Printed: April 1985
Tested at: Lethbridge
ISSN 0383-3445
Group 8b

Evaluation Report 407

Computorspray Model 647 Field Sprayer

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

COMPUTORSPRAY MODEL 647 FIELD SPRAYER

MANUFACTURER:
Australian Agricultural Machinery Group
P.O. Box 157
Belmont, West Australia 6104

DISTRIBUTOR:
Oliver Agricultural Supply
236 - 36 Street North
Lethbridge, Alberta
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RETAIL PRICE:
$9762.00 (April, 1985, f.o.b. Lethbridge, Alberta.)

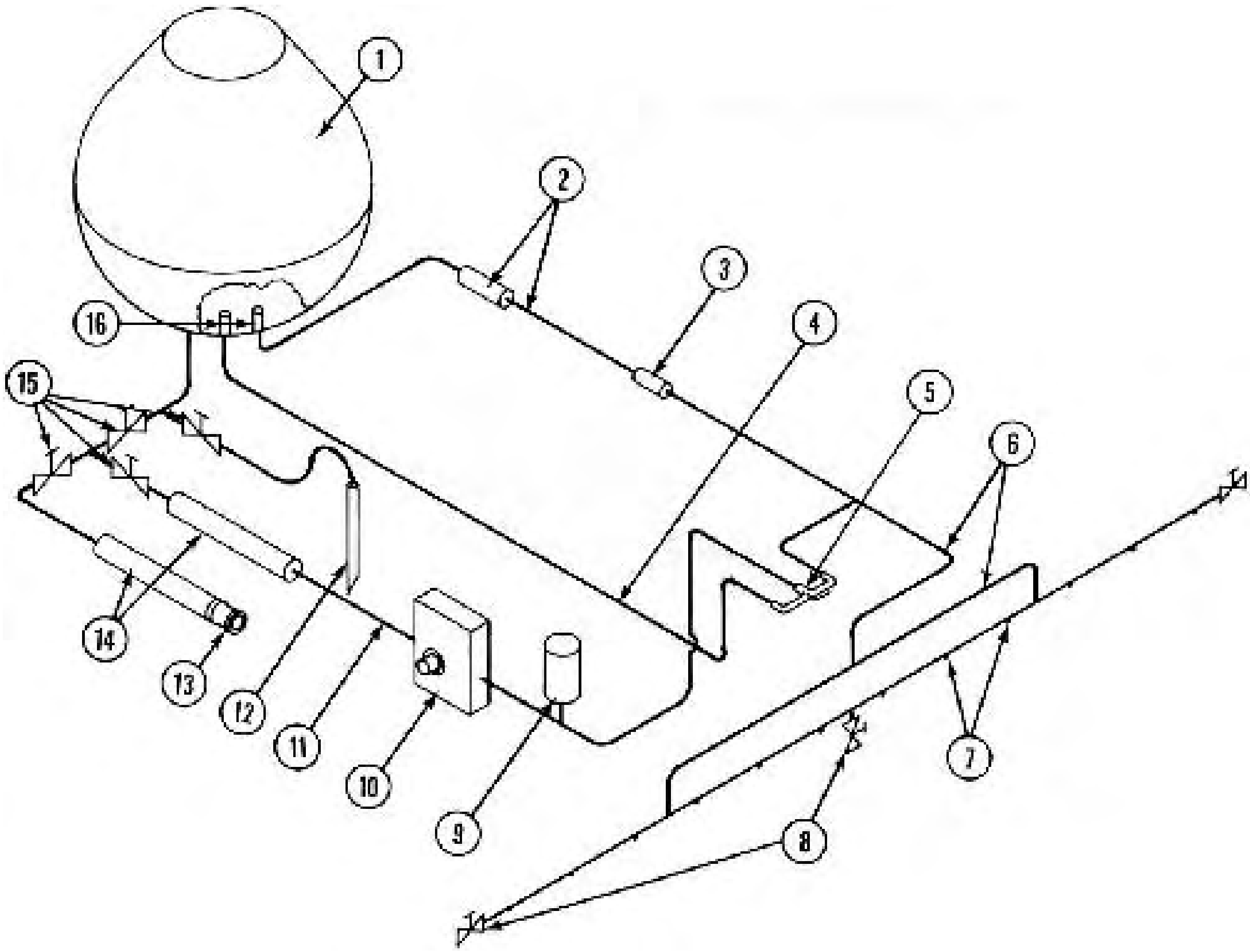

FIGURE 1. System Schematic for Computorspray Model 647 Field Sprayer: (1) Tank,(2) Secondary Agitation Line and Strainer,(3) Check Valve,(4) Primary Agitation Line,(5) Selector Control Valve,(6) Supply Hoses, (7) Nozzles, (8) Sprayline Flush Valves, (9) Air Chamber, (10) Pump, (11) Suction Line, (12) Chemical Inductor, (13) Reload Connection. (14) Strainers, (15) Reload System Control Valves, (16) Agitation Nozzles.

