Alberta Farm Machinery
Research Centre

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Evaluation Report 597

Brandt Quick Fold Model 70-830 Field Sprayer

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

BRANDT QUICK FOLD MODEL 70-830 FIELD SPRAYER

MANUFACTURER AND DISTRIBUTOR:

Brandt Industries Ltd.
705 Toronto Street
Regina, Saskatchewan
S4R 8G1
Phone: (306) 525-1314

RETAIL PRICE:

$13,526.40 (July, 1989, f.o.b. Lethbridge, Alberta)

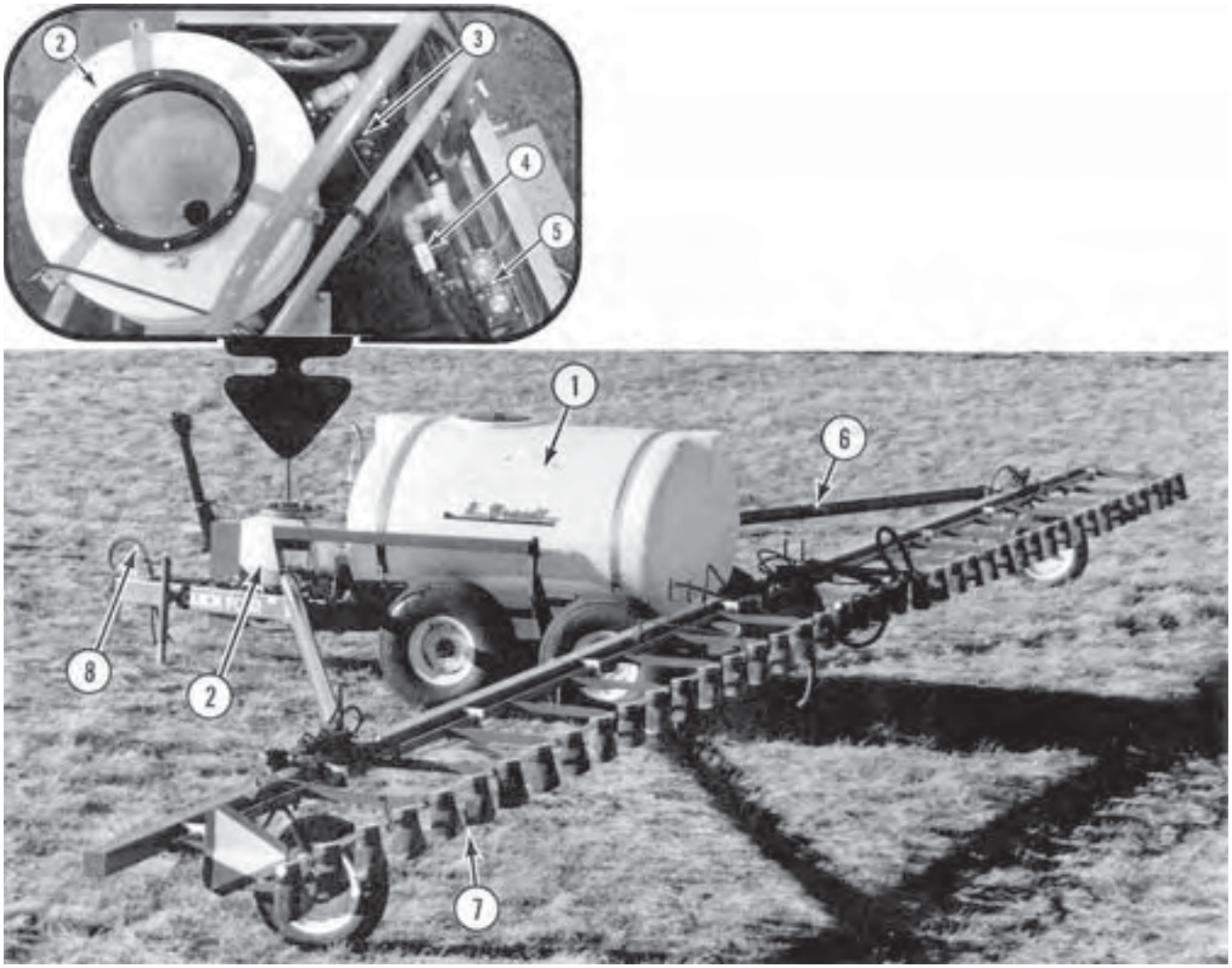

FIGURE 1. Brandt Quick Fold Model 70-830 Field Sprayer: (1) Spray Tank, (2) Chemical Inductor Tank, (3) Pump, (4) Agitator Valve, (5) Solenoid and Pressure Regulating Valves, (6) Boom Radius Arm, (7) Spray Boom and Nozzle Body Assemblies, (8) Boom Hydraulic Hoses.

SUMMARY AND CONCLUSIONS

Rate of Work: Operating at a speed of 5 mph (8 km/h) resulted in an instantaneous work rate of 42 ac/h (17 ha/h). At an application rate of 10 gal/ac (112 L/ha), about 80 ac (32.4 ha) could be sprayed with a full tank.

Quality of Work: Application rate depended on tractor speed, nozzle size and pressure. The 8002VS stainless steel nozzles supplied delivered 10.1 gal/ac (113 L/ha) at a forward speed of 5 mph (8 km/h) and nozzle pressure of 40 psi (276 kPa).

Nozzle calibration was very good. The delivery rate of the new 8002VS nozzles was about 2.0% higher than specified by the nozzle manufacturer. Variability among individual nozzle deliveries was about 1.0%.

Nozzle spray distribution patterns were good. Nozzle distribution patterns were acceptable above 34 psi (234 kPa) and very uniform above 42 psi (290 kPa). The Wind Cones did not affect the spray distribution patterns.

The Wind Cones reduced spray drift. In 18.6 mph (30 km/h) winds, off-swath drift from 8001 flat fan nozzles was 3% using the Brandt Wind Cones and 7% using a conventional sprayer.

System pressure was very good with negligible loss using the 8002 nozzles. The pressure gauge was very good and reliable. The strainers were very good and adequately prevented nozzle plugging.

Boom stability was good. The heavy duty 4 in (102 mm) square tubing and the suspension system on the castor wheels reduced boom bounce. Reduced boom movement improved spray distribution patterns and application rate uniformity.

Trailer and castor wheel soil contact pressure was 31 and 20 psi (214 and 138 kPa), respectively. This is comparable to an unloaded half-ton truck, which has a soil contact pressure of about 30 psi (207 kPa).

