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Evaluation Report 294

Morris M-10 Press Drill

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

MORRIS M-10 PRESS DRILL

MANUFACTURER AND DISTRIBUTOR:

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

RETAIL PRICE:

$23,090.00 (February, 1983, f.o.b. Humboldt; two units with duplex hitch, hydraulic transport, hydraulic markers, dual front castors, hydraulic depth cylinders and hoses, acremeter.)

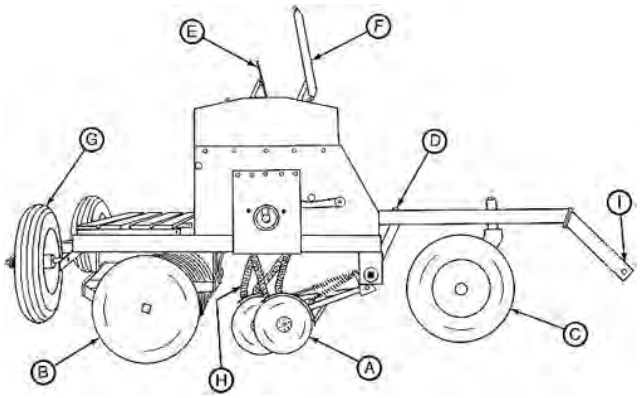

FIGURE 1. Schematic of Morris M-10: (A) Double Disk Openers, (B) Solid Press Wheels, (C) Castor Wheels, (D) Hydraulic Lift, (E) Grain Box Lid, (F) Fertilizer Box Lid, (G) Hydraulic Transport, (H) Fertilizer and Grain Delivery Tubes, (I) Hitch Point.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Morris M-10 was very good. Penetration and seed placement were good in a wide range of soil and trash conditions, providing the seedbed had been properly prepared. Performance of the press wheels was good; plugging did not occur. The rock guards reduced the lodging of stones between press wheels.

Accuracy of the seed metering system was very good in large and small seeds once the variable speed drive was properly zeroed. However, difficulty in correctly zeroing the drive resulted in considerable variation of the seeding rate between grain drill units. Alfalfa, bromegrass and Russian wild ryegrass were successfully metered through the grain box. A 50/50 mixture of rapeseed and Furadan could not be accurately metered through the grain box. The minimum seeding rate for rapeseed was 1.2 kg/ha (1.1 lb/ac). Variation in seeding rates among runs was very low for all seeds. Seeding rates were unaffected by ground speed, level of grain in the box, or field vibrations but were slightly affected by field slope.

Fertilizer metering system performance was very good. Accuracy in 11-51-00 fertilizer was good. Variation in application rates among individual runs was insignificant. Fertilizer rates were unaffected by ground speed, level of fertilizer in the box, or field vibrations, but were slightly affected by field slope.

Both the seed and fertilizer rates were convenient to adjust. The initial adjustment of the flap clearance in the feed cups and zeroing of the variable speed drive were difficult. Seed and fertilizer boxes were convenient to fill as an adequate walkway was provided. Cleaning both boxes was fairly easy. The boxes were well sealed against moisture. Plugging occurred only in 23-23-00 fertilizer when moisture condensed in the cups and downspouts. Transporting, using the optional transport system was safe and convenient. Eleven pressure grease fittings and two oil levels required daily servicing on each unit.

About 28 kW (37 hp) of tractor power should be available for each 3 m (10 ft) drill unit. An 84 kW (110 hp) tractor should have sufficient power reserve to operate a multiple hook-up of three units in most soil conditions at speeds up to 10 km/h (6 mph).

The operator's manual was very well written and contained a detailed parts list and much useful information on safety, operation, adjustment and specifications. The Morris M-10 was safe to operate if normal safety precautions were followed.

Only a few minor mechanical problems occurred during functional evaluation.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to eliminate the large differences in the seeding rates between grain drill units.
2. Indicating in the operator's manual the proper storage position for the marker transport pins.
3. Providing a storage location on the machine for the hand crank and the metering wheel engaging hook.
4. Modifying the hitch clevis to make hitching easier.
5. Providing a slow moving vehicle emblem as standard equipment.

Senior Engineer: G.E. Frehlich

Project Engineer: M.E. Jorgenson

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The variable speed drives will be adjusted in the factory using a new procedure to eliminate differences in the seeding rates between grain drill units.
2. & 3. In the next operator's manual, proper storage of the marker pin, hand crank and engaging hook will be illustrated.
4. Hitch clevis modifications are under consideration.
5. A slow moving vehicle bracket and socket are provided and a slow moving sign is available from the dealer.