SUMMARY

Weed Control: Weed control, when operating at forward speeds high enough to provide adequate pressure to produce acceptable distribution patterns, was very good and similar to that of other conventional flat fan nozzles normally used on the prairies. Weed control was reduced in and around the sprayer wheel tracks due to spray interference with the trailer frame and due to sprayer wheels travelling over the sprayed area. Spraying at rates reduced from those recommended by the chemical manufacturer requires further research. Preliminary results with Buctril M, under the climatic and growing conditions encountered during the test, indicated acceptable weed control at reduced rates and similar to control obtained with conventional flat fan nozzles. However, faster and more complete weed control occurred at the recommended rate. Timely application and environmental and growing conditions have as great an effect on weed control as the type of sprayer used and the chemical application rate. Spraying at rates other than those recommended by the chemical manufacturer would be at the operator's own risk.

Application Rates: Application rate was changed by using one of four available nozzles sizes in conjunction with various pump drive sprocket combinations. The application rate remained constant over a range of forward speeds since the pump was ground driven. However, operating the sprayer within the normally recommended range of pressures for flat fan nozzles, resulted in only a narrow range of acceptable forward speeds. Changes in tire circumference due to liquid level in the tank and field conditions could result in actual application rates varying up to 6%.

Distribution Patterns: Only a narrow range of forward speeds produced acceptable distribution patterns. At low speeds, nozzle pressures were too low for the flat fan nozzle spray pattern to be fully developed. At higher forward speeds, nozzle pressures became excessive and increased the possibility of spray drift. A pressure gauge should be added to allow monitoring of nozzle pressures over the full range of recommended forward speeds.

Nozzle Delivery: The variability of delivery rates among individual nozzles was low.

Workrate: Average workrate for the Computorspray varied from 20 to 49 ac/h (8 to 20 ha/h) depending on field conditions, operator skill and reload time.

Pump: Since the pump was ground driven, pump output was directly proportional to pump speed and therefore proportional to forward speed. Pump wear was negligible after 82 hours of operation.

Agitation: Agitation was inadequate when compared to normally recommended rates. However, without doing an assessment on the agitation effectiveness, taking into consideration factors such as tank shape, agitator type, size, and location within the tank, no conclusions can be drawn with regard to agitation effectiveness. If chemicals had been allowed to settle out, the Computorspray had to be driven a considerable distance to effectively agitate the entire solution again. This was inconvenient and time consuming.

Nozzle Assemblies: The nozzle assemblies could be fitted with nozzle tips other than Computorspray tips. Nozzle tip changing was inconvenient when compared to quick-attach and self-aligning nozzle caps available on the market. The diaphragm check valves usually stopped dripping when forward travel was stopped.

Controls: The Computorspray was easy to operate with the only two controls being a two way agitate/spray control valve and a rope operated pump drive clutch. There was some difficulty engaging and disengaging the pump clutch when the sprayer was moving.

Boom: Boom height was adjustable but not readily changed. Nozzles could not be angled forward. A 45 degree spraying angle is essential when spraying grassy weeds. The boom suspension quickly stabilized boom movement. The booms were equipped with a convenient “break-away” feature to prevent damage if obstacles were encountered. The booms could easily be placed in either transport or field position in less than four minutes.

Spray Tank: The spray tank was equipped with a reload and chemical inductor system which made adding chemical and water easy and convenient. A nurse tank equipped with an auxiliary pump was required for refilling and flushing. The shape of the tank made it easy to completely empty the tank and solution was provided to the pump in most hilly field conditions.

Strainers: The Computorspray plumbing system was adequately protected with strainers and plugging was infrequent. The thimble strainers in the nozzle assemblies were difficult to remove.

Pressure: No pressure gauge was provided. Operating the sprayer within PAMI’s recommended speed range prevented operation at very low and high pressures. A pressure gauge to indicate nozzle pressure would be convenient, since the operator could adjust forward speed to reach a nozzle pressure where spray distribution and droplet size was adequate.

Foam Marker: The foam marker was a useful aid in reducing overlap and misses and was convenient to-use. Light foamy marks were readily visible in most field conditions. Less foam solution was used and better qualify foam was produced in the afternoons when the water became warmer.

Safety: No serious safety hazards were encountered when operating the Computorspray in accordance with good spraying practice. The chemical induction system was considered a very good safety feature of the Computorspray.

Operator’s Manual: The operator’s manual adequately outlined spraying principles, operation, trouble shooting, maintenance and optional equipment. A parts list was also included.

Mechanical Problems: Only minor mechanical problems were encountered during the test. Engaging the pump clutch while moving, frequently caused the shear pin to break.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Installing a pressure gauge to indicate nozzle pressure.
2. Modifications to allow adjusting of the foam marker controls from the operator’s seat.
3. Modifications to allow engaging and disengaging the clutch more easily.
4. Modifications to make nozzle changing faster and more convenient.
5. Supplying a slow moving vehicle sign as standard equipment.

