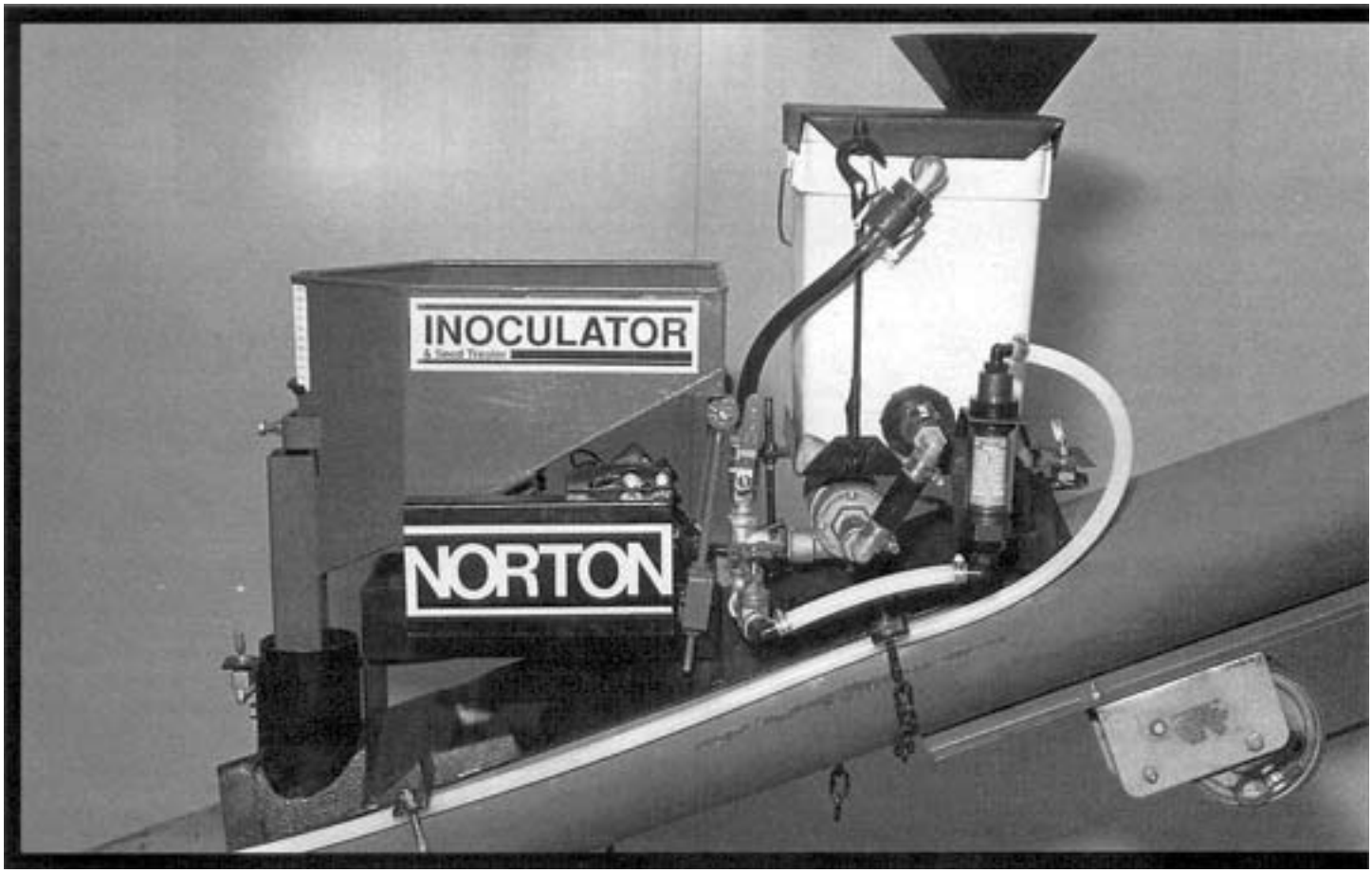
Printed: March, 1991
Tested at: Humboldt
ISSN 0383-3445
Group 9(f)

Evaluation Report 640



Norton Inoculator and Seed Treater

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

NORTON INOCULATOR AND SEED TREATER

MANUFACTURER AND DISTRIBUTOR:

Cinnabar Ag-Industries Ltd.
P.O. Box 23
Rocanville, Saskatchewan
S0A 3L0
Phone: (306) 645-4441

RETAIL PRICE:

$1,995.00 (December, 1990, f.o.b. Humboldt, Saskatchewan)

FIGURE 1. Norton Inoculator/Seed Treater: (1) Inoculant Hopper, (2) Liquid Tank, (3) Return Valve, (4) Pump Switch, (5) Liquid Flow Meter, (6) Flow Control Valve, (7) Shaker Switch, (8) Inoculant Hopper Gate.

