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Evaluation Report 171

Automatic Spot Field Marker

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

AUTOMATIC SPOT FIELD MARKER

MANUFACTURER:

Marshall Marking Systems Ltd.
Box 165
Turtleford, Saskatchewan
S0M 2Y0

DISTRIBUTOR:

Grandwest Enterprises Inc.
334 Packham Avenue
Saskatoon, Saskatchewan
S7N 2T1

RETAIL PRICE:

$597.00 (June, 1980, f.o.b. Saskatoon, less portable air tank.)

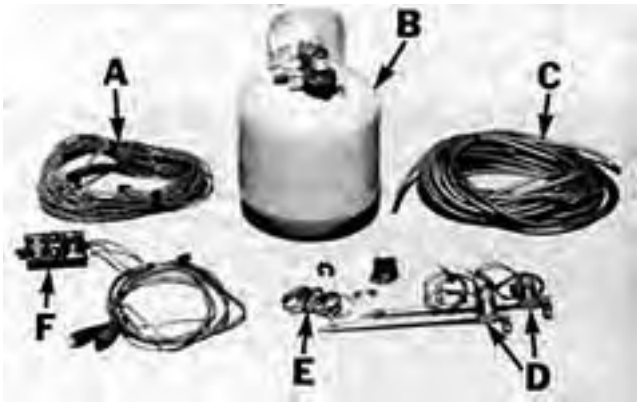

FIGURE 1. Automatic Spot Field Marker: (A) Wiring Harness, (B) Supply Tank, (C) Hoses, (D) Boom End Nozzles and Solenoid Valves. [E) Mounting Hardware, (F) Control Unit. A portable air tank (not shown) had to be supplied by the purchaser.

SUMMARY AND CONCLUSIONS

The Automatic Spot Field Marker was a useful aid in reducing overlap or misses with field sprayers. Operators could use the marks produced on the previous round to judge where they should drive for proper alignment.

Operating the Spot Marker was inconvenient. Filling the supply tank with diesel fuel and aluminum concentrate, agitating the mixture in the supply tank, and filling the portable air tank in the field were all inconvenient. The tractor mounted control unit was conveniently positioned but was overly sensitive to adjust. Mark length and spacing could be varied so that the 23 L (5 gal) supply tank had sufficient fluid to mark from 4 to 1300 ha (10 to 3200 ac). In normal conditions, the supply tank had to be filled every 50 to 100 ha (125 to 250 ac) when using an 18 m (60 ft) sprayer at 8 km/h (5 mph). In addition, a portable 23 L (5 gal) air tank, charged to 700 kPa (100 psi) provided enough charge to pressurize one supply tank. Operating costs for marking solution varied from 12 to 25 cents/ha (5 to 10 cents/ac).

The TeeJet 6502 nozzles supplied with the marker had insufficient flowrate and too wide a spray angle to provide visible marks. TeeJet 4009 nozzles produced acceptable marks. For best visibility, marks had to be spaced at 25 m (80 ft). Marks were more visible on cloudy days or when spraying away from the sun. Marks were hard to see when facing into the sun and some colour-blind operators had difficulty seeing marks. Proper mixing of diesel fuel and aluminum concentrate, as well as proper nozzle adjustment, were both important for optimum mark visibility. Marks were more easily seen on young, green crops than on stubble or summerfallow fields. Marks usually lasted several days unless deposited on loose porous soils. Rain quickly washed the marking solution off plant leaves. Crop damage was minimal.

The filler cap on the supply tank was a safety hazard and could cause serious injury if the air tank was not disconnected and pressure relieved before removing the cap. The situation was made more hazardous since the pressure regulator sometimes stuck, and would not allow the supply tank to fully decompress. Normal care also had to be observed with fire as diesel fuel is used as a carrying solution.

The operator's manual included useful information on installation and operation.

Installation time was about two hours using common tools.