Senior Engineer: E. H. Wiens

Project Technologists: P. A. Bergen
L. B. Storozynsky

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. A pressure gauge is not fitted on the Computorspray for the following reasons: -Gauges are unreliable and not accurate unless expensive ones are used.
   - Since the sprayer is not adjustable by farmers, we give them no reason to tinker with it.
   - The speed (pressure) range is best when operated near the middle of the range. However, Australian chemical companies find the entire range acceptable and better than over or under applying as would be the case with a fixed speed unit.
   - If a slower speed is required, the next smaller size nozzle can be used as per advice in the manual.
2. Providing foam marker control extensions to allow adjusting from the tractor cab would add considerable cost and is not proposed for the future. Once the air control is set, there is no need for further control. The air stops when the unit stops and starts again when the unit starts. It is only when towing that the foam marker exhausting valve has to be manually opened and then closed again when spraying resumes.
3. It is not proposed to change the rope operated throw-out dog clutch. For proper operation it is necessary to oil the clutch and throw over as indicated in the operator’s manual.
4. The 1986 Computorspray will be equipped with quick-attach nozzle caps which wilt be self-aligning so nozzles are at a slight angle to each other to avoid interference of spray patterns from adjacent nozzles.
5. We are not familiar with “a slow moving vehicle sign”. However, if this is common in Canada, no doubt we can add one to our unit.

GENERAL DESCRIPTION

The Computorspray model 647 is a trailing, boom-type field sprayer equipped with a ground driven pump. The sprayer is mounted on tandem axles, which are secured to the frame with rubber pads. The egg shaped, 500 gal (2270 L), fiberglass tank is mounted in the center of the trailer and is equipped with hydraulic agitation, fluid level indicator and a large filler opening. An operator platform is located in front of the tank to access the filler opening. The spray booms are mounted in front of the spray tank and are supported by cables and tires. The boom has 36 nozzles spaced at 20 in (508 mm), giving a spraying width of 60 ft (18.3 m). Four sizes of nozzles are available. The nozzle assemblies are equipped with diaphragm check valves to prevent spray drip when spraying is stopped. The booms fold back alongside the sprayer for transport. The piston pumps is chain driver from the right sprayer wheel.

The Computorspray is equipped with a reload system, a chemical inductor and a foam marker.

FIGURE 1 identifies the sprayer and liquid system components while detailed specifications are given in APPENDIX I.

SCOPE OF TEST

The Computorspray model 647 was operated for 82 hours in the conditions shown in TABLES 1 and 2 while spraying about 2947 ac (1193 ha). It was evaluated for quality of work, foam marker performance, rate of work, pump performance, ease of operation and adjustment, operator safety and suitability of the operator’s manual.

For field testing, the foam marker was modified to mark at both boom ends.

RESULTS AND DISCUSSION

QUALITY OF WORK

Application Rate and Distribution Patterns: Application rate with the Computorspray was changed by using one of four available nozzles sizes in conjunction with various pump drive sprocket combinations. The application rate, using a given nozzle size, remained constant over a range of forward speeds since the sprayer pump was ground driven. Pump output was directly proportional to forward speed.

The effect of small changes in tire pressure on application rates, under field conditions, was minimal. However, changes in tire circumference from a full to near empty tank and varying field surface conditions could result in actual application rates varying up to 6%.

TABLE 1. Operating Conditions.

Chemical Applied	Crop	Hours	Nozzle Number	Speed		Field Area	
				mph	km/h	ac	ha
Buctril M	Wheat	1	4	5.6	9	27	11
Mataven	Wheat	16	4	8.1	13	469	190
Buctril M	Wheat	1	3	8.1	13	27	11
Hoegrass/Buctril M	Wheat	5	3	7.5	12	151	61
Avenge/Carbyne/2, 4-D	Wheat	5	3	7.5	12	146	60
Avenge/2, 4-D	Wheat	2.5	3	9.3	15	90	36
2, 4-D	Wheat	7	3	7.5	12	222	90
2, 4-D/Furdan	Oats	4.5	3	7.5	12	119	48
Furdan	Wheat	39	3	9.3	15	1662	673
Buctril M	Wheat	1	2	9.3	14	32	13
Total		82				2947	1193

TABLE 2. Field Conditions.

Topography	Hours	Field Area	
		ac	ha
Level	36	1181	478
Undulating	24	830	336
Rolling	22	936	379
Total	82	2947	1193

TABLE 3 shows the manufacturer's application rates for each nozzle size as well as the manufacturer's recommended forward speed range and the resulting range of nozzle pressures. PAMI's recommended range of operating pressures for conventional flat fan nozzles is from 30 to 45 psi (207 to 310 kPa). At pressures below this range, unacceptable nozzle spray patterns and increased droplet sizes occur. Pressures above this range result in an increased number of smaller drops which are susceptible to drift and evaporation. Applying this recommended pressure range to the Computorspray nozzles resulted in a significant narrowing of the speed range for all nozzles (FIGURE 2). For example, the speed range for the number 3 nozzles was reduced from the manufacturer's recommended range of 5 to 11.2 mph (8 to 18 km/h) to a speed range of 8.3 to 10.0 mph (13.4to 16.1 km/h). This speed range could be excessive for a tractor drawn sprayer in rough fields.

TABLE 3. Application Rates, Spraying Speed Ranges and Corresponding Pressure Ranges.