SUMMARY AND CONCLUSIONS

Quality of Work: The accuracy of the liquid metering system was very good. A gate valve and flow meter permitted easy monitoring and control of liquid metering rates. Conversion charts in the operator's manual were required to convert flow indications to actual metering rates. The range of attainable flowrates was adequate, and mixing of liquid with seed was very uniform as it moved through the auger. The accuracy of the dry metering system was fair. The flow properties of the various inoculant products used in the test differed markedly from each other, and the metering system was very sensitive to these variations. Appropriate settings could usually be determined after some experimentation, and little adjustment was then required unless inoculant type or metering rate was changed. The range of metering rates was adequate, and appropriate inoculant uniformity and adhesion could be achieved.

Ease of Installation: Ease of installation was good. Two holes had to be cut in the auger tube for dispensing sticking agent and inoculant into the grain flow. Leveling adjustments to allow for different auger angles were provided, but did not cover a wide range of useful adjustment. Once installed, the Inoculator was easily and quickly removed and reinstalled if desired.

Ease of Operation and Adjustment: Ease of filling was very good. The reservoirs were easily accessed for filling and could be refilled while the unit was operating, However, if the liquid reservoir was pumped dry before being refilled, the outlet coupling had to be loosened to prime the pump, which was messy. The controls were good. All controls were conveniently located and easily used. Ease of setting rates was good. The operator's manual provided simple charts and instructions and the metering systems were easily adjusted, but inconsistent inoculant flow properties and lack of an easy method to determine grain flow rate made it difficult to quickly obtain precise inoculation rates. However, compared to traditional manual methods of inoculation, the Norton Inoculator greatly improved the speed and consistency of inoculation after some operator experience was gained. Ease of cleaning was very good. The inoculant hopper usually emptied itself, requiring no special cleaning procedures. The liquid reservoir had to be removed for complete cleaning, but appropriate provisions were made for this. The pump and valves were easily flushed using water or an appropriate solvent, and the exterior of the Inoculator could be cleaned with cold water. Ease of transporting was good. In general, the Inoculator did not interfere with normal hitching or towing of the auger. The weight of the Inoculator was mainly applied to the intake end of the auger, which made moving the auger by hand considerably more difficult. Ease of maintenance was good. Seasonal maintenance involved lubrication of 4 grease zerks, adjustment of the shaker drive belt tension, and draining liquid from the pump and valves before storing below freezing temperatures.

Power Requirements: The Norton Innoculator was intended to use a 12 volt DC power source, and drew 18 to 20 amps. For consistent delivery rates, it was necessary to have a charging system that would maintain the battery voltage.

Operator Safety: No safety hazards were apparent, however, normal safety precautions were required and warnings had to be heeded. Operators should be especially careful when working around the inlet of a grain auger.

Operator's Manual: The operator's manual was good. It provided useful information on safety, installation, operation, maintenance, and specifications. No trouble shooting section was provided, and the "standard safety symbols" were not used in the manual or on the machine.

Mechanical History: A few minor problems occurred.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Developing a more positive inoculant metering mechanism that is less sensitive to variations in inoculant flow properties.
2. Modifications to permit easier pump priming.
3. Revising the operator's manual to place greater emphasis on the safety information.
4. Use of more durable switches.
5. Using a more secure method to mount the pump motor.

Senior Engineer: J. D. Wassermann
Project Manager: C. A. Hanson
Project Technologist: W. F. Stock

