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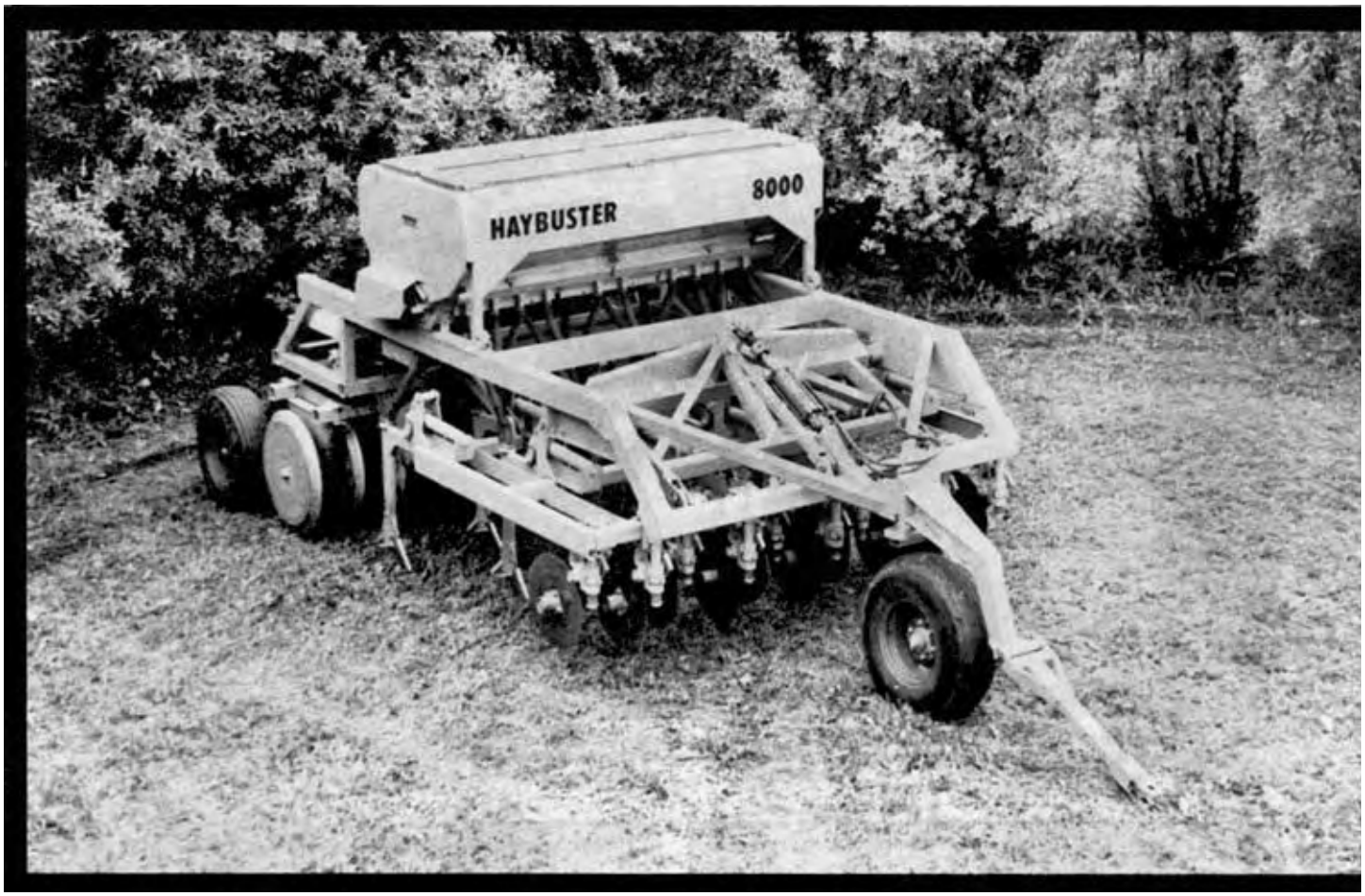

Haybuster 8000 No-Till Grain Drill

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

HAYBUSTER 8000 NO-TILL GRAIN DRILL

MANUFACTURER AND DISTRIBUTOR:

Haybuster Manufacturing Inc.
P.O. Box 1950
Jamestown, North Dakota

RETAIL PRICE:

$13,378 (August, 1986 f.o.b. Portage la Prairie, Manitoba) 8.3 ft (2.5 m) width, 10 in (25.4 cm) spacing, reset coulters, single drill hitch, and rear mount transport system.