Ease of Operation and Adjustment: Ease of adjusting application rate was rated as good. Ease of operating the controls

was good. The Spraying Systems remote control made it easy to regulate pressure and flow from the tractor seat. The agitator and throttle valve had to be adjusted before spraying. Access to the chemical inductor and spray tank valves was slightly obstructed by the chemical inductor tank.

Ease of adjusting the castor wheels for proper boom trailing was good. The adjustments were a trial and error procedure. The adjustment had to be repeated each time the castor wheel bell crank bent or failed.

Sprayer maneuverability was very good in both transport and field position. Backing the sprayer in transport position resulted in the booms gradually spreading outwards since the castor wheels were adjusted slightly toed in.

Ease of boom positioning was good. The operator could place the booms into field and transport position from the tractor seat by backing the sprayer and operating the tractor hydraulic lever. At first, care had to be exercised and constant reference to the folding instructions decal was required to prevent castor wheel and boom damage. The procedure got easier with experience.

Ease of adjusting nozzles was very good. Nozzle angle was adjusted manually and nozzle height was adjusted hydraulically from about 8 to 49 in (203 to 1245 mm). The quick-disconnect and self-aligning nozzle caps made nozzle changing easy.

Ease of filling the spray tank was good utilizing the inboard pump. It took about 20 minutes to fill the 800 gal (3637 L) spray tank. Care had to be exercised to prevent liquid from the spray tank entering the nurse tank.

Ease of adding chemical to the spray tank was fair. Although the chemical inductor tank was easily accessible, chemical splashing occurred during pouring. Chemical could be inducted during refilling or agitation. Preference depended on operator skill and time. Chemical induction during agitation was more convenient, but took 4 to 7 minutes, depending on power take-off speed. Chemical induction during refilling took 3 minutes, but required care to prevent chemical from entering the nurse tank.

Ease of hitching was good. The hitch jack provided was safe and the hitch was adjustable for levelling the sprayer trailer. Cranking the hitch jack handle was a little awkward.

Ease of cleaning was fair. Removing the nozzle caps for nozzle and strainer cleaning was quick, however, removing the strainers was sometimes difficult and messy. Removing the main line strainer was also inconvenient.

Ease of draining was fair. The drain plug was located at the rear of the spray tank and not easily accessible. In addition, the main line hose had to be removed to drain the sump.

Ease of lubrication was good. Most of the 20 grease fittings were accessible. The pump drive safety guard had to be removed to grease the pump drive pillow bearings. Lubrication frequency varied for each grease fitting.

Pump Performance: Pump capacity was very good. At a power take-off speed of only 420 rpm, the pump could deliver up to 22 gal/min (11 L/min) at a 40 psi (276 kPa) nozzle pressure. This was adequate to apply 31.3 gal/ac (351 L/ha) at a forward speed of 5 mph (8 km/h).

Agitator output exceeded recommended agitation rates.

Operator Safety: The operator's manual emphasized operator safety. The sprayer was safe to operate if normal safety and chemical precautions were taken.

Operator's Manual: The operator's manual was excellent, providing complete information and illustrations on safety, sprayer operation, maintenance, adjustments and parts.

Mechanical History: A few mechanical problems occurred during testing. The secondary boom universal joints loosened throughout the test, the pump pulley interfered with the pump housing and the radius arm latch binded, not securing the radius arm to the trailer. Damage to the castor wheel bell cranks occurred until adequate experience was gained folding and unfolding the booms.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifying the pump drive to prevent pump housing and pulley interference.
2. Modifying the secondary boom universal joints to prevent them from loosening.

Manager: R.P. Atkins

Field Technologist: L.B. Storozynsky

THE MANUFACTURER STATES THAT:

With regard to recommendation number:

1. The pump box was redesigned for the 1989 production. A flip-up guard allows easy access to the top sheave and bearings. Removal of a lower guard provides access to the remaining drive components. Greasing and maintaining the pump box is simple and easy to do.
2. The secondary universal joints were also redesigned for the 1989 production. To add the strength and durability required, it was decided to use an 1140 cross and bearing kit; the same cross and bearing kit used on PTO shafts. To achieve the required turning angles, however, a dual u-joint assembly was necessary. These two crosses are joined using an H-yoke. In addition to the higher strength universal joints, a spring "lift assist" kit was installed halfway down the boom. The spring helps reduce some of the shock loading experienced on the sprayer booms. These changes improved the boom sturdiness.

Manufacturer's Additional Comments:

a) The bellcranks on the hydraulic caster wheels were redesigned for the 1989 production. Two complete circular welds (top and bottom) on the bellcrank ensures the integrity of the shaft/bellcrank joint.

b) To assist the operator in bleeding the hydraulic system, bypass grooves have been installed internally in all three cylinders. This allows the operator to bleed the circuit from the tractor seat with no fluid loss.

c) The tank drain on the Quick Fold Sprayer was enhanced on the 1989 production by adding a 1 in (25 mm) ball valve in the main suction line. This valve is placed at sump height near the front of the tank and aimed away from the operator. This allows for easy and safe draining of the tank.

GENERAL DESCRIPTION

The Brandt Quick Fold Model 70-830 is a trailing, boom-type field sprayer. The trailer is mounted on a tandem walking beam axle and each boom is supported by a castor wheel with suspension system. The booms automatically fold back for transport. The 800 gal (3637 L) plastic tank is equipped with hydraulic agitation, fluid level indicator, drain hose and a filler opening with strainer.

The Brandt has 42 split-eyelet quick TeeJet nozzle assemblies with diaphragm check valves, spaced at 20 in (508 mm) intervals, giving a spraying width of 70 ft (21.3 m). Optional plastic Wind Cones can be attached to the boom to shield part of the spray. Nozzle height is hydraulically controlled. Nozzle angle is adjustable and remains constant throughout the height range.

The Brandt is equipped with a chemical inductor, filler opening access platform, remote control and reload systems. The reload system utilizes the inboard centrifugal pump. The pump is belt driven and operates at 3780 rpm at a power take-off speed of 420 rpm. The Spraying Systems remote control console mounts on the tractor and contains a pressure gauge and control switches to operate the pressure regulating and boom solenoid valves.