MANUFACTURER'S ADDITIONAL COMMENTS

1. The lids on the variable speed drives will have one bolt instead of eight for convenient filling in 1984.
2. Heavy duty steel packers are available in 1983.
3. The rate adjustment lever is now equipped with a knurled spring loaded clamping plate.
4. Grain and fertilizer level indicators are being considered.
5. Deviations of the seed and fertilizer rates between runs and between machines will be less than 5% when adjusted accurately.

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

GENERAL DESCRIPTION

The Morris M-10 is a 3 m (10 ft) press drill with 152 mm (6 in) spacing. It is equipped with 20 double disk openers in two rows of 10 each. Seeding depth is controlled by an adjustable compression spring on each opener and a hydraulic cylinder equipped with an adjustable stop. The divider in the combination grain and fertilizer box may be opened to allow filling the entire box with grain. The box is capable of holding 640 L (17.5 bu) of grain with 410 kg (900 lb) of fertilizer or 1050 L (28.8 bu) of grain only.

Grain is metered by externally cogged fine and coarse metering wheels through plastic feed cups, equipped with adjustable flaps and shutoff slides. Fertilizer is metered through the feed cups by coarse metering wheels only. The metering wheels are chain driven from the press wheels through a variable speed drive box.

Convoluted rubber hoses deliver the seed and fertilizer separately to the openers. Two gangs of 636 mm (25 in) diameter solid, V-shaped, press wheels pack the soil directly behind each opener.

An optional grass seed attachment is available, but was not evaluated.

The two unit test machine was equipped with an optional duplex hitch, transport system, front dual castors, acremeter, and a hydraulic marker.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Morris M-10 was operated in the conditions shown in TABLE 1 for 104 hours while seeding about 403 ha (996 ac). It was evaluated for quality of work, ease of operation, ease of adjustment, power requirements, operator safety, and suitability of the operator's manual. In addition, the seed and fertilizer metering systems were calibrated in the laboratory.

TABLE 1. Operating Conditions

Crop	Soil	Stone Conditions	Field Area ha	Hours
Spring wheat on summerfallow	Oxbow loam	moderately stony	37	11
Spring wheat on summerfallow			22	6
Durum wheat on summerfallow	Oxbow loam	moderately stony	39	11
Durum wheat on summerfallow			53	12
Barley on barley stubble	Oxbow loam	moderately stony	55	15
Oatys on oat stubble/breaking	Waitville loam	occasional stones	24	7
Corn on summerfallow	Whitewood loam	occasional stones	6	2
Flax on summerfallow	Kamsack clay	moderately stony	24	7
Flax on rapeseed stubble	Oxbow loam		20	6
Rapeseed/Furdan on summerfallow	Waitville & Whitewood loam	moderately stony	79	18
Rapeseed/Furdan on summerfallow	Blaine Lake silty clay loam	occasional stones	44	9
Total			403	104

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was good in a wide variety of field conditions provided the openers (FIGURE 2) were properly adjusted and adequate pre-seeding tillage had been performed. Opener depth and force were controlled by adjusting the nut on the compression spring rod, by repositioning the pressure rod connection on the opener, or by setting the hydraulic lift cylinder. When properly adjusted for the desired depth, the nut on the pressure rods just cleared the lift arm. Too much clearance between the nut and the lift arm resulted in excessive penetration or downward movement of the disks in soft soils.

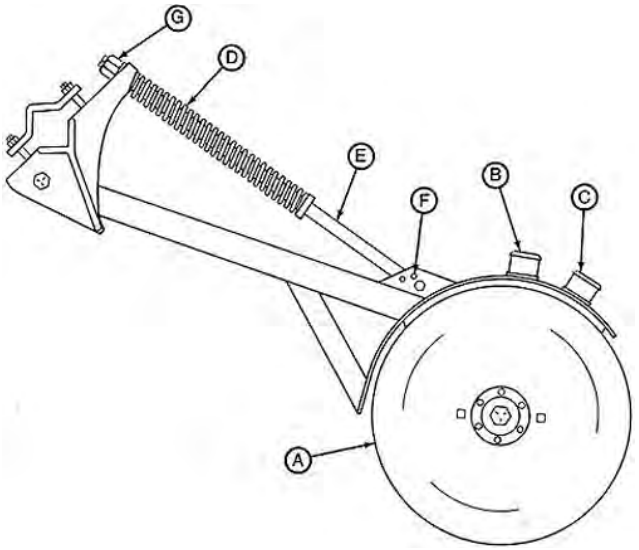

FIGURE 2. Double Disk Opener: (A) Disks, (B) Fertilizer Tube, (C) Grain Tube, (D) Spring, (E) Pressure Rod, (F) Depth Adjustment Holes, (G) Pressure and Depth Adjusting Nut.

