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Evaluation Report 147

Haybuster 1206 Grain and Fertilizer Drill

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

HAYBUSTER 1206 GRAIN AND FERTILIZER DRILL

MANUFACTURER:
Haybuster Manufacturing Inc.
Box 1008
Jamestown, North Dakota 58401

DISTRIBUTOR:
Agriculture Equipment Limited
Box 743
Lloydminster, Sask.
S9V 1C1

RETAIL PRICE:
$10,317.00 (January, 1979, f.o.b. Humboldt with 24 double disk openers on 150 mm spacing, disk scrapers, ballast box, fertilizer attachment, single drill hitch, acre counter, transport tow hitch, grass seed reduction unit and hydraulic marker.)

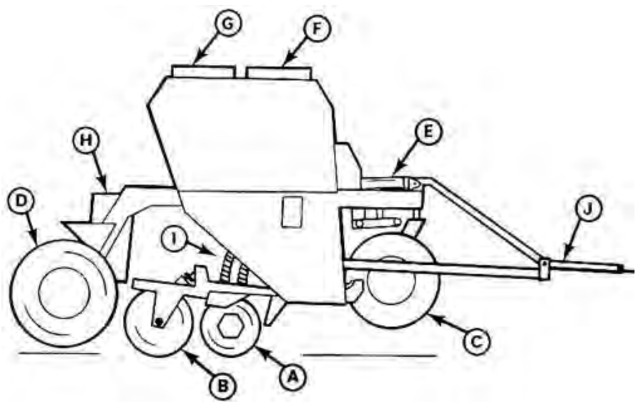

FIGURE 1. Schematic of Haybuster 1206: (A) Double Disk Openers, (B) Solid, Flat Rimmed Packer Wheels, (C) Castor Wheels, (D) Rear Wheels, (E) Hydraulic Lift, (F) Grain Box Opening, (G) Fertilizer Box Opening, (H) Ballast Box, (I) Fertilizer and Grain Delivery Tubes, (J) Hitch.

SUMMARY AND CONCLUSIONS

Overall functional performance of the Haybuster 1206 grain drill was good. Penetration was good when seeding into a prepared seedbed or directly into stubble but was poor when seeding directly into pastureland. The ability of the Haybuster to cut through residue was fair. Plugging of the openers occurred frequently in soft, trashy fields. In soft soils, the openers pushed the straw to the bottom of the furrow and in hard soils, large quantities of trash reduced penetration. Seed placement and seed coverage were good. Packer wheels, attached to the openers, maintained a uniform seeding depth and an even, compacted seed cover. Lodging of rocks between adjacent openers was a problem in stony fields. The double disk and packer wheel scrapers performed well except in very wet clay soils.

The accuracy of the seed metering system was very good in barley, wheat, oats and rapeseed. The minimum seeding rate in rapeseed was 5.6 kg/ha (5.0 lb/ac). The variation in seeding rates among seed runs was insignificant when seeding large seeds such as wheat, oats and barley or when seeding small seeds such as rapeseed. The seeding rates in all crops were unaffected by field roughness, field slope, ground speed or level of grain in the seed box.

Overall performance of the fertilizer attachment was good. Variation of the application rates among runs was low and the application rate was not affected by field roughness, ground speed or level of fertilizer in the fertilizer box. The application rate was affected by field slope and decreased 58% when seeding up a 15° slope.

A separate grass seed attachment was not available for the Haybuster 1206. Small grass seeds such as alfalfa could be seeded through the main grain box by activating an optional speed reduction unit on the grain drive. Large light seeds, such as bromegrass could not be seeded through the main box as they bridged over the seedcups. These seeds usually require an agitator to prevent bridging. An agitator was not available for the Haybuster 1206.

Both the seed and fertilizer rates were difficult to change. The seed and fertilizer boxes were convenient to refill as an adequate walkway was provided. The fertilizer box was easy to clean, but was not adequately sealed to prevent water entering the box in heavy rains. Forty-eight lubrication fittings required greasing.

About 38.8 kW (52 hp) of tractor power should be available for each 3.7 m (12 ft) section of drill. A 78 kW (105 hp) tractor should have sufficient power reserve to operate a two drill hookup in most soils at 8.0 km/h (5 mph).

The operator's manual was fair. The manual was brief and poorly illustrated but well written. The Haybuster 1206 was safe to operate if normal safety procedures were followed.

No serious mechanical problems occurred during functional evaluation.

RECOMMENDATIONS

It is recommended that the manufacturer consider:
1. Modifying the opener depth adjustment to prevent pin deformation and to facilitate setting of the seeding depth.
2. Installing rock deflectors to prevent lodging of stones between adjacent openers or packing wheels.
3. Supplying a slow moving vehicle sign.

Chief Engineer - E. O. Nyborg
Senior Engineer - L. G. Smith
Project Engineer - G. E. Frehlich

THE MANUFACTURER STATES THAT

With regard to recommendation number:
1. The depth control adjustment on the 1979 drill has been modified to eliminate the hairpin.
2. An optional rock bar kit is available for 1978 and 1979 drills to prevent rocks from lodging between runs.
3. A slow moving vehicle sign will be supplied on future drill productions.