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

SCOPE OF TEST

The Brandt Quick Fold Model 70-830 sprayer was operated for 73 hours in the conditions shown in TABLE 1 while spraying about 1803 ac (730 ha). The AFMRC evaluated rate of work, quality of work, ease of operation and adjustment, pump performance, operator safety and suitability of the operator's manual.

During the test, Spraying Systems Tee Jet flat fan 8002VS stainless steel nozzle tips supplied with the sprayer were used.

TABLE 1. Operating Conditions

Chemical Applied	Field	Hours	Speed		Field Area	
			mph	km/h	ac	ha
Tropotox	Peas	3	5	8	55	22
Target	Wheat	2	5	8	55	22
Stampede	Barley	20	5	8	390	158
Hoegrass II	Barley	9	5	8	405	164
Estaprop	Barley	5	5	8	26	11
Sweep	Summerfallow	3	5	8	44	18
2,4-D	Wheat	31	5	8	828	335
Total		73			18.3	730

RESULTS AND DISCUSSION

RATE OF WORK

During field testing, the Model 70-830 was operated at a speed of 5 mph (8 km/h), resulting in an instantaneous workrate of 42 ac/h (17 ha/h). Actual workrates were less depending on operator skill and reloading time. With a full spray tank, about 80 ac (32.4 ha) could be sprayed at 10 gal/ac (112 L/ha) before refilling.

QUALITY OF WORK

Application Rate: Application rate depended on tractor speed, nozzle size and pressure. The 8002VS nozzles supplied with the Brandt sprayer delivered 10.1 gal/ac (113 L/ha) at a forward speed of 5 mph (8 km/h) and a nozzle pressure of 40 psi (276 kPa). Changes to forward speed or nozzle pressure resulted in different application rates as shown in FIGURE 2. For example, at a nozzle pressure of 40 psi (276 kPa), reducing speed from 5 to 4 mph (8 to 6.4 km/h) increased application rate from 10.1 to 12.6 gal/ac (113 to 142 L/ha). To ensure uniform application rates it is recommended that the desired speed and pressure be kept constant.

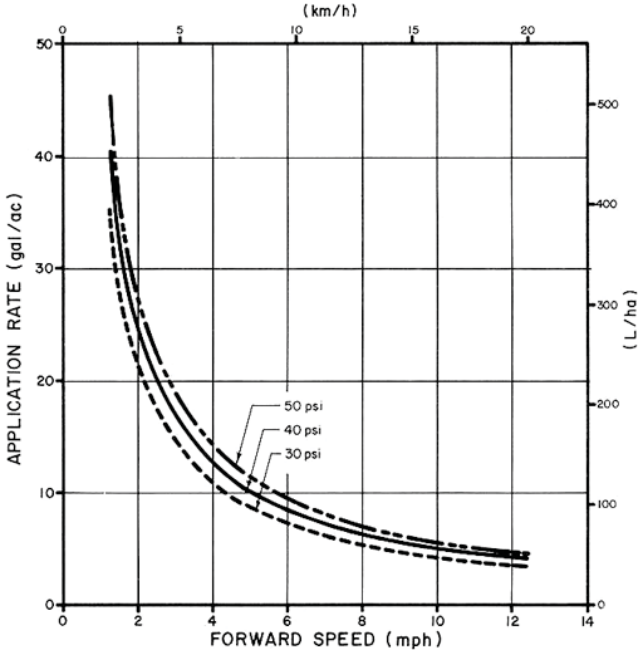

FIGURE 2. Application Rates at Various Forward Speeds and Pressures Using Tee Jet 8002VS Nozzles.

Nozzle Calibration: Nozzle calibration was very good. FIGURE 3 shows the average delivery of Spraying Systems Tee Jet 8002VS nozzle tips over a range of nozzle pressures. Measured delivery of the used 8002VS nozzle tips was about 2.0% higher than Spraying Systems rated output. Some researchers indicate that a nozzle needs replacement once delivery has increased by more than 10%.

Variability among individual nozzle deliveries for the TeeJet 8002VS nozzles was very good. Coefficient of variation (CV) indicates variability among individual nozzle deliveries. The coefficient of variation is the standard deviation of delivery rates for ten nozzles expressed as a percent of the mean delivery rate. The CV of nozzle deliveries of the used 8002VS nozzles was about 1.0%.

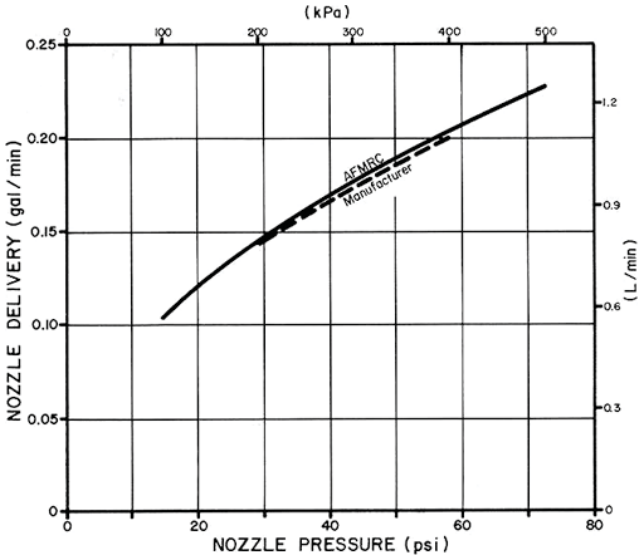

FIGURE 3. Delivery Rates for TeeJet 8002VS Stainless Steel Nozzles.

Distribution Patterns: Nozzle spray distribution patterns were very good. FIGURES 4 and 5 show spray distribution patterns along the boom with TeeJet 8002VS nozzles when operated at an 18 in (457 mm) nozzle height. The (CV)[1] at 15 psi (100 kPa) (FIGURE 4) was 43.3%, with application rates along the boom varying from 3.5 to 13.9 gal/ac (39 to 156 L/ha) at 5 mph (8 km/h). High spray concentrations occurred below each nozzle with inadequate coverage between nozzles. At 44 psi (300 kPa) (FIGURE 5) the distribution pattern improved considerably, reducing the CV to 9.3%. Application rate along the boom varied from 7.8 to 12.8 gal/ac (99 to 144 L/ha) at 5 mph (8 km/h). High pressures improved distribution by increasing the overlap and capacity among nozzles. Higher pressure, however, usually causes more spray drift.

Work done by the Saskatchewan Research Council[2] showed the Wind Cones did not affect the spray distribution patterns.