The downward force of each opener could be adjusted from zero to about 390 N (85 lb). An opener force of about 180 N (40 lb) was suitable in most conditions. The pressure rod connection on openers running in tractor or castor wheel tracks was changed one setting to obtain uniform penetration. As opener force was increased, stone and trash clearance were decreased.

Seed Placement: Ideally, grain is seeded into topsoil on a firm seedbed from 25 to 50 mm (1 to 2 in) deep. A firm seedbed aids in the packing of moist soil around the seed and provides a barrier to the seepage of rainfall below the seed zone. Pre-seeding tillage was the most important factor determining seed placement since the openers readily penetrated to the seedbed, but did not exert enough force to penetrate deeper.

Seeding depth was quite uniform with slight variations resulting from field or seedbed irregularities. Measurements of seeding depth when seeding wheat at 8 km/h (5 mph) showed that most of the seeds were within 10 mm (0.4 in) of the average seeding depth. Higher speeds caused more seed scatter, especially when seeding shallow crops such as rapeseed in stony fields. If the soil was loose and had been worked too deep, the disks did not turn causing poor seed placement.

Seed coverage was good and only slightly affected by ground speed. Seed coverage was reduced in moist heavy soils due to decreased penetration and soil flow. Seed and fertilizer were placed together in a narrow band.

Soil Compaction: The V-shaped press wheels followed directly behind the openers, effectively pressing the soil about the seeds. They provided adequate compaction in all soils encountered. Optional rubber press wheels are preferred in heavy clay soils where packing requirements are less, and in stony fields where impact from stones is greater.

Average packing force exerted by each press wheel ranged from 710 N (160 lb) with seed and fertilizer boxes empty, to 1010 N (225 lb) with seed and fertilizer boxes full. Press wheel furrow depth ranged from 40 to 65 mm (1.5 to 2.5 in) depending on soil conditions (FIGURES 3 and 4).

FIGURE 3. Soil Surface Before (right) and After (left) Seeding Summerfallow.

FIGURE 4. Soil Surface After Seeding Worked Stubble.

Plant Emergence: Generally, press drills promote rapid and uniform seed germination. Time and uniformity of plant emergence depends primarily upon seedbed preparation and moisture conditions. Plant emergence was uniform in all fields with adequate moisture. FIGURES 5 and 6 illustrate emergence in fields of barley and rapeseed.

FIGURE 5. Barley Emergence 23 Days After Seeding. Moisture Conditions Above Average.

Metering Accuracy: The grain and fertilizer metering systems were calibrated in the laboratory[1] and compared with the manufacturer's calibration. Since actual application rates depend on size, density and moisture content of seed and fertilizer particles, it

is not possible for a manufacturer to present charts to include all the varieties of seed and fertilizer used. Field calibration checks may be necessary for seed with properties differing from those shown in the manufacturer's charts. Research has shown, however, that small variations in seed or fertilizer application rates will not significantly affect grain crop yields.

FIGURE 6. Rapeseed Emergence 27 Days After Seeding. Moisture Conditions Above Average.

Grain Metering System: The accuracy of the grain metering system (FIGURE 7) was very good in wheat, barley, oats, rapeseed and flax, once the variable speed drive was properly zeroed. It was difficult to initially set the variable speed drive to zero when following the instructions in the operator's manual. This produced large differences in the seeding rate between drill units, and between actual rates and the rates indicated in the operator's manual. Calibration checks of each unit were required in the field to ensure correct seeding rates, especially at low settings. It is recommended that the manufacturer consider modifications to eliminate the large differences in the seeding rates between drill units.

