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Evaluation Report 37

Versatile Model 480 Field Sprayer

A Co-operative Program Between

ALBERTA FARM MACHINERY RESEARCH CENTRE

PAMI PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

Versatile Model 480 Field Sprayer

Manufacturer:
Versatile Manufacturing Limited
1260 Clarence Avenue
Winnipeg, Manitoba
R3T 1T3

Versatile Manufacturing Ltd., Parts Department
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No. 3 - 410 Duchess St., Saskatoon S7K 0R1
6730 - 64 Ave., Red Deer T4P 1K4

Retail Price:
$2,213.00 (April, 1977 f.o.b. Lethbridge, Alberta)

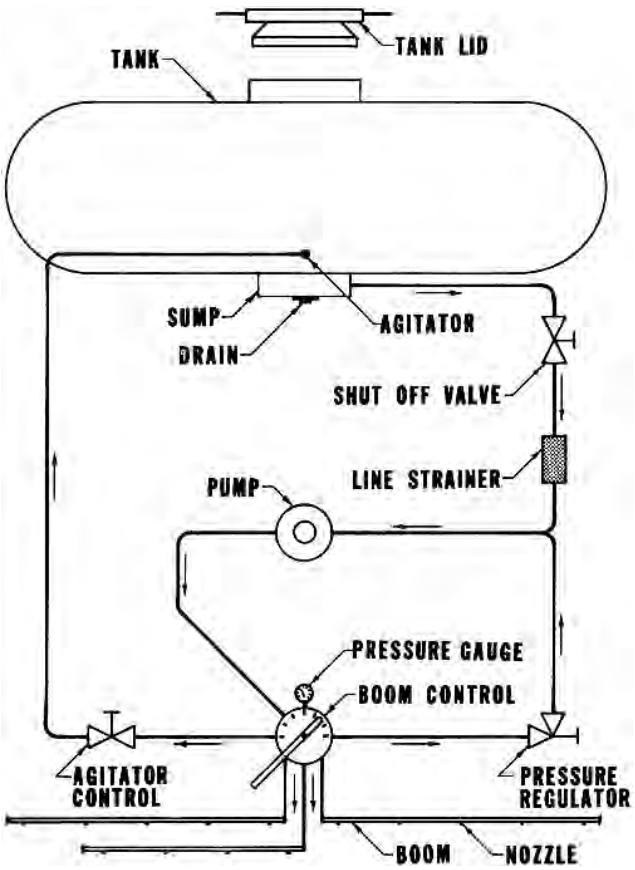

Figure 1. Flow Diagram for Versatile Model 480.

Summary and Conclusions:

Functional performance of the Versatile model 480 field sprayer was very good. An extended durability test was not conducted. Durability of the Versatile 480 during functional evaluation was fair.

The Versatile 480 performed satisfactorily at speeds up to 12 km/h (7.5 mph) resulting in a field capacity of 26 ha/h (64 ac/h). The tandem boom castor wheel assemblies performed well, especially on rough fields, however, excessive whip occurred at the unsupported boom ends.

Nozzle distribution patterns were very uniform at pressures greater than 205 kPa (30 psi) with the 80° stainless steel nozzle tips supplied as standard equipment. Nozzle tip wear was negligible. Nozzle check valves occasionally stuck open allowing some nozzles to drip when the boom control valve was closed.

Pump capacity was adequate to agitate and apply most commonly used chemicals. Pressure losses through the plumbing system were minimal. Filtering was adequate and strainer plugging was infrequent.

Controls were convenient and easy to operate from the tractor seat. Boom height was easily adjusted without the use of tools. Nozzle angle adjustment, folding into transport, hitching to a tractor and servicing were convenient. All lubrication points were accessible. The Versatile 480 was 3 860 mm (12.7 ft) wide in transport causing difficulty when going through narrow gates. The operator's manual clearly outlined sprayer operation and calibration.

Some mechanical problems occurred during the test: the tank straps and the outer boom upright assemblies both broke several times. The rocker axles also loosened causing tire and frame damage.

Recommendations

It is recommended that the manufacturer consider:

1. Modifications to reduce boom whip.
2. Modifications to eliminate braking of the outer boom uprights.
3. Supplying a high capacity 100 mesh strainer at the tank filler opening.
4. Providing a platform to facilitate safe and convenient addition of chemicals to the tank.
5. Modifications to reduce transport width.
6. Supplying a slow moving vehicle sign.
7. Modifications to eliminate tank strap breakage.
8. Modifications to eliminate loosening of the rocker axles during operation.
9. Supplying a torque arm to prevent the pump body from rotating with the power take-off.
10. Supplying a metric or dual calibrated pressure gauge, or suitable conversion charts to facilitate sprayer operation after conversion to the SI system.
11. Using consistent units in the operator's manual.

Chief Engineer: E.O. Nyborg
Senior Engineer: E.H. Wiens
Project Engineer: K.W. Drever

The Manufacturer States That:

With regard to recommendation number:

1. A bolt on boom truss has been designed for 1977 production and is also available for the 1976 model 480.
2. Boom uprights are now fabricated from formed channel. These are interchangeable with boom uprights on all 1976 models.
3. Incorporation of a tank filler opening strainer is being investigated.
4. Incorporation of a platform is being investigated.
5. A change in transport width is not being considered at this time.
6. Supplying a slow moving vehicle sign will be taken under consideration.
7. The tank strap thickness has been increased from 3.2 mm (118 in) to 4.8 mm (3/16 in).
8. The retaining pin hole in the rocker axle pivot has been sized to provide a tight .t for the roll pin.
9. The pump now has a torque arm and tie chain as standard equipment.
10. Availability of a dual calibrated pressure gauge is being investigated.
11. Operator's manuals have been changed to ensure consistent units throughout.