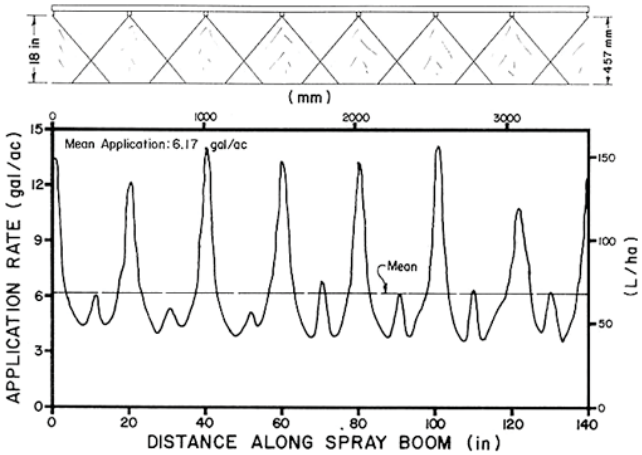

FIGURE 4. Typical Distribution Pattern Along the Boom at 15 psi (100 kPa) with Spraying Systems Tee Jet 8002VS Stainless Steel Nozzles, at an 18 in (457 mm) Nozzle Height and at 5 mph (8 km/h).

FIGURE 6 shows how nozzle pressure affected pattern uniformity for the Tee Jet 8002VS flat fan nozzles. The nozzles produced acceptable patterns at pressures above 34 psi (234 kPa) and very uniform patterns at pressures above 42 psi (290 kPa). The nozzle manufacturer recommends that 8002VS nozzles not be used at pressures below 35 psi (241 kPa). After 73 hours of field use,

[1]The coefficient of variation (CV) is the standard deviation of application rates for successive 0.63 in (16 mm) sections along the boom expressed as a percent of the mean application rate. The lower the CV, the more uniform is the spray coverage. The CV below 10% indicates very uniform coverage while a CV above 15% indicates inadequate uniformity. The CV's above were determined in stationary laboratory tests. In the field, CV's may differ due to boom vibration and wind. Different chemicals vary as to the acceptable range of application rates. For example, 2, 4-D solutions have a fairly wide acceptable range, while other chemicals may have a narrow range.

[2]Maybank, J., Saskatchewan Research Council, R. Grover, Agriculture Canada, "Field Sprayers", Agriculture Canada Publication 1482, 1989, P. 17.

there was no significant change in spray pattern uniformity.

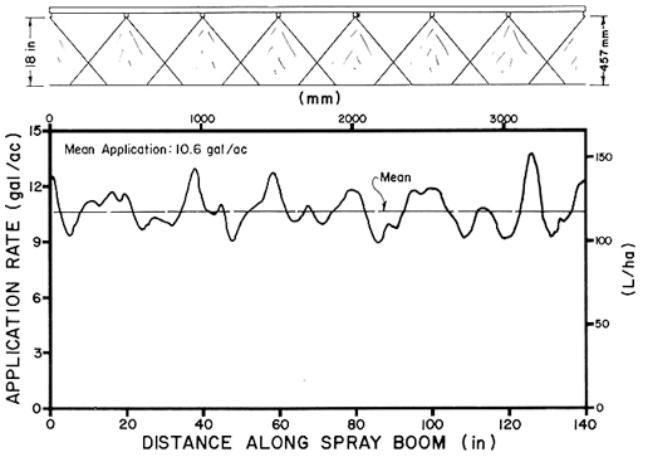

FIGURE 5. Typical Distribution Pattern Along the Boom at 44 psi (300 kPa) with Spraying Systems Tee Jet 8002VS Stainless Steel Nozzles, at an 18 in (457 mm) Nozzle Height and 5 mph (8 km/h).

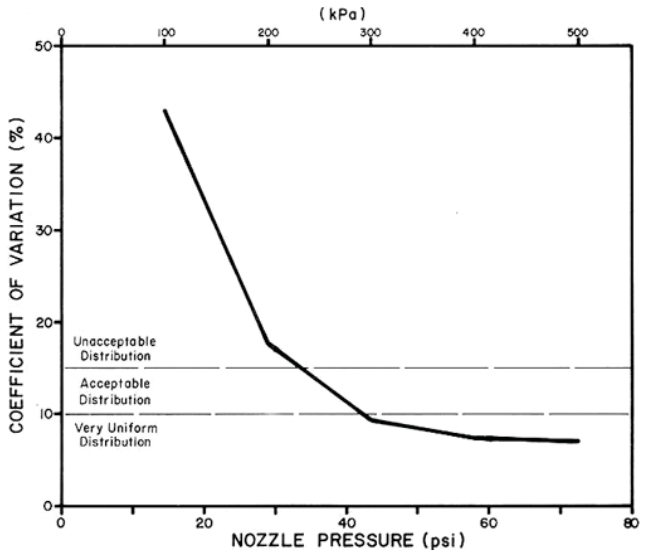

FIGURE 6. Spray Pattern Uniformity for TeeJet 8002VS Stainless Steel Nozzles Operated at an 18 in (457 mm) Nozzle Height.

Spray Drift: Work by the Saskatchewan Research Council[3] indicates that off-swath drift from 8001 flat fan nozzles operated at a nozzle pressure of 40 psi (276 kPa) and nozzle height of 18 in (457 mm) was about 3% of the emitted material in 18.6 mph (30 km/h) winds.

TABLE 2 shows the drift fraction at various wind speeds using the Brandt Wind Cone and a conventional sprayer. As shown, the Brandt Wind Cones reduced spray drift when compared to the conventional sprayer, but did not eliminate it.

TABLE 2. Drift Fraction (%) Using 8001 Flat Fan Nozzles

Sprayer	Speed		
	6.2 mph (10 km/h)	12.4 mph (20 km/h	18.6 mph (30 km/h
Conventional	1.5	3.0	7.0
Brandt	0.5	1.0	3.0

System Pressure: System pressure was very good. Pressures in the plumbing system were measured at the pump, remote control and booms using different sized nozzles. Nozzle pressures at the left boom were higher than at the center and right booms. However, the pressure difference was negligible when using nozzles with delivery rates of less than 0.55 gal/min (2.5 L/min). For reference, the 8002 nozzle delivers 0.17 gal/min (0.77 L/min) at a 40 psi (276 kPa) nozzle pressure.

The pressure gauge was very good. The gauge was accurate when new and indicated about 2 psi (14 kPa) high at the end of the test. This was considered negligible.