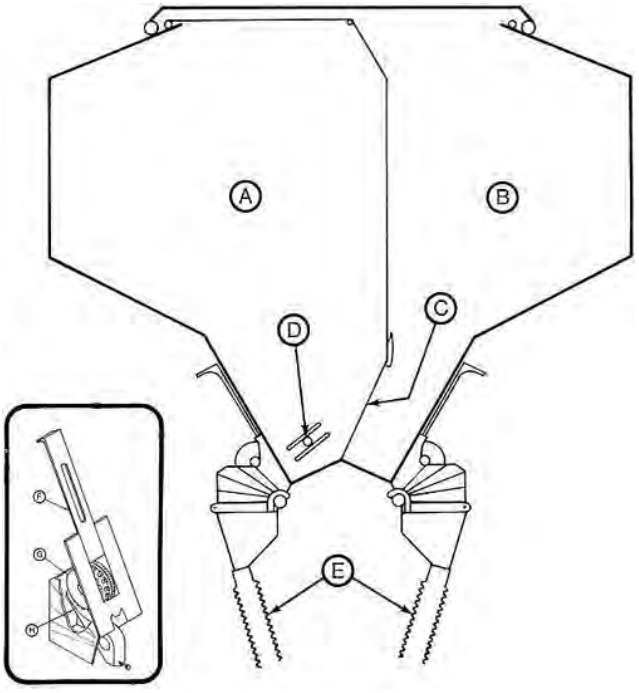

FIGURE 7. Seed and Fertilizer Metering System: (A) Grain Box, (B) Fertilizer Box, (C) Partition Door, (D) Agitator Shaft, (E) Grain and Fertilizer Spouts, (F) Adjustable Shutoff Slides, (G) Externally Cogged Metering Wheels, (H) Adjustable Flap.

A 50/50 mixture of rapeseed and Furadan could not be accurately metered through the grain box using the fine metering wheel recommended for rapeseed. The mixture could be seeded using the coarse metering wheel, but obtaining the desired seeding rate was difficult. The seeding rate adjustment was very sensitive with small movements of the rate adjustment lever producing large changes in the seeding rate.

Level of seed in the box, ground speed, and field vibrations did not affect the seeding rate for either large or small seeds. Seeding rates were slightly affected by variations in field slopes. For example, travelling up a 15° hill increased the seeding rate by 13%. Travelling down a 15° hill decreased the seeding rate by 10%.

The coefficient of variation[2] (CV) can be used to describe the variation of seeding rates among individual seed cups. An accepted variation for seeding grain is a CV value not greater than 15%. If the CV is less than 15%, seeding is uniform, whereas if the CV is greater than 15%, the variation among individual seed cups is excessive.

For wheat, oats and barley, seeding was very uniform. For example, when seeding wheat at 86 kg/ha (77 lb/ac), the CV was only 3%. When seeding rapeseed at 6.9 kg/ha (6.2 lb/ac), the CV was 9.3%.

Fertilizer Metering System: Accuracy of the fertilizer metering system was good. FIGURE 8 shows a slight difference between Machinery Institute and manufacturer's calibration curves for 11-51-00 fertilizer. The difference is probably due to the variation in the size and density of fertilizer used in the two calibrations. The density of the fertilizer used in the manufacturer's calibration was not indicated in the operator's manual.

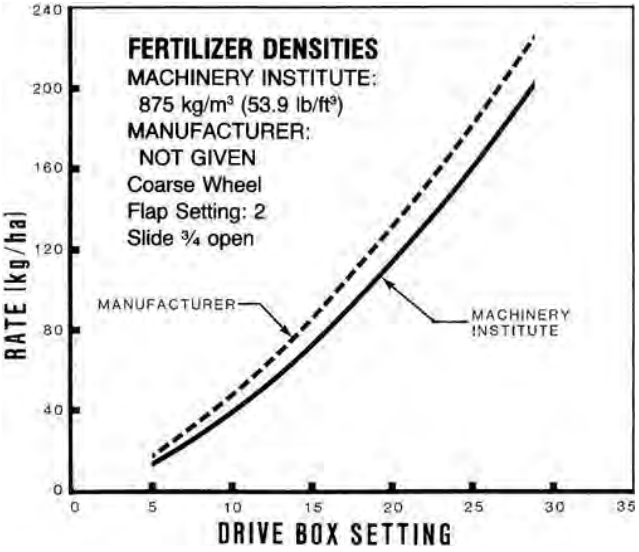

FIGURE 8. Fertilizer Calibration.