Nozzle Size	Application Rate		Manufacturer's Recommened Spraying Speed Range		Nozzle Pressure Range Corresponding to Speed Range	
	gal/ac	L/ha	mph	km/h	psi	kPa
1*	1.3	15	6.2 - 12.4	10 - 20	14 - 59	95 - 410
2	2.7	30	6.2 - 12.4	10 - 20	13 - 58	90 - 400
3	4.5	50	5.0 -11.2	8 - 18	10 - 56	70 - 385
4	8.9	100	3.1 - 8.1	5 - 13	6 - 48	45 - 330
4*	17.8	200	1.2 - 4.3	2 - 7	4 - 54	25 - 370

*Denotes Optional Kits
Tire Pressure = 18 psi (125 kPa)

FIGURE 3 shows the resulting spray distribution pattern with number 3 nozzles when operating the Computorspray at 5.1 mph (8.3 km/h) (resulting nozzle pressure of 11 psi (75 kPa).The coefficient of variation (CV)[1] of this pattern was 38.1%, with application rates along the boom varying from 1.5 to 8.3 gal/ac (17 to 983 L/ha). The spray distribution pattern at this speed was unacceptable, with high spray concentrations occurring below each nozzle and inadequate coverage between nozzles. Poor patterns of this sort were typical at the lower end of the manufacturer's recommended speed range due to corresponding low nozzle pressures.

Increasing the forward speed to 9.1 mph (14.6 km/h), with a corresponding nozzle pressure of 36 psi (250 kPa), resulted in an improved distribution pattern (FIGURE 4). The CV was reduced to 16.9% with application rates along the boom varying from 2.9 to 6.1 gal/ac (33 to 69 L/ha). The higher forward speed increased nozzle pressure, resulting in more fully developed nozzle patterns and thus improved distribution patterns. Excessively increasing forward speed, however, could result in excessive nozzle pressures which would result in more small droplets which are susceptible to drift. Therefore, only a narrow range of forward speeds produced acceptable distribution patterns.

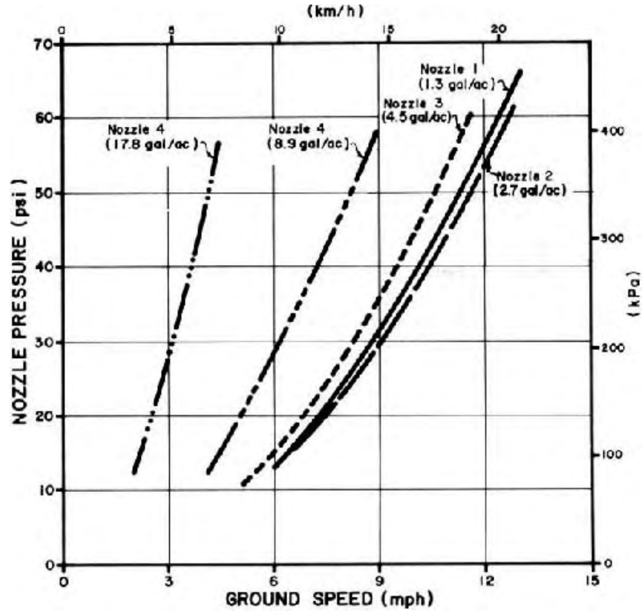

FIGURE 2. Nozzle Pressures over a Range of Forward Speeds for Computorspray Nozzles.

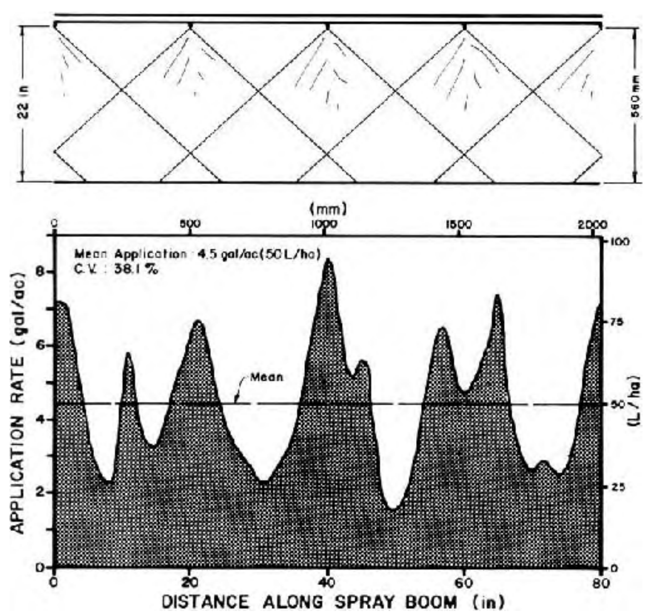

FIGURE 3. Typical Distribution Pattern Along the Boom Using Number 3 Nozzles at 5.1 mph (8.3 km/h) at a 22 in (560 mm) Nozzle Height.

FIGURE 5 shows the spray pattern uniformity for each of the four nozzles when operated over the manufacturer's recommended range of spraying speeds. The distribution patterns were especially poor at the lower recommended spraying speeds. At low forward speeds there was inadequate system pressure to fully develop the individual nozzle spray patterns. In some cases pressure was even too low to open the diaphragm check valves. For example, the number 4 nozzles could not be operated below a spraying speed of 4.0 mph (6.5 km/h) since there was inadequate pressure to open the diaphragm check valves.