Use of Optional Nozzles: The split-eyelet quick TeeJet nozzle assemblies (FIGURE 7) accepted a wide range of standard nozzle tips. However, only the flat fan nozzle tips could be used with the Wind Cones mounted on the sprayer. The Wind Cones had to be removed to use flood or cone nozzle tips.

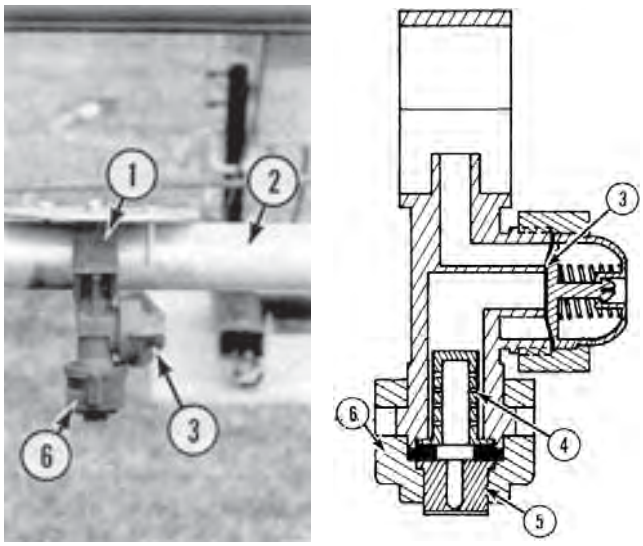

FIGURE 7. Split-Eyelet Quick Tee Jet Nozzle Assembly: (I) Split-Eyelet Clamp, (2) Spray Boom, (3) Diaphragm Check Valve, (4) Strainer, (5) Nozzle Tip and (6) Quick-Disconnect and Self-Aligning Nozzle Cap.

System Strainers: The Brandt sprayer system strainers were very good. The tank filler opening and pump inlet hose were equipped with 18 and 50 mesh strainers, respectively. The 50 mesh nozzle strainers effectively prevented the TeeJet 8002VS nozzles from plugging.

Boom Stability: The Brandt sprayer boom stability was good. Field observations indicated that the booms remained stable in the field conditions encountered during the test. The heavy square tubing used for boom rail construction and suspension system on the castor wheels reduced boom bounce on rough fields. Some horizontal boom end movement occurred. Reduced boom movement in the field improved spray distribution pattern and application rate uniformity. Boom operation across gullies was also good.

Soil Compaction and Crop Damage: The trailer and castor wheels travelled over about 3% of the total field area sprayed. The wheel tread of the trailer was adjustable from 7.39 to 8.15 ft (2.25 to 2.28 m) to match most tractor wheel treads. The only crop damage in addition to that caused by the tractor wheels was that caused by the castor wheels. This was about 1.5% of the total area sprayed.

Soil contact pressure beneath the castor wheels was less than that of an unloaded one-half ton truck. The average soil contact pressures under the sprayer wheels with a full tank are given in TABLE 3.

TABLE 3. Soil Compaction by Sprayer Wheels

	Tire Track Width		*Average Soil Contact Pressure	
	in	mm	psi	kPa
Trailer Wheels	8.1	206	31	214
Boom Wheels	3.7	94	20	138

**For comparative purposes, an unloaded one-half ton truck has a soil contact pressure of about 30 psi (207 kPa).*

EASE OF OPERATION AND ADJUSTMENT

Application Rate: Adjusting the application rate was rated as good and was done by changing forward speed, nozzle size or pressure. The operator's manual provided good information on selecting nozzle size, pressure and forward speed to obtain the desired application rates. The quick TeeJet nozzle assemblies made changing nozzles easy. Each change in forward speed should be calibrated.

Controls: Ease of operating the controls was good. The Brandt sprayer was equipped with a Spraying Systems remote control console (FIGURE 8) to operate sprayer controls from the tractor

[3]*Maybank, J., Saskatchewan Research Council, R. Grover, Agriculture Canada, "Field Sprayers", Agriculture Canada Publication 1482, 1989, P. 17.*

seat. The remote control console included a pressure gauge to monitor nozzle pressure, boom solenoid valve switches to control flow to the booms and a pressure regulating switch to adjust nozzle pressure. The desired nozzle pressure was difficult to adjust. Depending on the butterfly valve position, small adjustments of the pressure switch resulted in small or large pressure changes. With experience, nozzle pressure became easier to adjust.

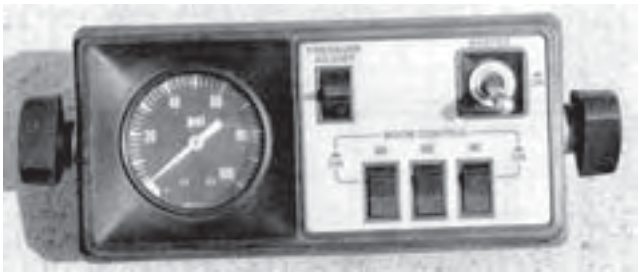

FIGURE 8. Spraying Systems Remote Control Console.

The agitator and throttle control valves were mounted on the sprayer hitch frame and could not be operated from the tractor seat. The agitator valve was normally fully open during spraying and only had to be opened once. The throttle valve was used to set the nozzle pressure operating range. Adjusting the throttle valve and viewing the pressure gauge was inconvenient since the gauge was on the tractor. The throttle valve was left fully opened operating at a power take-off speed of 420 rpm and using 8002 nozzles.

The chemical inductor tank restricted access to the induction and tank valves. The inductor tank was usually contaminated with dirt and chemical residue requiring care.

Both front and rear tank level indicators had to be read and then averaged to give an indication of liquid level.

Castor Wheel Adjustments: Ease of adjusting the boom castor wheels was good. Boom maneuverability and positioning depended on castor wheel adjustment. The adjustments were a trial and error procedure requiring basic tools. The adjustments were easy to perform and once adjusted, did not normally have to be readjusted.

Maneuverability: Sprayer maneuverability was very good. Ease of towing the sprayer was very good in both field and transport position. An inside turning radius of 37 ft (11.3 m) in transport position provided good maneuverability. Sharper turns could cause damage to the secondary universal joints and nylon bushings. Backing up the sprayer in transport position was difficult since the booms slowly spread apart. Operators should avoid circumstances requiring backing up.