Durability problems encountered during the test included a broken solenoid valve wire, a malfunctioning manual override switch and a sticking pressure regulator.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to decrease the sensitivity of the mark length and space length controls.
2. Supplying higher capacity nozzles with a narrower spray angle.
3. Modifications to eliminate the safety hazard associated with removing the filler cap on the supply tank.
4. Modifications to improve performance of the manual override switch.

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Project Engineer: K. W. Drever

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. Modifications have been made to the control box to decrease the sensitivity of the mark length and space length controls.
2. High capacity nozzles and 5,inch downspouts have been added to the units.
3. A chain attaching the filler cap to the supply tank handle will be added to future models.
4. There have been no problems with the manual override switch.

NOTE: This report has been prepared using SI units of measurement. A conversion table is given in APPENDIX II.

GENERAL DESCRIPTION

The Automatic Spot Field Marker is mounted on field sprayers to aid in aligning successive passes in the field. A portable pressurized air tank (not supplied) delivers an aluminum concentrate-diesel mixture from a 23 L (5 gal) supply tank to solenoid valve controlled nozzles mounted at either end of the sprayer boom. Both the length and spacing of the aluminum colored marks are adjustable from the control unit mounted on the tractor. Manual operation is also possible.

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

SCOPE OF TEST

The Automatic Spot Field Marker was mounted on a 18 m (60 ft) trailing field sprayer and used for 86 hours of typical spraying. Laboratory tests were also conducted to aid evaluation.

The Spot Marker was evaluated for ease of installation, ease of operation and adjustment, quality of work, operator safety, and suitability of the operator's manual.

RESULTS AND DISCUSSION

EASE OF INSTALLATION

Installation Time: The Spot Marker was easy to install on a sprayer, taking one man about two hours using common tools found in most farm shops. Sufficient brackets and mounting hardware were provided to install all components.

Supply Tank and Air Tank: The supply tank and air tank had to be mounted on the sprayer frame at a location, which provided convenient access for filling. A suitable location on most sprayers was on the drawpole assembly.

Solenoid Valves, Nozzles and Hoses: The solenoid valves, nozzles, hoses and valve wires were easily attached to the sprayer boom with the clamps and ties provided.

Control Unit and Wiring Harness: The control unit mounted on the tractor with four screws. A quick connector was provided to disconnect the control unit when unhitching. Alligator clamps were provided to connect the control unit to the tractor battery.

EASE OF OPERATION AND ADJUSTMENT

Filling: The supply tank was inconvenient to fill. Since the tank was not equipped with an agitator, a 1.1 L (0.25 gal) can of aluminum concentrate had to be premixed with about 23 L (5 gal) of diesel fuel and the mixture added to the supply tank. The operator's manual suggested using an electric drill to ensure adequate mixing but this was usually impractical in the field. Pouring the mixture into the supply tank also was inconvenient since the 19 mm (0.75 in) filler opening would only accept a small funnel. In addition, a portable air tank had to be recharged with compressed air and connected to the supply tank whenever the supply tank was filled.

Aluminum concentrate settled in the diesel fuel if the sprayer was allowed to stand with solution in the supply tank. Extended vigorous hand shaking of the pressure vessel was needed to ensure proper mixing, if the sprayer had been allowed to stand.

About a 23 L (5 gal) tank of compressed air, pressurized to 700 kPa (100 psi) was needed for each full tank of marking solution. About half of this compressed air was used to spray the solution, while the remainder was lost due to leaky quick couplers and depressurizing the supply tank for filling.

Field Operation: The marks left by the marking solution allowed successive passes of the sprayer to be properly aligned (FIGURE 2). Marks were left at the outer edge of the previous round, so on the next round an operator could eliminate most sprayer misses or overlaps by aligning the outer end of the spray boom with the marks. This still required considerable operator skill and judgement, since, as with most sprayers, the outer ends of the booms were over 9 m (30 ft) from the tractor and the sprayer could not be aligned by sighting down the row of marks. The operator had to judge the distance from the mark to where he should be driving and then use the mark as a check on whether the sprayer was properly aligned. This was effective as long as the marks were readily visible.

