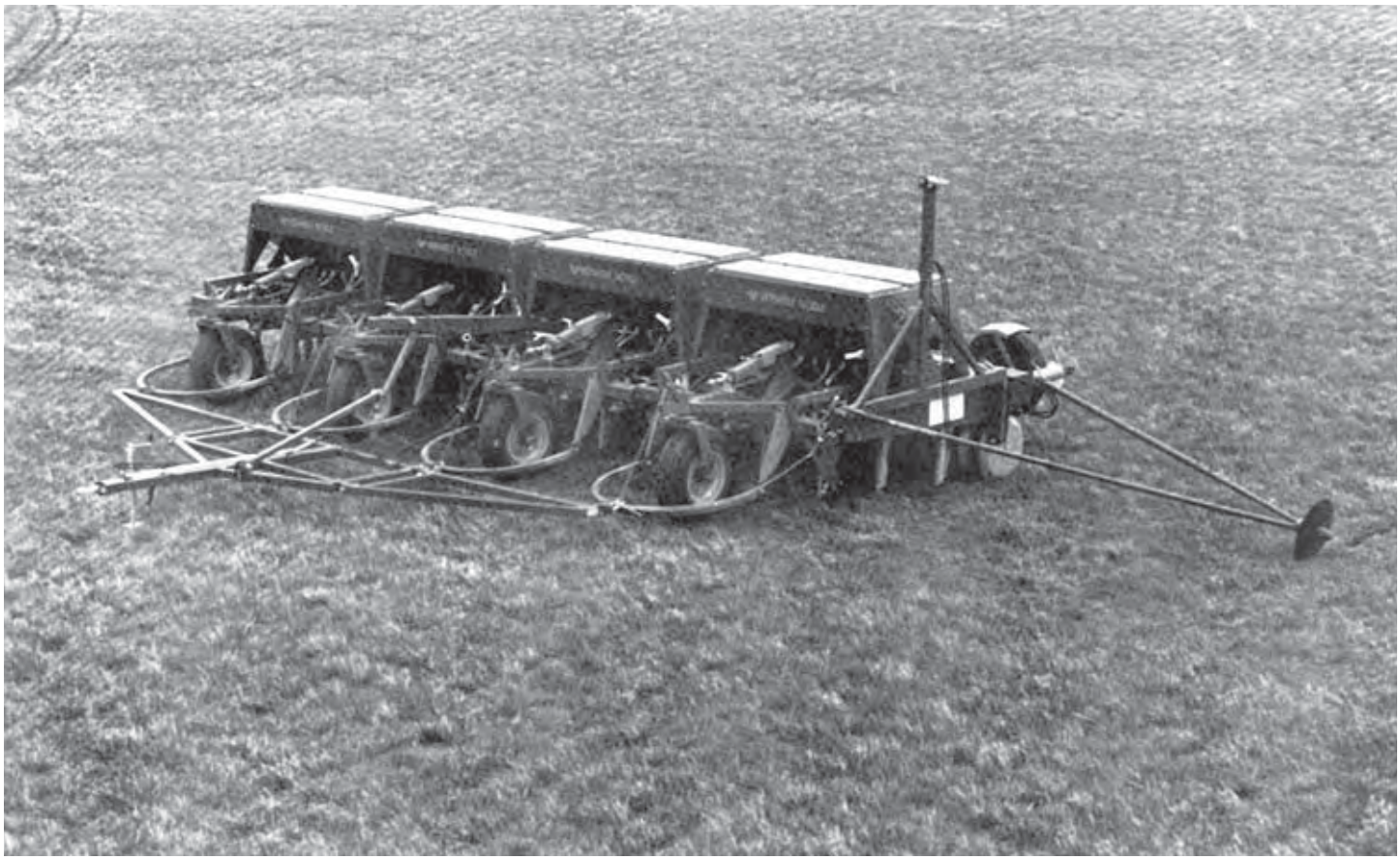
MACHINERY INSTITUTE

Printed: June, 1983
Tested at: Lethbridge
ISSN 0383-3445

Evaluation Report 302



Versatile Noble 2000 Seed Drill

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI
PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

VERSATILE NOBLE 2000 SEED DRILL

MANUFACTURER:

Versatile Noble Cultivators Company
P.O. Box 60
Nobleford, Alberta
T0L 1S0

DISTRIBUTOR:

Versatile Farm Equipment Company
1260 Clarence Avenue
Winnipeg, Manitoba
R3T 1T3

RETAIL PRICE:

$41,475.00 (June 1983, f.o.b. Lethbridge, Alberta) for the four basic unit, 28 ft (8.4 m) wide test machine.

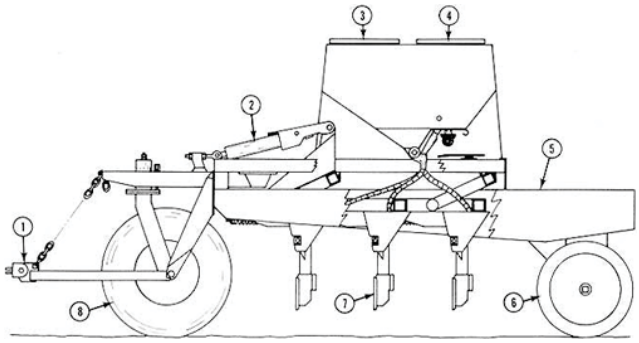


FIGURE 1. Versatile Noble 2000: (1) Hitch, (2) Hydraulic Lift Cylinder, (3) Grain Box, (4) Fertilizer Box, (5) Rear Walkway, (6) Press Wheels, (7) Hoe Openers, (8) Caster Wheel.