Fertilizer distribution among individual feed cups was very uniform. For example, when applying 11-51-00 fertilizer at a rate of 56 kg/ha (50 lb/ac), the coefficient of variation among individual feed cups was only 1.5%.

Level of fertilizer in the box, ground speed and field vibrations did not affect the application rate of 11-51-00 fertilizer. Field slopes had a slight effect on the fertilizing rates. For example, travelling up a 15° hill decreased the fertilizing rate by about 8%. Travelling down a 15° hill increased the fertilizing rate by about 8%.

Grass Seeding: An optional grass seeding attachment was available for the Morris M-10, but was not evaluated. However, alfalfa, bromegrass, and Russian wild ryegrass were seeded through the grain box. There were significant differences between the Machinery Institute and manufacturer's calibration curves for alfalfa (FIGURE 9). Calibrations for seeding bromegrass and Russian wild ryegrass through the grain box were not given in the operator's manual. The Machinery Institute's calibrations for bromegrass and Russian wild ryegrass are shown in FIGURES 10 and 11. These calibrations were obtained using the coarse metering wheel and a flap setting of two with the shutoff slide fully open.

EASE OF OPERATION

Wet Fields: The interior disk scrapers were effective in preventing mud, soil, and trash buildup between the double disks in all conditions encountered. The scrapers were spring loaded, easily removed and showed little wear after 104 hours of use. Only slight mud buildup occurred on the outside of the disks. External disk

[1]*T773, "Detailed Test Procedures for Grain Drills".*

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

scrapers were not available for the Morris M-10.

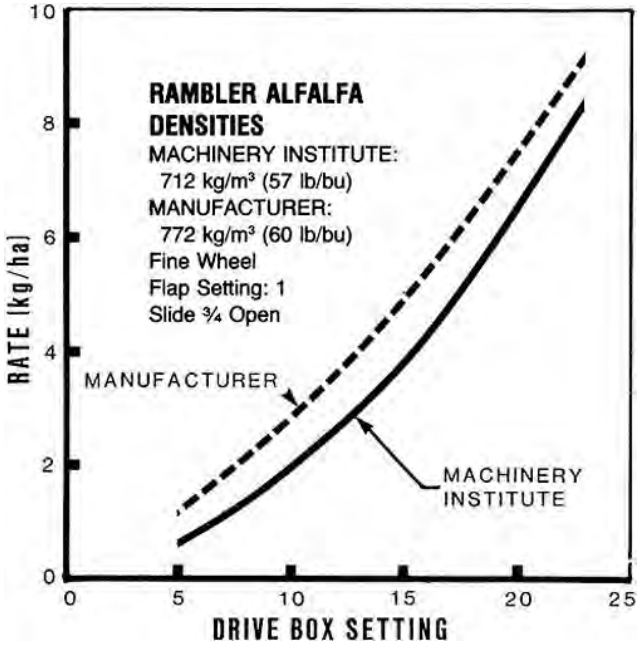

FIGURE 9. Alfalfa Calibration.

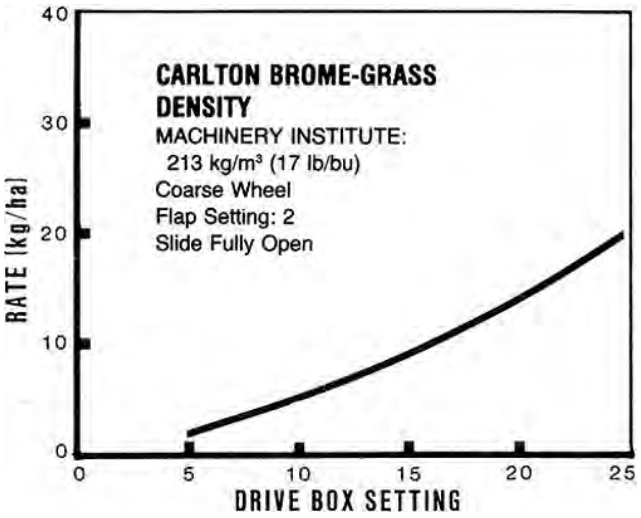

FIGURE 10. Bromegrass Calibration.

