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Evaluation Report 487

Haybuster 107 No-Till Grain Drill

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

HAYBUSTER 107 NO-TILL GRAIN DRILL

MANUFACTURER AND DISTRIBUTOR:

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

RETAIL PRICE:

$15,950.00 (August 1986 f.o.b. Portage la Prairie, Manitoba) 10.5 ft (3.2 m) width, 7 in (180 mm) spacing, with acre counter, ballast tanks, mid-row fertilizer banding unit, and combination dry-anhydrous fertilizer placement shanks.

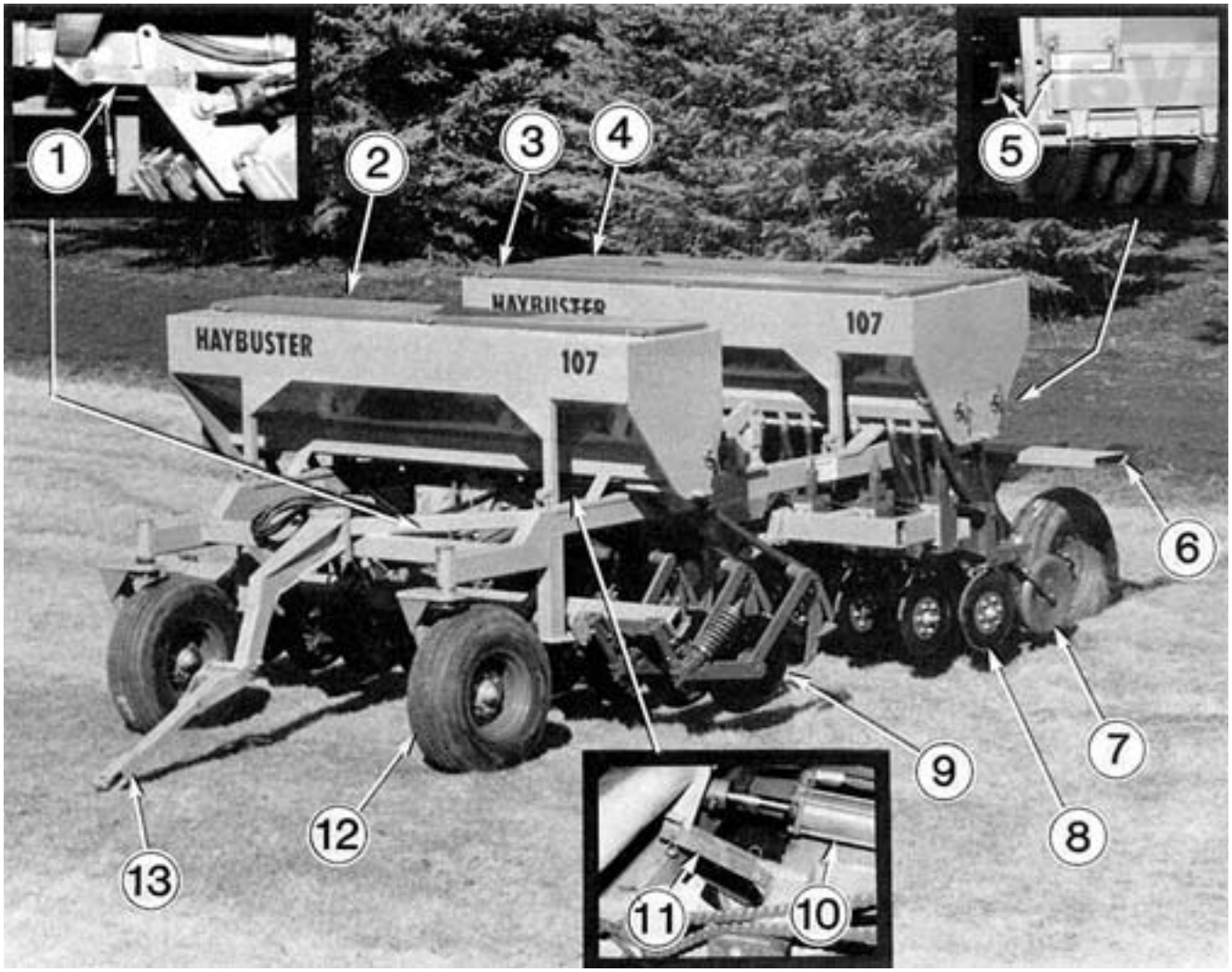

FIGURE 1. Haybuster 107 No-Till Grain Drill: (1) Side-Bander Transport Lock, (2) Side-Bander Fertilizer Box, (3) Grain Box, (4) Rear Fertilizer Box, (5) Rate Adjustment, (6) Operator Platform, (7) Gauge Press Wheel, (8) Offset Double Disk Opener, (9) Side-Banding Opener, (10) Hydraulic Cylinder, (11) Opener Transport Lock, (12) Castor Wheel, (13) Hitch.

SUMMARY

Quality of Work: Penetration was very good when seeding directly into moist stubble fields and good when seeding into dry stubble fields. The ability of the offset double disk opener to cut through surface residue was good in firm soils and fair in soft moist soils, Failure of the openers to cut through the surface residue results in seed being placed either in the residue or on the soil surface. The gauge-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 23% when travelling up a 15° slope. Ground speed also had a significant effect on the seeding rate.

The accuracy of the fertilizer metering devices 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 application rate decreased by as much as 30% 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 opener frame, the outside of the openers and around the press wheels, eventually causing plugging. Exterior disk scrapers were not provided. Large openings in the seed and fertilizer box made filling easy. A lack of steps made the operator platforms somewhat inaccessible. 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.

Ease of Adjustment: Twenty-eight grease fittings on the drill required regular lubrication. Both the seed and fertilizer rates were very easy to adjust. The depth adjustment was straight forward, but time consuming.