THE MANUFACTURER STATES THAT

With regard to recommendation number

1. We are aware of the variations in the flow properties of the different inoculants on the market. In discussions with producers about this problem, they have indicated to us that the accuracy obtained with our system is far superior to anything else they have ever used and were very happy with it. There will be no changes made in 1991.
2. The pump should prime by jogging the pump switch to purge the air out of the system. If this cannot be accomplished without loosening the cam lever coupling, then there is not enough clearance between the bottom of the treater tank and the 90° nylon elbow at the inlet end of the suction line. A minimum of 5/16 in (1 cm) must be obtained (see trouble shooting).
3. Several revisions have been made to the operator's manual since the test unit was delivered to PAMI. These include:
   – specifying a 20 amp fuse for the shaker motor instead of the original 10 amp fuse.
   – use of the standard safety symbol to emphasize all safety notes, as welt as on the shaker belt shield.
   – addition of a trouble shooting section. As stated in the report, the manual is relatively simple, and most information was easily found using the table of contents. We simply feel an index is unnecessary, and have no plans to add one. The most recent revision of the manual will be included with all machines sold in 1991, and will also be provided at no cost to owners of previously purchased units.
4. In 1991 we will be using heavy duty switches as opposed to the light duty automotive switches used in 1990.
5. On all units built in 1991, the pumps wilt be installed using two U-bolts that wrap around the motor removing any weight and vibration from the rivets used to attach the motor mount to the motor.

MANUFACTURERS ADDITIONAL COMMENTS

The nylon bushings in the shock absorbers are being revised for 1991 to a snap-in design versus the old glue-in bushings. This should eliminate the problems with these bushings mentioned in the report.

Numerous customers have requested that the wet and dry systems be made available as individual units for specific applications. Therefore, a limited number of machines will be sold this way in 1991.

GENERAL DESCRIPTION

The Norton Inoculator and Seed Treater (FIGURE 1) is an auger mounted device for applying sticking agent and inoculant to pulse seeds. Mixing of the seed, sticking agent and inoculant occurs as the material is conveyed through the length of the auger. Metering of inoculant and sticking agent are independently adjustable, and either meter may be operated individually for application of fungicides or other treatments to cereal and forage seeds, as well as to pulse seeds.

Sticking agent or other liquid products are drawn from a plastic reservoir and pumped through a gate valve and flow meter to the inlet of the auger. A variable-flow recirculation circuit permits continuous agitation of suspended solutions by diverting some of the pump discharge back to the reservoir instead of through the flowmeter.

Dry products are gravity fed from a vibrating hopper into a port in the auger tube. An adjustable slide gate at the lower end of the hopper controls material flow.

Both metering systems are powered from the auger motor's 12 volt negative ground electrical system, or from the battery of any standard farm vehicle. The Norton Inoculator and Seed Treater can be installed on most 6, 7 or 8 in (15, 18 or 20 cm) augers.

Detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The machine evaluated by PAMI was configured as described in the General Description, FIGURE 1, and Specifications section of this report. The manufacturer may have produced different versions of this machine either before or after the PAMI tests. Therefore, when using this report, check to ensure the machine being considered is the same as the one evaluated in this report. If differences are found, PAMI or the manufacturer may be contacted to determine the effect of the changes on performance.

The main objective of the test was to determine the functional performance of the Norton Inoculator and Seed Treater. Measurements and observations were made to evaluate the Norton Inoculator for Quality of Work, Ease of Operation and Adjustment, Power Requirements, Operator Safety and Suitability of the Operator's Manual. Although extended durability testing was not conducted, the mechanical failures which occurred during the test were recorded.

The Norton Inoculator and Seed Treater were installed on a 7 in (18 cm), 40 ft (12 m) long "Pool" (Brandt) auger, and was powered from the auger motor's charging system. The test machine was used during the spring seeding season to inoculate approximately 7500 bu (205 t) of field peas and lentils using a variety of commercial inoculants. This corresponded to about 10 hours of actual use.

RESULTS AND DISCUSSION

QUALITY OF WORK

Liquid Metering: The accuracy of the Norton Inoculator and Seed Treater liquid metering system was very good.

Liquid flow was regulated with the gate valve, and liquids were delivered through a plastic tube to a fitting at the auger inlet. The liquid flow meter was easy to read and indicated U.S. and metric flow rates. However, it was important that operators not rely on direct flow meter indications to determine gate valve settings, because for any desired flow rate, various liquids produced different indications of the flow meter. Even water flow rates did not correspond directly to the indications on the flow meter, however, conversion charts presented in the operator's manual for several liquids agreed very closely with the rates obtained by PAMI. Small variations in liquid flow could occur due to operation of the dry metering system or an unstable supply voltage, but these variations were indicated in the flow meter and could be corrected by the operator. The level of fluid in the reservoir had an insignificant effect on flow rate.