Manufacturer's Additional Comments:

1. The 1977 model 480 is available with two boom options: 16,760 mm (55 ft) and 20,730 mm (68 ft). The 1818 L (400 gal) tank and 9.5L tires are standard equipment on both.
2. Nozzle spacing has been changed to allow symmetrical spacing of both 508 mm (20 in) and 1016 mm (40 in) coverage nozzles.
3. Clamp on nozzles are now used in lieu of the screw-in type for easier assembly and better sealing.
4. The pump inlet has been increased to 32 mm (1-1/4 in) for reduced pump restriction.
5. A 32 mm (1-1/4 in) line strainer with improved bowl sealing and increased capacity has been incorporated.

6. An anti-rollover stop has been added to the boom walking beam and is also available for 1976 models.
7. An oil filled pressure gauge is now being used.
8. A liquid level decal with litres, U.S. and Imperial gallons is now being used.
9. A pump storage rack has been incorporated for transporting with a vehicle that has no power take off.
10. Screw-in grease fittings are now used throughout.

General Description

The Versatile model 480 is a trailing boom field sprayer. The trailer is mounted on tandem axles and each boom is supported by a tandem walking beam castor assembly. The low profile 1818 L (400 gal) galvanized steel tank is equipped with hydraulic agitation and a fluid level indicator.

The Versatile 480 has 42 nozzles spaced at 508 mm (20 in) giving a spraying width of 21,336 mm (70 ft). End nozzles are provided for spraying roadsides, fence rows and ditches. Nozzles are equipped with check valves to prevent spray drip when the booms are shut off. Boom height and spray angle are adjustable. The booms fold back for transport. Controls are mounted on an adjustable stand at the front of the trailer. The 540 rpm teflon roller pump is driven from the tractor power take-off.

Figure 1 shows the flow diagram for the Versatile 480 while complete specifications are given in Appendix I.

Scope of Test

The Versatile 480 was operated for 52 hours in the conditions shown in Table 1 while spraying about 985 ha (2 433 ac). It was evaluated for quality of work, distribution patterns, nozzle wear, pump capacity, ease of operation, operator safety and suitability of the operator's manual.

Table 1. Operating Conditions

Chemical Applied	Hours	Speed		Spraying Rate		Field Area	
		km/h	mph	ha/h	ac/h	ha	ac
2, 4-D	26	10	6.0	21	51	537	1326
Banvel-3	8	9	5.5	19	47	152	376
Carbyne	5	9	5.5	19	47	95	235
Atrazine	2	3	2.0	7	17	14	34
Water	11	8	5.0	17	42	187	462
TOTAL	52					985	2433

Results and Discussion

QUALITY OF WORK

Distribution Patterns: Figures 2 and 3 show the spray distribution pattern along the length of the boom when equipped with the 80° TeeJet 8002 stainless steel nozzles supplied with the sprayer and operated at 140 and 310 kPa (20 and 45 psi). The coefficient of variation[1] at 140 kPa (20 psi) was 24% with application rates along the boom varying from 44 to 114 L/ha (3.9 and 10.1 gal/ac) at a forward speed of 8 km/h (5 mph). High concentration of spray occurred directly below each nozzle with inadequate coverage between nozzles due to insufficient overlap. At a pressure of 275 kPa (40 psi) the distribution pattern improved considerably resulting in a coefficient of variation of 6% (Figure 3). Application rates along the boom varied from 91 to 121 L/ha (8.1 to 10.8 gal/ac) at a speed of 8 km/h (5 mph). The improved distribution pattern at higher pressure was the result of improved spray overlap between nozzles.

Figure 4 compares spray pattern uniformity at various boom pressures for the 80° TeeJet 8002 nozzles supplied with the sprayer and for nozzles of the same capacity but with a spray angle of 65° (Tee Jet 6502). Spray distribution for the 80° nozzles was acceptable at pressures above 185 kPa (27 psi) and was very uniform (CV below 10%) at pressures above 205 kPa (30 psi).

When equipped with 65° nozzles, spray distribution was acceptable at pressures above 205 kPa (30 psi) and very uniform at pressures above 240 kPa (35 psi). For a given pressure the 80° nozzles produced more uniform distribution than the 65° nozzles.

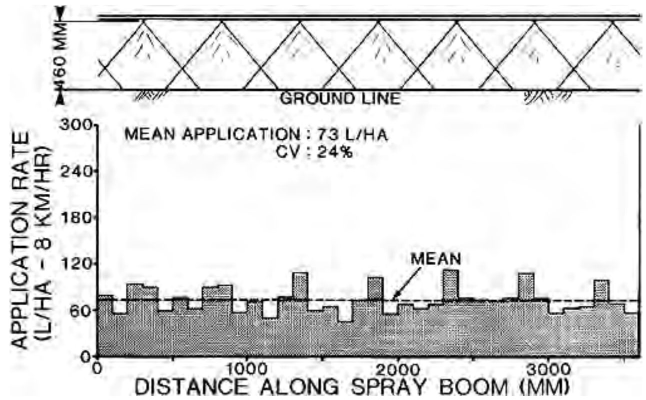

Figure 2. Distribution Patterns for a Section of Boom at 140 kPa (20psi) with TeeJet 8002 (80°) Nozzles, 460 mm (18 in) above the Ground.