SUMMARY AND CONCLUSIONS

Overall Performance: Performance of the Versatile Noble 2000 seed drill was very good when seeding into seed beds that had been tilled prior to seeding. Performance was good when seeding directly into stubble.

Seed Placement and Emergence: Seed and fertilizer were normally placed in a 1.3 in (32 mm) wide band, with most seeds within 0.55 in (14 mm) of the average seed depth in uniform soil conditions. Each press wheel followed directly behind an opener, exerting a packing force of 259 lb (1154 N), which effectively packed the soil around the seed. Seeding into soft conditions resulted in increased seed depth due to the press wheels sinking into the soft soil.

Trash Clearance: Trash clearance was good with some plugging occurring in heavy trash conditions. The spring cushioned hoe opener assemblies provided adequate protection to the hoe openers with only slight damage to the pivot bushing resulting from excessive opener tripping.

Grain Metering System: Metering calibrations in wheat, oats and barley were accurate. Differences between the manufacturer's and PAMI's metering calibrations could probably be attributed to the difference in seed size and density used for the respective calibrations. The manufacturer's calibration was low when seeding canola using the fast speed grain drive. It was desirable to use the slow speed grain drive, when seeding canola, to obtain the required low seeding rates.

Variation in seeding rates among seed runs across the width of the machine was insignificant when seeding large seeds such as wheat, oats and barley. Variation among seed runs was within the acceptable range when seeding canola. The seeding rates in all crops were unaffected by level of seed in the box, variations in ground speed and field roughness. Travelling up a 15-degree slope caused a 6% increase while travelling down a 15-degree slope caused a 3% decrease in seeding rate. Seeding on a side slope caused a 4% change in seeding rate.

Fertilizer Metering System: Fertilizer metering calibration was accurate when density and particle size differences were considered. Variation in application rate among runs across the width of the machine was low. The application rate was not significantly affected by level of fertilizer in the box, ground speed or by field vibrations. The application rate was, however, affected by field slope. For example, when applying 11-51-00 fertilizer at a setting of 22, travelling up a 15-degree slope caused an 18% decrease while travelling down a 15-degree slope caused a 25% increase in application rate. Seeding on a side slope caused a 5% increase in application rate.

Ease of Operation and Adjustment: Hitching in field position was convenient. Two people were needed for hitching in transport position since the hitch was not supported. The optional transport package enabled the drill to be placed in transport position in 5 to 10 minutes for quick and easy transporting.

The seed and fertilizer rate were easy to adjust. Adjusting the seed rate became more difficult when the seed box was full. Seeding depth was adjusted with the hydraulic lift cylinder. The large metal walkway and wide hopper openings made filling the grain and fertilizer boxes safe and convenient. The partition in the grain box could be set in two positions to suit application rates. The fertilizer hopper bottom could swing downward to permit easy cleaning.

A single disc marker with an adjustable cutting angle was provided. The marker was fairly heavy, making it difficult to put in transport position. The area counter read 14% low.

Access to the clutch drive shaft grease fitting was poor. Access to all other lubrication points was good.

Power Requirements: Tractor size depended on field conditions, soil type, seeding depth, ground speed and drill width. In light soil, seeding at a normal seeding depth at 5 mph (8 km/h), a 43 hp (32 kW) tractor was needed to operate one 7 ft (2.1 m) wide section of the Versatile Noble 2000 drill. In heavy soil, at the same depth and speed, a 49 hp (37 kW) tractor was needed.

Operator Safety: The Versatile Noble 2000 seed drill was safe to operate provided normal safety precautions were observed. Operator care was required when transporting on public roads.

Operator's Manual: The operator's manual was very good, containing useful information on adjustments, maintenance and operation as well as a complete parts list.

Mechanical Problems: Several mechanical problems occurred during the evaluation. The front transport wheel hub broke, welds on the caster wheel mounts cracked, two hoe opener pivot bushings were lost and two were broken, and a transport wheel caster mount broke.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to facilitate easier and safer hitching in transport position.
2. Modifications to permit easier access to the clutch drive shaft grease fitting.
3. Modifications to the caster wheels to prevent wheel oscillation while transporting.
4. Modifying the transport wheel mounts to prevent weld failure.

Senior Engineer: E. H. Wiens

Project Engineer: L. J. deBoer

THE MANUFACTURER-STATES THAT

With regard to recommendation number:

1. As shown on page 24 of the assembly manual, there should have been spring washers on both sides of the hitch ring. When the 1 x 7-1/2 in cap screw is tightened, the friction between the hitch ring and the spring washer is sufficient to hold the ring horizontal for easier hook-up.
2. A new perforated safety grating is planned for the drill walk next year. This will allow greasing of the clutch components through these perforations without removing the drill walk.
3. There should be ample adjustment on the caster pivot retarding discs to virtually tighten the caster solid. Component quality will be checked more closely to ensure the full amount of adjustment can be achieved consistently. It is also important to keep grease away from the caster pivot retarding discs to ensure they exert the proper friction.
4. There is a change being made to the gusset on the transport wheel mount, which will prevent this type of failure in the future.