Power Requirements: A 110 hp (82 kW) tractor should have sufficient power reserve to operate one section of the 10.5 ft (3.2 m) drill with side bander in all field conditions and speeds.

Operator Safety: The Haybuster 107 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: No mechanical problems occurred during the 140 hours of field testing.

RECOMMENDATIONS:

It is recommended that the manufacturer consider:

1. Providing steps to give a safer and more convenient access to the operator platforms.
2. Providing a slow moving vehicle sign.
3. Providing an operator's manual with step-by-step instructions on assembly, operation and 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 recommendations:

1. Steps have been provided on the 107 to give safer and more convenient access. Steps are standard equipment on all new models and can be purchased for all earlier models.
2. Because the drills can be assembled in different widths of 10 feet to 40 feet 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.
3. 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.

GENERAL DESCRIPTION

The Haybuster 107 (FIGURE 1) is a 10.5 ft (3.2 m) grain drill designed for no-till, minimum till, and conventional seeding. It is equipped with 18 double disk openers spaced 7 in (180 mm) apart in two ranks. Seeding depth is controlled by a hydraulic cylinder and adjusted with spacers on the gauge wheels. The grain box has a capacity of 14.9 bu (0.52 m³) and the fertilizer box has a capacity of 1150 lb (520 kg). Gates can be removed and both boxes filled with grain to give a capacity of 29.8 bu (1.08 m³).

Seed and fertilizer are metered by externally ridged traction wheels through infinitely adjustable sliding gates. Flexible rubber hoses separately deliver seed and fertilizer to the openers. Grass seed may be sown through the main seed box. The 15 in (380 mm) diameter gauge-press wheels pack the soil directly behind the openers.

The test drill was equipped with interior disk scrapers as well as optional ballast barrels, an acremeter, and a mid-row fertilizer banding unit. The side banding unit was equipped with 9 knife openers spaced 14 in (360 mm) apart in one rank and each preceded by a single disk cutting coulter. Fertilizing depth was controlled by a single hydraulic cylinder. The banding box had a capacity of 1670 lb (760 kg) of fertilizer.