Boom Positioning: Ease of boom positioning was good. With experience, positioning the booms from the tractor seat took less than a minute. Placing the sprayer booms into field position required care. The operator had to operate the tractor hydraulics until the boom castor wheels were about 30 to 45 degrees to the boom. With small tractors, the spray tank obstructed the operator's view of the castor wheels. As a result, the castor wheels could easily be placed beyond 45 degrees, requiring the operator to manually reposition the wheels to the hydraulic bell-crank. After backing up the sprayer to fully unfold the booms, the tractor hydraulics had to be operated again to release the castor wheels from the hydraulic bellcrank and to latch the boom radius arms to the sprayer trailer. Damage to the booms resulted when the radius arms were not securely latched before driving forward. Verifying the folding instructions was required until enough experience was gained.

The transport width was 16 ft (4.88 m) and could be conveniently reduced to 8.8 ft (2.68 m) for high speed road transport (FIGURE 9), by manually disconnecting and securing the radius and pivot arms to the sprayer.

Nozzle Adjustment: Ease of adjusting nozzle angle and height was very good. Nozzle angle was easily adjusted by loosening five clamps and rotating the spray booms. Spray interference with the castor wheels occurred when forward nozzle angle was adjusted more than 26 degrees forward. Cone interference occurred in transport position when the nozzle angle was set towards the rear. Nozzle angle remained constant at all boom heights.

Nozzle height was easily adjusted hydraulically from the tractor and could be adjusted from about 8 to 49 in (203 to 1245 mm). The desired nozzle height was easily set by adjusting the hydraulic cylinder stop collar.

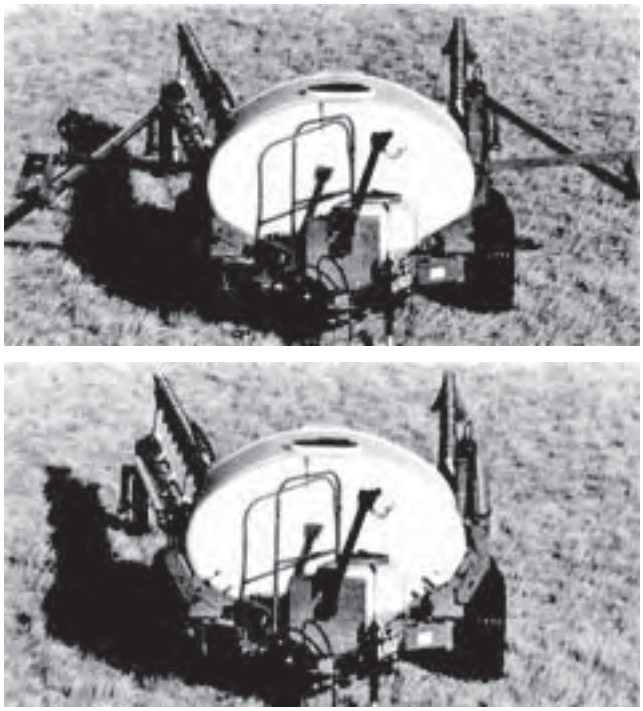

FIGURE 9. Brandt in Transport Position: (Upper) Partial Transport; (Lower) Complete Transport.

Adjusting the castor wheel assemblies levelled the spray boom from end to end. This adjustment required the use of tools.
The quick-disconnect and self-aligning nozzle caps made nozzle changing easy.

Tank Filling: Ease of filling the spray tank was good. The 800 gal (3637 L) spray tank could be filled utilizing the filler opening or reload system. The reload system using the sprayer pump was more convenient, but was slow. The time required to fill the spray tank averaged about 20 minutes, regardless of the power take-off speed. A supply hose was needed to fit the 2 in (51 mm) female quick coupler provided to connect the nurse tank to the reload system.

Chemical Inducting: Ease of adding chemical to the spray tank was fair. Standard equipment included a 22 gal (100 L) chemical inductor tank. The inductor tank filler opening was low and easier to access than the spray tank filler opening. Normal caution was still needed to prevent chemical splashing.

The manufacturer recommended adding chemical during agitation, rather than reloading. Inducting chemical during reloading required greater operator skill, tended to foam the chemical more, allowed rinsing the inductor tank with clean water, required caution to prevent chemical from entering the nurse tank and took about 3 minutes regardless of power takeoff speed. Inducting chemical during agitation was more convenient for the unskilled operator, less foaming occurred, and took about 4 to 7 minutes, depending on the power take-off speed. Induction times include inducting 22 gal (100 L) of chemical and rinse solution and adding 22 gal (100 L) of rinse to the inductor tank.

Hitching: Ease of hitching the Brandt sprayer to a tractor was good. The hitch jack provided was safe however cranking the hitch jack handle was awkward because of the difficulty keeping the handle in a horizontal position. The hitch was adjustable to level the spray tank trailer. Hitching also included the hook-up of two hydraulic lines, an electronic coupler with pressure line for the remote control system and connecting the power take-off shaft.

Cleaning: Ease of cleaning was fair. Removing nozzle caps from the TeeJet nozzle assemblies for cleaning was quick. Removing the strainers from the TeeJet nozzle assemblies was difficult at times. The top of the nozzle assemblies had to be tapped or the strainer pried with a screwdriver, causing chemical solution to splatter on the operator. The inside of the Wind Cones accumulated dirt and chemical residue and required that the operator wear protective gear during strainer or nozzle removal.

The pump inlet hose strainer was difficult to remove at times, requiring the use of a tool. The strainer should be positioned horizontally to reduce chemical contact during removal. The spray and chemical inductor tank were easily flushed using the reload system.

Draining: Ease of draining the spray tank was fair. The drain plug was located under and at the rear of the spray tank. The drain plug could only be removed by crawling under the booms and spray tank. After removing the drain plug the operator had to quickly crawl from under the sprayer to prevent from getting wet.

The spray tank could not be completely drained through the drain opening. Fluid that remained in the spray tank sump was drained by removing the pump inlet hose.

The pump cavity was easily drained by opening the cock at the bottom of the pump. Draining the hoses was easily done by loosening the ring clamps and removing the hose ends.

Lubrication: Ease of lubricating the sprayer was good. The Brandt sprayer had 20 pressure grease fittings. Most grease fittings were easily accessible. The pump drive assembly safety guard had to be removed to grease the pump drive grease fittings. The sprayer had to be placed into field position to grease the trailer hinge grease fittings.

