 m (37 ft) wide Morris CP-631 in light and heavy primary tillage. 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 Morris CP-631 in the stated conditions.

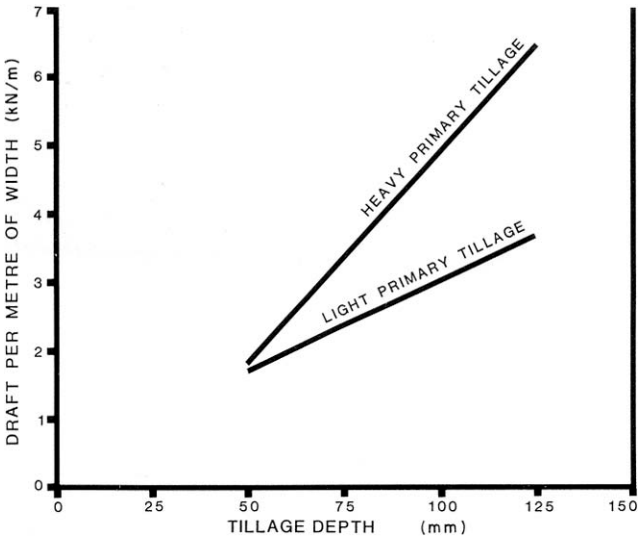


FIGURE 10. Average Draft Requirements for Heavy Duty Cultivators at 8 km/h.

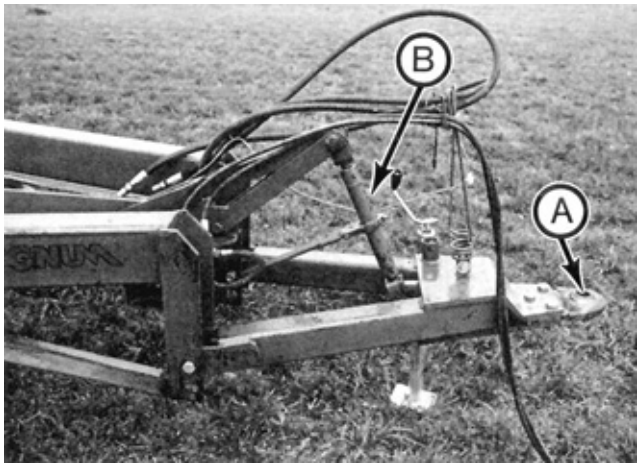


FIGURE 9. Hitch: (A) Swivel Hitch, (B) Hitch Height Adjustment.

TABLE 2. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.3 m Wide Morris CP-631 in Light Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	59	72	86	100	116	132
75	85	101	119	137	156	177
100	111	131	152	174	197	221
125	137	160	185	211	236	265

TABLE 3. Tractor Size (Maximum Power Take-off Rating, kW) to Operate the 11.3 m Wide Morris CP-631 in Heavy Primary Tillage.

DEPTH (mm)	SPEED (km/h)					
	7	8	9	10	11	12
50	56	67	80	93	108	123
75	108	127	147	167	189	212
100	160	186	213	242	271	301
125	211	245	280	315	352	390

Tractor size may be determined by selecting the desired tillage depth and speed from the appropriate table. For example; in light primary tillage at 75 mm (3 in) depth and 10 km/h (6 mph), a 137 kW (184 hp) tractor is needed to operate the Morris CP-631. In heavy primary tillage, at the same depth and speed, a 167 kW (224 hp) tractor is needed.

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 (17 ft) over farm land or over secondary roads. In Alberta and Manitoba, the neutral ground wire may be as low as 4.8 m (16 ft) over farm land. In all three provinces, lines in farm yards may be as low as 4.6 m (15 ft).

Transport height of the 11.3 m wide model of the Morris CP-631 is 4.7 m, which is high enough to contact prairie power lines. The legal responsibility for safe passage under utility lines rests with the machine 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 test machine was 5.6 m wide in transport position, necessitating caution when transporting.

Wing and depth control transport locks were provided. Danger areas should be avoided when climbing onto the machine to fasten these locks.

A slow moving vehicle sign with bracket was supplied with the cultivator as standard equipment.

When the cultivator was fitted with mounted harrows and folded for transport, the weight on the transport wheels exceeded the maximum load recommended by the Tire and Rim Association Standards for the tires supplied by the manufacturer.

STANDARDIZATION

Hydraulics: Difficulties were encountered during the test, 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 Morris CP-631 operator's manual contained information on operation, maintenance, trouble shooting and safety. It was clearly written and well illustrated.

DURABILITY RESULTS

TABLE 4 outlines the mechanical history of the Morris CP-631 during 164 hours of field operation while tilling about 1400 ha (3500 ac). The intent of the test was evaluation of functional performance. The following mechanical problems represent those which occurred during functional testing. An extended durability evaluation was not conducted.

TABLE 4. Mechanical History

ITEM	OPERATING HOURS	EQUIVALENT FIELD AREA (ha)
Frame:		
two wing extension bolts were lost and replaced at	98, 124	837, 1059
Shank and Holder:		
the sweep bolts loosened continually, requiring frequent tightening		During the Test
the existing eccentric collars on the spring-trip mechanisms were replaced with ones of new design by the manufacturer		During the Test
five sweeps broke and were replaced at	8, 82, 90	88, 700, 768
two shanks bent and were replaced at	82, 90	700, 768
five shank pivot pins broke and were replaced at	86	734
four shank holders were found to be cracked at	135	1152

DISCUSSION OF MECHANICAL HISTORY

Eccentric Collars: The existing eccentric collars on the spring-trip mechanism were replaced by the manufacturer with ones having a knurled inner face. The purpose of this redesign was to prevent loosening of the collars during tripping. The improved collars did not loosen throughout the remainder of the test.