Multiple drill hitches, end hitches and stablizers are also available as optional equipment.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Haybuster 107 was operated under field conditions as shown in TABLE 1 for 140 hours, while seeding 785 ac (318 ha). It was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

During the test small to large stones were encountered in 500 ac (200 ha). The drill was transported over 185 m (298 km) on paved roads and 115 m (185 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 107 was equipped with double disk offset furrow openers each trailed by an individual gauge-press wheel. Penetration of the openers was very good when seeding directly into moist stubble fields and good when seeding into dry stubble fields. In hard fields it was necessary to add ballast to the drill and increase the compression on the opener springs. A total of 250 lb (113 kg) could be added to the drill by filling the two ballast barrels with water. This proved to be adequate in most fields encountered.

TABLE 1. Operating Conditions

Field Condition	Operating Hours	Equivalent Field Area	
		ac	ha
Soil Type:			
-sand	22	120	49
-sandy loam	42	235	95
-clay loam	38	215	87
-clay	38	215	87
TOTAL	140	785	318
Crop:			
-winter wheat	27	150	61
-spring wheat	31	175	71
-rapeseed	46	260	105
-flax	12	65	26
-alfalfa & bromegrass	12	70	29
- canary seed	8	45	18
-sorghum	4	20	8
TOTAL	140	785	318
Land:			
-stubble	103	575	233
-stubble mulch	37	210	85
TOTAL:	140	785	318

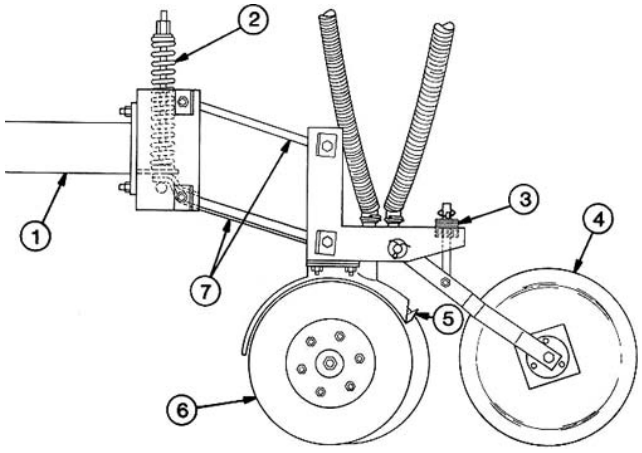

FIGURE 2. Offset Double Disk Opener: (1) Drill Frame, (2) Pressure Spring, (3) Depth Adjustment Spacers, (4) Gauge-Press Wheel, (5) Mud Scraper, (6) Seed Disks, (7) Parallel Linkage.

The ability of the offset double disk opener to cut through surface residue was good in firm soils and fair in soft, moist soils. Straw was pushed into the furrow bottom without being cut when operating in soft, moist soils (FIGURE 3). Extremely heavy surface residue prevented proper opener penetration regardless of soil conditions. Straw and chaff should be spread evenly before seeding.

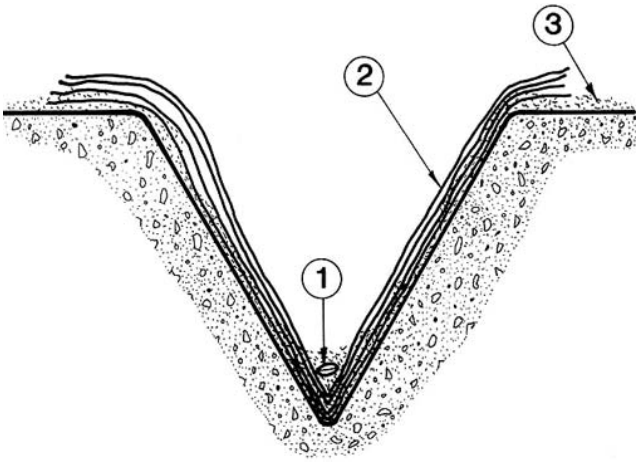

FIGURE 3. Schematic Representation of Hairpinning in Soft Moist Conditions: (1) Seed, (2) Uncut Straw, (3) Chaff.