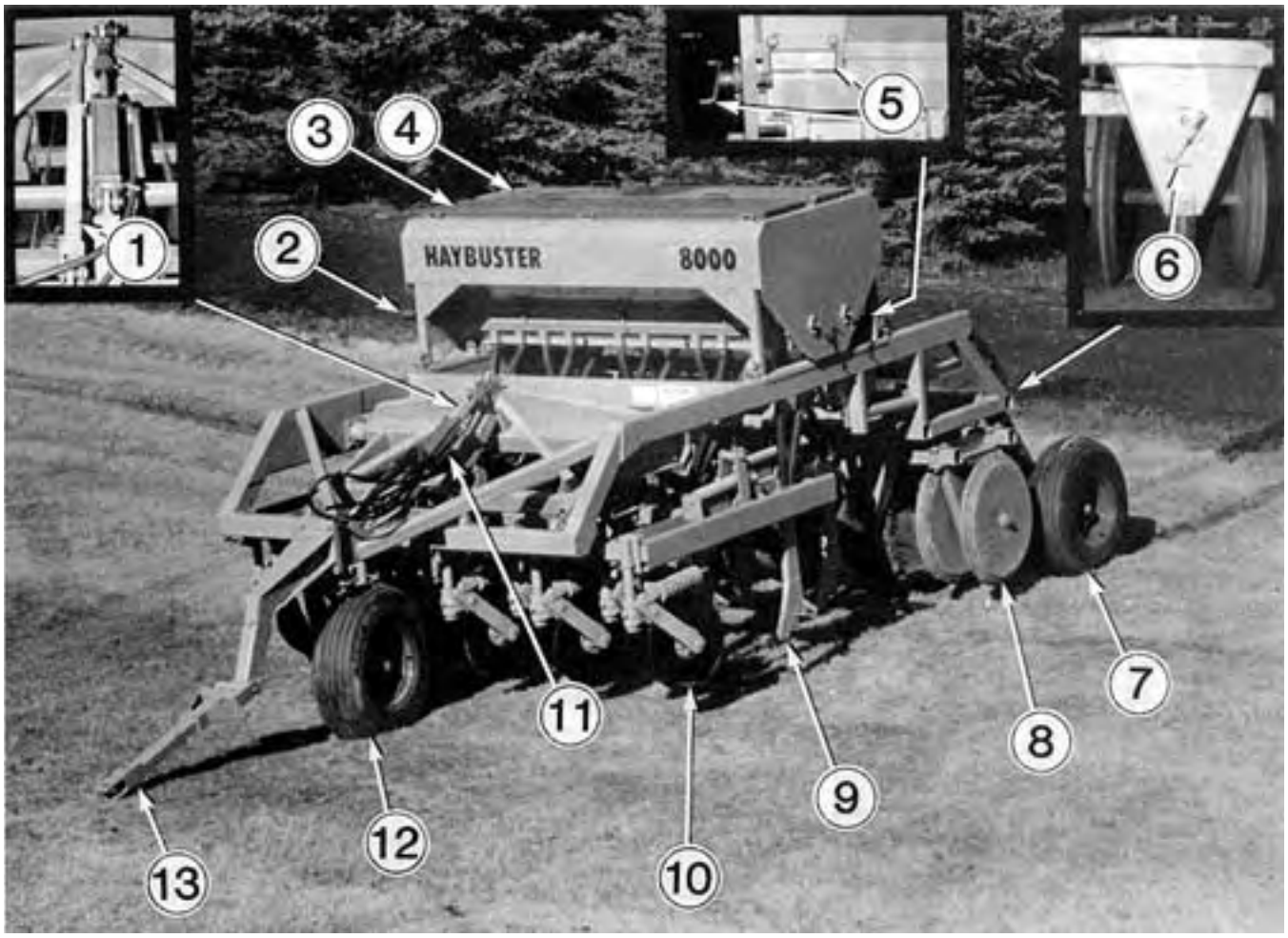

FIGURE 1. Haybuster 8000 No-Till Grain Drill: (1) Opener Transport Lock, (2) Feedshaft Indicator, (3) Seed Box, (4) Fertilizer Box, (5) Rate Adjustment, (6) Press Wheel Transport Lock, (7) Transport Wheels, (8) Press Wheels, (9) Hoe Openers, (10) Cutting Coulter, (11) Hydraulic Cylinder, (12) Castor Wheel, (13) Hitch.

SUMMARY

Quality of Work: Penetration was excellent when seeding directly into moist or dry stubble fields. The ability of the hoe opener to pass through surface residue was very good in firm soils and fair in soft moist soils. The press wheels provided adequate compaction in most soils encountered.