Maximum attainable flow rates depended on the properties of the liquid being metered. With the recirculation circuit shut off, flows up to 1.5 gal/min (7 L/min) were attainable with most liquids, including water. In many cases, this flow rate would be suitable for grain flows as high as 80 bu/min (2.2 t/min) or 4800 bu/h (131 t/h). However, PAMI found that auger plugging could be a problem when applying certain liquids to grain flows above approximately 40 bu/min (1.1 t/min). The operator's manual recommends a grain flow rate of 10 to 20 bu/min (0.3 to 0.6 t/min), and this would be quite

acceptable. The manufacturer also recommends using slow auger speeds to minimize seed damage. Maximum flow attainable with canola oil used as an inoculant sticking agent was about 0.3 gal/min (1.2 L/min), although the operator's manual suggested rates up to 0.6 gal/min (2.8 L/min) should be possible. Use of the recirculation circuit reduced the maximum flow rates for all liquids. The extent of the reduction depended on the setting of the recirculation valve. The recirculation feature appeared to be an effective way of mixing solutions.

The manufacturer provided calibration charts for a total of 7 different liquids. Operators should check the delivery rates of liquids not covered in the operator's manual. This would be easily done with a measured container and a watch.

At typical inoculation rates, the liquid was uniformly mixed with the seed while being conveyed through the auger.

Dry Metering: The accuracy of the dry metering system was fair.

Inoculant was metered through an adjustable slide gate located at the discharge end of the vibrating hopper and delivered to the grain stream through a port in the auger tube (FIGURE 2). The position of the slide was indicated on an indexed scale (FIGURE 3), and corresponding flow rates for various inoculants were indicated on a series of graphs in the operator's manual.

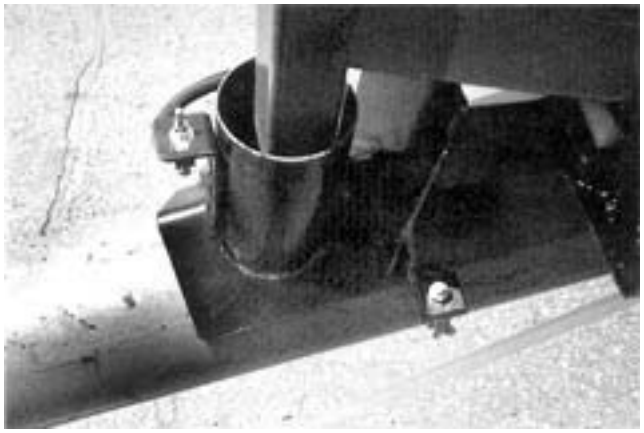


FIGURE 2. Port in Auger Tube.

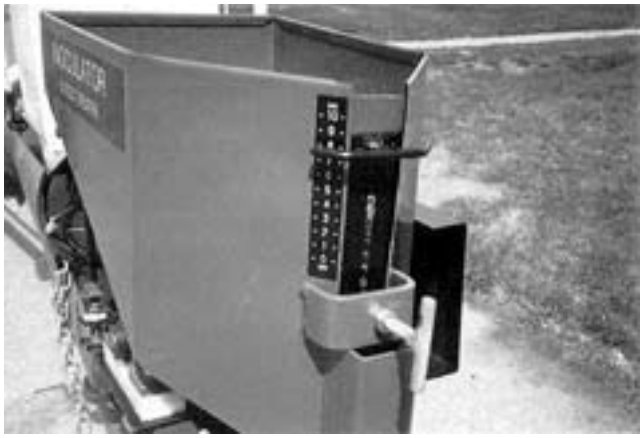


FIGURE 3. Indexed Slide Gate.

Some inoculants seemed to resist flow in the hopper, even at large gate settings. These were usually peat based "self stick" products that were unusually damp or were being used in humid conditions, such as at night. In these conditions, the inoculant tended to "pack" in the hopper rather than flow out the gate, which caused inconsistent metering if ignored. Operators had to manually loosen the inoculant and move it to the gate to achieve satisfactory flow. In these conditions, a relatively large amount of inoculant remained in the hopper after flow had stopped (FIGURE 4). The manufacturer suggested that the hopper could be made to empty more completely if it was sprayed with a non-stick coating, such as a domestic cooking spray, before filling.

With some other inoculants, vibration from the auger alone could cause product to flow through the gate, even if the vibrating hopper was switched off. This meant that the slide gate had to be closed, then reset to the previous position when starting again.