One hydraulic cylinder raised and lowered all of the openers at once. Individual depth adjustment of the openers travelling in the

tractor wheel tracks was possible by moving spacers on the gauge-press wheels. Pressure adjustment on the individual openers was also possible by changing the length of the pressure spring.

The downward force on each opener could increase from 0 to over 800 lb (3560 N) as the springs compressed. The maximum average force with grain and fertilizer boxes empty and the machine loaded with 250 lb (113 kg) of ballast was 370 lb (1650 N) per opener.

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 oil seeds 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.

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

Seeding depth was fairly uniform with slight variations resulting from field or seedbed irregularities. Measurements of seeding depth when seeding wheat at 5 mph (8 km/h) in stubble, showed that at least 68% of the seeds were within 0.63 in (16 mm) of the average seeding depth.[1] Higher speeds caused more seed scatter. Seed coverage was good and only slightly affected by ground speed. Seed coverage was reduced in hard packed ground and in trashy conditions. Seed and fertilizer were placed together in a narrow band. Fertilizer could also be placed in a narrow band between the seed rows, using the optional mid-row banding unit.

The Haybuster 107 could be used for seeding conventionally into a prepared seedbed without requiring machine modifications. The test unit performed very well in the stubble mulch fields encountered.

Soil/Stubble Disturbance: Minimizing soil disturbance is important under dry conditions in that it lessens moisture loss and reduces germination of some annual weeds. The angle between the two seed disks of the Haybuster 107 is about 7 degrees. This angle was small enough to keep soil disturbance minimal in most field conditions (FIGURE 4).

FIGURE 4. Soil Disturbance and Stubble Knockdown with Haybuster 107.

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 small angle between the seed disks minimized the amount of stubble knockdown in most field conditions, and resulted in very good snow catch. The Haybuster 107 disk opener left about 50% of the stubble standing. About 30% of the stubble was left standing when the side banding unit was used in front of the main seeder.

Soil Compaction: The narrow metal gauge-press wheels followed directly behind each opener, effectively pressing the soil about the seeds. The press wheels provided fair compaction in most soils encountered. In moist clay, soil and seed would stick to the wheels and eventually stop them from turning. In light, fluffy soil the wheel was too narrow to support the opener resulting in poor depth control.

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 was 250 lb (1110 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 5). In dry fields, complete emergence occurred only after rain. Seed emergence in heavy trash ranged from fair to poor as the trash prevented proper opener penetration.

FIGURE 5. Emergence of Wheat Drilled Directly into Stubble with Average Moisture Conditions, 53 Days After Seeding.

Metering Accuracy: The grain and fertilizer metering systems (FIGURE 6) were calibrated in the laboratory and compared with the manufacturer's calibrations. The accuracy of the seed metering system on the Haybuster 107 in wheat and rapeseed was good. Differences between PAMI calibrations and the manufacturer's calibration charts 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 yields.

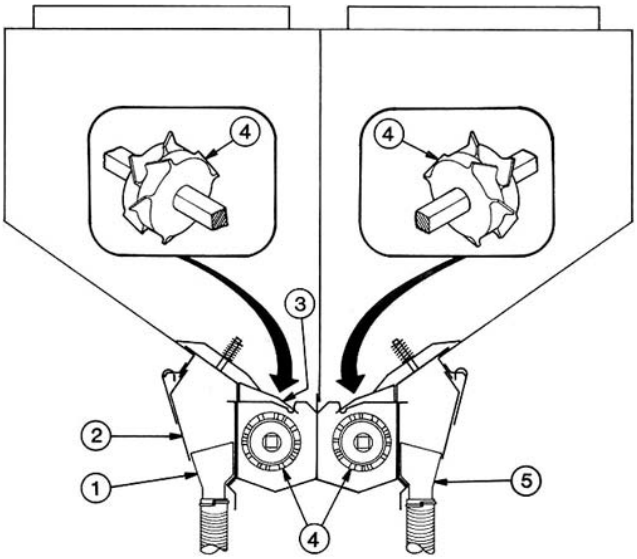

FIGURE 6. Grain and Fertilizer Metering Systems: (1) Seed Cup, (2) Wind Guards, (3) Feed Wheel Covers, (4) Externally Ridged Traction Wheels, (5) Fertilizer Cup.