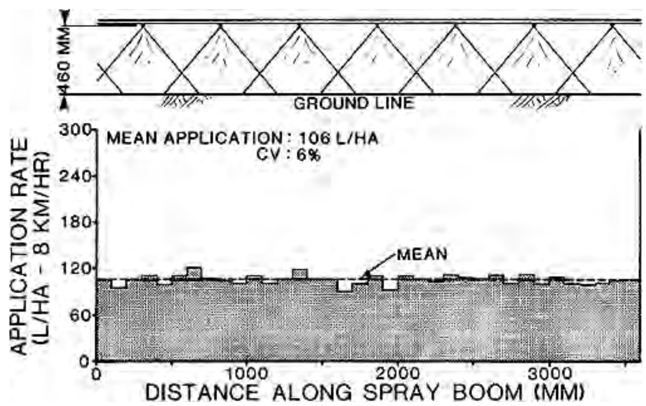

Figure 3. Distribution Patterns for a Section of Boom at 275 kPa (40 psi) with TeeJet 8002 (80°) Nozzles, 460 mm (18 in) above the Ground.

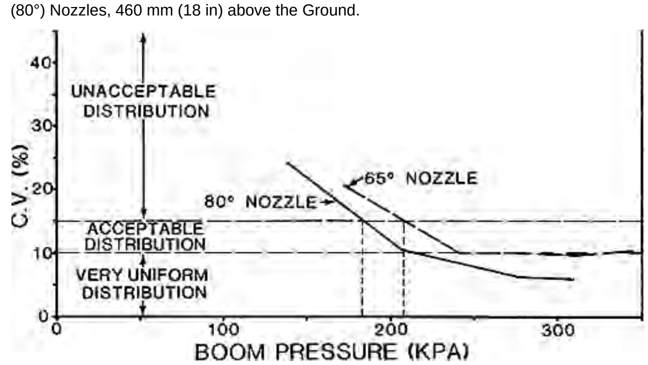

Figure 4. Spray Pattern Quality at Various Boom Pressures with 80° and 65° Nozzles.

Spray Drift: To obtain acceptable spray distribution the Versatile 480 had to be operated at pressures above 185 kPa (27 psi). Work by the Saskatchewan Research Council[1] indicates that drift at the edge of the spray pattern is about 1% of the amount sprayed when using TeeJet 8002 nozzles at a pressure of 205 kPa (30 psi). These nozzles apply about 90 L/ha (8.0 gal/ac) at this pressure. Drift from sprayers using lower capacity 650 nozzles is about 3% of the amount sprayed at 170 kPa (25 psi) and 6% at 275 kPa (40 psi)[3]. The nozzles supplied with the Versatile 480 were effective in reducing drift due to lower recommended boom height and larger spray droplet size.

Nozzle Calibration and Wear: Figure 5 compares the delivery rates of the stainless steel TeeJet 8002 nozzles when new and after

[1]The coefficient of variation (CV) is a measure of distribution pattern uniformity. The lower the CV, the more uniform is the spray coverage. Some researchers claim that a CV below 10% indicates very uniform coverage while a CV above 15% indicates inadequate uniformity of coverage for chemicals having a narrow range of application rates. The CV 's shown in this report were determined in stationary laboratory trials. Field trails have shown that a CV in actual field conditions may be up to 10% higher than that obtained in stationary tests due to boom vibration and wind effects. Manufacturer recommendations for different chemicals vary as to the acceptable range of application rates. For example, 2,4-D solutions have a fairly wide range of acceptable rates (±14%) while chemicals such as Buctril M have a very narrow acceptable range.

[2]Maybank, J., Yoshida, K., Shewchuk, S.R., "Comparison of Swath Deposit and Drift Characteristics of Ground-Rig and Aircraft Herbicide Spray Systems (Report of the 1975 Field Trials)", Saskatchewan Research Council Report No. P76-1, January, 1976, p. 16.

[3]Maybank, J., Yoshida, K., "Droplet Deposition and Drift from Herbicide Sprays - Analysis of the 1973 Ground-Rig Trials", Saskatchewan Research Council Report No. P73-16, December, 1973. p. 65.

52 hours of operation. Delivery from the nozzles increased by only 0.6% after 52 hours. Some researchers indicate that a nozzle needs replacement once discharge has increased by more than 10%.

Figure 5 also shows the variability in delivery rate among individual nozzles. The shaded areas represent the range over which the deliveries from 10 nozzles varied when new and after field tests. A narrow range indicates that nozzle discharges are very similar while a wider range indicates a higher variability among individual nozzle deliveries. Variability among individual nozzle deliveries on the Versatile 480 was low. The coefficient of variation of the nozzle deliveries was 2.4% when new and increased to 4.4% after the field tests.

The delivery from new nozzles was 7.7% lower than the manufacturer's rated capacity. This was due to the nozzle check valves, which caused a 35 kPa (5 psi) pressure drop from the boom to the nozzles.

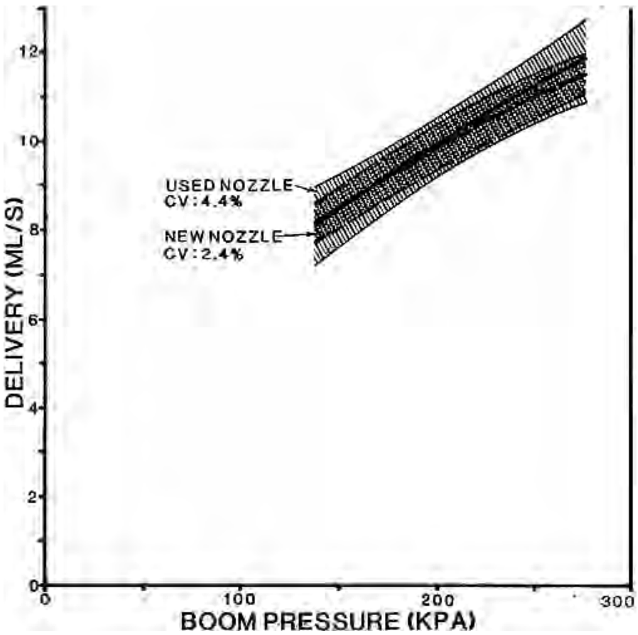

Figure 5. Delivery Rates of TeeJet 8002 Nozzles - New and Used 52 Hours.