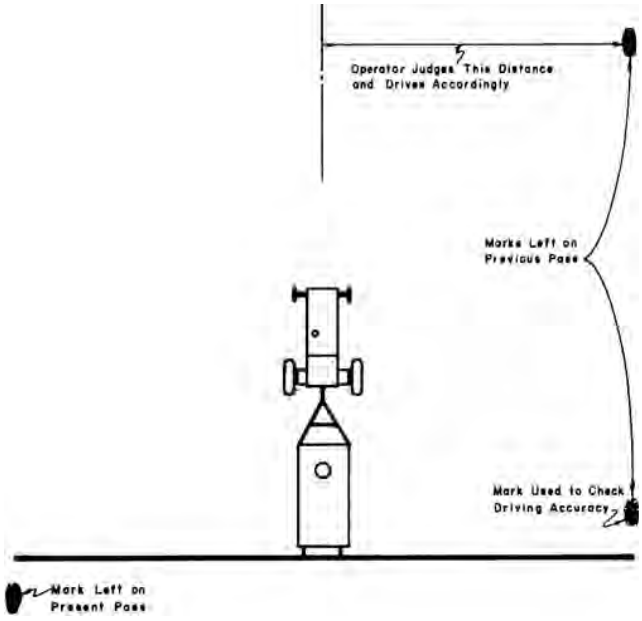

FIGURE 2. Schematic Illustrating Spot Marker Operation.

Controls: FIGURE 3 shows the control unit. The on-off toggle switch and the switch to operate either the left or right nozzle were convenient. Setting the mark length and mark spacing was tedious since small dial movements caused large changes in mark length and spacing. It is recommended that the manufacturer consider modifications to make the mark length and spacing controls less sensitive.

Fluid Level: A fluid level indicator was not provided on the supply tank. Fluid level had to be judged by trial and error. Compressed air charge remaining in the compressed air tank could be gauged only if the owner-supplied air tank was supplied with a pressure gauge.

FIGURE 3. Control Unit.

QUALITY OF WORK

Mark Visibility: The TeeJet 6502 nozzles supplied with the Spot Marker did not provide a readily visible mark. The nozzles had insufficient flowrate and the 65° spray angle was too wide to provide enough concentration of marker fluid. Also, the marker fluid drifted considerably even in light winds. Tee Jet 4009 nozzles were purchased and installed. These nozzles, with a high flowrate and a 40° spray angle, provided much more visible marks. It is recommended that the manufacturer consider supplying nozzles with a higher flowrate and a narrower spray angle.

Mark visibility depended on crop, mark length, mark spacing, sunlight conditions, and operator sight. For best visibility, marks had to be spaced every 25 m (80 ft). Depending on field and light conditions, marks could be seen up to 500 m (1650 ft). Marks were more visible on cloudy days or when spraying away from the sun. Marks were hard to see when facing into the sun. Some colour-blind operators had difficulty seeing the marks. Thorough mixing of the aluminum concentrate with the diesel fuel was important for bright, highly visible marks. Marks were more visible if the spray nozzle was tipped forward when spraying around a field or was tipped backward when spraying back and forth across a field.

Mark visibility was best when spraying young, green crops. Marks were much less visible on standing stubble fields. Most of the marking fluid was sprayed on the ground and was not readily visible through the stubble. Where stubble and trash had been tilled, the marks were easier to see.

Mark Durability: The marking fluid usually remained visible for several days on green crops. Fluid quickly soaked into loose, porous soils and rain quickly washed the marking solution off plant leaves.

Crop Damage: Crop injury was minimal. The marking fluid contacted less than 0.1% of the total crop area and usually caused no injury. In a few cases the leaf tips were slightly burned.