The accuracy of the seed metering system was good in wheat and rapeseed with a wide range of settings. The variation in seeding rates between seed runs was insignificant. The seeding rates of all crops were relatively unaffected by field roughness or level of grain in the grain box. The seeding rate of wheat decreased by as much as 25% when travelling up a 15° slope. Ground speed also had a significant effect on the seeding rate.

The accuracy of the fertilizer metering device was good. Variation in application rates between runs was insignificant. Application rates were not affected by field roughness, or level of fertilizer in the fertilizer box. The rate decreased by as much as 25% when travelling down a 15° slope. Ground speed also had a significant effect on the rate.

Ease of Operation: Wet field conditions caused a build-up of mud around the sides of the openers and between the press wheels, eventually causing plugging. The large space between adjacent openers allowed excellent trash and stone clearance.

The overall height of the machine made filling of the seed and fertilizer boxes difficult if bagged seed and fertilizer were piled at ground level or if a short drill fill was used.

The seed and fertilizer boxes were easy to clean but leaked a small amount of moisture in heavy driving rains. The drill was very easy to transport with adequate ground clearance.

Ease of Adjustment: The 77 grease fittings on the drill required regular lubrication. Both the seed and fertilizer rates were very easy to adjust. The depth adjustment was fast and simple.

Power Requirements: A 120 hp (89 kW) tractor should have sufficient power reserve to operate one section of the 8.1 ft (2.5 m) drill in all field conditions and speeds.

Operator Safety: The Haybuster 8000 was safe to operate if normal safety precautions were observed.

Operator's Manual: The operator's manual lacked detailed information, especially on assembly, operation and optional equipment.

Mechanical History: The corners of four sealer plates were broken off after 50 ac (20 ha) of stony land and a total of 315 ac (127 ha) of all soil types.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing a slow moving vehicle sign.
2. Providing an operator's manual with step-by-step instructions on assembly, operation, optional equipment and more complete calibration charts.

Station Manager: G.M. Omichinski

Project Engineer: D.J. May

THE MANUFACTURER STATES THAT

With regard to the recommendation:

1. Because the drill can be assembled in different widths of 8 to 48 ft and can be transported in field working position or from the end transport system, location of the slow moving decal will vary with each individual set. Recommendation is being considered.
2. A more complete operator's manual is being developed and will be provided with each machine. Additional seed rate charts can be requested and are available to the operator.

Manufacturer's Additional Comments:

In regard to the mechanical problem of sealer plate ears breaking off, we had received sealer plates of poor material and quality. Since that time the material has been improved and closer watch of purchased parts for flaws is being conducted.

GENERAL DESCRIPTION

The Haybuster 8000 (FIGURE 1) is a 8.3 ft (2.5 m) grain drill designed for no-till, minimum till, and conventional seeding. It is equipped with 10 hoe openers spaced 10 in (250 mm) apart in two ranks and places the seed in paired rows 3 in (75 mm) apart. Seeding depth is controlled by a single hydraulic cylinder. The grain box has a capacity of 14.0 bu (0.49 m^3) and the fertilizer box a capacity of 1100 lb (500 kg). Gates can be removed and both boxes filled with grain to give a capacity of 25.0 bu (0.88 m^3).

Seed and fertilizer are metered by externally ridged traction wheels through infinitely adjustable sliding gates. Convoluted flexible rubber hoses separately deliver seed and fertilizer to the openers. Two gangs of 27 in (690 mm) diameter press wheels pack the soil behind the openers. Grass seed may be sown through the main seed box. Fertilizer can be deep banded or placed with the seed by changing caps on top of the shanks. The 18 in (460 mm) diameter coulters cut a groove for the openers to follow in hard packed ground.

The test drill was equipped with optional reset shanks for working in stones, manually mounted transport wheels and an acremeter.

Other options available but not included on the test unit were hitches, stabilizers and markers for multiple drill hook-ups. Also available were single outlet seed tubes and sealer plates, shanks for deep banding liquid, dry or anhydrous ammonia fertilizer, two sizes of cutting coulters and three shank spacings.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Haybuster 8000 was operated under field conditions as shown in TABLE 1 for 100 hours, while seeding 450 ac (182 ha). It was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety, and suitability of the operator's manual.

TABLE 1. Operating Conditions

Field Condition	Operating Hours	Equivalent Field Area	
		ac	ha
Soil Type:			
-sand	14	65	26
-sandy loam	40	180	73
-clay	20	90	36
-clay loam	26	115	47
TOTAL	100	450	182
Crop:			
-winter wheat	40	180	73
-spring wheat	14	65	26
-barley	37	165	67
-rye	9	40	16
-millet & oats	100	450	182
TOTAL			
Land:			
-stubble	81	365	148
-stubble mulch	19	85	34
TOTAL:	100	450	182

During the test small to large stones were encountered in 180 ac (73 ha). The drill was transported over 200 mi (320 km) on paved roads and 60 mi (97 km) on gravelled roads.