MANUFACTURER'S ADDITIONAL COMMENTS
1. The 1979 operator's manual has been expanded to include more graphic information.
2. The spring operated roller bar has been lengthened on the 1979 drill to accommodate two lower holes. This allows deeper penetration in hard, dry soils. The new bar also fits the 1978 drill.

GENERAL DESCRIPTION

The Haybuster 1206 is a 3.7 m grain drill designed for no-till, minimum-till and conventional seeding. It is equipped with 24 double disk openers, spaced 152 mm apart in two rows of twelve each. Seeding depth is controlled by gauge wheels individually attached to each opener and opener force is controlled with a hydraulic cylinder. The grain box has a capacity of 768 L grain and the fertilizer box has a capacity of 752 kg fertilizer. The addition of metal sheets and removal of divider plugs permits carrying of grain in the fertilizer box when fertilizer is not required.

Seed is metered by internally fluted, double run feed cups and fertilizer is metered by externally ridged traction wheels. Flexible rubber hoses separately deliver the seed and fertilizer to the openers. Grass seed is sown through the main grain box by engaging a speed reduction unit on the grain drive. The 410 mm diameter gauge wheels pack the soil directly behind the openers. The test machine was equipped with a ballast box, disk scrapers and a single hydraulically controlled marker.
Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Haybuster 1206 was operated in the conditions shown in TABLE 1 for 64 hours while seeding about 122 ha. 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 systems were tested and calibrated in the laboratory.

TABLE 1. Operating Conditions

Crop	Soil	Stone Conditions	Field Area ha	Hours
Grass mixture on summerfallow	Oxbow loam	moderately stony	10	5
Wheat on stubble	Wayburn loam	occasional stones to moderately stony	30	18
Rapeseed on stubble	Wayburn loam	occasional stones	9	4
Wheat on stubble	Echo loam	occasional stones	9	4
Wheat on stubble	Hatton fine sandy loam	stone free	9	4
Wheat on stubble	Fox valley silty loam	stone free	9	4
Wheat on stubble	Fox valley silty loam	occasional stones	11	5
Wheat on stubble	Echo loam	occasional stones	7	4
Wheat on stubble	Regina heavy clay	occasional stones	12	5
Wheat on stubble	Regina heavy clay	stone free	9	5
Grass mixture on pastureland	Oxbow loam	occasional stones	3	4
Wheat on summerfallow	Oxbow loam	occasional stones	4	2
Total			122	64

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: The drilling of seeds directly into stubble or pastureland in a no-till planting operation requires an opener that will cut through heavy surface trash, penetrate dry compacted soils and produce a minimum amount of soil disturbance.

Excessive soil disturbance promotes weed growth and loss of soil moisture.

The Haybuster 1206 was equipped with double disk openers with individually attached packer wheels (FIGURE 2). Penetration of the openers was good when seeding directly into moist stubble fields, fair when seeding directly into dry stubble fields and poor when seeding directly into pastureland. In all except conventionally prepared fields, it was necessary to add ballast to the rear ballast box. In very hard soil conditions additional ballast was required on the front of the drill.

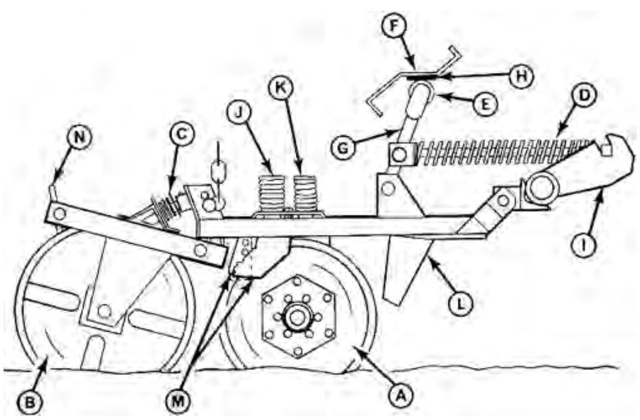

FIGURE 2. Double Disk Opener and Gauge Wheel Assembly: (A) Disks, (B) Gauge Wheel, (C) Opener Depth Adjusting Hairpin and Washers, (D) Spring, (E) Bearing, (F) Roller Barplate, (G) Roller Bar, (H) Shim Plate, (I) Pressure Adjusting Arm, (J) Fertilizer Drop Tube, (K) Grain Drop Tube, (L) Rock Guard, (M) Disk Scrapers, (N) Gauge Wheel Scraper.

The ability of the double disk openers to cut through surface residue was fair when operating in firm soils. Some straw was pushed into the furrow bottom without being cut when operating in soft, moist soils. Extremely heavy surface residue prevented proper opener penetration regardless of the soil condition. The double disk openers failed to cut through heavy trash and the gauge wheels reduced the seeding depth as they raised the openers when passing over heavy trash. It is very important for proper penetration and seed placement that the straw and chaff be evenly spread before seeding.

The force on the openers was controlled by the position of the hydraulic lift cylinder and limited by the weight of the machine. The opener depth was determined by the relative position of the packer wheels with respect to the double disk openers. Additional depth adjustment for openers travelling in the tractor wheel tracks was obtained by bolting a small metal plate between the roller bar bearing and the underside of the roller bar bearing plate (FIGURE 2).