GENERAL DESCRIPTION

The Versatile Noble 2000 is a basic 7 ft (2.1 m) hoe drill. Hitches are available for hitching up to eight basic drill units together. Each basic unit is equipped with 10 openers in three rows. Seeding depth is controlled with a hydraulic cylinder. The divider in the combination grain and fertilizer box may be installed in two positions giving filled capacities of 13.5 bu (490 L) of grain and 681 lb (309 kg) of fertilizer or 20.4 bu (743 L) of grain only.

Grain is metered by externally fluted feed rolls while fertilizer is metered with star-shaped traction wheels. Coiled steel tubes deliver both seed and fertilizer to the openers. One gang of 23 in (584 mm) diameter steel press wheels pack the soil directly behind the openers.

The test machine consisted of four basic drill units with 8.1 in (206 mm) spacing, equipped with optional equipment including a disc marker, acre tally, seed shaft speed reducer, seed box covers and transport package.

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

SCOPE OF TEST

The four-unit, 28 ft (8.5 m) Versatile Noble 2000 seed drill was operated in the conditions shown in TABLE 1 for 127 hours while seeding about 1445 ac (585 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 metering systems were evaluated in the laboratory.

TABLE 1. Operating Conditions

Crop	Soil	Stone Conditions	Field Area		Hours
			ac	ha	
Wheat on tilled stubble	Heavy loam	occasional stones	329	133	27
Wheat on stubble	Heavy loam	moderately stony	24	10	2
Wheat on tilled stubble	Clay	occasional stones	342	138	28
Wheat on summerfallow	Heavy loam	occasional stones	439	178	36
Winter wheat on stubble	Heavy loam	occasional stones	64	26	7
Winter wheat on stubble	Loam	occasional stones	137	55	15
Winter wheat on summerfallow	Heavy loam	occasional stones	46	19	5
Winter wheat on summerfallow	Silty loam	occasional stones	64	26	7
Total			1445	585	127

RESULTS AND DISCUSSION

QUALITY OF WORK

Penetration: Penetration was very good in a wide variety of field conditions provided adequate pre-seeding tillage had been performed. Penetration was good when seeding directly into stubble fields. Opener depth was controlled by the position of the hydraulic lift cylinders. The depth of the openers could not be individually adjusted, resulting in variation in seed depth in the tractor wheel tracks.

The hoe assemblies (FIGURE 2) were equipped with a spring cushion trip and a 1.75 in (45 mm) wide, vertical hoe opener. The spring cushions were effective in providing opener protection in stony conditions.

Seed Placement: In normal prairie conditions, grain is seeded into moist soil on a firm seedbed from 1 to 2 in (25 to 50 mm) deep. A firm seedbed aids in packing of moist soil about the seed and provides a barrier to seepage of rainfall below the seed zone.

The Versatile Noble 2000 normally placed seed and fertilizer within a 1.3 in (32 mm) wide band. When seeding in pre-tilled uniform soil conditions, variation in seed depth was quite uniform. For example, at an average seeding depth of 2 in (50 mm), although seeding depth across the width of the machine varied from 0.9 to 3.1 in (22 to 78 mm), most of the seeds were placed within 0.55 in (14 mm) of the average seed depth. Seeding depth increased due to both caster wheel and press wheel sinking in soft soils.

Soil Compaction: The V-shaped steel press wheels followed directly behind the openers, effectively pressing the soil about the seeds. Average packing force exerted by each press wheel ranged from 259 lb (1154 N) with empty seed and fertilizer boxes to 343 lb (1528 N) with full boxes. Press wheel furrow depth ranged from 1.2 to 2.0 in (30 to 50 mm) depending on soil conditions. FIGURES 3 and 4 show the soil surface after seeding into summerfallow and stubble fields, in dry loose soils, high field speeds caused excessive soil disturbance. The manufacturer recommends not to seed at speeds in excess of 4.5 mph (7 km/h) with 8.1 in (206 mm) spacing.

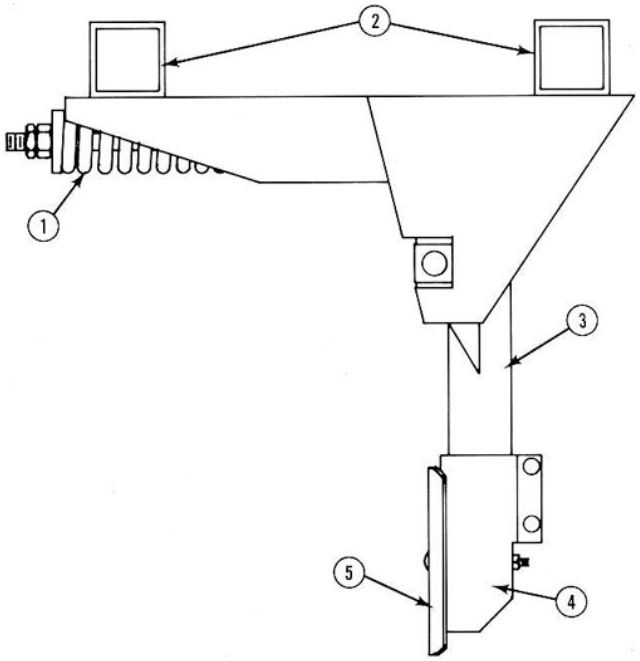


FIGURE 2. Hoe Assembly: (1) Cushion Spring, (2) Frame Mounts, (3) Shank, (4) Boot, (5) Hoe Opener.