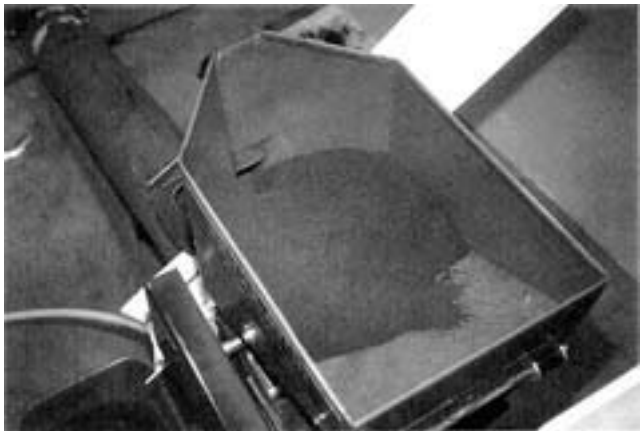


FIGURE 4. Sticking Inoculant in Hopper.

PAMI found that non-self-stick inoculants were usually easier to properly meter. It is recommended that the manufacturer consider developing a more positive inoculant metering mechanism that is less sensitive to variation in inoculant flow properties. Most operators determined appropriate settings for grain flow, auger speed, and inoculant metering rate by trial and error, then made as few further adjustments as possible. PAMI suggests that a manual flow calibration should be performed each time inoculants or inoculant metering rates are changed.

Depending on the inoculant and seed being used, metering rates up to 21 lb/min (9.5 kg/min) were possible, which corresponded to grain flow rates up to 75 bu/min (2 t/min). In normal use, rates of 20 bu/min (0.6 t/min) were more typical and appropriate inoculant metering rates were achievable. Inoculant metering rate was affected considerably by variations in product level in the hopper, but small variations in oscillation frequency as caused by changes in the supply voltage or operation of the liquid metering system had little effect for most products.

As with liquid products, application of inoculant was usually very uniform by the time the seed was discharged from the auger (FIGURE 5). Some "self stick" products actually adhered very poorly to the seed, but introduction of water to the grain using the inoculator's liquid metering system produced satisfactory results. Even with "conventional" inoculants that required a sticking agent, careful adjustment of sticking agent application rate was usually necessary to optimize application uniformity.

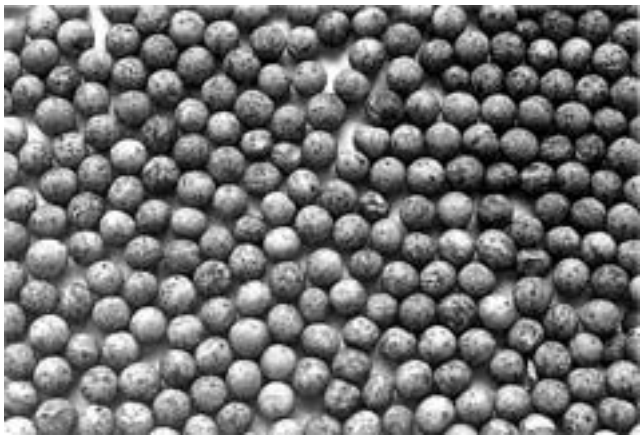


FIGURE 5. Uniform Inoculant Application.

In general, patience and persistence were required to achieve consistent and reliable inoculant metering, but experienced operators could produce excellent results with relatively little effort compared to the more manual inoculating methods.

EASE OF INSTALLATION

Ease of installation was good.

The Norton Inoculator and Seed Treater could be installed on

most 6 to 8 in (150 to 200 mm) diameter augers, and took two men approximately one hour to install. Two holes had to be cut in the auger tube using an electric drill and an acetylene torch or plasma cutter. The Inoculator was positioned a short distance from the lower end of the auger and secured to the top of the auger tube with two flexible clamps. The liquid hose was routed to a fitting installed at the auger inlet (FIGURE 6). Levelling adjustments were provided on the Inoculator for both reservoirs, which permitted installation and proper operation on augers of different lengths. Although a large levelling adjustment was provided, PAMI found that the achievable range of auger angles was in fact very narrow. The liquid reservoir adjustment stopped at lower angles, while the hopper contacted the recirculation hose at higher angles (FIGURE 7). The fluid line was restricted when installed under the clamps as per the manufacturer's directions (FIGURE 8), and the hoses were therefore rerouted.

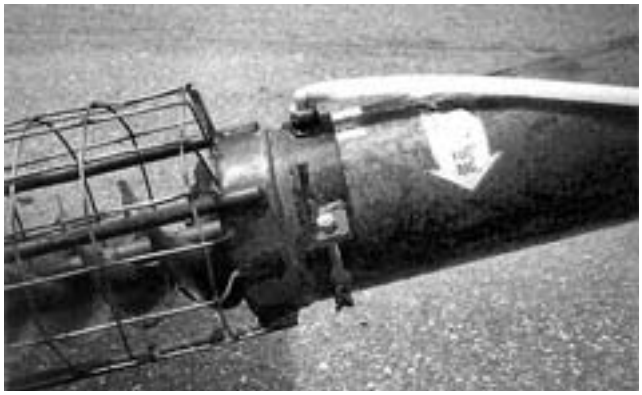


FIGURE 6. Liquid Outlet into Grain Stream.