The downward force on each opener could be adjusted from 0 to 2850 N for the front row of openers and from 0 to 2580 N for the back row of openers. The maximum average opener force with the grain and fertilizer boxes full and the machine loaded with 1190 kg of ballast was 1765 N per opener. This force was sufficient for most field conditions but was not adequate for hard dry stubble fields or pastureland.

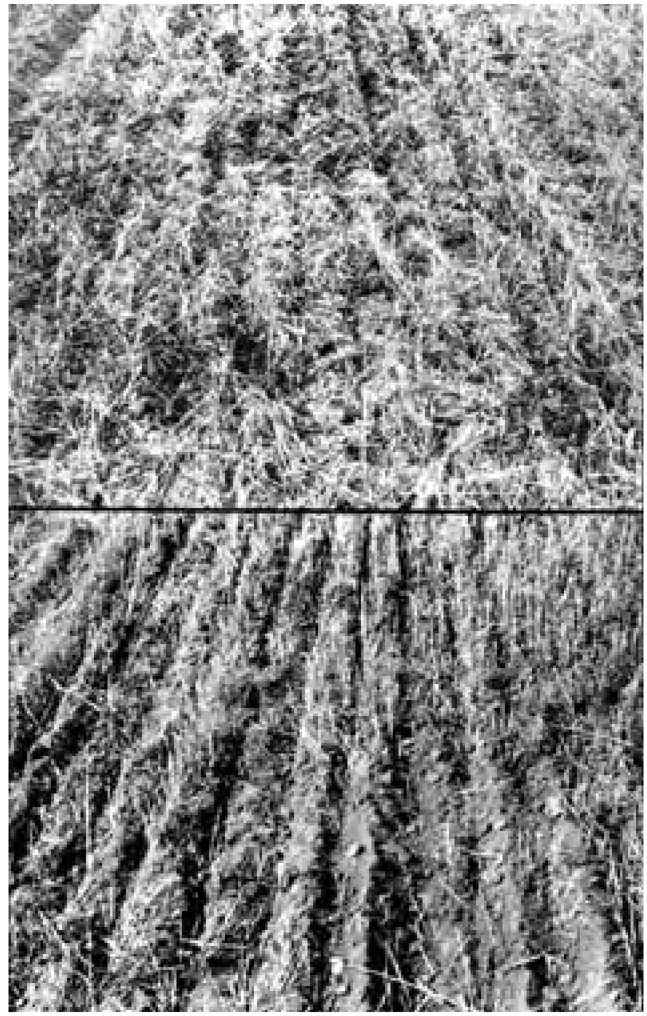

FIGURE 3. Soil Surface after Seeding Directly into Stubble. (Top: heavy trash cover; Bottom: light trash cover.)

FIGURE 4. Soil Surface after Seeding into Summerfallow.

Seed Placement: The basic rules for the conventional seeding of cereal and oilseed crops also apply to the direct drilling of these crops into stubble. The seed is ideally placed when it is in moist soil on a firm seedbed 20 to 50 mm from the soil surface with the soil packed tightly about the seed for optimum moisture contact and minimum soil drying.

In very heavy trash, seed placement was poor. Failure of the openers to cut through the surface residue resulted in the seed being placed either in the residue or on the soil surface. In lighter trash conditions and softer soils the trash was pushed to the bottom of the furrow without being cut (FIGURE 5). The seed was then placed on this trash and covered with a mixture of trash and soil. This reduced the contact between the seed and the soil that is necessary for good germination. Seed placement in fields with evenly spread trash was very good.

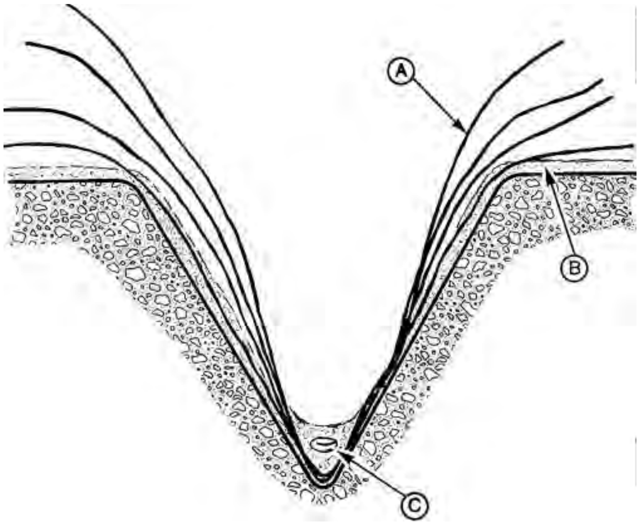

FIGURE 5. Schematic Showing Poor Seed Placement Due to Poor Trash Cutting. (A) Uncut Straw, (B) Chaff, (C) Seed.

The packer wheels, attached individually to each opener, acted as gauge wheels to provide very uniform seeding. The coefficient of variation[1] can be used to indicate the uniformity of the seeding depth. The higher the CV the less uniform is the depth of seeding.

The lower the CV the more uniform the seeding depth. A CV value of 30% represents fairly uniform seeding. The coefficient of variation when seeding wheat into a level stubble field at 8.0 km/h at an average 33.4 mm depth was 22.0%. This value is low and indicates good control of the seeding depth.

The average seeding depth was significantly affected by a change in ground speed. The average seeding depth increased from 33.4 mm to 40.4 mm as the operating speed decreased from 8.0 km/h to 4.8 km/h.