FIGURE 3. Soil Surface After Seeding into Summerfallow.

FIGURE 4. Soil Surface After Seeding into Stubble.

Trash Clearance: The 19 in (483 mm) ground-to-frame clearance and the 8.1 in (206 mm) hoe spacing arranged in three rows resulted in fairly good trash clearance with some plugging occurring in heavy trash areas. In heavy, loose trash areas, straw tended to wrap around the openers, which eventually resulted in plugging.

Operation in Stony Fields: The spring cushion hoe opener assembly provided adequate protection in stony conditions. Excessive tripping of the opener caused the pivot bushings to fail on

two hoe openers. Maximum lift height when openers encountered stones or field obstructions was 5.75 in (146 mm).

Plant Emergence: As with most drills, plant emergence depended primarily upon seedbed preparation and soil moisture. FIGURE 5 illustrates good emergence in a pre-tilled stubble field seeded to wheat.

FIGURE 5. Wheat Emergence on Pre-Tilled Stubble.

Metering Accuracy: The grain and fertilizer metering systems (FIGURE 6) were calibrated in the laboratory[1] and compared with the manufacturer's calibrations. Since the actual application for certain settings depends 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. Field calibrations may be necessary for seed and fertilizer with properties differing from those indicated in the manufacturer's table. Research has shown, however, that small variations in seed or fertilizer application rates will not significantly affect grain crop yields.

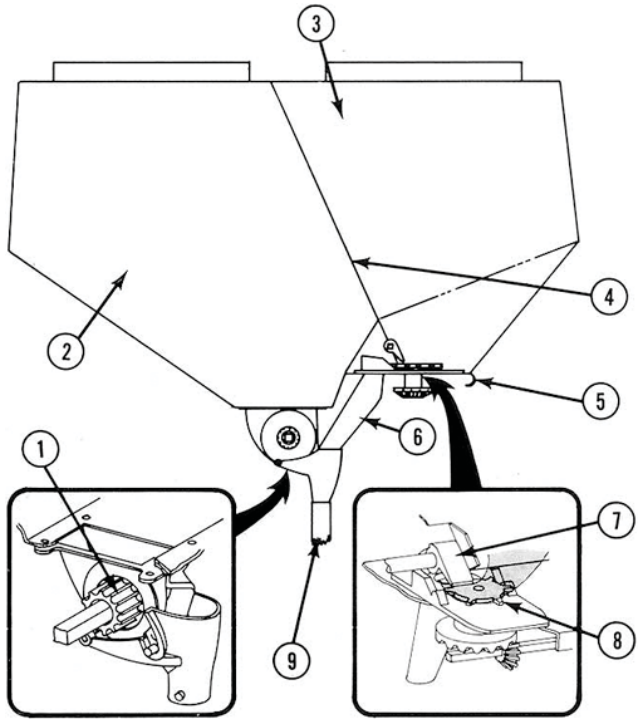


FIGURE 6. Grain and Fertilizer Metering Systems: (1) Externally Fluted Feed Roll, (2) Grain Box, (3) Fertilizer Box, (4) Seed Box Partition, (5) Fertilizer Hopper Drop Bottom, (6) Fertilizer Spout, (7) Adjustable Fertilizer Feed Gate, (8) Star-Shaped Feed Wheel, (9) Grain and Fertilizer Delivery Tube.

Grain Metering System: FIGURES 7 to 9 show calibration curves obtained by PAMI and the manufacturer for the Versatile Noble 2000 in wheat, barley and oats using the fast speed drive. All calibration curves were accurate. The difference between calibration curves obtained by PAMI and those given by the manufacturer are probably due to different seed size, density and moisture content. The seed densities (bushel weights) used by PAMI are indicated on the graphs. FIGURE 10 shows the calibration for canola using the fast and the slow speed grain drives. The manufacturer's calibration was lower than that obtained by PAMI when using the fast speed drive. Also, with the fast speed drive, the minimum obtainable seeding rate was 7.5 lb/ac (8.4 kg/ha). Therefore, the slow speed grain drive should be used at the low seeding rates required when seeding canola.

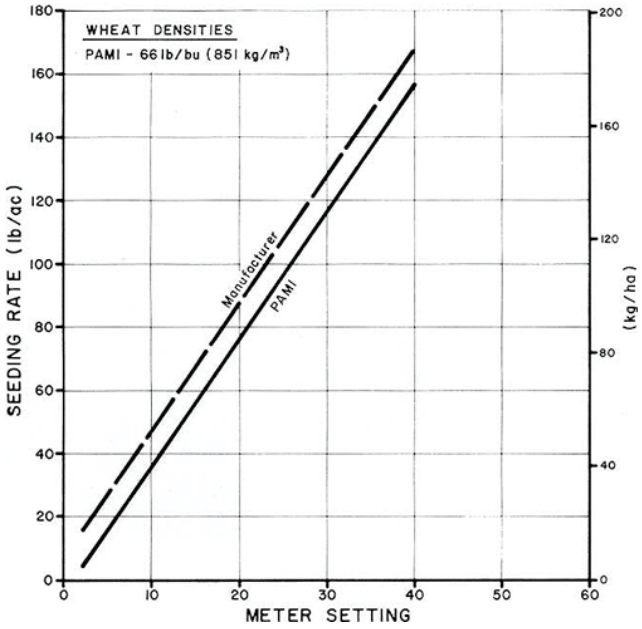


FIGURE 7. Metering Accuracy in Wheat.