Use of End Nozzles: Figure 6 illustrates a typical distribution pattern using boom end nozzles. The distribution pattern was unacceptable due to improper overlap between the end nozzles and the rest of the boom nozzles. Application rates varying from 4 to 106 L/ha (0.4 to 9.4 gal/ac) were obtained when using the end nozzle. Increased spray drift could be expected because the end nozzles directed spray out from the boom where wind would have a greater effect. End nozzles should be restricted to use along roadsides, ditches and fence lines, as specified in the operator's manual. They should only be used on calm days since the drift hazard is high.

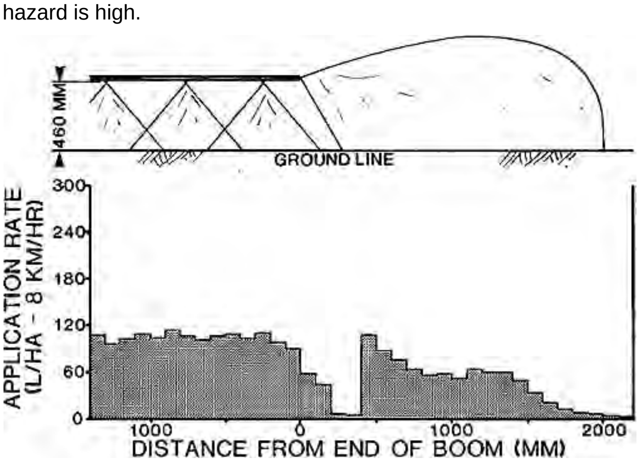

Figure 6. Distribution Pattern at the End of the Boom at 275 kPa (40 psi) using End Nozzles, 460 mm (18 in) above the Ground.

Use of Optional Nozzles: The Versatile 480 was equipped with standard TeeJet nozzle body assemblies (Figure 7) so a wide range of nozzle tips could be used on the sprayer. Nozzle height and angle was adjustable allowing flat fan, flooding or cone type nozzles to be used.

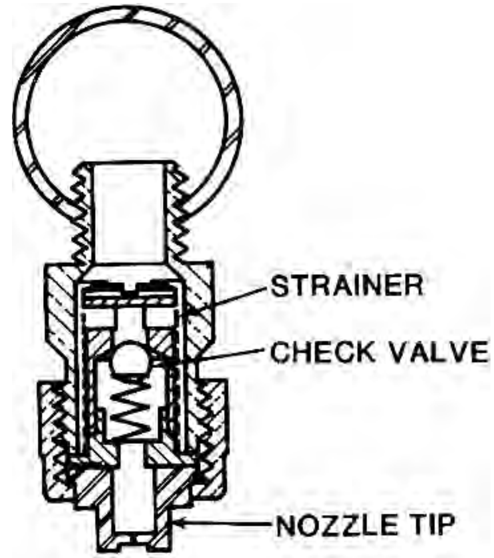

Figure 7. Cross Section of Nozzle.

Booms: The Versatile 480 was driven over a series of standard obstacles to determine boom stability. The obstacles were semi-circular in cross section with lifts of 40, 65 and 105 mm (1.6, 2.6 and 4.1 in). The boom castor wheels were driven over the obstacles at speeds of 6, 9 and 12 km/h (3.7, 5.6 and 7.5 mph). Horizontal boom movement in the direction of travel and vertical movement were measured at the boom end and midway between the castor wheels and trailer.

Figure 8 shows vertical boom movement (bounce) when the castor wheels were driven over the obstacles at 9 km/h (5.6 mph). The maximum movement at the end of the boom was a lift of 190 mm (7.5 in) and a drop of 100 mm (3.9 in). This resulted in a variation in boom height above the ground from 650 mm (25.5 in) to 360 mm (14.1 in) compared to the correct boom height of 460 mm (18 in). Figure 9 compares nozzle overlap at these three boom heights.

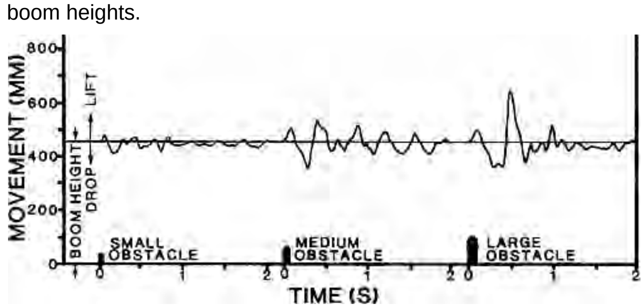

Figure 8. Vertical Boom Movement at Boom End (lift and drop) when the Boom Castor Wheels are Driven over Different Obstacles at a Forward Speed of 9 km/h (5.6 mph).

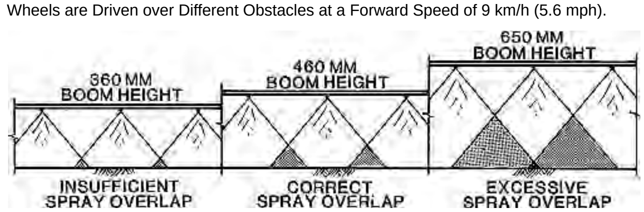

Figure 9. The Effect of Boom Lift and Drop on Spray Overlap.