Seed placement when renovating dry pastureland was poor as the double disk openers failed to penetrate the hard compacted soil.

The Haybuster could be successfully used for seeding conventionally into a prepared seedbed without requiring machine alterations.

Soil Compaction: The amount of packing force exerted by the packing wheels was governed by the force required for penetration of the double disks. The hydraulic cylinder adjusted the force acting on the opener assembly and the less force required by the double disks, the greater the force on the packer wheels.

The packer wheels were very effective in packing soil about the seed but the protruding lip on the wheel rim created an excessive amount of soil disturbance. The soil was flung upwards by the flat rims, (FIGURE 6), especially at higher operating speeds. It is important in a no-till operation to minimize soil disturbance to reduce the germination of weeds and loss of soil moisture.

Seed Emergence: In general, the crops seeded directly into stubble (FIGURES 7 & 8) or seeded conventionally into a prepared seedbed germinated well and emerged evenly if adequate moisture was present. In the dry fields, complete emergence occurred only after rain.

Seed emergence in heavy trash areas ranged from fair to poor as the trash prevented proper opener penetration. Emergence in the renovated pastureland was poor due to poor penetration, dry soil conditions and competition from the existing growth. Proper pasture renovation requires that the existing growth be removed in 150 mm wide strips, using a chemical defoliant, and the new seed placed in the centre of these strips.

FIGURE 6. Soil disturbance by the Packer Wheels.

FIGURE 7. Emergence of Wheat Drilled Directly into Wheat Stubble (Top: 25 days after seeding; Bottom: 45 days after seeding) Moisture Conditions were Average.

Metering Accuracy: The grain and fertilizer systems (FIGURE 10) were calibrated in the laboratory using a standard procedure[2] and compared with the manufacturer's calibration.

Since the actual application rates for certain settings depend on factors such as size, density and moisture content of seeds and fertilizer particles, it is not possible for a manufacturer to present charts to include all the variations of seed and fertilizer used. Research has shown, however, that small variations in seed

[1]The coefficient of variation is the standard deviation of the seeding depths expressed as a percent of the mean seeding depth.

[2]PAMI T776-R79, Detailed Test Procedure for Grain Drills.

or fertilizer application rates will not significantly affect grain crop yields.

FIGURE 8. Emergence of Rapeseed Drilled Directly into Wheat Stubble (Top: 21 days after seeding; Bottom: 41 days after seeding). Moisture Conditions were Average.

FIGURE 9. Poor Wheat Emergence 41 Days after Seeding into Excessive Trash.

Seed Metering System: The accuracy of the seed metering system on the Haybuster 1206 in wheat, barley, oats and rapeseed was very good. Differences between the actual seeding rate and manufacturer's calibration chart were insignificant when using standard seed densities. Actual seeding rates should be checked when seed density differs significantly from the values stated in the operator's manual.

Large seeds such as barley and oats are metered through the right side of the feed cup and small seeds such as rapeseed are metered through the left side. The grass seed reduction unit is activated for low seeding rates.

Field roughness, level of seed in the grain box, variation in field slope or ground speed did not affect the seeding rate for either large or small seeds.

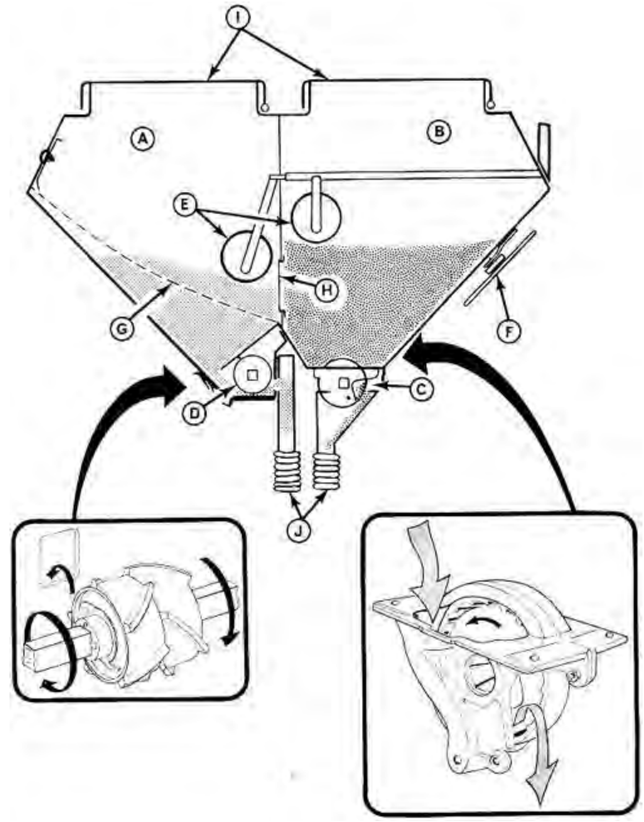

FIGURE 10. Seed And Fertilizer Metering Systems: (A) Fertilizer Box, (B) Grain Box, (C) Internally Fluted Double Run Feedcup, (D) Externally Ridged Traction Wheel, (E) Grain and Fertilizer Level Indicators, (F) Grain Shaft Rotation Indicator, (G) Separator Sheets, (H) Divider Plugs, (I) Grain and Fertilizer Box Lids, (J) Grain and Fertilizer Delivery Tubes.