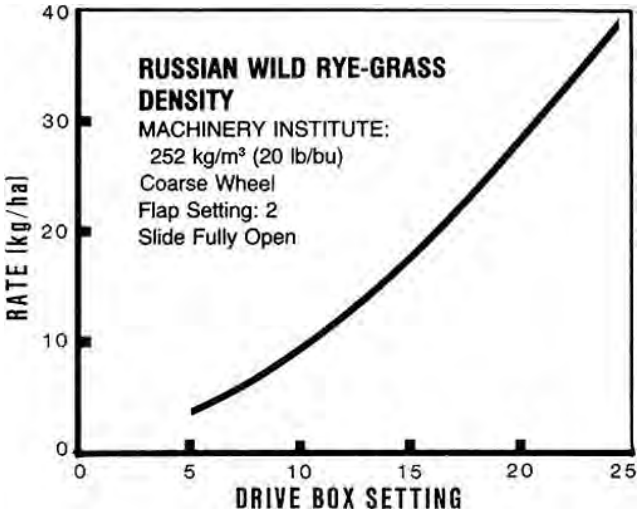

FIGURE 11. Ryegrass Calibration.

Only slight buildup of mud on the press wheels occurred in wet clay fields. The stone guards effectively prevented plugging when seeding through small pot holes or wet depressions.

Stony Fields: The rock guards prevented rocks from jamming between the press wheels in stony conditions. However, roots and tree stumps frequently jammed between the press wheels and had to be removed by hand.

Trip height was adequate to clear stones up to 150 mm (6 in). Stones did not lodge between disks, but roots and stumps occasionally caught in the interior disk scrapers and stopped disk rotation. Some damage occurred to the press wheels and disks while operating in stony fields.

Markers: The optional hydraulic markers were effective and easy to use. They were controlled hydraulically from the tractor cab, and produced a deep visible furrow on either side of the machine. The marker length was easy to adjust for different tractor sizes.

Filling: The 570 mm (22 in) wide metal walkway on the rear of the drill made filling with grain and fertilizer safe and convenient. The fertilizer and grain compartments were covered by one lid that could be reversed for front or rear filling. An interior grain box cover prevented the grain and fertilizer from being mixed. The lids were difficult to close requiring the operator to stretch both arms to unlock the lid supports (FIGURE 12).

FIGURE 12. Difficult Closing of the Grain and Fertilizer Box Lids.

The partition between the seed and fertilizer compartment could be opened to permit filling both compartments with seed. This permitted carrying 640 L (17.5 bu) of grain and 410 kg (900 lb) of fertilizer, or 1050 L (28.8 bu) of grain only in each 3 m (10 ft) unit.

Grain and fertilizer level indicators were not available for the Morris M-10.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent seepage into the box during moderate rains. Vinyl weather covers protected the seed and fertilizer cups from driving rains. However, in wet weather, moisture condensed in the fertilizer cups and spouts, and caused plugging when applying 23-23-00 fertilizer. An optional fertilizer box screen was available to prevent lumps of fertilizer from entering the feed cups.

Cleaning: The 220 mm (8.7 in) seed box opening and 168 mm (6.6 in) fertilizer box opening permitted cleaning with a 4.5 L (1 gal) pail only. The tapered boxes and agitator shaft in the grain box hindered cleaning. Grain and fertilizer in the bottom of the box could be brushed through the feed cups after opening the bottom flaps.

Area Counter: The optional acre counter for each drill unit was accurate to within 1% and recorded the nearest tenth acre up to one million acres. A metric counter was not available.

Shaft Monitors: An oscillating arm was attached to each seed metering shaft to indicate shaft rotation. Visibility of the indicator was very good even in dusty conditions. Although the fertilizer metering system was not equipped with a shaft monitor, the operation of the feed cups could be observed if the weather covers were raised.

Transporting: The Morris M-10 optional transport attachment (FIGURE 13) was safe and convenient to use. One man could move the drill into or out of transport position in about 10 minutes. The rigid hitch made it difficult to remove or install the drawpin if the drawbar and hitch were not carefully aligned. It is recommended that the manufacturer consider modifying the hitch clevis to make hitching easier. Both field and transport hitches folded up conveniently when not in use. A hitch jack was available as optional equipment.

The manufacturer recommended that the drill not be transported at speeds above 16 km/h (10 mph) or with boxes more than 1/2 full. Excessive wheel shimmy limited transport speed to 16 km/h

(10 mph). Locking all castor wheels permitted safe transport speeds up to 32 km/h (20 mph). The 4.6 m (15 ft) transport width made transporting on prairie roads and highways safe and convenient. Transport locks for the markers and openers were easy to install.