[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. For a flat fan nozzle a CV below 10% indicates very uniform coverage while a CV above 15% indicated 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.

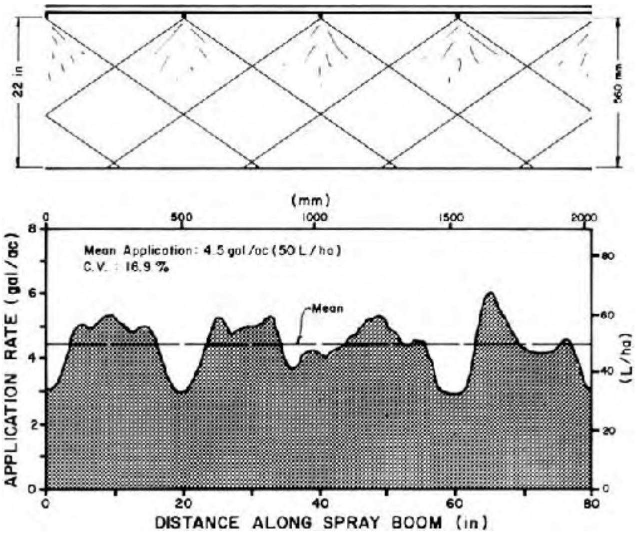

FIGURE 4. Typical Distribution Pattern Along the Boom Using Number 3 Nozzles at 9.1 mph (14.6 km/h) at a 22 in (560 mm) Nozzle Height.

Spray pattern uniformity, in general, was poor when compared with conventional flat fan nozzles.

No pressure gauge was supplied with the sprayer. A pressure gauge, indicating nozzle pressure, would be convenient to allow the operator to adjust forward speed to obtain a nozzle pressure where spray distribution and droplet size would be proper. This would also eliminate the need to remember speed ranges. Therefore, it is recommended that the manufacturer install a pressure gauge to indicate nozzle pressure.

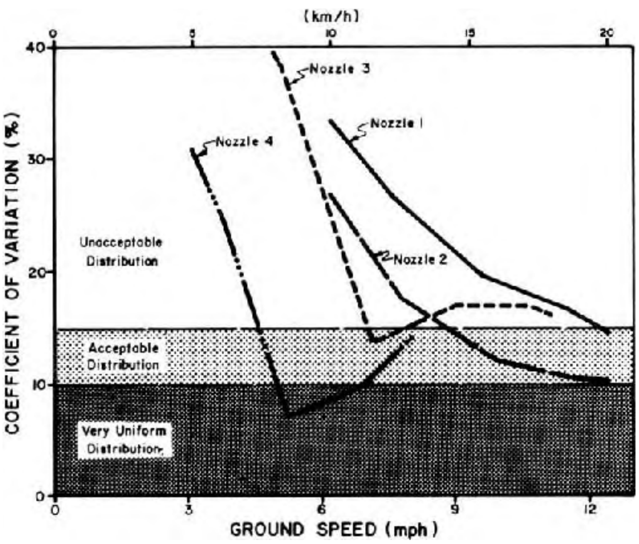

FIGURE 5. Spray Pattern Uniformity over a Range of Forward Speeds for Computorspray Nozzles Operated at a 22 in (560 mm) Nozzle Height.

Weed Control: Field observations indicated that weed control for the Computorspray was reduced in and around the wheel tracks. Previous tests conducted by the Machinery Institute, on other sprayers, have shown that reduced weed control occurred in the wheel tracks where the crop was sprayed in front of the sprayer wheels. Additionally, the trailer frame interfered with the spray from those nozzles located in front of the trailer wheels. This also contributed to the poor weed control in the vicinity of the tire tracks. An experiment was conducted with the Computorspray and conventional flat fan nozzles to evaluate weed control. Both spray systems were used at recommended rates as well as at reduced water and chemical rates. Water rates or application rates were reduced to half and one third of recommended. At each application rate, full and half chemical rates were used. It should be noted that all results are preliminary and based on one year's data. Aisc, only one chemical, namely Buctril M, was used.

At the recommended rate of Buctril M and application rates of 4.5 and 9.0 gal/ac (50 and 100 L/ha) the Computorspray, when operated at speeds where spray patterns were acceptable, completely controlled stinkweed, redroot pigweed and wild buckwheat. Reducing the application rate to 2.7 gal/ac (30 L/ha), at full chemical rate, resulted in good weed control but control was not as complete as at the higher rates. Similar weed control was obtained with conventional flat fan nozzles.

Reducing the chemical rate, still resulted in acceptable weed control, however, faster and more complete weed control occurred at recommended Buctril M rates. The poorest weed control occurred at an application rate of 2.7 gal/ac (30 L/ha) when applied at half the recommended chemical rate. Similar weed control was also obtained with conventional flat fan nozzles.

In summary, preliminary results indicated that weed control with the Computorspray, when operated at speeds where spray patterns were acceptable, was similar to that of conventional flat fan nozzles. Over the many years of PAMI sprayer tests, field observations have indicated that weed control is as dependent upon timely application and environmental and growing conditions at the time of spraying, as it is upon the rates used and the application device or technique being used.