[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.*

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 7, travelling up a 15° slope decreased the seeding rate of wheat by as much as 23%. When increasing field speed from 3 to 7 mph (5 to 11 km/h) the seeding rate of wheat decreased as much as 24%.

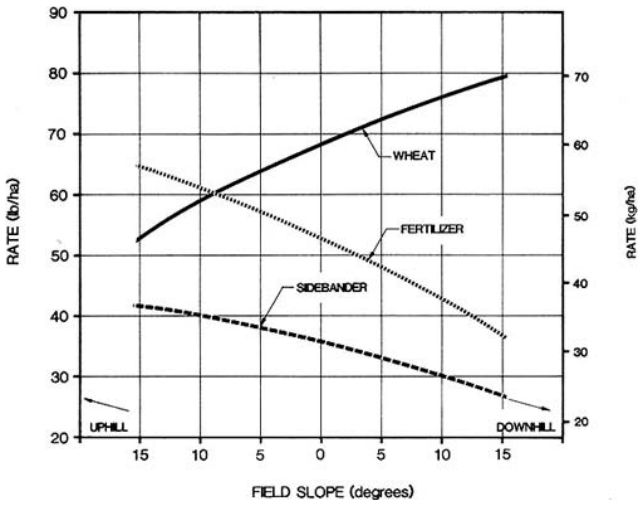

FIGURE 7. Variation in Seed and Fertilizer Application Rate with Change in Field Slope while Seeding Wheat and 11-51-00 Fertilizer.

The coefficient of variation (CV) can also be used to describe the variation of application rates among individual seed cups. If the CV is less than 15%, seeding is acceptable whereas if the CV is much greater than 15%, the variation among individual seed or fertilizer cups is excessive. When seeding rapeseed at 8.8 lb/ac (9.8 kg/ha) the CV was 7.4% indicating very uniform seeding.

Fertilizer Metering System: FIGURE 8 shows PAMI calibration results in comparison with the manufacturer's calibrations. The small difference between the two calibrations is probably due to the difference in density of fertilizer.

The variation in fertilizing rates from one run to another was very small. When distributing 11-51-00 fertilizer at a rate of 47.8 lb/ac (53.7 kg/ha), the CV among individual seed cups was 6.4% indicating very uniform metering.

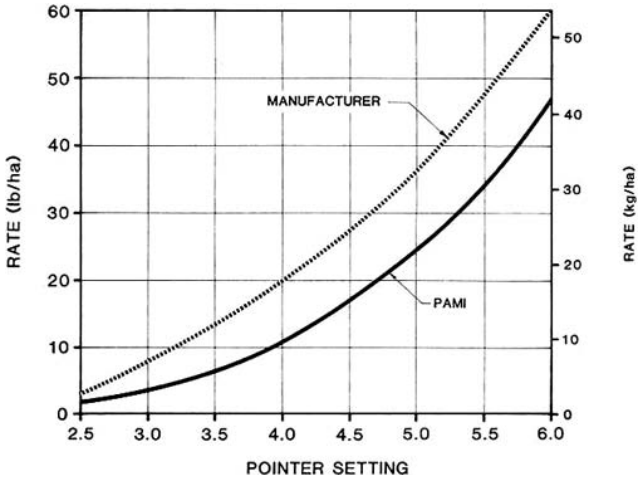

FIGURE 8. PAMI Calibrations Compared to Manufacturer's Calibrations While Applying Fertilizer.

The fertilizer application rate was not significantly affected by the level of fertilizer in the box, or field vibrations. Variations in field speed and variation in field slope did have an effect on the fertilizing rate. As shown in FIGURE 7, travelling down a 15° slope decreased the fertilizing rate by as much as 30%. When increasing field speed from 3 to 7 mph (5 to 11 km/h) the fertilizer application rate decreased as much as 26%.