FIGURE 7. Interference Between Hopper and Return Line when Adjusting for Steep Auger Angles.

FIGURE 8. Restricted liquid line when Fastened Behind Clamps.

Once installed, the Inoculator was easily removed and reinstalled if desired, which took 1 man about 15 minutes. A piece of steel flashing and two large hose clamps were supplied to cover the port in the auger tube if the auger was to be operated with the Inoculator removed.

Power was supplied to the Inoculator through an electric cable. Mini-alligator clips at the end of the cable permitted operation from any conventional 12 volt battery (FIGURE 9). The cable was long enough to reach the auger motor's own battery, or the battery of a nearby farm vehicle.

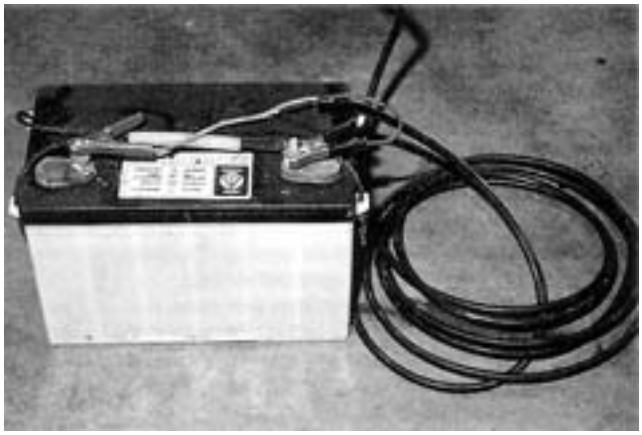


FIGURE 9. 12 Volt Power Hook-up.

EASE OF OPERATION AND ADJUSTMENT

Filling: Ease of filling was very good.

When the Inoculator was installed according to the manufacturer's instructions, the reservoirs were positioned approximately 4 to 5 ft (1.2 to 1.5 m) above the ground level. The reservoirs were easily accessed for filling and could be refilled while the unit was operating. The inoculant hopper held about 0.43 ft^3 (12.9 L) of inoculant. Depending on the application rate, the grain being inoculated, and the inoculant being used, this was sufficient to inoculate from approximately 20 to 130 bu (0.6 to 3.5 t) of seed. The liquid reservoir held 3.1 gal (14 L), which was usually adequate for several inoculant refills.

If the liquid reservoir was pumped empty and refilled, the pump had to be reprimed by loosening the coupler on the pump supply line. This was not difficult to do, but was generally messy and bothersome, as some liquid had to be spilled to establish pump flow. This procedure could be avoided if the tank was refilled before it was actually pumped empty. It may be especially undesirable to perform this procedure frequently if toxic seed treatments are being used. It is recommended that the manufacturer consider modifications to permit easier pump priming.

Controls: The controls were good.

All controls were conveniently located. Two electric switches activated the vibrating mechanism for the inoculant hopper and the electric pump for the liquid metering system. Adjustment of the hopper slide gate required no tools, and settings for the slide gate were clearly indicated on a graduated scale. Adjustment of liquid flow rate was achieved with a gate valve, and reasonably precise settings could be made. Opening a ball valve returned some liquid to the reservoir for mixing or stirring of solutions.

Although none of the controls were specifically labelled or otherwise identified, the functions of most were self evident.

Setting Rates: Ease of setting rates was good.

Although the operator's manual provided simple charts for most inoculants and the metering systems were easily adjusted, obtaining precise inoculant application rates was often a complicated process. This is because in order to set liquid and inoculant rates, the operator must first know or be able to preset a particular grain flow rate, and in practice this can be difficult.

A further complication to setting rates was the inconsistency in flow and metering properties among different inoculants. Some inoculants flowed very easily, so that even when the gate was completely closed, some product still passed into the auger, and very small changes in gate position caused quite large changes in flow rates. Other inoculants, especially the "self-stick" types, tended to be very moist and prone to bridging, which made consistent metering difficult. These products required very large gate settings to achieve moderate metering rates, and relatively large gate adjustments resulted in small changes in metering rate. All inoculants tended to dry out somewhat when exposed to air, and this often had a marked

effect on the flow properties of the inoculant.