It is proposed to continue the reduced rate study for several more years and also introduce additional chemicals and spraying devices. These results will be discussed in a future PAMI report. It should be cautioned that, until such time as more definitive answers are available on spraying at reduced rates, spraying at rates other than those recommended by the chemical manufacturer will be at the operator's own risk.

Nozzle Calibration: Delivery rates for each set of new nozzles were measured on a test boom to determine the variability among individual nozzle deliveries. The variability in delivery for each of the four sets of nozzles was very low (CV less than 1%). A low CV indicates similar discharge rates for all nozzles in a set while a high CV indicates large variability among individual nozzle deliveries. Although the delivery rate variability among nozzles was very low, this is of little consequence if the distribution patterns are not acceptable.

Spray Drift: There were no tests conducted to evaluate spray drift. Field observations indicated that with the number 2 nozzles, a larger percentage of the total spray volume was susceptible to drift than the number 3 or number 4 nozzles. A more detailed drift study is required to quantify and compare spray drift for various application techniques.

Pressure Losses in Plumbing System: Pressure losses along the Computorspray boom did not significantly affect the variability among individual nozzle delivery rates. The CV of nozzle deliveries for each of the four nozzle sets, when mounted on the sprayer boom, was less than 2%, when new.

Reload Strainer: The Computorspray 647 was equipped with a reload system which has a combination 16/120 mesh strainer located between the reload coupler and the bottom of the tank (FIGURE 1). The strainer effectively removed foreign particles from the water during tank filling. Most of the larger foreign particles flushed back out onto the ground when the filler hose was disconnected from the reload coupler.

Line Strainers: A combination 16/120 mesh strainer similar to the reload strainer was located in the pump suction line and a smaller plastic line strainer of 40 mesh was located in the secondary agitation line (FIGURE 1). Both strainers were effective in removing foreign material.

Nozzle Assemblies: Although the nozzle assembly (FIGURE 6) was designed for use with Computerspray nozzles, other flat fan nozzles could be fitted into the assembly. However, the use of other nozzles would necessitate a pressure gauge to ensure properly developed spray patterns.

The 120 mesh thimble strainers effectively prevented nozzle plugging. The diaphragm check valves located on top of the nozzle assemblies usually stopped dripping from the nozzles when forward travel was stopped.

Boom Stability: Under normal field conditions the booms remained stable. The rubber boom mountings and spring cushioned cable suspension reduced boom movement when operating in rough fields. The boom wheels effectively operated as gauge wheels in most field conditions. When operating through gullies, the boom pivot and suspension allowed the booms to fold back temporarily, preventing boom damage.

Soil Compaction and Crop Damage: The Computorspray trailer wheels travelled over about 2% of the total field area sprayed. The wheel tread width of the trailer was 64 in (1625 mm), corresponding to the wheel tread width on most suitably sized tractors. Crop damage caused by the boom wheels was negligible.

Soil contact pressure beneath the trailer wheels with a full tank was about 23 psi (158 kPa) with a tire track width of 7.2 in (182 mm). For comparative purposes, an unloaded one-half ton truck has a soil contact pressure of about 30 psi (207 kPa).

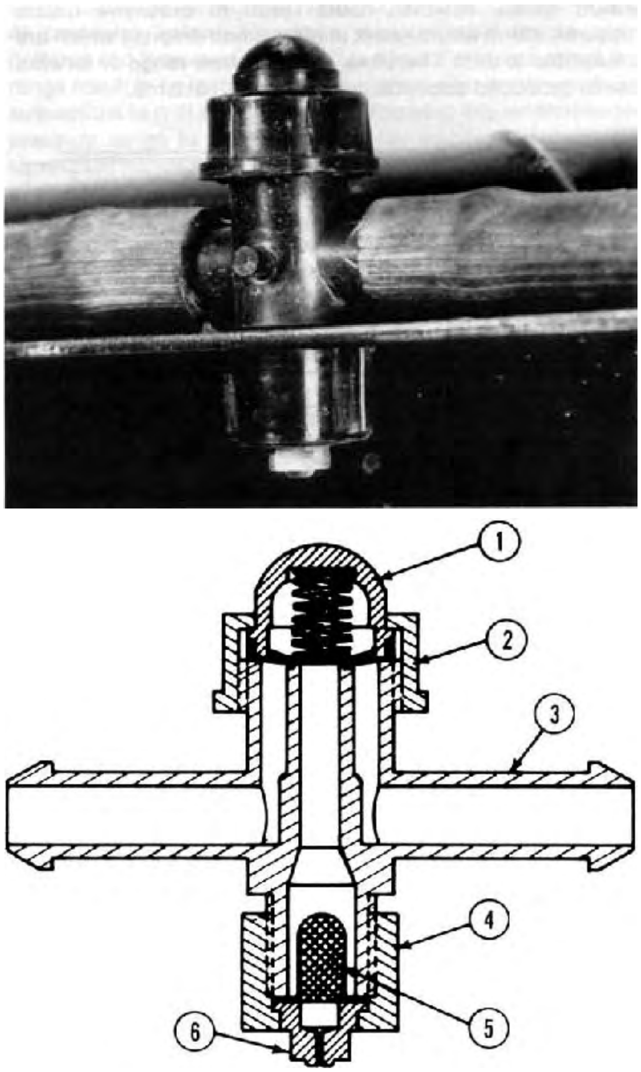

FIGURE 6. Cross section of Nozzle Assembly: (1) Diaphragm Check Valve, (2) Check Valve Nut, (3) Sprayline Connection, (4) Nozzle Nut, (5) Thimble Strainer, (6) Nozzle.