FIGURE 13. Full Transport Position.

EASE OF ADJUSTMENT

Lubrication: Lubrication was easy with good access to the 11 pressure grease fittings on each unit. Sight glasses made checking the oil level in the drive boxes easy; however, eight metric bolts had to be removed to add oil. The grease fittings and oil levels required daily servicing that took about six minutes. The wheel bearings required packing with grease each season.

Seeding and Fertilizing Rates: Seeding and fertilizing rates were easily changed by moving the rate adjustment lever on the drive box to the desired setting. Shutoff slides and bottom flaps on each feed cup had to be adjusted for different varieties of grain and fertilizer. For fine seeds such as rapeseed and alfalfa, each coarse metering wheel was disengaged from the fine metering wheel, using the supplied engaging hook. A hand crank was provided for turning the metering wheels, but could only be used for the right unit of multiple drill hook-ups. It is recommended that the manufacturer provide a storage location on the machine for the engaging hook and the hand crank.

The locking knob on the rate adjustment lever required excessive hand tightening to prevent the lever from slipping. The initial clearance of the feed cup flaps was difficult to set and adjust. A small mirror and flat feeler gauge were required for accurate setting.

Different row spacings were easily obtained by closing the appropriate shutoff slides.

Depth Adjustment: Seeding depth was easily adjusted by positioning the stop collar on the hydraulic cylinders. Individual openers could be adjusted by turning one nut on the pressure rod, or by moving the pressure rod connection to one of three different holes on the opener.

POWER REQUIREMENTS

Maximum draft with filled grain and fertilizer boxes on level fields with average soil moisture was about 5840 N (1310 lb) while average draft under these conditions was about 4580 N (1031 lb) for each 3 m (10 ft) drill unit. Average power requirement for one unit at 8 km/h (5 mph) was 10.2 kW (13.7 hp). When considering tractive efficiency and the tractor operating at 80% of full load, as well as variations in soil and field conditions, about 28 kW (37 hp) of tractor power should be available for each 3 m (10 ft) unit. In other words, an 84 kW (110 hp) tractor should have sufficient power to operate a multiple hook-up of three units in most soils at 10 km/h (6 mph).

OPERATOR SAFETY

The Morris M-10 was safe to operate if normal safety precautions were observed.

The 570 mm wide metal platform at the rear of the drill was skid proof and large enough for safe and convenient filling. The rear transport wheels were locked when in field position, making them safe to step on for mounting the rear platform.

The drill was equipped with a mounting bracket for a slow moving vehicle sign, but no sign was supplied. It is recommended that a slow moving vehicle sign be supplied as standard equipment. Transport locks were provided for the markers and openers.

Tire loads did not exceed the Tire and Rim Association maximum load rating. Slight overloading will occur if the machine is equipped with the single castor wheel.

OPERATOR'S MANUAL

The operator's manual was simple, concise and well illustrated, containing much useful information on operation and maintenance. Information was provided on safety, field preparation, lubrication, adjustments, transporting, specifications and calibration procedures. Both English and metric calibration charts for a wide variety of grains and fertilizers, and a detailed parts list were included.

DURABILITY RESULTS

The Morris M-10 press drill was operated for 104 hours while seeding about 403 ha (996 ac). The intent of the test was evaluation of functional performance and an extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that occurred during functional testing.

TABLE 2. Mechanical History

Item	Operating Hours	Field Area ha
-The marker transport lock arm bent when the cable caught on the transport pin, and was repaired at	1, 3	6,12
-A faulty seed box latch broke and was replaced at	1	6
-A hydraulic hose end failed and was replaced at	3	12
-Bolts on the hitch, seed boxes or markers came loose and were replaced or tightened at	11, 16, 30, 61, 70, 104	37, 50, 121, 226, 256, 403
-The front weather covers were damaged when pinched between the hydraulic cylinders and their step collars at	16	50
-The rigid hitch clevis was bent while going through a ditch at	40	158
-The spring pin on a marker transport lock was lost and replaced at	70	256

DISCUSSION OF MECHANICAL PROBLEMS

Marker Transport Lock: The marker transport locks were bent when the marker cable caught on the transport pin (FIGURE 14). The transport pin had been stored in the transport lock and not in the storage position provided on the frame. This storage position was not shown in the operator's manual and it is recommended that the storage location be shown.