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 8000 was equipped with hoe openers (FIGURE 2). Penetration of the openers was excellent when seeding directly into moist or dry stubble fields (FIGURE 3). There was no provision for the addition of ballast to the drill nor was there a need for it.

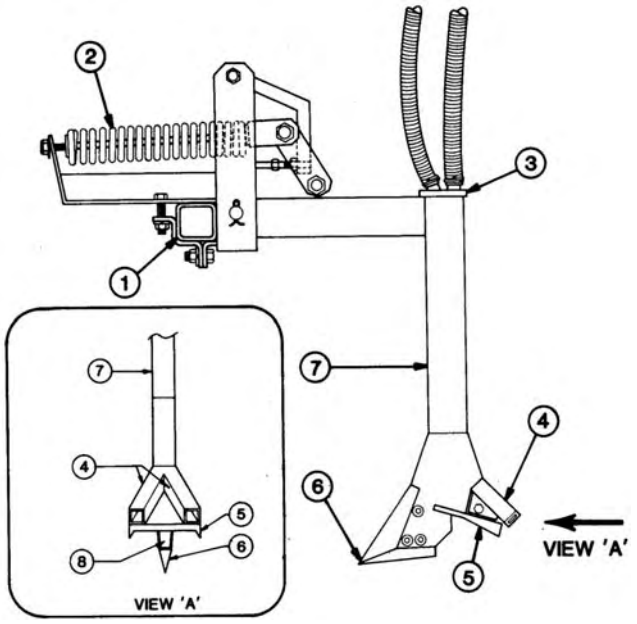

FIGURE 2. Hoe Opener: (1) Drill Frame, (2) Rock-Trip Tension Spring, (3) Shank Inlet Tubes, (4) Shank Outlet Tubes, (5) Sealer Plate, (6) Hoe Point, (7) Shank, (8) Deep Banding Outlet.

FIGURE 3. Soil Disturbance and Stubble Knockdown with the Haybuster 8000.

The ability of the hoe opener to pass through surface residue was very good in all conditions, especially with the coulters lowered to the proper depth. However, in heavy trash conditions the opener would sometimes leave clumps of straw in the field, which affected seedling development. Generally, straw and chaff should be spread evenly before seeding.

The depth of all openers was set with a screw-out collar on the hydraulic cylinder. There was no scale on the collar so initial depth adjustment required a process of trial and error. Individual depth adjustment of the openers travelling in the tractor wheel tracks was not possible.

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 with the soil packed tightly about the seed

for optimum moisture contact and minimum soil drying. Generally, small oilseeds and winter wheat should be seeded 0.8 to 1.5 in (20 to 40 mm) from the soil surface. Cereals should be seeded 1.5 to 2.5 in (40 to 65 mm) from the soil surface.

Seeding depth was fairly uniform with some variation resulting from field or seedbed irregularities. Measurements of seeding depth when seeding wheat at 5 mph (8 km/h) in stubble showed that 68% of the seeds were within 0.75 in (19 mm) of the average seeding depth[1]. Higher speeds caused more seed scatter.

The test machine was equipped with dual outlet seed tubes to place the seed in narrow paired rows 3.0 in (75 mm) apart. With a 10 in (250 mm) shank spacing this left a 7.0 in (180 mm) space between alternate rows. Single outlet seed tubes could also be used to place the seed in single rows.

Seed coverage was fair and was slightly affected by ground speed in soft soils. Seed coverage was reduced in hard packed ground. Fertilizer could be placed below and to the side, or with the seed in a narrow band. With optional shanks and caps the drill could deep band dry, liquid or anhydrous ammonia fertilizer. A 1.5 in (40 mm) layer of soil separated the dry fertilizer from the seed when deep banding.

The Haybuster 8000 could be used for seeding conventionally, into a prepared seedbed without requiring machine alterations. The test unit performed well in the stubble mulch fields encountered.

Soil/Stubble Disturbance: Minimizing soil disturbance is important in that it lessens moisture loss and reduces germination of some annual weeds. The width of the openers was 1.0 in (25 mm) at the ground surface. The drill was equipped with 4.0 in (100 mm) wide sealer plates and dual outlet seed tubes which ran just below the soil surface (FIGURE 2). This opener arrangement caused considerable soil disturbance.