FOAM MARKER PERFORMANCE

Field Operation: The test machine was equipped with an optional foam marker (FIGURE 7). Since the marker only marked on the left boom end, it was only useful in reducing overlaps or misses if the fields were sprayed in a counter-clockwise circular pattern. The foam marks allowed successive passes of the applicator to be properly aligned. Alignment required operator skill and judgement since the boom end was over 30 ft (9.1 m) from the operator.

For this test, the foam marker was modified to mark at both boom ends, to facilitate spraying back and forth across fields.

Controls: An air pump (FIGURE 8), driven from the ground driven countershaft, was used to pressurize and aerate a soap and water solution in the foam tank. The marker was turned off by opening the exhausting valve located in the air pressure line and venting the air. Foam mark spacing was controlled by regulating the amount of air passing through the aerator with a regulating valve located by the tank. The controls were easy to operate and adjust but the operator had to stop spraying and dismount from the tractor to access them. It is recommended the manufacturer make modifications so the foam marker controls can be adjusted from the operator’s seat.

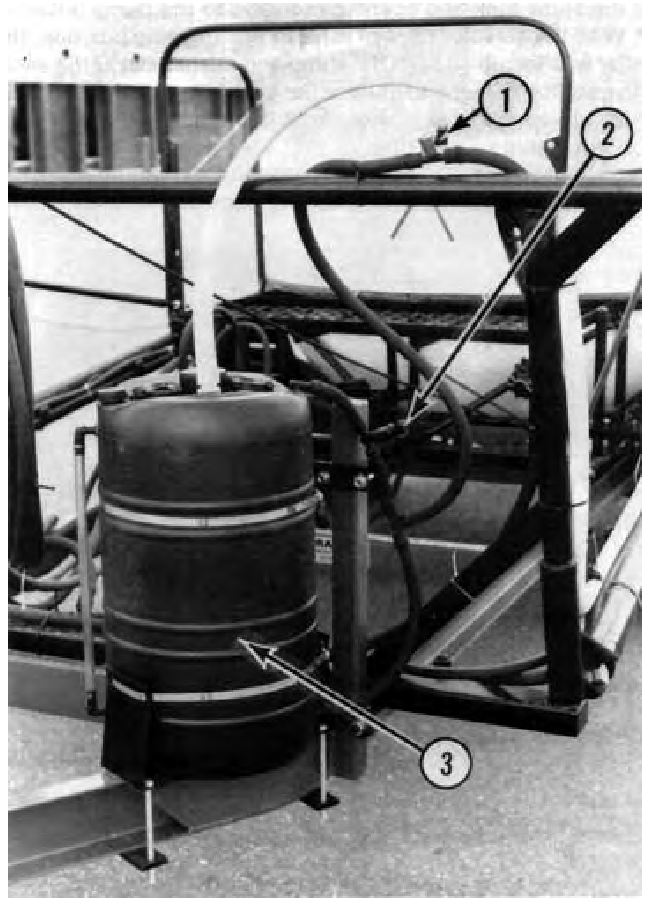

FIGURE 7. Optional Foam Marker: (1) Exhausting Valve, (2) Regulating Valves, (3) Tank.

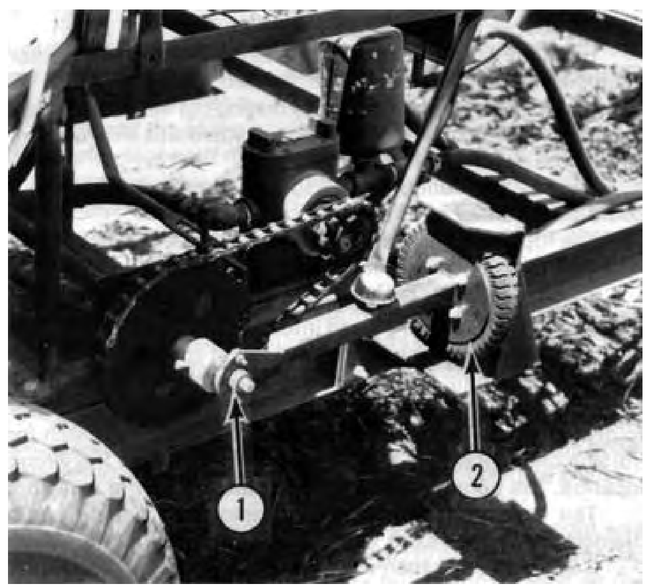

FIGURE 8. Air Pump: (1) Countershaft, (2) Pump.

Filling: The 11.2 gal (51 L) foam tank was easy to fill using a pail and funnel. A fluid level indicator was provided on the foam tank.