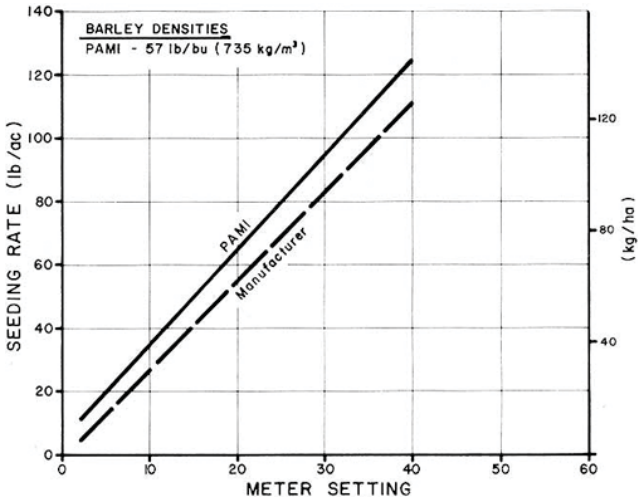


FIGURE 8. Metering Accuracy in Barley.

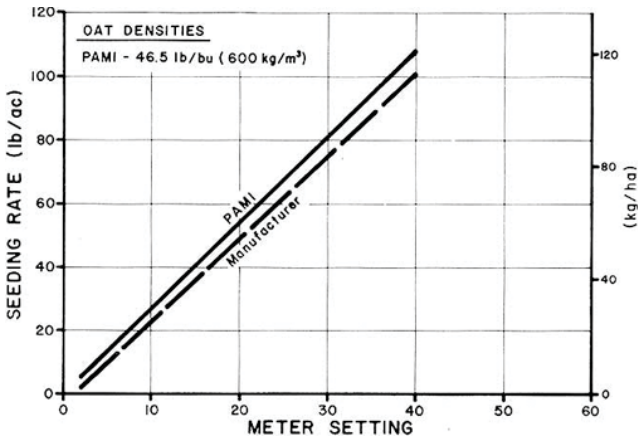


FIGURE 9. Metering Accuracy in Oats.

Level of seed in the grain box, variation in ground speed, and

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

field roughness did not affect the seeding rate of either large or small seeds. Travelling up a 15 degree slope caused a 6.4% increase in seeding rate and travelling down a 15 degree slope caused a 2.8% decrease. Seeding on a side slope caused a 4% change in seeding rate.

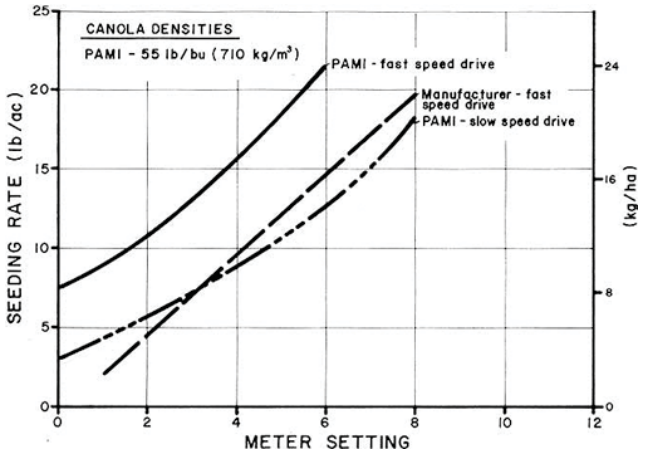


FIGURE 10. Metering Accuracy in Canola.

The coefficient of variation (CV)[2] is commonly used to describe the variation of application rate among individual seed cups across the width of the machine. An accepted variation for grain or fertilizer 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.

The seeding rate across the width of the machine for wheat, oats and barley was very uniform with CV's of 2 to 6%. The CV, when seeding canola with the slow speed drive, varied from 29% at 3.1 lb/ac (3.4 kg/ha) to 7% at 19 lb/ac (21 kg/ha).

Grain crackage through the grain metering system was negligible for both small and large seeds.

Fertilizer Metering System: FIGURE 11 shows the calibration curves for fertilizer obtained by PAMI and the manufacturer when using the slow speed drive while metering 11-51-00 fertilizer. The slight difference between the two curves is probably due to the variation in the size and density of the fertilizer used in the two calibrations. Application rates when using the high speed drive range from about 100 to 387 lb/ac (112 to 430 kg/ha).

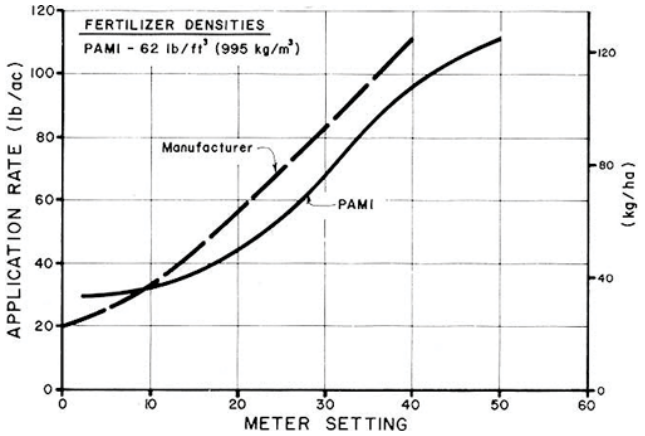


FIGURE 11. Metering Accuracy in Fertilizer.