The lift and drop at the centre of the boom was about half that at the boom end. Operation at 6 km/h (3.7 mph) over the obstacles caused vertical boom movements very similar to that at 9 km/h (5.6 mph). Driving over the obstacles at 12 km/h (7.5 mph) caused vertical boom movements about 1.5 times greater than that at 9 km/h (5.6 mph).

Driving over an obstacle with the boom wheels also caused the forward speed of the boom to vary in relation to the tractor speed, since the boom initially deflects rearward and then springs forward.

Figure 10 shows the forward speed of the boom end relative to the ground when the boom wheels were driven over the standard obstacles. Boom forward speed is important since the application rate is inversely proportional to speed (doubling the forward speed cuts the application rate in half). Assuming that the nozzle spray follows boom movement, the traces of speed in Figure 10 illustrate the variation in application rates. High application rates occur at low speeds and low application rates occur at high speeds. Extremely high variations in application rate can result for short periods of time due to horizontal boom movement. For example, at a forward speed of 9 km/h (5.6 mph) driving over the 65 mm (2.6 in) obstacle caused boom speed to vary from 13 to 0.5 km/h (8.1 to 0.3 mph). Respective application rates could vary from 65 to 1750 L/ha (5.8 to 156 gal/ac). This variation occurred in only 0.08second during which time the sprayer travelled 200 mm (7.9 in). Speed changes due to horizontal vibration were very similar on the Versatile 480 at operating speeds of 5 and 9 km/h (3.7 to 5.6 mph). At 12 km/h (7.5 mph) speed changes were about twice as large.

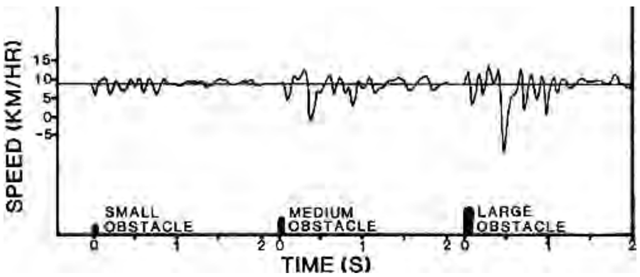

Figure 10. Variation in Boom End Speed when the Boom Castor Wheels are Driven over Different Obstacles at an Average Forward Speed of 9 km/h (5.6 mph).

The data presented in Figure 10 are based on the assumption that the nozzle spray output follows boom movement over very short periods of time (0.1 second). The extreme variations in application rate suggested due to boom movement indicate that more research is required on boom stability and its effect on nozzle discharge and spray distribution.

Measurement of boom stability and field observations indicated that boom whip was excessive along its entire length. More severe boom movement occurred at the unsupported boom ends (Figure 11).

The walking beam castor assembly was effective in reducing vertical boom movement. Boom operation was satisfactory on rolling terrain and across gullies.

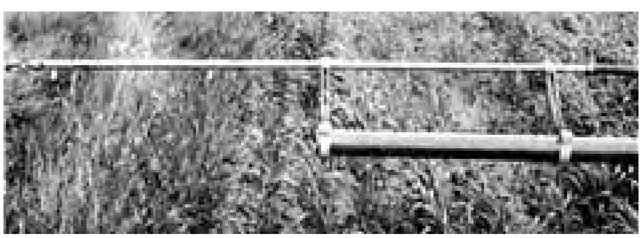

Figure 11. Unsupported Boom Ends.

Castor Stability: The castor wheel assemblies operated satisfactorily in all field conditions. The walking beam castor assembly was effective in improving operation when crossing gullies or in rough fields.

Pressure Losses in Plumbing System: Pressures in the plumbing system were measured at the pump outlet, boom control, boom inlet and boom end. The pressure drop throughout the system was negligible indicating that hose and fitting sizes were adequate. The non-drip nozzle check valves (Figure 7) caused a pressure drop of 35 kPa (5 psi) at the entrance to each nozzle. This pressure drop could affect calibration and nozzle spray patterns. Control valve pressure must be set 35 kPa (5 psi) higher than the desired application pressure to compensate for this pressure drop.

Pressure Gauge: The pressure gauge was accurate in the normal operating range at the beginning of the test. At the end of the test the pressure gauge read 7 kPa (1 psi) high. This was considered negligible.

The pressure gauge was calibrated only in psi. Due to the present changeover to the SI (metric) system, a pressure gauge calibrated in both psi and kPa, or suitable conversion tables, should be supplied with the sprayer.

Tank Strainer: No strainer was provided at the tank filler opening. A fine (100 mesh) high capacity strainer would be desirable to remove foreign particles before they enter the sprayer tank.

Line Strainer: The 50 mesh screen located in the line strainer adequately removed most particles that could damage the pump. Water containing impurities like sand, which could pass through the 50 mesh screen, could cause pump damage. The plastic strainer bowl was conveniently removed for cloning without tools.

Nozzle Strainers: The 50 mesh nozzle strainers prevented nozzle plugging. The check valves located in the nozzle strainers usually stopped boom drip after the boom control was shut off. Occasionally, some check valves stuck open and required tapping to properly seat them.

Soil Compaction and Crop Damage: The trailer and boom wheels travelled over about 2% of the total field area sprayed. The wheel tread of the trailer was 1640 mm (5.4 ft) and matched the wheel tread on most tractors used for spraying. The only crop damage, in addition to that caused by the tractor wheels, was that caused by the castor wheels. This was only 0.6% of the total area sprayed. The soil contact pressure beneath the castor wheels was about half that of an unloaded pickup truck. The average soil contact pressure under the sprayer wheels with a full tank are given in Table 2.