Fertilizer Banding Unit: A fertilizer side banding unit was installed as optional equipment on the Haybuster 107. The side banding used the same type of metering device as in the seed and the fertilizer box.

The variation in fertilizing rates from one run to another was very low. When distributing 11-51-00 fertilizer at a rate of 47.3 lb/ac (53.0 kg/ha), the CV among individual seed cups was 7.1%.

The fertilizer application rate was not significantly affected by the level of fertilizer in the box, or field vibrations. Variations in field speed and variations in field slope did have a significant effect on the fertilizing rate. As shown in FIGURE 7, travelling down a 15° slope decreased the fertilizing rate by as much as 30%. When increasing field speed from 3 to 7 mph (5 to 11 km/h) the fertilizer application rate decreased as much as 27%.

Grass Seeding: A grass seeding attachment was not available as optional equipment for the Haybuster 107. It was possible to meter large and small seeds such as ryegrass and alfalfa 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 9.

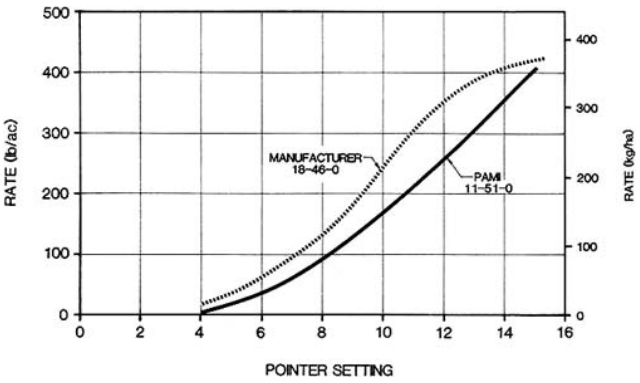

FIGURE 9. PAMI Calibrations Compared to Manufacturer's Calibrations While Seeding Alfalfa.

EASE OF OPERATION

Wet Fields: In very wet conditions mud and seed would stick to the gauge-press wheels preventing them from turning. Also, mud would work into the space between the disks and the opener frame and prevent the disks from turning. The interior double disk scrapers required adjustment as they became worn. Exterior scrapers were not provided on the Haybuster 107.

Stony Field: Compression of the pressure springs as the openers went over stones permitted the openers to lift a maximum of 10 in (250 mm). The opener force increased to 800 lb (3560 N) as the springs compressed to the maximum. Average opener force during normal operation varies from 100 to 300 lb (445 to 1330 N).

Trashy Fields: Heavy surface residue caused poor opener penetration and poor seed placement. The addition of ballast improved performance marginally. Surface residue should be spread evenly before attempting to seed through it.

Filling: The Haybuster 107 was easy to fill as it had large openings on both the seed and fertilizer boxes. The tops of the boxes were 6.0 ft (1.83 m) above the ground for easy filling with most drill fills. Access to both the rear platform and especially the platform on the side banding unit was inconvenient and at times unsafe. It is recommended that the manufacturer consider providing steps to give safer and more convenient access to the operator platforms.

The grain box had a capacity of 14.9 bu (0.52 m^3) and the fertilizer box had a capacity of 1150 lb (522 kg), while the side banding box a capacity of 1670 lb (760 kg) of fertilizer with a density of 62.4 lb/ft^3 (1000 kg/m^3). The drill was not equipped with grain and fertilizer level indicators.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent leakage into the box in light rains, but small amounts of moisture entered during heavy driving rains. The fertilizer shaft should be checked before operation to ensure that it is free to rotate and that the fertilizer has not caked. Seed and fertilizer cups should be checked periodically to ensure they haven't 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 107 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 2%.

Transportability: The Haybuster 107 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 10.2 ft (3.1 m), which permitted easy travel down most roadways.

The limited ground clearance (FIGURE 10) of 5 in (125 mm) occasionally resulted in the openers dragging on high crowned roadways. Mechanical locks were provided to hold the main set of openers as well as the side banding openers in the raised position.

FIGURE 10. Ground Clearance During Transport.