Fertilizer distribution across the width of the drill was quite uniform. For example, when applying 11-51-00 fertilizer at a rate of 45 lb/ac (50 kg/ha), the coefficient of variation among individual seed cups was 5%.

The fertilizer application rate was not significantly affected by level of fertilizer in the box, ground speed or field roughness.

It was, however, affected by field slope. FIGURE 12 shows the variation in fertilizer application rates obtained when fertilizing uphill, downhill and on level ground with the fertilizer selection lever set at 22 while applying 11-51-00 fertilizer. The application rate varied from 38 lb/ac (42 kg/ha) while seeding up a 15-degree slope to 58 lb/ac (65 kg/ha) while seeding down a 15-degree slope. Seeding on a side slope caused a 4% change in application rate.

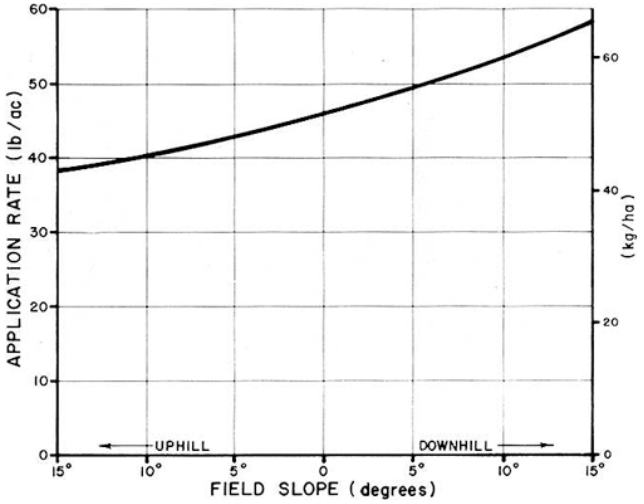


FIGURE 12. Variation in Fertilizer Application Rate with Change in Field Slope When Applying 11-55-00 Fertilizer at a Selection Lever Setting of 22.

EASE OF OPERATION

Hitching: Hitching in field position was convenient since the hitch was supported with a hitch jack. One man hitching in transport position was difficult since the transport hitch was not supported with a jack and since the hitch link did not remain in the horizontal position. It was, therefore, necessary to hold both the hitch and hitch link by hand. This also presented a safety hazard since the operator's hand was close to the tractor drawbar. It is recommended that modifications be made to facilitate easier and safer hitching in transport position.

Filling: The 28.7 in (730 mm) wide metal walkway and the wide opening lids made filling with grain and fertilizer safe and convenient. The partition between the grain and fertilizer boxes (FIGURE 6) could be set in two positions to suit application rates, thereby minimizing downtime for filling. This permitted carrying 13.5 bu (490 L) of grain and 681 lb (309 kg) of fertilizer or 20.4 bu (743 L) of grain only in each 7 ft (2.1 m) unit. Changing the partition in the seed box required two people and was very difficult due to the poor accessibility to the bolts. It took two men, 30 to 45 minutes to move the partition in each seed box.

Moisture: The grain and fertilizer boxes were adequately sealed to prevent leakage into the box in light rains. The optional seed box tarp cover was effective in preventing moisture from entering the seed box in heavy rain. If the drill is subjected to rain, the fertilizer attachment should be checked before operation to ensure that the feed shaft is free to turn and that the fertilizer is 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 was easy to clean. The bottom of the fertilizer box containing the feed wheels could be swung down to permit cleaning with a brush, water or compressed air.

Area Counter: The area counter read about 14% low on most fields. The counter recorded the nearest tenth acre up to 1000 acres. A metric counter was not available.

Marker: The Versatile Noble 2000 was equipped with a single disc marker. The marker cutting angle was adjustable. The marker was fairly heavy, making it difficult to place into transport position.

Transporting: The optional drill transport package (FIGURE 13) was convenient for transporting the drill over long distances. It took 5 to 10 minutes to place the drill in transport position. When transporting at speeds above 10 mph (16 km/hr), the front caster wheels tended to oscillate which resulted in damage occurring to the wheel hub and the caster brackets. The caster pivot retarding discs needed to be periodically tightened to reduce this problem. The drill should not be transported with grain and fertilizer tanks full due to the excessive weight placed on the transport wheels. Backing up in transport position resulted in interference between the wheel guard and the packer wheel when the caster wheel swivelled.

[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.

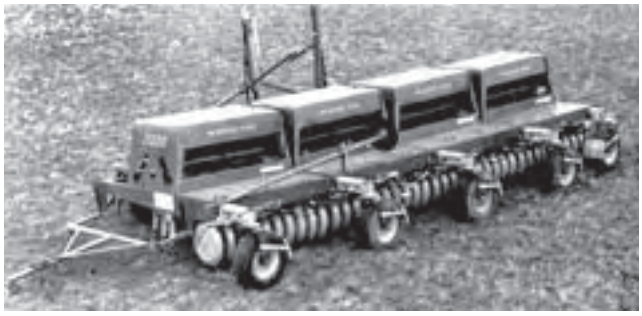


FIGURE 13. Transport Position.

EASE OF ADJUSTMENT

Lubrication: Lubrication was easy with good access to all but one grease fitting. The clutch drive shaft was difficult to grease since it was located under the rear walkway. It is recommended that modifications be made to permit easier access to the clutch driveshaft grease fitting.