The coefficient of variation (CV) can also be used to describe the variation of application rates among individual seed cups. An accepted variation for grain or fertilizer application is a CV value not greater than 15%. If the CV is less than 15%, seeding is acceptable whereas if the CV is much 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 81.4 kg/ha the CV was only 2.3%. Seeding rapeseed was also very uniform. When seeding rapeseed at a rate of 11.7 kg/ha the CV was only 4.8%.

Fertilizer Metering System: TABLE 2 shows PAMI calibration results for 11-48-0 fertilizer with a density of 928 kg/m³. Comparisons with the manufacturer's calibrations in the same table indicate a significant difference between the two calibrations at the higher rates. This 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 by the manufacturer was not indicated in the operator's manual. An optional 14 tooth sprocket is available to give a wider range of fertilizing rates. The calibration in TABLE 2 is for the standard 15 tooth sprocket only.

TABLE 2. Fertilizer Calibration

Setting	PAMI (kg/ha)	Manufacturer (kg/ha)
B-1	34.6	33.7
B-2	59.6	44.9
B-3	67.1	56.1
A-1	72.4	59.5
B-4	87.0	61.7
B-5	96.6	57.3
B-6	113.9	84.1
A-2	120.5	89.8
A-3	144.2	123.4
A-4	173.2	140.3
A-5	191.8	157.1
A-6	225.4	185.1
Densities 928 kg/m³		

The variation in the fertilizing rate from one run to another was quite low. For example, when distributing 11-48-0 fertilizer at a rate of 60.8 kg/ha, the coefficient of variation among individual feed cups was 6.8%.

The fertilizer application rate was not significantly affected by the level of fertilizer in the box, ground speed or field vibrations. It was, however, significantly affected by field slope. FIGURE 11 shows the variation in fertilizer application rates obtained when fertilizing uphill, downhill and on level ground. The application rate varied from 26 kg/ha while seeding up a 15° slope to 66 kg/ha while seeding down a 15° slope. The application rate on level ground was 62 kg/ha.

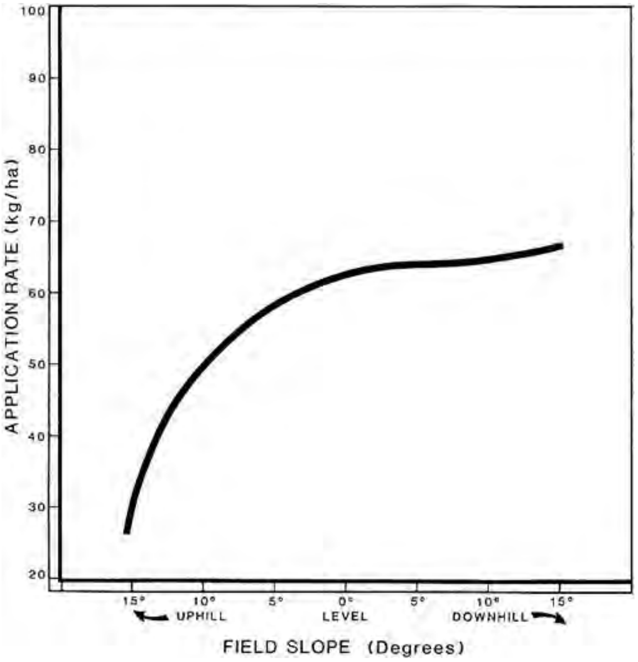

FIGURE 11. Variation in Fertilizer Application Rate with Change in Field Slope While Applying 11-48-0 Fertilizer at the 2B Setting.

Grass Seeding: A grass seeding attachment was not available as optional equipment for the Haybuster 1206. The large light seeds such as bromegrass were seeded through the grain box by mixing the seed with heavier material such as cracked grain or fertilizer. Failure to mix the seed with heavier material resulted in bridging of the seed over the seedcups. A grain agitator was not available to aid in the seeding of light grasses through the grain box.

Small seeds such as alfalfa and rapeseed were also seeded through the grain box by activating the speed reduction unit. The accuracy and the uniformity with which small seeds could be seeded through the grain box was very good.

TABLE 3 shows the calibration table for seeding alfalfa through the grain box with the speed reduction unit engaged. TABLE 4 is the calibration table for seeding Russian Wild Ryegrass through the grain box without the reduction unit engaged. Calibration charts for ryegrass were not included in the operator's manual.

TABLE 3. Alfalfa Calibration (Speed Reduction Unit Activated)

Setting		Left Side Cup	
		PAMI (kg/ha)	Manufacturer (kg/ha)
12 Tooth	A-7	5.1	6.7
	A-6	5.9	7.5
	A-4	6.4	8.1
	B-5	6.9	8.9
	B-4	7.3	9.3
	B-3	7.8	10.0
	B-1	8.7	11.9
20 Tooth	A-7	9.3	12.0
	A-5	10.2	13.0
	B-6	11.1	14.0
	B-4	12.3	15.6
	B-1	14.5	18.4
Densities:		838 kg/m³ - Rambler Alfalfa	730 kg/m³

TABLE 4. Ryegrass Calibration (Speed Reduction Unit not Activated)

Setting		Left Side Cup PAMI (kg/ha)
12 Tooth	A-7	15.2
	A-5	16.9
	A-4	17.5
	B-5	18.7
	B-4	19.9
	B-3	21.1
	B-1	23.5
Densities:		296 kg/m³ - Russian Wild Ryegrass

EASE OF OPERATION

Wet Fields: Excessive mud buildup on the packer wheels and slight buildup on the disks combined to plug the machine when operating in extremely wet clay soils (FIGURE 12). Plugging occurred more readily in heavy trash areas as the straw was pushed ahead of the openers and packer wheels.