Shanks and Sweeps: The shank and sweep failures occurred when encountering rocks. Although the failures do not represent a serious problem, it is recommended that the manufacturer specify a lower spring-trip setting for adequate shank and sweep protection in stony soils.

The sweep bolts were installed without lock washers and, as a result, they loosened during operation, requiring frequent retightening. It is recommended that lock washers be included during sweep installation to prevent loosening.

Shank Pivot Pins: Ends broke off the shank pivot pins because holes for the pin retainers were drilled too close to the ends of pins (FIGURE 11). It is recommended that the manufacturer modify the pins to prevent such breakage.

Shank holders: The shank holder failures occurred because the shank U-bolts loosened slightly allowing sideway movement of the shank (FIGURE 12). It is recommended that the manufacturer modify the shank holder to prevent such breakage.

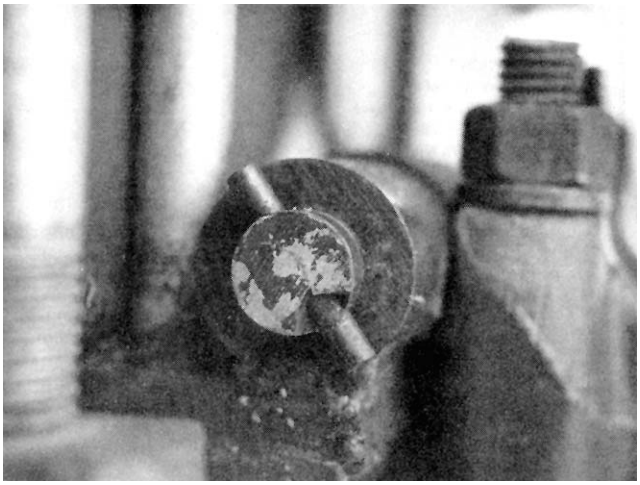


FIGURE 11. Shank Pivot Pin.

FIGURE 12. Shank Holder Crack.

APPENDIX I

SPECIFICATIONS

MAKE: Morris Chisel Plow
MODEL: CP-631 (11.3 m size)
SERIAL NUMBER: 78836
MANUFACTURER: Morris Rod Weeder Co. Ltd.
85 York Road
Yorkton, Saskatchewan
S3N 2X2

DIMENSIONS:	**FIELD POSITION**	**TRANSPORT POSITION**
width	11,370 mm	5550 mm
length - with harrows	7370 mm	7370 mm
height	1990 mm	4650 mm
maximum ground clearance	200 mm	200 mm
wheel tread	10,480 mm	2060 mm
SHANKS:		
number	37	
lateral spacing	305 mm	
trash clearance (frame to sweep tip)	610 mm	
number of shank rows		
centre section		
wings		
distance between rows		
extension - front	810 mm	
front - middle	860 mm	
middle - rear	760 mm	
shank cross section	25 x 50 mm	
shank stem angle	42°	
sweep hole spacing	56 mm	
sweep bolt size		
upper	7/16" x 2"	
lower	7/16" x 1-3/4"	
HITCH:		
vertical adjustment range	400 mm	
DEPTH CONTROL:	hydraulic	
FRAME:	102 mm square tubing	
TIRES:		
centre section	4, 9.5L x 15, 6 ply	
wings	2, 9.5L x 15, 6 ply	
NUMBER OF LUBRICATION POINTS:	49 grease fittings - as required 6 wheel bearings - keep seals moist	
HYDRAULIC CYLINDERS:		
depth control		
centre section	2, 89 x 305 mm	
wings	2, 89 x 305 mm	
wing lift	2, 76 x 610 mm	

WEIGHTS: (Without Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
right wheel	526 kg	
right centre wheels	1296 kg	1806 kg
left centre wheels	1206 kg	1758 kg
left wheel	546 kg	
hitch	238 kg	248 kg
TOTAL	3812 kg	3812 kg

WEIGHTS: (With Mounted Harrows)	**FIELD POSITION**	**TRANSPORT POSITION**
right wheel	618 kg	
right centre wheels	1546 kg	2150 kg
left centre wheels	1524 kg	2024 kg
left wheel	622 kg	
hitch	-92 kg	44 kg
TOTAL	4218 kg	4218 kg

OPTIONAL EQUIPMENT:
four width options from 9.4 m to 11.3 m
hitch jack
mounted finishing harrows
ring type hitch clevis

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

CONVERSION TABLE

1 hectare (ha)	= 2.5 acre (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 millimetre (mm)	= 0.04 inches (in)
1 metre (m)	= 3.3 feet (ft)
1 kilowatt (kW)	= 1.3 horsepower (hp)
1 kilogram (kg)	= 2.2 pounds mass (lb)
1 kilonewton (kN)	= 220 pounds force (lb)
1 kiionewton/metre (kN/m)	= 70 pounds force/foot (lb/ft)
1 kilopascal (kPa)	= 0.2 pounds force/square inch (psi)

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