Retaining stubble is also important since it helps trap snow to insulate winter wheat, to provide moisture in the spring, and to reduce soil erosion. The Haybuster 8000 hoe opener left about 30% of the stubble standing (FIGURE 3) enough to retain good snow cover.

Soil Compaction: Two gangs of wide metal deep V-type press wheels were arranged so that one press wheel followed directly behind each opener, effectively pressing the soil and seeds against the sidewall of the furrow. The press wheels provided adequate compaction in most soils encountered.

In very hard packed soil, the seed would sometimes be left with little or no covering soil to be packed around it.

Average packing force exerted by each wheel with the boxes empty was about 300 lb (1300 N).

Plant Emergence: In general, the crops seeded directly into stubble or conventionally into a prepared seedbed, germinated well and emerged evenly if adequate moisture was present (FIGURE 4). In dry fields, complete emergence occurred only after rain. Seed emergence in heavy trash was good, but after emergence seedling development was reduced under the clumps of trash left behind by the drill.

FIGURE 4. Emergence of Barley Drilled Directly into Stubble with Average Moisture Conditions, 37 days after Seeding.

[1]Seeding depth was determined by measuring the seedling root length to the ground surface. Ungerminated seeds either on the surface or below the soil surface were not considered.

Seed Metering Accuracy: The grain and fertilizer metering systems (FIGURE 5) were calibrated in the laboratory and compared with the manufacturer's calibration. The accuracy of the seed metering system on the Haybuster 8000 in wheat and rapeseed was good. Differences between the manufacturer's calibration charts and PAMI calibrations may be due to a number of factors such as seed size, density and moisture content. Since seed densities were not stated in the operator's manual, actual rates should be checked by the operator. Small variations in seed or fertilizer application rates will not significantly affect grain crop yield.

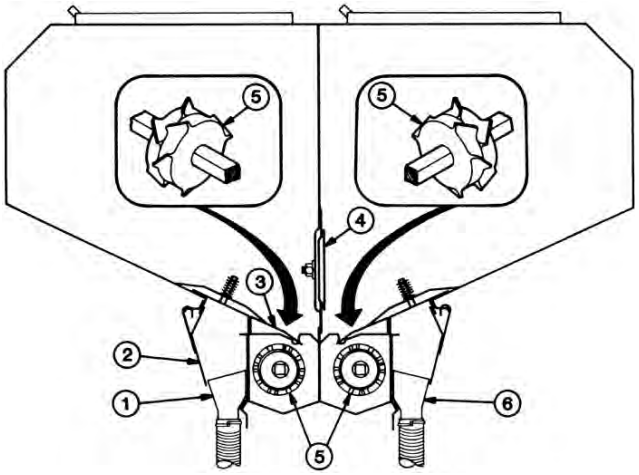

FIGURE 5. Seed and Fertilizer Metering Systems: (1) Fertilizer Cups, (2) Wind Guards, (3) Feed Wheel Covers, (4) Divider Plate Plugs, (5) Externally Ridged Traction Wheels, (6) Seed Cups.

Field roughness and level of seed in the grain box did not significantly affect the seeding rate for either large or small seeds. Variation in field speed and variation in field slope had a significant effect on the seeding rate. As shown in FIGURE 6 travelling up a 15° hill decreased the seeding rate of wheat as much as 25%. When increasing field speed from 3 to 7 mph (5 to 11 km/h) the seeding rate of wheat decreased as much as 17%.

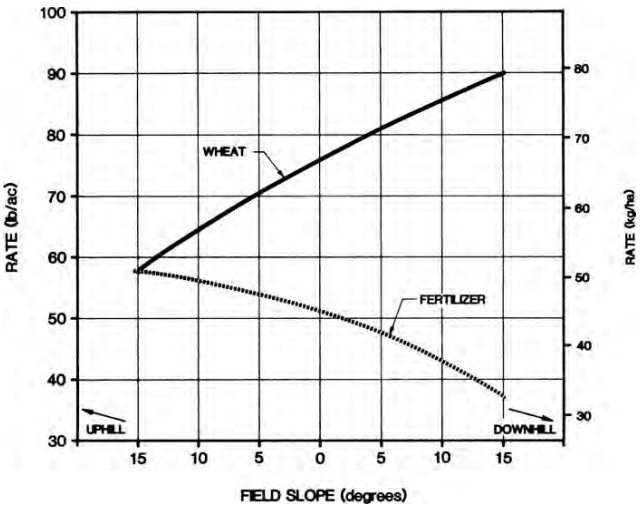

FIGURE 6. Variation in Seed and Fertilizer Application Rate with Change in Slope while Seeding Wheat and 11-51-00.