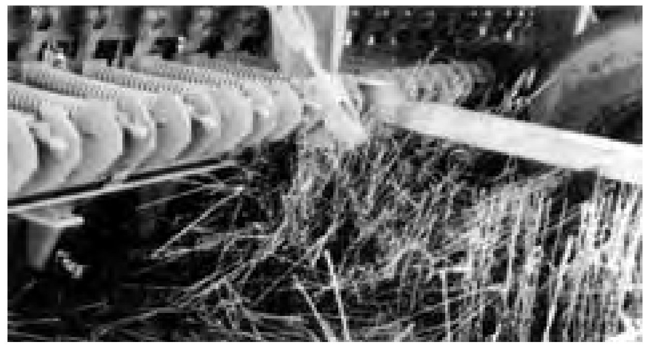

FIGURE 12. Plugging when Operating in Wet Clay Soils.

Stone shields that prevented small stones from being flung between the disks also served as exterior scrapers. Neither the exterior nor the interior disk scapers were spring loaded or self-adjusting and slight mud buildup did occur on the disks reducing the ease of rotation and causing plugging in extremely wet soils.
The small scraper rods for the packer wheels kept the packers clean except in wet clay soils. Excessive mud buildup prevented packer wheel rotation and caused plugging,

The front castor wheel scrapers and the two rear wheel scrapers prevented excessive mud buildup on the tires in all the field conditions encountered.

Stony Fields: Lodging of small 150 to 180 mm diameter rocks between adjacent openers occurred frequently in stony fields (FIGURE 13). A metal bar was usually needed to remove the rocks. It is recommended that rock deflectors be added for operation in stony fields.

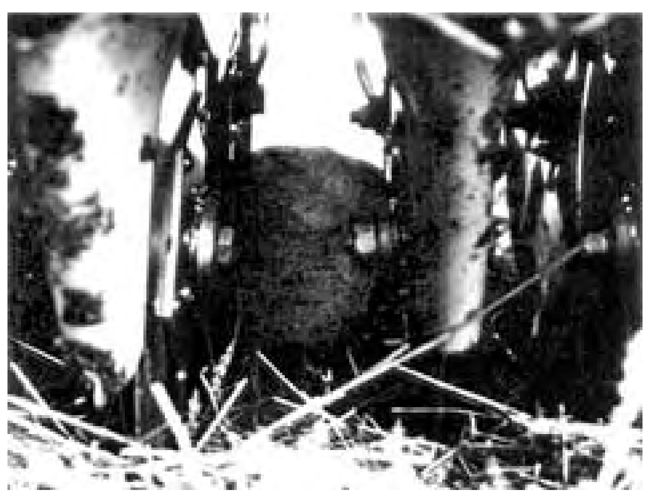

FIGURE 13. Rocks Lodging Between Openers.

The spring loaded trip mechanism permitted the front openers to lift a maximum of 155 mm and the back openers a maximum of 190 mm to clear rocks and other obstructions. The opener force reduced from a maximum of 2870 N to 1780 N as the spring compressed and the opener tripped. Opener force during normal operation varied from 500 N to 1200 N.

Trashy Fields: Heavy surface residue caused poor opener penetration, poor seed placement and plugging. Plugging occurred when trash was pushed forward by the rock guards attached to the front of the double disk openers. Plugging occurred more frequently in wet fields.

FIGURE 14. Large Quantity of Surface Residue Encountered during Field Testing.

Filling: The 240 mm wide metal walkway and the two wide opening lids made filling with grain or fertilizer safe and convenient. The Haybuster 1206 was capable of carrying 765 L of grain and 750 kg of fertilizer. Metal sheets were supplied as standard equipment to place in the bottom of the fertilizer box to permit use of the box for carrying grain. Large removable plugs permitted the grain to run from the fertilizer box to the grain box. Level indicators aided in determining low grain or fertilizer levels. A red rotating blade was connected to the grain drive shaft to indicate rotation and to alarm the operator of grain drive problems.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent leakage into the box in light rains, but small amounts of water entered during heavy rains. If the drill is forced to stand out in the rain, the fertilizer shaft must be checked before operation to ensure that it is free to rotate and that the fertilizer has not caked.

Cleaning: As with most drills, a vacuum cleaner or compressed air was needed for thorough cleaning of the grain box. The fertilizer box should be cleaned out by removing the bottom of the box and the inside panels. The bottom dropout panels were equipped with quick-release latches for fast and uncomplicated removal but the inside panels were very difficult to remove due to the confined space. The fertilizer box did not self-clean and the last 10 kg of fertilizer had to be cleaned out by hand.

Acremeter: The acremeter was accurate to within 4.5% if the drill was operated at full seeding width. The counter recorded the nearest tenth acre up to 10,000 acres. A metric counter was not available. Erroneous tallies were obtained due to slippage between the pegged wheel on the counter and the drive shaft. The surface of the shaft was roughened using a centre punch to eliminate the slippage.