Quantity of Fluid Used: The amount of marking fluid needed depended on crop conditions, field topography, sprayer size, forward speed and operator skill. The solenoid nozzle control valves could be set to open from 0.25 to 2.4 s and to close from 3.2 to 185 s. This meant that the 23 L (5 gal) supply tank held sufficient fluid to cover from 4 to 1300 ha (10 to 3200 ac) when using Tee Jet 4009 marking nozzles on a 18 m (60 ft) sprayer at 8 km/h (5 mph). Typical area covered by one supply tank full of marking fluid ranged from 50 to 100 ha (125 to 250 ac).

Operating costs for marking solution varied from 12 to 25 cents/ha (5 to 10 cents/ac).

OPERATOR SAFETY

Removing the filler cap (FIGURE 4) on the supply tank was hazardous unless the tank was first decompressed by uncoupling the air hose. If this was not done the cap popped up and could cause serious injury. Occasionally the pressure regulator stuck, making it impossible to know when the supply tank was fully decompressed. Modifications are recommended to eliminate this safety hazard.

Normal care also had to be observed with fire as diesel fuel is used as a pressurized carrying solution.

OPERATOR'S MANUAL

The operator's manual included useful information on installation and operation. The section on air regulator adjustment was somewhat confusing since pressure adjusting instructions were included for three different kinds of air regulators. To further confuse matters, the regulator supplied with the test machine was a fourth variety, not described in the operator's manual.

FIGURE 4. Filler Cap on Supply Tank.

ELECTRICAL POWER REQUIREMENTS

The Spot Marker drew a maximum current of 0.7 A and could be attached to a 12 V electrical system with either a positive or negative ground.

DURABILITY RESULTS

The Automatic Spot Field Marker was operated for 86 hours. The intent of the test was functional evaluation and an extended durability evaluation was not conducted. The following mechanical problems occurred during functional testing.

TABLE 1. Mechanical Problems

Item	Operating Hours
Electrical	
-An electrical wire connecting the right solenoid valve to the connection block broke and was repaired at	20
-The manual override switch began functioning intermittently at	end of test
Supply Tank	
-The warning decal located on the supply tank, warning operators to release the pressure before removing the filler cap, came loose at	22
-The pressure regulator stuck and would not allow the supply tank to fully decompress periodically	throughout the test

DISCUSSION OF MECHANICAL PROBLEMS

Manual Override Switch: The manual override switch (FIGURE 3) began operating intermittently at the end of the test due to dust entering the switch. It is recommended that the manufacturer consider modifications to improve switch performance.

APPENDIX I
SPECIFICATIONS

MAKE:	Automatic Spot Field Marker
MODEL:	B79
SERIAL NUMBER:	04160
ELECTRICAL POWER REQUIREMENTS: 12 V	
CONTROL BOX:	
-- size	67 x 130 x 140 mm
-- controls	mark length, space length, on-off switch, left or right selector switch, manual override switch
MARKING SYSTEM:	
-- type	silver spray
-- marker fluid	Spot silver concentrate mixed with diesel fuel
FLUID SYSTEM:	
-- reservoir capacity	23L
-- pressure source	compressed air from portable air tank
-- marking nozzles	2, Spraying Systems Tee Jet 6502
-- nozzle control valve	12 V electrical solenoid valve, 10 W rating
-- nozzle hose length	2, 10670 mm
WIRING HARNESS:	
-- power supply cable	2640 mm long complete with battery clips
-- nozzle control valve cable	2, 18160 mm long
OPTIONS:	
	Spraying Systems 6508, 4006, 2506 nozzles; spring loaded drop hoses for high booms

APPENDIX II
CONVERSION TABLE

1 litre (L)	= 0.2 Imperial gallon (gal)
1 metre (m)	= 3.3 feet (ft)
1 millimetre (mm)	= 0.04 inches (in)
1 hectare (ha)	= 2.5 acres (ac)
1 kilometre/hour (km/h)	= 0.6 miles/hour (mph)
1 kilopascal (kPa)	= 0.15 pounds/square inch (psi)

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