The manufacturer recommended screening of inoculant to break up lumps and ensure consistent metering, but a suitable screen was not provided. In practice, PAMI found that screening was impractical when inoculating large quantities of seed and operating the unit continuously, because product was metered out of the hopper quicker than it could be refilled through the screen. Although screening did improve metering characteristics somewhat, most operators were able to achieve almost equal results by simply breaking large lumps by hand and periodically stirring the inoculant as it was metered. In general, after one or two trials, most operators could achieve very accurate rates after making some adjustments.

Setting liquid flow was easy if there was a calibration chart in the manual for the liquid to be metered. When using the recirculation valve, a significant reduction in flow occurred. In some cases, the valve had to be partially or completely closed to obtain adequate liquid flow rates.

Compared to traditional manual methods of inoculation, the Norton Inoculator greatly improved the speed and consistency of inoculation, but these benefits only became apparent after several batches of seed were inoculated. A farmer who only seeded 100 to 150 bu (2.7 to 4.0 t) of seed, for instance, may be equally successful inoculating manually.

Cleaning: Ease of cleaning was very good.

The inoculant hopper usually emptied itself completely, requiring no special cleaning procedures. If small amounts of inoculant remained in the hopper, as happened with certain products, they were easily brushed to the hopper outlet by hand. Because inoculant products contain live bacteria, they should be used immediately after the package is opened. Attempting to recover unused inoculant from the hopper for later use would probably be pointless. Therefore, if a significant amount of leftover inoculant remains in the hopper, it should simply be emptied into the auger or otherwise discarded.

The liquid reservoir was cleaned by removing one of the hoses and pumping as much of the contents as possible into a spare container, then disconnecting the outlet and return lines and removing the reservoir from the Inoculator. If the reservoir was not pumped out first, liquid would flow from the outlet as soon as it was uncoupled. A small amount of liquid always remained in the reservoir after pumping, so removal of the reservoir was necessary for complete cleaning. The cam-lock couplers and snap retainers made reservoir removal easy. The pump and valves were easily flushed using water or an appropriate solvent, depending on the liquid that was in the system. If solvents are used to flush the system, it is important that the solvent be carefully chosen to ensure proper flushing of chemicals and to prevent possible damage to the plastic components. The manufacturer recommended varsol as a flushing solvent, and this appeared to be suitable. The pump and plumbing components appeared to be compatible with all agricultural products likely to be used.

The exterior of the Inoculator could be cleaned with cold water.

Transporting: Ease of transporting was good.

Care was required to avoid rough roads or excessive speeds when towing an auger with the Norton Inoculator attached. The weight of the unit on the auger tube is believed to have caused a broken weld on the frame of the auger PAMI used for the test. The Inoculator did not otherwise interfere with normal hitching or towing of the auger. Moving the auger by hand was made considerably more difficult as most of the inoculator's weight, 96 lb (44 kg), was applied to the hitch or intake end of the auger.

Maintenance: Ease of maintenance was good.

Routine servicing consisted of 4 grease zerks for the shaker shaft bearings that required seasonal lubrication. The tension of the shaker drive belt was adjusted by moving the position of the electric motor, which required tools to remove the shield and loosen the motor mounting bolts.

If the Inoculator may be subjected to freezing temperatures, it is important to drain all water from the system. A drain plug on the pump housing permitted draining of the pump itself, but access to the plug was inconvenient. The manufacturer recommends covering the unit when not in use to prevent deterioration and weathering of some components, and to store it inside during winter.

POWER REQUIRMENTS

The Inoculator is intended to use a 12 volt DC power source, such as an automotive charging system. During the test, the unit was operated from the battery of the electric start auger motor as well as from the battery of a farm vehicle. With both motors operating, current of 18 to 20 amps was required, although this varied with the voltage available at the battery. Variations in battery voltage could affect the metering rates of inoculant and liquid. This made it important that the power source be continually recharged, as when the engine of the vehicle is running, rather than using a separate battery with no charging system. When using an auger motor as the power source, users should check the charging capacity of the alternator, as some will only supply 15 amps or less. This would be insufficient for prolonged operation of the inoculator.

OPERATOR SAFETY

No safety hazards on the Norton Inoculator were apparent. However, normal safety precautions were required and warnings had to be heeded.

The operator's manual emphasized safety, but safety precautions were not adequately identified with special type or the standard safety alert symbol. The test unit had a warning decal on the belt shield cautioning against operation with the shield removed. All moving parts were well shielded.