Transporting: The Haybuster 1206 could be transported in normal field position when transporting one unit or changed to transport position for moving several units. Changing from field position to transport position required turning the wheels 90° and pulling the drill from the end with the transport hitch provided (FIGURE 15). For moving a single unit drill, more road clearance is obtained with the machine in field position.

The Haybuster 1206 could be transported at speeds of 25 km/hr providing the grain and fertilizer boxes were empty. Speeds in excess of this are not recommended, especially for machines consisting of more than one unit. Opener ground clearance when transporting was adequate for all the conditions **encountered.**

Marker: The Haybuster 1206 was equipped with a single disk hydraulic marker. The marker was mounted on the end towing hitch and had to be removed when pulling the drill from the end transport position. The marker cutting angle could be adjusted to produce a visible mark in all field conditions.

FIGURE 15. Single Unit Haybuster in Transport.

FIGURE 16. Hydraulically Controlled Marker.

EASE OF ADJUSTMENT

Lubrication: Lubrication time was lengthy with fair access to the 48 pressure grease fittings. A grease gun with a flexible hose was required for the majority of the fittings. The rear filling platform swung upwards to facilitate greasing of the openers. The frequency of lubrication was not indicated by the manufacturer.

Seeding Rates: The grain seeding rate was set by positioning three chains to obtain the desired sprocket ratios. Forty-two different settings were possible. Movement of the two primary drive chains from one sprocket to another required loosening of the idler sprockets, repositioning of the chains and retightening of the idlers. The secondary drive chain had to be broken and links added or removed to change to different sprockets. The sprockets for the secondary chain drive had to be loosened on the shaft and properly aligned for each sprocket selection. This was sometimes difficult due to rusting of the shafts and the sprocket hubs. The slow speed drive for seeding small grains and grasses was activated by removing a pin and adding one chain.

Fertilizing Rate: The fertilizer application rate was also set by selecting the proper sprocket ratio. Twelve different settings were possible with the standard 15 tooth sprocket on the secondary drive. A 14 tooth sprocket was available as optional equipment. The primary drive chains were moved from one set of sprockets to another by loosening the idler sprockets. The secondary drive chain had to be broken and moved when changing to the optional 14 tooth sprocket.

Depth: Adjustment of the depth was difficult and time consuming. Each gauge wheel had to be adjusted separately. The clip on the depth adjusting rod had to be removed, washers repositioned and the clip replaced (FIGURE 18). The clips bent readily, especially when operating in stony fields and became very difficult to remove. It is recommended that the manufacturer redesign the depth adjustment system to reduce clip bending and to facilitate depth changes.

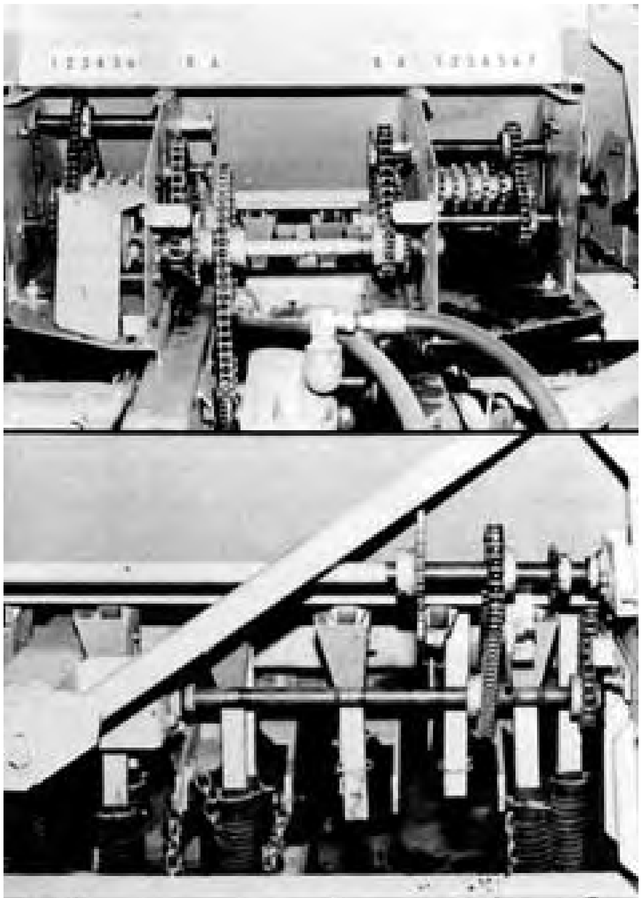

FIGURE 17. Selection of Seeding and Fertilizing Rates: (Top: Primary Drive Chain and Sprocket Selection. Bottom: Secondary Drive Chain and Sprocket Selection).