The coefficient of variation (CV) can be used to describe the variation of application rates between individual seed cups. If the CV is less than 15%, seeding is acceptable whereas if the CV is much greater than 15%, the variation between individual seed or fertilizer cups is excessive. When seeding rapeseed at 15.1 lb/ac (16.9 kg/ha) the CV was 7.3% indicating very uniform seeding.

Fertilizer Metering System: FIGURE 7 shows PAMI calibration results in comparison with the manufacturer's calibration chart. The differences are probably due to the difference in size and the density of the fertilizer.

The CV between individual feed cups was 7.6% when distributing 11-51-00 fertilizer at a rate of 51.7 lb/ac (57.9 kg/ha). This indicates the drill had very good uniformity when drilling fertilizer.

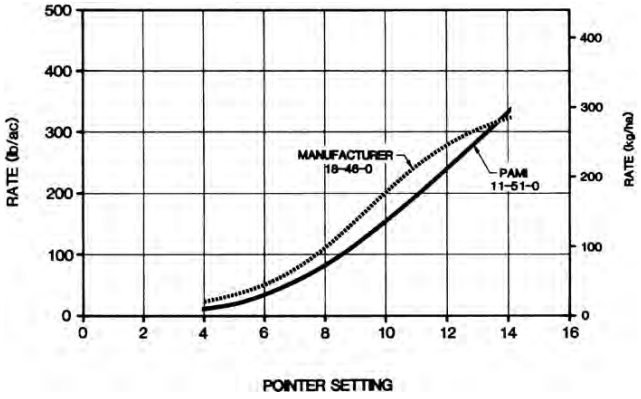

FIGURE 7. PAMI Calibration Compared to Manufacturer's Calibration While Applying Fertilizer.

The fertilizer application rate was not significantly affected by the level of fertilizer in the box or field vibrations. Variation in field speed and variation in field slope had a significant effect on the application rate. As shown in FIGURE 6, travelling down a 15° hill decreased the fertilizer application rate as much as 25%. When increasing field speed from 3 to 7 mph (5 to 11 km/h) the fertilizer application rate decreased as much as 18%.

Grass Seeding: A grass seeding attachment was not available as optional equipment for the Haybuster 8000. Large and small seeds such as ryegrass and alfalfa were metered through the grain box with good accuracy. Occasionally large light seeds would bridge across the slide gate opening. The manufacturer supplied calibration charts for some grass seeds. See FIGURE 8.

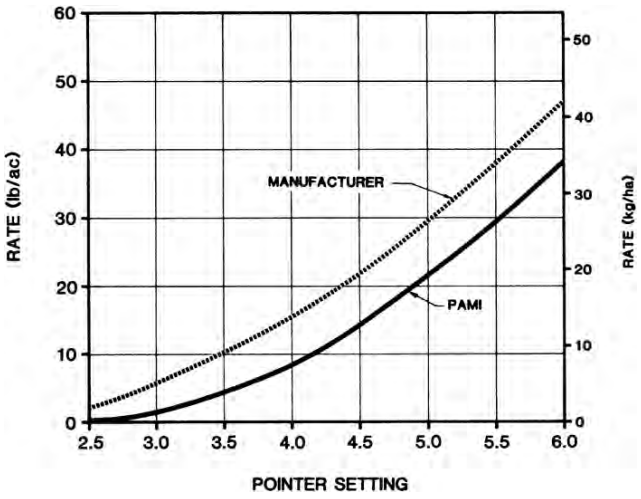

FIGURE 8. PAMI Calibrations Compared to Manufacturer's Calibrations While Seeding Alfalfa.

EASE OF OPERATION

Wet Fields: The Haybuster 8000 worked well under wet field conditions. Mud sometimes stuck to the sides of the openers around the seed tubes and sealer plates, causing a plowing action. In sticky clay soil, mud would stick to the sides of the press wheels and eventually plug them. Straw and seeds would also stick to the press wheels in wet conditions.

Stony Field: The stone trip mechanism was factory set at about 1500 lb (6700 N). The maximum lift height when the openers encountered a stone or other obstructions was 7.0 in (180 mm). The stone trip worked very well and gave adequate protection to the openers.

Trashy Fields: Heavy surface residue had no effect on opener penetration. Straw tended to bunch up in front of the openers and be left in small piles in the fields. Adjustment of the cutting coulters helped the openers go through the dry trash. In moist trash the effect of the coulters was reduced.

Filling: The Haybuster 8000 was easy to fill due to the large openings on both the seed and fertilizer boxes. Since the platform was 3.7 ft (1.1 m) from the ground, handling bagged seed and fertilizer was difficult. Some drill fills were too short to adequately reach the top of the drill, which was 7.0 ft (2.1 m) above the ground.