While the safety features were adequate, PAMI still emphasizes the importance of conscientious maintenance and operating practices to prevent accident or injury. If the operator must make adjustments or work in dangerous areas, it is important that all associated mechanisms be shut off. Extra caution is required when working around the inlet of a grain auger.

A piece of steel flashing and two clamps were supplied to cover the port in the auger tube when the inoculator was removed. Use of this safety device is crucial and should not be neglected.

OPERATOR'S MANUAL

The operator's manual was good.

It was reasonably well organized and most information was clearly written and well illustrated. Although no index was provided, the relatively short length of the manual and the table of contents allowed most information to be easily located.

The safety section of the manual described the "standard safety symbol", which is usually used to emphasize safety information, but the symbol was not used in any other place in the manual or on the machine. It is recommended that the manufacturer consider revising the operator's manual to place greater emphasis on the safety information.

The metering graphs provided for setting liquid and inoculant rates were easily interpreted and corresponded well to PAMI's measurements. Examples were provided for performing manual calibrations for products that weren't covered in the graphs or for verifying the suggested settings.

The operator's manual provided useful information on safety, installation, operation, maintenance and specifications. No trouble shooting section was provided.

MECHANICAL HISTORY

The intent of the tests was the evaluation of functional performance. Extended durability testing was not conducted. However, TABLE 1 outlines the mechanical history of the Norton Inoculator for the 10 hours of operation during which about 7500 bu (205 t) of field peas and lentils were inoculated.

Table 1. Mechanical History

Item	Hours	Equivalent Seed
-The switch for the electrical pump broke and was replaced at	The beginning of the test.	
-The rives holding the pump to the frame broke from vibration. The motor was clamped to the frame with a large hose clamp at	The beginning of the test.	
-One of the nylon bushings in the inoculant hopper shock absorbers came loose and was replaced at	0.5	160 bu (4.4 t)
-The switch for the shaker motor broke and was replaced at	1.0	280 bu (7.4 t)

APPENDIX I
SPECIFICATIONS

MAKE:	Norton	
MODEL:	Inoculator and Seed Treater	
DIMENSIONS: (approximate)	**Shipping**	**Installed**
-- length	48 in (122 cm)	32 in (81 cm)
-- width	22 in (56 cm)	14 in (36 cm)
-- height	26 in (66 cm)	33 in (84 cm)
WEIGHT:	96 lb (43.6 kg)	
DRY RESERVOIR:		
-- material	formed sheet metal	
-- capacity	0.43 ft³ (12.9 L)	
WET RESERVOIR:		
-- material	molded polythylene	
-- capacity	3 gal (14 L)	
DRY METERING SYSTEM:		
-- type	vibratory, variable slide gate adjustment	
-- drive	electric	
-- indicator	indexed positions on slide gate	
WET METERING SYSTEM:		
-- type	pump outlet to common 0.5 in (12 mm) gate valve	
-- drive	electric	
-- indicator	Hedland Model 61 3002 in line flow meter	
-- hose material	polyethylene	
NUMBER OF LUBRICATION POINTS:	4	
NUMBER OF V-BELTS:	1	

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Fair
Very Good	Poor
Good	Unsatisfactory

SUMMARY CHART

NORTON INCOULATOR AND SEED TREATER

RETAIL PRICE	$1,995.00 (December, 1990, f.o.b. Humboldt, Saskatchewan)
QUALITY OF WORK	
-Liquid Metering System	**Very good;** easy monitoring and control of rates, adequate range
-Dry Metering System	**Fair;** meter sensitive to variations in properties of inoculants, very uniform results possible after proper settings obtained
EASE OF INSTALLATION	**Good;** took two men 1 hour to install, some tools required.
EASE OF OPERATION AND ADJUSTMENT	
-filling	**Very good;** reservoirs easily accessed, could be filled while operating.
-controls	**Good;** conveniently located and easily used
-setting rates	**Good;** meters easily adjusted, but trial and error required to achieve precise rates
-cleaning	**Very good;** all components easily cleaned
-transportation	**Good;** weight made moving auger by hand difficult
-maintenance	**Good;** seasonal lubrication and service required
POWER REQUIREMENTS	12 volts DC, 18 to 20 amps
OPERATOR SAFETY	Normal safety precautions required
OPERATOR'S MANUAL	**Good;** most information easily found
MECHANICAL HISTORY	a few minor problems occurred

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