Marker: A marker was not available for the Haybuster grain drill. When operating in tall stubble or under dusty conditions it was difficult to see the edge of the previous pass.

EASE OF ADJUSTMENT

Lubrication: The Haybuster 107 had 17 grease fittings on the main seeding unit and 11 grease fittings on the side banding unit, which required regular lubrication. The drive gears and chains also require regular oiling. Lubricating the entire machine took about 15 minutes.

Seeding and Fertilizing Rates: The seeding and fertilizing rates were adjusted in an identical manner. A calibration screw was turned until a pointer reached the scale position indicated in the rate charts. Then the metering 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 feed-wheel 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 18 double disk offset openers were raised and lowered at the same time with one hydraulic cylinder from the tractor seat. To set the depth, a screw-out collar on the hydraulic cylinder (FIGURE 11) was adjusted to lower the main frame so the openers would penetrate the soil approximately 2 in (50 mm). Then spacers were moved either up or down on the gauge wheel in order to fine tune the depth. This procedure took 1 person about 20 minutes to complete.

The side banding unit had only a screw-out collar on the hydraulic cylinder as a depth adjustment. Pressure springs on both the seed furrow openers and the mid-row banding openers could be adjusted to suit the soil type.

POWER REQUIREMENTS

Maximum draft at 1.6 in (40 mm) depth with 250 lb (113 kg) of ballast on level fields with average soil moisture was about 3000 lb (13.3 kN) while average draft was about 2200 lb (9.7 kN). The sidebanding unit had an average draft of 2500 lb (11.1 kN). A 110 hp (82 kW) tractor should be adequate in all fields and field speeds.

OPERATOR SAFETY

The Haybuster 107 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.

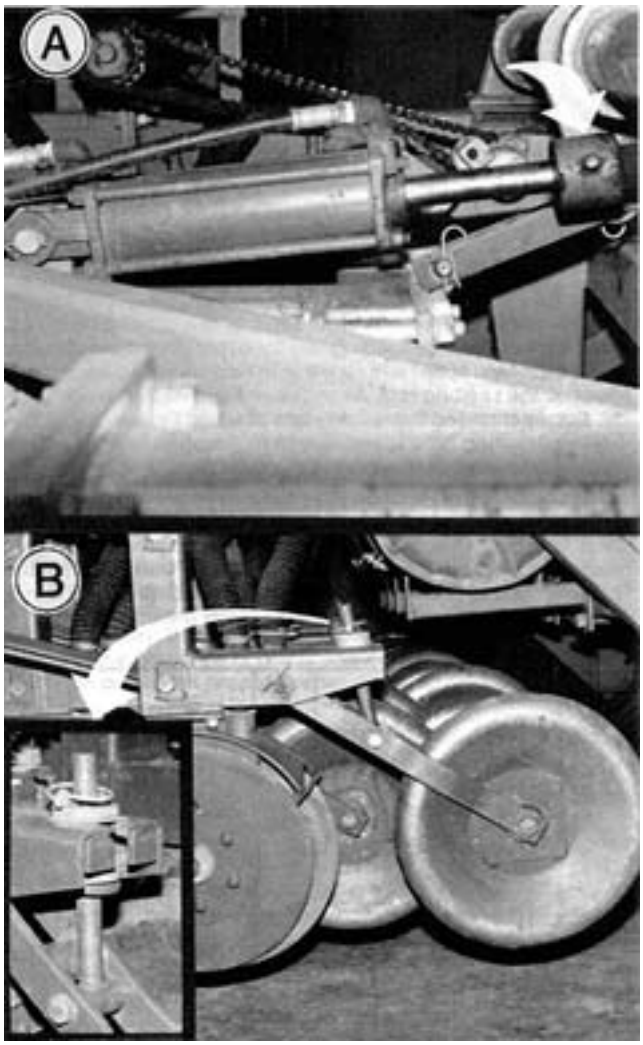

FIGURE 11. Depth Adjustments: (A) Hydraulic Cylinder with Screw-Out Collar, (B) Gauge Wheel (Spacers in Inset).