The grain box had a capacity of 14.0 bu (0.49 m³) of grain and the fertilizer box had a capacity of 1100 lb (500 kg) of fertilizer with a density of 62.4 lb/ft³ (1000 kg/m³). The drill was not equipped with grain and fertilizer level indicators, but did have a feed indicator to check that the feedshafts were turning.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent leakage in light rains, but small amounts of moisture entered the boxes and seed cups during heavy driving rains. If the drill is left out in heavy rains the fertilizer shaft should be checked before operating to ensure that it is free to rotate and that the fertilizer has not caked. Seed and fertilizer cups should also be checked periodically to ensure they have not plugged.

Cleaning: The grain and fertilizer boxes could be easily cleaned by removing baffles, and removing excess grain and fertilizer with a vacuum cleaner or dumping it through the clean out slides. The manufacturer also recommends flushing with water at the end of the season, and coating with a lubricant, all parts that have been in contact with fertilizer.

Acremeter: The Haybuster 8000 was equipped with an optional acre counter. It was resettable and read to the nearest thousandth of an acre to a maximum of 100 acres and was accurate to within

Transportability: The Haybuster 8000 trailed well and rode smoothly behind a tractor or light truck at speeds up to 30 mph (50 km/h) provided grain and fertilizer boxes were empty. The manufacturer recommends not exceeding 10 mph (16 km/h). The overall width of the machine was 8.1 ft (2.5 m), which permitted easy travel down most roadways.

There was ample ground clearance to prevent openers from dragging on roads (FIGURE 9). Mechanical locks were provided for the openers and the press wheel gangs.

FIGURE 9. Ground Clearance During Transport.

Marker: The test machine was not equipped with a marker system but they are available as optional equipment on multiple drill arrangements. A marker was not required on a single drill as the previous pass could be easily seen.

EASE OF ADJUSTMENT

Lubrication: The Haybuster 8000 had 77 grease fittings on the main seeding unit, which required regular lubrication. The drive gears and chains required oiling regularly.

Seeding and Fertilizing Rates: The seeding and fertilizing rates were adjusted in an identical manner. The calibration screw was turned until the pointer reached the scale position indicated in the rate charts. Then the rate was checked and the calibration screw moved if necessary until the desired rate was achieved. Wheel space gauges for checking the space between the feedwheel and the tank wall were included with the drill. The space may occasionally have to be changed for very large or very small seeds.

Depth: All 10 hoe openers were raised and lowered at the same time with one hydraulic cylinder from the tractor seat. The depth was set by turning a screw-out collar on the hydraulic cylinder, which changed the stroke length of the cylinder.

POWER REQUIREMENTS

Maximum draft at 1.6 in (40 mm) depth on level fields with average soil moisture was about 5500 lb (24.5 kN) while average draft was about 3800 lb (16.9 kN). A 120 hp (89 kW) tractor should be adequate in most fields and field speeds.

OPERATOR SAFETY

The Haybuster 8000 was safe to operate if normal safety precautions were observed. Pinch points and moving parts were adequately shielded but the drill lacked warning decals. The tractor's slow moving vehicle sign was not visible from behind the drill. It is recommended the manufacturer consider providing a slow moving vehicle sign.

OPERATOR'S MANUAL

The operator's manual contained information on lubrication, adjustment, calibration, warranty and safety. It lacked information on assembly and operation and was somewhat sketchy throughout. The operator's manual did not include metric calibration charts for the grain and fertilizer rates or densities of the grain and fertilizer used in the manufacturer's calibration. It is recommended that the manufacturer consider providing an operator's manual with step-by-step instructions on assembly, operation, optional equipment and more complete calibration charts.

MECHANICAL HISTORY

The Haybuster 8000 was operated for 100 hours while seeding 450 ac (182 ha). The intent of the test was an evaluation of functional performance and an extended durability evaluation was not conducted.

Sealer Plates: The corners of four sealer plates were broken off after 50 ac (20 ha) of stoney land and a total of 315 ac (127 ha) of all soil types (FIGURE 10).