Lubrication frequency for each grease fitting varied. Two required greasing daily, six every 20 hours, eight every 100 hours and two every 1000 ac (405 ha). Lubrication frequency for the pump drive assembly grease fittings was not indicated.

PUMP PERFORMANCE

Output: The Hypro 9203C centrifugal pump output was very good. The pump operated at about 3780 and 4820 rpm at power take-off speeds of 420 and 540 rpm, respectively. At the PTO speed of 420 rpm, the pump delivered 22 gal/min (100 L/min) at a 40 psi (276 kPa) nozzle pressure. This was adequate to apply 31.3 gal/ac (351 L/ha) at a forward speed of 5 mph (8 km/h), which was more than adequate for prairie conditions. Higher application rates could be obtained by closing off the agitator valve or increasing the PTO speed.

Agitation: Agitation output was very good. The Brandt sprayer was equipped with four horizontally mounted orifice plate agitators. TABLE 4 shows agitator outputs during various operating conditions using the 0.16 in (4 mm) diameter orifices. Agitation rates varied depending on PTO speed and amount the throttle, regulator and agitator valves were opened. Maximum agitation rates occurred with the throttle valve closed and the agitator valve fully opened.

TABLE 4. Agitator Outputs

Operating Conditions	PTO Speed	Agitator Output	
	rpm	gal/min	L/min
Engine Idle	270	14 to 19	164 to 86
Reloading	420	22 to 30	100 to 136
Field Spraying	420	23	106

Agitator output exceeded the recommended agitation rates for emulsifiable concentrates. Normally recommended agitation rates for emulsifiable concentrates such as 2,4-D are 1.5 gal/min per 100 gal of tank capacity (1.5 L/min per 100 L of tank capacity). For wettable powders such as Atrazine, recommended agitation rates are 3.0 gal/min per 100 gal of tank capacity (3.0 L/min per 100 L of tank capacity).

At high agitation rates, foaming may occur with some chemicals. However, the agitation rate could easily be reduced by partially closing the agitator valve.

OPERATOR SAFETY

The operator's manual emphasized operator safety. The Brandt sprayer had warning decals to indicate dangerous areas. The pump drive system was well shielded. The sprayer was equipped with a slow moving vehicle sign.

Caution: Operators 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 was excellent. It was clearly written and well illustrated. It provided useful information on safety, machine specifications, sprayer operation, maintenance, adjustments, trouble shooting, optional equipment and parts.

MECHANICAL PROBLEMS

TABLE 5 outlines the mechanical history of the Brandt during 73 hours of operation while spraying about 1803 ac (730 ha). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

TABLE 5. Mechanical History

Item	Hours	Equivalent ac	Field Area (ha)
Pump			
-The pump pulley loosened from the pump shaft, damaging the shaft and the shaft was repaired at	18	370	(150)
-The pump housing and pump pulley interfered causing the pump housing and pulley to wear at	18	370	(150)
Trailer			
-The left boom latch didn't lock and the cable was adjusted at	3, 17	55, 370	(136, 150)
Booms			
-The castor wheels jammed during unfolding causing damage to the castor wheel bell crank at	13, 29, 44	320, 690, 1055	(130, 279, 427)
-The left castor wheel shock absorber bracket broke and was rewelded at	17	370	(150)
-The secondary boom universal joint bolts loosened or broke and were replaced	throughout the test		
-The castor wheel hydraulic rams operated out of sequence	throughout the test		
-The left castor wheel grease nipple loosened and was tightened at	44, 49	1055, 1135	(427, 460)
-The radius arm latch allen screws loosened and were tightened at	52	1135	(460))

DISCUSSION OF MECHANICAL PROBLEMS

Pump: The pump pulley rubbed against the pump housing causing wear to both (FIGURE 10). It is recommended the manufacturer modify the pump drive to prevent pump housing and pulley interference.

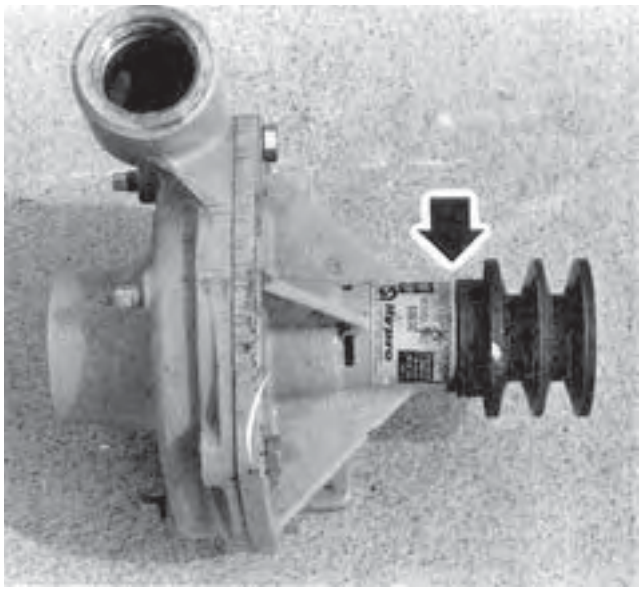

FIGURE 10. Interference between the Pump Housing and Pulley.

Booms: During boom folding and unfolding the castor wheels jammed several times throughout the test. The castor wheels jammed when not positioned as specified in the operator's manual and the castor wheel hydraulic rams moved out of sequence. Damage to the castor wheel crank bell bracket resulted if the jammed castor wheel was not noticed in time. Repairing the bell crank was difficult and if not done properly the castor wheels were difficult to adjust for proper boom trailing.

The hydraulic system was bled and the hydraulic sequence valves adjusted to operate the castor wheel rams simultaneously. The bleeding procedure was difficult, time consuming and provided

only a temporary solution. Towards the end of the field test, Brandt made modifications to prevent the right boom from extending first by installing lock valves at each hydraulic ram. The lock valves and operating the tractor at a high rpm resulted in both castor wheel rams extending at the same rate.

Throughout the test the secondary boom universal joint bolts would loosen and eventually break (FIGURE 11). It is recommended the manufacturer consider modifying the secondary boom universal joints to prevent the bolts from loosening.

FIGURE 11. Loose Secondary Boom Universal Joint.

Trailer: The trailer latch would occasionally bind on the radius arm catch. This resulted in the boom radius arm not being secured to the trailer. Adjusting the cables did not eliminate the problem. In this case, securing the boom radius arm often required manual latching. If the boom radius arm is not secured damage could occur to the entire boom assembly.