OPERATOR'S MANUAL

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

MECHANICAL HISTORY

The Haybuster 107 was operated for 140 hours while seeding 785 ac (318 ha). The intent of the test was an evaluation of functional performance and an extended durability evaluation was not conducted. No mechanical problems occurred during the test period.

APPENDIX I
SPECIFICATIONS

MAKE:	Haybuster
MODEL:	107 No-Till Grain Drill
SERIAL NUMBER:	851194

DIMENSIONS:

-- height	6.0 ft (1.83 m)
-- length	15.7 ft (4.78 m)
-- width	10.2 ft (3.10 m)
-- effective seeding width	10.5 ft (3.20 m)
-- transport ground clearance	5.0 in (125 mm)

SEED AND FERTILIZER METERING SYSTEMS:

-- type	externally ridged-traction wheels
-- drive	gear and chain driven off central ground wheel
-- adjustment	turn calibration screw to open or dose slide gate opening
-- transfer to openers	convoluted rubber hose

OPENERS:

-- type	
-main unit	offset double disk
-side banding unit	single cutting coulter followed by banding knife.
-- disk diameter	
-main unit	14 in (355 mm)
-side banding unit	18 in (455 mm)
-- number of openers	
-main unit	18
-side banding unit	9
-- number of ranks	
-main unit	2
-side banding unit	1
-- distance between	
-ranks	9.5 in (240 mm)

GAUGE-PRESS WHEELS:

-- type	narrow, metal wheel
-- diameter	15 in (380 mm)
-- width	2 in (50 mm)
-- number	18
-- spacing	7 in (180 mm)

TIRES:

-- number	4
-- tire size	
-castor wheels	(2), 9.5 L - 14 SL
-rear wheels	(2), 7,6 - 15 SL

GRAIN AND FERTILIZER BOX CAPACITIES:

-- grain box capacity	14.9 bu (0.52 m^3)
-- fertilizer box capacity	1150 lb (520 kg)
-- side banding box capacity	1670 lb (760 kg)

WEIGHT: (Without ballast)	**Boxes Empty**	**Boxes Full**
-- on rear wheels	3475 lb (1576 kg)	5449 lb (2469 kg)
-- on castor wheels	3166 lb (1436 kg)	4830 lb (2191 kg)
-- on hitch	15 lb (7 kg)	15 lb (7 kg)
total weight	6656 lb (3019 kg)	10288 lb (4667 kg)

NUMBER OF CHAIN DRIVES:

-- main unit	2
-- side banding unit	2

NUMBER OF LUBRICATION POINTS:

-- main unit	17
-- side banding unit	11

NUMBER OF HYDRAULIC CYLINDERS:

-- main unit	1
-- side banding unit	1

NUMBER OF SEALED BEARINGS:

-- main unit	84
-- side banding unit	22

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very good	Poor
Good	Unsatisfactory

SUMMARY CHART

HAYBUSTER 107 NO-TILL GRAIN DRILL

RETAIL PRICE:	$15,950.00 (August 1986 f.o.b., Portage la Prairie, Man.)
QUALITY OF WORK:	
Penetration	**Very good;** moist stubble fields **Good;** dry stubble fields
Trash Cutting	**Good;** firm soils **Fair;** soft moist soils
Accuracy of:	
Seed Metering Device	**Good;** wheat and rapeseed
Fertilizer Metering Device	**Good;** 11-51-0, field speed and field slope had significant effect on seed and fertilizer rates
EASE OF OPERATION:	
Wet Field Conditions	Some plugging
Filling	Easy, limited access to platforms
Transportability	**Very Good**
EASE OF ADJUSTMENT:	
Seed and Fertilizer Rates	Very easy to change
Depth	Simple but time consuming
POWER REQUIREMENTS:	110 hp (82 kW) tractor has sufficient reserve for all field conditions and speeds.
OPERATOR SAFETY:	Safe, if normal precautions observed
OPERATOR'S MANUAL:	Lacked detailed information in some areas
MECHANICAL HISTORY:	No failures occurred during the test

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