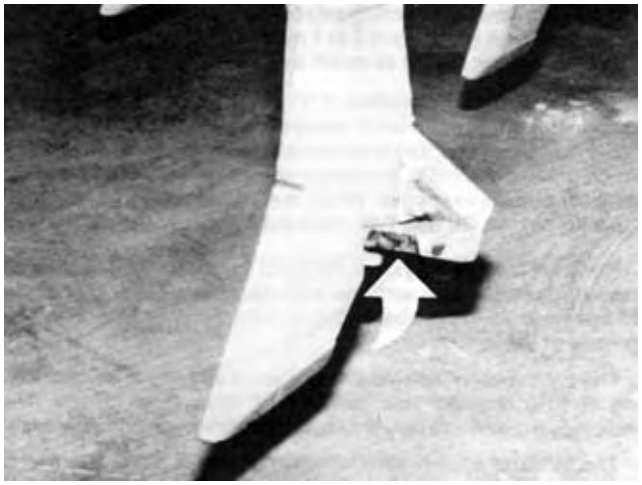

FIGURE 10. Broken Sealer Plate.

APPENDIX I
SPECIFICATIONS:

MAKE:	Haybuster
MODEL:	8000 No-till Grain Drill
SERIAL NUMBER:	85927
DIMENSIONS:	
-- height (transport)	7.3 ft (2.2 m)
-- height (field)	7.0 ft (2.1 m)
-- length (transport)	21.7 ft (6.6 m)
-- length (field)	20.3 ft (6.2 m)
-- width	8.1 ft (2.5 m)
-- effective seeding width	8.3 ft (2.5 m)
-- transport ground clearance (openers)	8.0 in (200 mm)
SEED AND FERTILIZER METERING SYSTEM:	
-- type	externally ridged traction wheels
-- drive	gear and chain driven off press wheels
-- adjustment	turn calibration screw to open or close slide gate opening
-- transfer to openers	convoluted rubber hose
OPENERS:	
-- type	hoe with deep banding points
-- width	1.0 in (25 mm)
-- number of openers	10 per unit
-- opener spacing	10 in (250 mm)
-- number of ranks	2
-- distance between ranks	28 in (710 mm)
PRESS WHEELS:	
-- type	deep-V metal wheel
-- diameter	27 in (690 mm)
-- width	3 in (75 mm)
-- number of press wheels	10 per unit
-- number per gang	5
-- wheel spacing	10 in (250 mm)
TIRES:	
-- number	3
-- tire size	
-castor wheels	(1), 9.5 L - 14 SL
-rear wheels (optional)	(2), 9.5 L - 14 SL
GRAIN AND FERTIUZER BOX CAPACITIES:	
-- grain box capacity	14.0 bu (0.49 rn³)
-- number of grain boxes	1 per unit
-- fertilizer box capacity	1103 lb (503 kg)
-- number of fertilizer boxes	1 per unit

WEIGHT: (Without ballast)	**Boxes Empty**	**Boxes Full**
-- on press wheels	2916 lb (1323 kg)	4330 lb (1964 kg)
-- on castor wheels	2403 lb (1090 kg)	2754 lb (1249 kg)
-- on hitch	15 lb (7 kg)	15 lb (7 kg)
total weight	5335 lb (2420 kg)	7099 lb (3220 kg)

NUMBER OF CHAIN DRIVES:	3
NUMBER OF LUBRICATION POINTS:	77
NUMBER OF HYDRAULIC CYLINDERS:	1
NUMBER OF SEALED BEARINGS:	16

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART

HAYBUSTER 8000 NO-TILL GRAIN DRILL

RETAIL PRICE:	$13,378.00 (August, 1986 f.o.b. Portage !a Prairie, Manitoba)
QUALITY OF WORK:	
Penetration	**Excellent;** moist stubble fields
	Excellent; dry stubble field
Trash Clearance	**Very Good**
Accuracy of:	
Seed Metering Device	**Good;** wheat and rapeseed
Fertilizer Metering Device	**Good;** 11-51-00 (field slope & speed had a significant effect on seed and fertilizer rates.)
EASE OF OPERATION:	
Wet Field Conditions	Some plugging of press wheels
Filling	**Good;** boxes quite high
Transportability	**Very good;** high ground clearance
EASE OF ADJUSTMENT:	
Seed and Fertilizer Rates	Very easy to change
Depth	Quick and simple; no calibrated scale
POWER REQUIREMENTS:	120 hp (89 kW) tractor has sufficient reserve for most field conditions and speeds.
OPERATOR SAFETY:	Safe, if normal precautions observed
OPERATOR'S MANUAL:	Lacked detailed information in some areas
MECHANICAL HISTORY:	Corners of four sealer plates broken off in stony land

ALBERTA FARM MACHINERY RESEARCH CENTRE

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html

Prairie Agricultural Machinery Institute
Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:

P.O. Box 1060
Portage la Prairie, Manitoba, Canada R1N 3C5
Telephone: (204) 239-5445
Fax: (204) 239-7124

P.O. Box 1150
Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-5033
Fax: (306) 682-5080