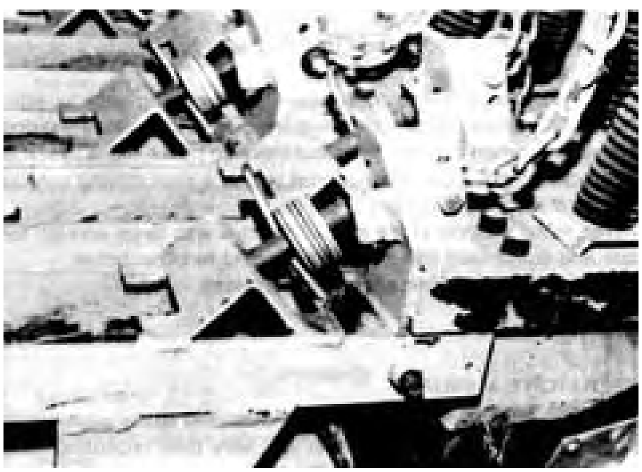

FIGURE 18. Depth Adjustment by Repositioning Washers.

POWER REQUIREMENTS

Maximum draft with 1200 kg ballast and filled grain and fertilizer boxes on level fields with average soil moisture was about 10,100 N while average draft was about 7100 N. When considering variations in soil and field conditions, about 38.4 kW of tractor power should be available for each 3.7 m section of drill. In other words a 78 kW tractor should have sufficient power reserve to operate a two drill hookup in most soils at 8.0 km/hr.

OPERATOR SAFETY

The Haybuster 1206 grain drill was safe to operate if normal safety precautions were observed.

The drill was not equipped with a slow moving vehicle sign. Provincial highway regulations require displaying a slow moving vehicle sign when transporting machinery on public highways. It is recommended that the manufacturer supply a slow moving vehicle sign as standard equipment.

The metal platform at the rear of the drill was large enough for safe and convenient filling of the grain and fertilizer boxes. All moving parts were adequately shielded.

OPERATOR'S MANUAL

The operator's manual was well written and easily understood but poorly illustrated. The manual was very brief regarding daily maintenance and provided no illustrations showing location of maintenance points. The operator's manual did not include the density of fertilizer used in the calibration tables and did not include metric calibration charts.

DURABILITY RESULTS

The Haybuster 1206 was operated for 64 hours while seeding about 122 ha. The intent of the test was an evaluation of the functional performance and an extended durability evaluation was not conducted. TABLE 5 outlines the mechanical problems that occurred during the functional testing.

TABLE 5. Mechanical History

Item	Operating Hours	Field Area ha
-The jackshaft for the grain drive was bent and replaced at	4	10
-A double run feedcup was broken and repaired at	7	14

DISCUSSION OF MECHANICAL PROBLEMS

Jackshaft: The jackshaft on the secondary chain drive was bent when the chain jumped off the sprockets. The sprocket had moved on the shaft causing misalignment.

Feedcup: The feedcup was broken when the chain for the secondary grain drive caught on the edge of the seed drop tube tearing it off the feedcup.

APPENDIX I
SPECIFICATIONS

MAKE:	Haybuster Grain and Fertilizer Drill
MODEL:	1206
SERIAL NO.:	78332
OVERALL DIMENSIONS:	
-- height	1660 mm
-- length	1890 mm
-- width	3685 mm
-- effective seeding width	3658 mm
-- transport ground clearance	150 mm
SEED METERING SYSTEM:	
-- type	double run feed cups with internally fluted feed rolls
-- drive	friction drive from castor wheels through chains and sprockets
-- adjustment	changing speed of feed shaft by interchanging sprocket sizes
-- transfer to openers	convoluted rubber hose
FERTILIZER METERING SYSTEM:	
-- type	externally ribbed traction feed wheels on a horizontal shaft
-- drive	friction drive from castor wheels through chains and sprockets
-- adjustment	change speed of feed shaft by interchanging sprocket sizes
-- transfer to openers	convoluted rubber hose
OPENERS:	
-- type	double disk
-- disk diameter	356 mm
-- number of openers	24
-- opener spacing	150 mm
-- number of rows	2
-- distance between rows	100 mm
PACKER WHEELS:	
-- type	solid with flat rim
-- diameter	410 mm
-- width	35 mm
-- number	24
-- spacing	150 mm
FRONT CASTOR WHEELS:	
-- number	2
-- tire size	11L x 14SL, 6 ply
REAR WHEELS:	
-- number	2
-- tire size	7.60 x 15SL, 4-ply
GRAIN AND FERTILIZER BOX CAPACITIES:	
-- grain box capacity	768 L
-- fertilizer box capacity	752 kg

WEIGHT: (with ballast)	**boxes empty**	**boxes full**
-- weight on castor wheels	1536 kg	2082 kg
-- weight on rear wheels	1644 kg	2278 kg
total weight	3180 kg	4360 kg

NUMBER OF CHAIN DRIVES:	12
NUMBER OF LUBRICATION POINTS:	48
NUMBER OF HYDRAULIC LIFTS:	1
NUMBER OF SEALED BEARINGS:	159

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

APPENDIX III
METRIC UNITS

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

1 hectare (ha)	= 2.47 acres (ac)
1 kilometre/hour (km/hr)	= 0.62 miles/hour (mph)
1 metre (m) = 1000 millimetre (mm)	= 39.37 inches (in)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 kilogram (kg)	= 2.20 pounds (lb)
1 newton (N)	= 0.22 pounds force (lb)
1 litre (L)	= 0.028 bushels (bu)
1 kilogram/hectare (kg/ha)	= 0.9 pounds/acre (lb/ac)
1 kilogram/cubic metre (kg/m^3)	= 0.08 pounds/bushel (lb/bu)

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