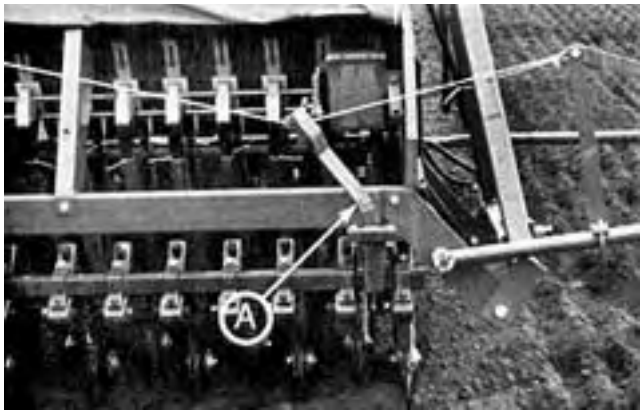

FIGURE 14. Marker Lift Cable Caught on Marker Transport Pin. Pin was to be Stored at Location A.

APPENDIX I
SPECIFICATIONS

MAKE: Morris Press Drill
MODEL: M-10
SERIAL NUMBERS: 1806 and 1807

OVERALL DIMENSIONS (DUPLEX):

		Field	Transport
-- height	-without markers	2090 mm	2230 mm
	-with markers	2830 mm	2900 mm
-- width	-without markers	6470 mm	4570 mm
	-with markers	6800 mm	4570 mm
-- length		6000 mm	8100 mm
-- ground clearance			170 mm
-- effective seeding width		6096 mm	

SEED METERING SYSTEM:
- -- type: externally cogged fine and coarse metering wheels
- -- drive: chain driven through variable speed drive box from press wheels
- -- adjustment: fine or coarse wheels, flaps and shutoff slides on feed cups, lever on variable speed drive
- -- transfer to openers: convoluted rubber hose

FERTILIZER METERING SYSTEM:
- -- type: externally cogged coarse metering wheels
- -- drive: chain driven through variable speed drive box from press wheels
- -- adjustment: flaps and shutoff slides on feed cups, lever on variable speed drive
- -- transfer to openers: convoluted rubber hose

OPENERS:
- -- type: double disk
- -- disk diameter: 350 mm
- -- number of openers: 20 per unit
- -- opener spacing: 152 mm
- -- number of rows: 2
- -- distance between rows: 140 mm

PRESS WHEELS:
- -- type: V-shaped solid steel
- -- diameter: 635 mm
- -- width: 43 mm
- -- number: 20 per unit
- -- spacing: 152 mm
- -- number of gangs: 2 per unit

CASTOR WHEELS (WITH TRANSPORT):
- -- number: 4 per unit
- -- tire size: 7.60 x 15, 6-ply

GRAIN AND FERTILIZER BOX CAPACITIES:
- -- grain box capacity: 640 L per unit
- -- fertilizer box capacity: 410 kg per unit
- -- all grain capacity: 1050 L per unit

WEIGHT (DUPLEX WITH TRANSPORT SYSTEM):

	Boxes Empty	Boxes Full
-- field		
-right unit front castor	538 kg	842 kg
-left unit front castor	538 kg	842 kg
-right unit press wheels	1465 kg	2072 kg
-left unit press wheels	1465 kg	2072 kg
Total Weight	4006 kg	5828 kg
-- transport		
-right unit front castor	885 kg	1338 kg
-left unit front castor	885 kg	1338 kg
-right unit transports	1118 kg	1576 kg
-left unit transports	1118 kg	1576 kg
Total Weight	4006 kg	5828 kg

NUMBER OF CHAIN DRIVES: 5 per unit

NUMBER OF HYDRAULIC LIFTS: 1 per unit
1 for marker
1 for transport per unit

NUMBER OF LUBRICATION POINTS: 11 pressure grease fittings
2 oil level

NUMBER OF SEALED BEARINGS: 54 per unit

OPTIONS INCLUDED ON TEST MACHINE:
-- two unit hitch; hydraulic transport; dual castor wheels; hydraulic marker; acremeter

OTHER AVAILABLE OPTIONS:
-- convex rubber press wheels; multiple hitch for three, four, five or six units; screen insert for fertilizer box; grass seeding attachment

APPENDIX II
MACHINE RATINGS

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

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

APPENDIX III
CONVERSION TABLE

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

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