Table 2. Soil Compaction by Sprayer Wheels

	Average Soil Contact Pressure[3] With Tank Full		Tire Track Width	
	kPa	psi	mm	in
Trailer Wheels	215	31	150	5.9
Front Castor Wheels	105	15	65	2.6
Rear Castor Wheels	97	14	48	1.9

[3]For comparative purposes an unloaded pickup truck has an approximate soil pressure of 207 kPa (30 psi).

PUMP CAPACITY

Agitation Capability: The pump, when new, had a delivery rate of 1.2 L/s (15.8 gal/min) at 276 kPa (40 psi) and 540 rpm (Figure 12). This was adequate to apply 156 L/ha (13.9 gal/ac) of emulsifiable concentrates or 61 L/ha (5.4 gal/ac) of wettable powders at 8 km/h (5 mph) and provide sufficient agitation to keep the solution in the tank properly mixed. Normally recommended agitation rates for emulsifiable concentrates such as 2,4-D are 0.03 L/s per 100 L of tank capacity (1.5 gal/min per 100 gal of tank capacity). For wettable powders such as Atrazine and Sevin, recommended agitation rates are 0.05 L/s per 100 L of tank capacity (3.0 gal/min per 100 gal of tank capacity).

If a pump wear allowance of 20% is assumed, a worn pump could apply and agitate 113 L/ha (10.1 gal/ac) of emulsifiable concentrates or 19 L/ha (1.7 gal/ac) of wettable powders. The pump was adequate for most chemicals when new, but was inadequate for wettable powders, when worn.

Operation at Reduced Speed: Figure 12 also shows that reducing pump speed from 540 to 400 rpm resulted in a 37% decrease in pump output. Reduction of pump speed could occur when reducing the tractor speed for corners or when operating at reduced engine speed to obtain a correct ground speed to suit nozzle calibration.

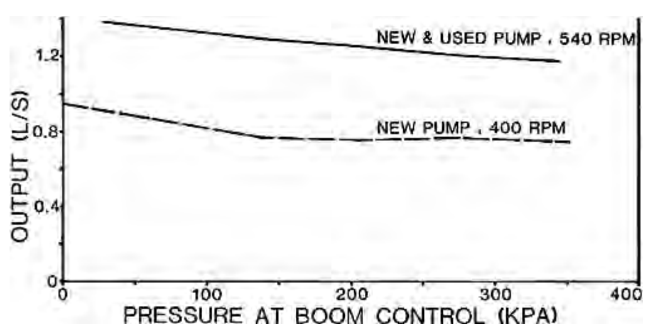

Figure 12. Pump Curves.

Pump Wear: Pump output was the same throughout the test, indicating that there was negligible pump wear.

EASE OF OPERATION

Controls: Application rate was controlled by adjusting ground speed and spraying pressure. Pressure was easily regulated by adjusting the pressure regulating valve or the gate valve controlling agitation flow or a combination of both (Figure 13). Chemical flow to the boom was conveniently controlled with one lever. The adjustable control support provided convenient positioning of the controls so that they could be reached from the tractor seat.

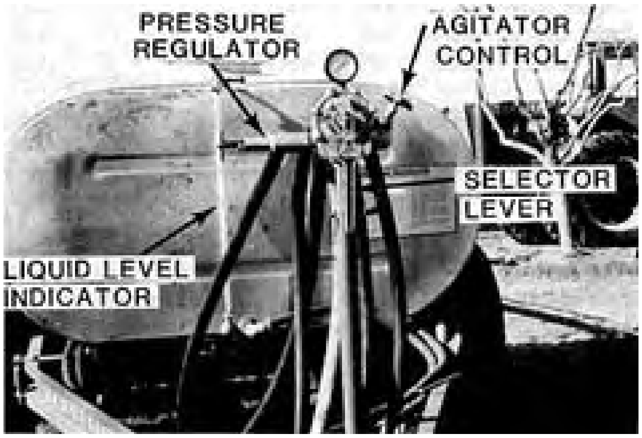

Figure 13. Controls.

The tank liquid level indicator was easy to read if the solution in the tank was opaque. With clear solutions such as Banvel, the fluid level in the tube was difficult to read. The gauge was only a rough indicator of fluid remaining in the tank since operation on hills and movement of the liquid in the tank caused the fluid level in the tube to fluctuate.

Transport: The Versatile 480 sprayer could be folded into transport or unfolded into field position by one man in four minutes without tools.

The Versatile 480 had a turning radius of 7350 mm (24 ft) in transport. The tendency for the inside boom to cut a corner short (Figure 14) combined with a transport width of 3 860 mm (12.7 ft) caused some difficulty in going through gates.

The sprayer towed well at speeds up to 40 km/h (25 mph). Backing the sprayer in transport position was difficult.

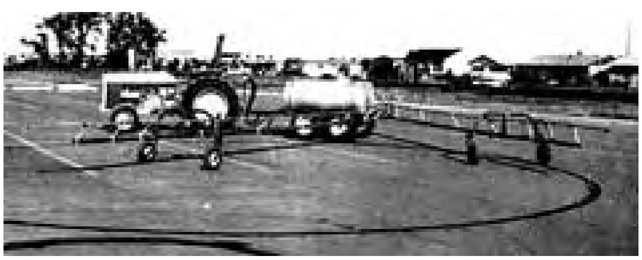

Figure 14. Boom Cutting the Corner Short.

Tank Filling: The low profile tank was easily filled by gravity from a nurse tank on a farm truck. The 365 mm (14.4 in) opening was adequate for adding chemicals and water. The tank filler opening location near the rear of the tank made filling from a truck convenient. If a truck was not used, lifting the chemical up to the tank was awkward since there was no place to stand except on the tires. A step or a platform should be provided to prevent the possibility of spillage or slipping while handling toxic chemicals.