Twenty-one grease fittings required greasing every 5 hours, while twenty-six grease fittings required greasing every 50 hours.

Seeding and Fertilizer Rate: The seeding rate was adjusted by changing the rate selection lever (FIGURE 14) to the desired setting. The rate selection lever became more difficult to adjust when the grain box was full. The seeding rate could be zeroed by turning the zeroing nut and by adjusting the individual seed cups. Changing to the optional slow speed drive required changing of the sprockets and deleting some roller chain links.

FIGURE 14. Seeding Rate Selection Lever.

The fertilizer rate was easily adjusted by moving the selection lever (FIGURE 15) to the desired setting. The fertilizer drive was easily changed from low to high speed drive. Each fertilizer gate should be adjusted according to the operator's manual and checked periodically.

FIGURE 15. Fertilizer Rate Selection Lever.

Depth of Tillage: Seeding depth was adjusted by positioning the stop collar on the hydraulic cylinders. The frame could be levelled by adjusting the setscrews on the packer gang bearing standards.

POWER REQUIREMENTS

Draft: Draft (drawbar pull) requirements depended on field preparation, soil type and moisture. Average draft at a normal seeding depth and at 5 mph (8 km/hr), with fully loaded seed and fertilizer boxes, ranged from 1872 lb (8330 N) in silty loam to 2132 lb (9485 N) in clay soil, for each 7 ft (2.1 m) drill unit.

Tractor Size: Tractor size needed to pull a 7 ft (2.1 m) section of the Versatile Noble 2000 seed drill varied from 43 hp (32 kW) in silty loam to 49 hp (37 kW) in clay soil. These tractor sizes have been adjusted to include tractive efficiency and represent a tractor operating at 80% of maximum power take-off rating as determined by Nebraska tests or as presented by the tractor manufacturer. The tractor sizes given will have ample power reserve to operate in the stated conditions.

OPERATOR SAFETY

The Versatile Noble 2000 seed drill was safe to operate if normal safety precautions were observed. The platform at the rear of the drill was large enough for safe filling of the grain and fertilizer boxes. The wheel guards on the rear transport wheels were safe to step on while filling the drill with grain and fertilizer. A slow moving vehicle sign was provided.

Travelling at speeds in excess of 10 mph (16 km/h) resulted in the caster wheels oscillating which could result in a safety hazard when travelling on public roads.

OPERATOR'S MANUAL

The operator's manual contained useful information on adjustments, maintenance and operation as well as a complete parts list. Calibration charts were provided in the operator's manual and on the drill box. Seeding rates were expressed in Imperial units (lb/ac) only.

MECHANICAL PROBLEMS

The Versatile Noble 2000 was operated for 127 hours while seeding about 1445 ac (585 ha). 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 did occur during the functional testing.

TABLE 2. Mechanical History

Item	Operating Hours	Field Area ac	(ha)
-Several delivery spouts came out of the openers at	4, 14	49, 171	(20, 69)
-The threads on one fertilizer gate adjusting bolt stripped at	14	171	(69)
-The lock nuts on the hoe spring tension adjustment loosened and were tightened at	55	670	(271)
-The front transport wheel hub broke due to oscillation of the tire while transporting at	56	683	(276)
-A weld on the caster wheel mount cracked and was re-welded at	56, 109	683, 1286	(276, 520)
-The depth control hydraulic hose developed a leak due to interference with the hitch lifting mechanism at	66	805	(326)
-The hoe openers were worn and were inverted at	92	1121	(454)
-An adapter to prevent delivery spout damage was added to ten openers at	92	1121	(454)
-The cotter pin on the main drive sprocket sheared at	95	1158	(469)
-The fertilizer drive sprocket loosened and was lost at	109	1286	(520)
-Pivot pins came out of two hoe openers, causing the pivot bushings to break at	120	1386	(561)
-The packer wheel nuts needed tightening		throughout the test	
-A transport wheel caster mount broke at		end of test	
-Some of the coiled steel seed and fertilizer delivery tubes showed excessive rust at		end of test	
-Two packer wheel standards were twisted, causing rubbing between the mounting bolts and the packer wheel at		end of test	

DISCUSSION OF MECHANICAL PROBLEMS

Wheel Hub: The front caster wheels tended to oscillate while transporting at speeds greater than 10 mph (16 km/h). The oscillation became so severe that it caused the front of the drill to tip forward which resulted in the wheel hub breaking.

Tightening the caster pivot retarding discs reduced the problem of wheel oscillation while transporting but did not eliminate it.

Although the front caster wheel pivot retarding discs were tightened to their maximum, wheel oscillation still occurred. It is recommended that modifications be made to the caster wheels to prevent oscillation of the wheels while transporting.

Transport Wheel Mounts: The welds cracked on three of the transport wheel mounts and one of the mounts broke completely (FIGURE 16) while turning. It is recommended that modifications be made to the transport wheel mounts to reduce weld failure.

Delivery Tubes: An adapter (FIGURE 17) was added to 10 hoe openers to protect the steel coiled delivery tubes from damage caused by the tripping action of the hoe opener. It took two men

one hour to install the ten adapters. The adapters were effective in preventing damage to the coiled steel tubes.

Hoe Opener: The tripping action of the hoe opener assembly caused the welds on the pivot pins to break, which in turn caused the pivot bushings to come loose. Two pivot bushings were lost and two broke during the test.