APPENDIX I
SPECIFICATIONS

MAKE:	Brandt
MODEL:	Quick Fold 70-830
SERIAL NUMBER:	19761
MANUFACTURER:	Brandt Industries Ltd. 705 Toronto Street Regina, Saskatchewan S4R 8G1
OVERALL DIMENSIONS:	
wheel tread	
-- trailer	
-minimum	7.39 ft (2.25 m)
-maximum	8.15 ft (2.28 m)
-- boom wheels (transport)	7.44 ft (2.27 m)
wheel base	
-- trailer	3.33 ft (1.02 m)
-- transport height	5.67 ft (1.73 m)
-- transport length	46.92 ft (14.3 m)
-- transport width	
-partial	15.96 ft (4.86 m)
-complete	8.83 ft (2.69 m)
-- field height	5.67 ft (1.73 m)
-- field length	16.92 ft (5.16 m)
-- field width	70.29 ft (21.42 m)
-- clearance height	8 in (203 mm)
-- turning radius	37 ft (11.3 m)
TIRES:	
-- trailer	4, 12.5L - 15SL, 8-ply
-- boom	2, 5.00 - 15SL, 4-ply

WEIGHT:

TRANSPORT POSITION

	Empty	Loaded
-- left trailer wheels	1280 lb (576 kg)	5100 lb (2295 kg)
-- right trailer wheels	1300 lb (598 kg)	5290 lb (2380 kg)
-- left boom wheel	430 lb (194 kg)	430 lb (194 kg)
-- right boom wheel	430 lb (194 kg)	430 lb (194 kg)
-- hitch	230 lb (103 kg)	1020 lb (459 kg)
total	3700 lb (1665 kg)	12270 lb (5522 kg)

FIELD POSITION

	Empty	Loaded
-- left trailer wheels	1200 lb (540 kg)	5090 lb (2290 kg)
-- right trailer wheels	1280 lb (576 kg)	5230 lb (2353 kg)
-- left boom wheel	430 lb (194 kg)	430 lb (194 kg)
-- right boom wheel	430 lb (194 kg)	430 lb (194 kg)
-- hitch	360 lb (162 kg)	1090 lb (491 kg)
total	3700 lb (1666 kg)	12270 lb (5522 kg)

SPRAY TANK:	
-- material	plastic
-- capacity	800 gal (3637 L)
-- agitation	hydraulic, 0.156 in (4 mm) orifice agitators
FILLER OPENING:	
-- shape	round
-- size	
-small	4.75 in (121 mm) I.D.
-large	15.76 in (400 mm) I.D.
-- location	top, front
-- height above ground	68 in (1727 mm)
CHEMICAL INDUCTOR:	
-- capacity	20 gal (91 L)
-- strainer	18 mesh
-- opening	
-small	4.75 in (121 mm) I.D.
-large	12.0 in (305 mm) I.D.
-- height above ground	45 in (1143 mm)
STRAINERS:	
-- pump inlet hose	one - 50 mesh
-- nozzle assembly	forty-two - 50 mesh
-- spray tank	one - 18 mesh
PUMP:	
-- make	Hypro
-- model	9203C
-- type	centrifugal
-- operating speed	3760 rpm @ 420 PTO rpm 4797 rpm @ 540 PTO rpm
-- type of drive	belts
CONTROL MONITOR:	
-- make	Spraying Systems Co.
-- model	744
-- pressure gauge	dial, 0-100 psi (0-690 kPa)
SOLENOID VALVES:	
-- make	Spraying Systems Co.
-- model	145
-- size	2, 1 in (25.4 mm) NPT, 12 VDC, 35 watt
SPRAY BOOM:	
-- material	aluminum
-- size	1 in (25.4 mm) Schedule 80
-- height adjustment	
-type	hydraulic
- range	8 to 49 in (203 to 1245 mm)
- angle adjustment	manual, 26° forward
-- nozzle assembly	
-make	Spraying Systems
-type	split-eyelet diaphragm check valve
-number	42
-spacing	20 in (508 mm)
-cap	quick-connect, color coded, self-aligning
-- effective spraying width	70 ft (21.3 m)

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Very Good
Good	Fair
Poor	Unsatisfactory

SUMMARY CHART

BRANDT QUICK FOLD MODEL 70-830 FIELD SPRAYER

RETAIL PRICE:	$13,528.40 (July 1989, f.o.b. Lethbridge)
RATE OF WORK:	42 ac/h (17 ha/h) @ 5 mph (8 km/h)
QUALITY OF WORK:	
Application Rate	depended on tractor speed, nozzle size and pressure
Nozzle Calibration	
- delivery	**very good;** 2.0% high
- coefficient of variation	**very good;** about 1.0%
Spray Distribution	
- without Wind Cones	**good;** acceptable above 84 psi (284 kPa) and very uniform above 42 psi (290 kPa)
- with Wind Cones	**very good;** no effect on distribution
Spray Drift	8% @ 18.6 mph (30 km/h) winds (8001 nozzles)
Pressure	
- loss	**very good;** negligible
- gauge	**very good;** reliable
Straining	**very good;** 50 mesh nozzle strainers were effective
Boom Stability	**good;** reduced boom bounce with suspension castor wheels
Soil Contact Pressure	
- trailer	31 psi (214 kPa)
- castor	20 psi (138 kPa)
EASE OF OPERATION AND ADJUSTMENT:	
Application Rate	**good**
Controls	**good;** agitator and throttle valves had to be adjusted manually
Castor Wheel Adjustments	**good;** trial and error
Maneuverability	**very good;** turning in transport position was easily done
Boom Positioning	**good;** improved with experience
Nozzle Adjustments	**very good;** nozzle height hydraulically controlled
Tank Filling	**good;** took 20 minutes
Chemical Inducting	**fair;** slow
Hitching	**good;** hitch jack was safe and hitch was adjustable
Cleaning	**fair;** strainer or nozzle removal was messy
Draining	**fair;** drain plug not easily accessible
Lubrication	**good;** accessible
PUMP PERFORMANCE:	**very good;** adequate capacity for nozzles and agitation
OPERATOR SAFETY:	normal precautions should be taken when handling chemical
OPERATOR'S MANUAL:	**excellent;** complete
MECHANICAL HISTORY:	secondary boom universal joints would loosen throughout the test, radius arm latch binded, castor wheel bell crank damaged during folding and unfolding

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