Nozzle Adjustment: Nozzle height could be adjusted without the use of tools. However, when the levelling handle was pulled out to allow height to be adjusted, the levelling bar dropped down causing misalignment of the holes and the handle (Figure 15). This was awkward since the operator had to hold the boom in position, pull the handle out and align the holes simultaneously. Modifications so that the levelling bar holes were aligned when the levelling bar rested on the frame would simplify boom height adjustment. Nozzle angle was conveniently changed by loosening three bolts and rotating the boom.

Nozzle Cleaning: The nozzles were easily removed for cleaning with wrenches.

Figure 15. Boom Height Adjustment Mechanism.

Hitching: The sprayer could be hitched to a tractor when the tank was empty without the use of a jack. A jack was required when the tank was full. The quick disconnect coupling used to attach the sprayer pump to the power takeoff shaft was convenient.

Pump: A torque arm was not provided to prevent rotation of the pump body on the power take-off shaft. Some means of stabilizing the pump body is required.

Servicing and Cleaning: Lubricating the sprayer was easy since all fittings were accessible. The tank could be flushed and drained by removing the drain plug located at the bottom of the sump.

OPERATOR SAFETY

Transport: Since the width of the sprayer in transport position was 3860 mm (12.7 ft), caution had to be exercised when transporting the sprayer on roads and highways.

The sprayer was not equipped with a slow moving vehicle sign. This item should be standard equipment to comply with safety regulations.

Caution: Operators of all spraying equipment are cautioned to wear suitable eye protection, respirators and clothing to minimize operator contact with chemicals. Although many commonly used agricultural chemicals appear to be relatively harmless to humans, they may be deadly. In addition, little is known about the long term effects of human exposure to many commonly used chemicals. In some cases, the effects may be cumulative, causing harm after continued exposure over a number of years.

OPERATOR'S MANUAL

The operator's manual clearly outlined sprayer setup, operation, calibration, servicing requirements and parts. The section on nozzle tip selection discussed conversion factors for solutions that are heavier or lighter than water. This discussion was confusing and could be eliminated without detracting from the manual. This section also discussed calibration at nozzle spacings other than 508 mm (20 in). This was irrelevant since nozzle spacing on the Versatile 480 was not adjustable.

Some sections of the operator's manual were prepared in U.S. units and some in both U.S. and Imperial units. It is recommended that the operator's manual be prepared in consistent units throughout and that at least Imperial and SI (metric) units be used to be consistent with the change over to the SI system.

Durability Results

Table 3 outlines the mechanical history of the Versatile 480 sprayer during 52 hours of field operation while spraying about 985 ha (2433 ac). The intent of the test was evaluation of functional performance. The following failures represent only those, which occurred during the functional testing. An extended durability evaluation was not conducted. Consider each failure separately since some are not as serious as others.

Table 3. Mechanical History

Item	Hours	Hectares	Acres
Plumbing Assembly			
-a damaged pressure gauge was replaced at		beginning of test	
Mainframe			
-the left front tank strap broke and was welded at	6	114	281
-the left rear tank strap broke and was welded at	12, 36	227, 682	561, 1684
-the right rear tank strap broke and was welded at	14	265	655
-the roll pin on the left rocker axle assembly loosened, causing main frame and tire damage at	43	814	2012
-the roll pin on the right rocker axle assembly was missing at	end	985	2433
Boom Assembly			
-the grease fitting on the left rear castor pivot loosened and was repaired at		beginning of test	
-both right and left boom uprights at the extreme ends of the booms broke and were repaired		four times	
-the bolts holding the boom adjustment clamp and tube loosened, causing the boom pipe to slide back and forth in the boom clamp bushings at	17	322	795
-a complete nozzle assembly was lost and replaced at	39	739	1825
-the boom support tube was bent back slightly at	39	739	1825
-the left boom universal joint was bent at	40	758	1872

Discussion of Mechanical Problems

PLUMBING ASSEMBLY

Pressure Gauge: The pressure gauge was damaged because it was subjected to a pressure over 690 kPa (100 psi). The pump was started with the pressure regulator almost closed and the boom and agitator control shut off. This caused the pressure to surge over 690 kPa (100 psi) and damage the pressure gauge. More explicit instructions to ensure that pressure surges do not occur when priming the pump are required.

MAIN FRAME ASSEMBLY

Tank Straps: Failure of the tank straps occurred at the first bend immediately beside the bottom bolt (Figure 16). Since several tank strap failures occurred throughout the test, modifications should be made to prevent failure.

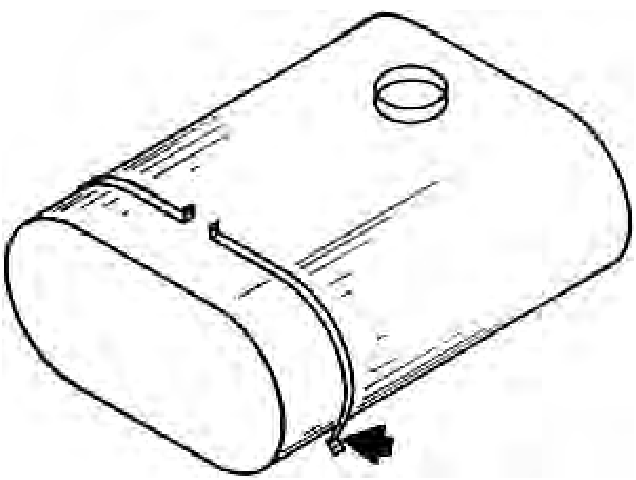

Figure 16. Location of Typical Tank Strap Failure.

Rocker Axles: The left tandem rocker axle loosened because the roll pin holding the rocker axle fell out. The rocker axle moved outwards causing the outer axle bracket to bend (Figure 17). This also damaged the tires. The roll pin on the right rocker axle also fell out but was replaced before damage occurred. Modifications are required to prevent the rocker axles from loosening.