Packer Wheels: The metal spacers between the packers tended to wear, causing the packers to loosen. The packer wheel nuts needed tightening throughout the test.

FIGURE 16. Transport Wheel Mount Weld Failure.

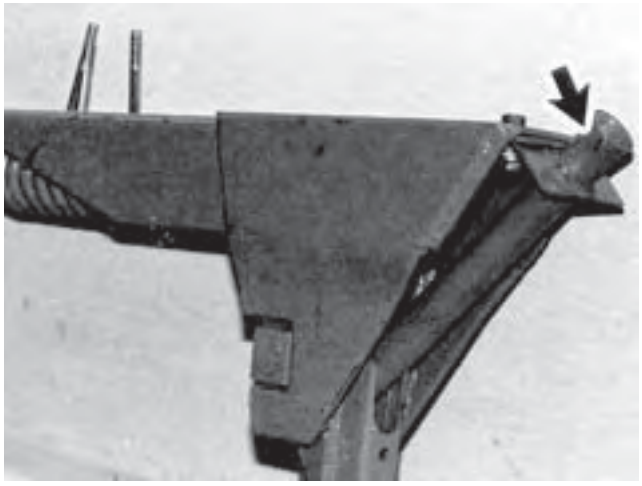


FIGURE 17. Coiled Steel Deliver Tube Adapter: (Upper) Front Row Adapter, (Lower) Middle and Rear Row Adapter.

APPENDIX I
SPECIFICATIONS

MAKE:	Versatile Noble Seed Drill
MODEL:	2000
MANUFACTURER:	Versatile Noble Cultivators Company P.O. Box 60 Nobleford, Alberta T0L 1S0

DIMENSIONS (Four Basic Unit Test Drill):	**Field Position**	**Transport Position**
-- height	8.9 ft (2710 mm)	9.4 ft (2855 mm)
-- length	23.0 ft (7010 mm)	34.8 ft (10,610 mm)
-- width-effective seeding width	27.6 ft (8400 mm)	18.7 ft (5710 mm)
-- transport ground clearance	26.6 ft (8100 mm)	5 in (127 mm)

SEED METERING SYSTEM:	
-- type	externally fluted feed rolls
-- drive	chain and gear from press wheels
-- adjustment lever	controlling feed roll protrusion
-- transfer to openers	coiled steel tubes
FERTILIZER METERING SYSTEM:	
-- type	star-shaped feed wheels rotating on a vertical shaft
-- drive	chain and gear from press wheels
-- adjustment lever	controlling feed inlet size
-- transfer to openers	coiled steel tubes
OPENERS:	
-- type	hoe
-- point	vertical
-- number	10 per drill unit
-- spacing	8 in (203 mm)
-- number of rows	3
-- distance between rows	18 in (457 mm)
-- options	regular hoe points, hard faced narrow hoe points 8, 9, 10, 12 and 13.5 in (203, 229, 254, 305, and 343 mm) hoe spacing
PRESS WHEELS:	
-- type	V-shaped formed steel
-- diameter	23 in (584 mm)
-- width	4 in (102 mm)
-- number	10 per drill unit
-- spacing	8 in (203 mm)
CASTER WHEELS:	
-- number	4
-- tire size	9.5L-15, 6-ply
GRAIN AND FERTILIZER BOX CAPACITIES:	
-- with box partition in position	1
-- grain	54 bu (1960 L)
-- fertilizer	2729 lb (1236 kg)
-- with box partition in position	2
-- grain	81.6 bu (2972 L)

WEIGHTS (Field Position):	**Boxes Empty**	**Boxes Full**
-- weight on press wheels	10,370 lb (4704 kg)	13,730 lb (6228 kg)
-- weight on caster wheels	5115 lb (2320 kg)	7176 lb (3255 kg)
Total weight	15,485 lb (7024 kg)	20,906 lb (9483 kg)

WEIGHTS (Transport Position):	**Boxes Empty**	**Boxes Full**
-- weight on front caster wheels	7980 lb (3620 kg)	10,941 lb (4963 kg)
-- weight on transport wheels	7505 lb (3404 kg)	9965 lb (4520 kg)
Total weight	15,485 lb (7024 kg)	20,906 lb (9483 kg)

NUMBER OF CHAIN DRIVES: 16

NUMBER OF LUBRICATION POINTS: 54

NUMBER OF HYDRAULIC LIFTS: 9

NUMBER OF SEALED BEARINGS: 7

OTHER OPTIONAL ATTACHMENTS:
-- 16 tooth seed box sprocket
-- Tag-A-Long marker

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

-excellent	-very good
-good	-fair
-poor	-unsatisfactory

APPENDIX III
CONVERSION TABLE

acres (ac) x 0.40	= hectares (ha)
miles/hour (mph) x 1.61	= kilometres/hour (km/h)
inches (in) x 25.4	= millimetres (mm)
feet (ft) x 0.305	= metres (m)
horsepower (hp) x 0.75	= kilowatts (kW)
pounds (lb) x 0.45	= kilograms (kg)
pounds force (lb) x 4.45	= newtons (N)
bushels (bu) x 36.4	= litres (L)
pounds/acre (lb/ac) x 1.12	= kilograms/hectare (kg/ha)
pounds/bushel (lb/bu) x 12.5	= kilograms/cubic meter (kg/m^3)

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