BOOM ASSEMBLY

Boom Uprights: Breaking of the outer boom uprights occurred four times. This failure was a result of excessive loads on the outer boom upright assembles due to the overhang at the outer end of the boom (Figure 11). Failure occurred where the upright was welded to the clamp assembly (Figure 18). Modifications to the boom end upright are required.

Figure 17. Damage to Rocker Axle.

Figure 18. Typical Boom Upright Failure.

Nozzle Assembly: One complete nozzle assembly was lost after 39 hours. Several other nozzles had also loosened. The nozzles had to be checked periodically. The boom pipe wall into which the nozzle bodies were screwed (Figure 7), did not provide adequate thread to prevent the assemblies from loosening in the field.

Boom Support Tubes: The boom support tubes deformed slightly (Figure 19). This occurred under normal field operation due to the opposite forces on the boom support tube from the radius brace and castor wheels. Functional performance of the sprayer was not affected by bowing of the booms.

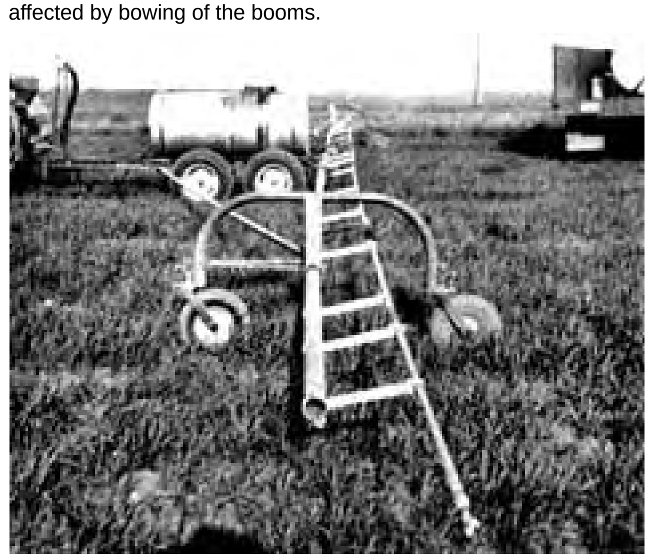

Figure 19. Bowed Boom Support Tube.

Universal Joint: The left boom universal joint was bent as a result of interference when turning too short (Figure 20). Bending of the universal joint did not affect sprayer operation.

Figure 20. Short Turn in Transport causing Bending of the Boom Universal Joint.

APPENDIX I
SPECIFICATIONS

Model:	Versatile 480	
Serial Number:	000813	
	Field Position	**Transport Position**
Overall Width:	21,175 mm (69.5 ft)	3860 mm (12.7 ft)
Overall Length:	4700 mm (15.4 ft)	12,900 mm (42.3 ft)
Overall Height:	1470 mm (4.8 ft)	1470 mm (4.8 ft)
	Trailer	**Castor**
Wheel Base:	860mm (2.8 ft)	1430mm (4.7 ft)
Wheel Tread:	1640 mm (5.4 ft)	14,292 mm (46.9 ft)
Tire Size:	4 - 9.5L x 15SL, 6 ply rib implement	4 - 480/400 x 8, 2 ply rib implement
Weights:	**Tank Empty**	**Tank Full**
-- left trailer wheels	281 kg (620 lb)	1148 kg (2530 lb)
-- right trailer wheels	281 kg (620 lb) 1	161 kg (2560 lb)
-- left castor		
-front	60 kg (132 lb)	60 kg (132 lb)
-rear	39 kg (87 lb)	39 kg (87 lb)
-- right castor		
-front	59 kg (131 lb)	59 kg (131 lb)
-rear	37 kg (82 lb)	37 kg (82 lb)
-- hitch	2.1 kg (47 lb)	91 kg (201 lb)
TOTAL	778 kg (1719 lb)	2595 kg (5723 lb)
Tank:	material - galvanized steel capacity - 1818 L (400 gal)	
Strainers:	line strainer - 50 mesh nozzle strainer - 50 mesh c/w check valves	
Pump: (540 rpm PTO driven) Hypro C1700 teflon roller		
Agitation:	hydraulic	
Pressure Gauge:	Marsh (0-100 psi)	
Booms:	3/4 inch galvanized steel pipe	
Nozzles: (TeeJet 8002 stainless steel)	number - 42 + 2 TeeJet OC 03 brass end nozzles spacing - 508 mm (20 in)	
Spraying Width:	21,336 mm (70 ft) (without end nozzles)	
Boom Adjustment:	height: maximum 760 mm (29.9 in) minimum 240 mm (9.4 in) nozzle angle - 360° Hitch	
Height Adjustment:	maximum 595 mm (23.4 in) minimum 405 mm (15.9 in)	
Lubrication Points:		
-- walking beam pivots	2	
-- boom wheel bearings	4	
-- boom walking beam	2	
-- castor pivots	4	

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

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

APPENDIX III
METRIC CONVERSIONS

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

1 hectare (ha)	= 2.47 acre (ac)
1 litre per hectare (L/ha)	= 0.09 Imperial gallon per acre (gal/ac)
1 kilopascal (kPa)	= 0.15 pound per square inch (psi)
1 kilometre per hour (km/h)	= 0.62 mile per hour (mph)
1 kilowatt (kW)	= 1.34 horsepower (hp)
1 litre per second (L/s)	= 13.2 Imperial gallons per minute (gal/min)
1 metre (m) = 1000 millimetres (mm)	= 39.37 inches (in)
1 litre (L)	= 0.22 Imperial gallon (gal)

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