Mark Visibility: Mark visibility was dependent on crop height, field surface conditions, mark quality and spacing. Mark visibility was adequate in most field conditions. The foam marks were difficult to see in crops over 8 in (203 mm), especially when spraying in the same direction in which the crop had been seeded. Mark spacing varied considerably at a normal setting. Spacing was usually adequate if the maximum spacings were about 50 ft (15.2 m) or less. Mark length also varied considerably.

Mark Durability: The marks remained visible for well over an hour on cool and cloudy days and for less than 30 minutes in hot, dry and windy conditions. This was adequate when making successive passes. However, when reloading the sprayer the marks could disappear before spraying was resumed.

The quality of foam mark improved only slightly if more than the recommended amount of soap solution was added to the water. Usually about 1 pint (0.57 L) of soap solution per tank of water was adequate. The best foam was obtained with warm, soft water. More soap solution was usually required early in the morning due to the colder water temperature resulting in a lower quality, watery foam mark.

Quantity of Fluid Used: The amount of marking fluid needed depended on desired mark spacing. More fluid was usually used in the morning than in the afternoon. This was because colder water temperature in the mornings resulted in a lower quality, watery foam which emptied from the tank more rapidly than good quality foam. Using more soap solution in the mornings helped slightly.

One tank of soap and water solution was more than adequate for spraying out a tank of chemical solution.

RATE OF WORK

Field Speed: Application rates could be maintained over a wide range of speeds since pump output was proportional to ground speed. However, as has already been discussed, operating in the lower part of the recommended speed ranges is not recommended. During the test, the Compertorspray was operated at speeds up to 9.3 mph (15 km/h) if the field was smooth enough to allow safe tractor operation. Some of the manufacturer's recommended forward speeds would be excessive for rough fields encountered on the prairies.

Average Workrate: The average workrate for the Computorspray field sprayer varied from about 20 to 49 ac/h (8 to 20 ha/h). Considerable variation can be expected due to field conditions, operator skill and tank refill time.

PUMP PERFORMANCE

Priming: The Husky ground driven piston pump supplied with the Computorspray was self priming. The spherical shape of the tank bottom provided the pump with liquid in all topographic conditions encountered during the test. The spray solution in the tank could be completely sprayed out.

Output: The ground driven piston pump operated at speeds from 57 to 428 rpm when the sprayer was operated within the recommended field speeds given in TABLE 3. The piston pump delivery rate was proportional to speed. Pump wear was negligible after 82 hours of operation.

Agitation: Agitation with the Computorspray field sprayer occurred mainly through the turbulence created in the spray tank while filling through the reload system (FIGURE 1). This required the use of an auxiliary supply pump from the nurse tank. Chemical was loaded through the chemical inductor, or through the top filler opening, near the start of refilling in order to allow for maximum agitation.

Primary agitation occurred through the primary agitation nozzle (FIGURE 1) while travelling with the pump engaged and the selector valve in the agitate position. Although the total pump flow was returned to the tank, the agitation rate varied, depending on the application rate sprocket setting and ground speed.

TABLE 4 shows the primary agitation rates at the maximum recommended travel speeds for each application rate setting.

TABLE 4. Maximum Primary Agitation Rates.

Nozzle Number	Application Rate		Maximum Recommended Ground Speed		Maximum Primary Agitation Rate	
	gal/ac	L/ha	mph	km/h	gal/min	L/min
1	1.34	15	12.4	20	2.5	11.2
2	2.67	30	12.4	20	4.4	20.0
3	4.45	50	11.2	18	6.4	29.0
4	8.9	100	8.1	13	9.0	40.7

Secondary agitation occurred through the secondary agitation nozzle while spraying (FIGURE 1). The secondary agitation rate varied little with the application rate setting. At the minimum and maximum recommended spraying speeds of each application rate setting, the agitation rates were about 0.22 gal/min (1 L/min) and 0.51 gal/min (2.3 L/min) respectively.

Primary and secondary agitation rates were very low when compared to normally recommended rates. Without doing a detailed assessment on agitation effectiveness, taking into consideration factors such as tank shape, agitator type, fluid velocity, size and location of nozzles within the tank, no conclusions can be drawn with regard to agitation effectiveness.

No agitation problems were noticed while spraying the same day the tank was filled, when using those chemicals listed in TABLE 1. However, leaving the spray solution over a period of time, due to weather conditions for example, could cause chemicals to settle or come out of suspension. The Computorspray had to be driven a considerable distance to effectively agitate the entire solution again. This was inconvenient and time consuming. Modifications to increase agitation rates would reduce the distance required to re-agitate chemicals. The operator's manual gave an adequate outline of tank loading and agitation procedures.

EASE OF OPERATION AND ADJUSTMENT

Controls: The Computorspray field sprayer controls were very easy to operate. A two way agitate/spray control valve was located at the front of the sprayer (FIGURE 1). The control valve had sufficient hose length so it could be mounted on the tractor.

The pump drive clutch was a rope operated throw-out dog clutch located on the right countershaft sprocket. The clutch was easy to operate when the sprayer was stationary. However, when spraying, it was difficult to disengage the clutch, usually requiring about three attempts. Engaging the clutch while driving was easy but the clutch shear pin would frequently break. The shear pin was easily replaced. Modifications are required to make it easier to disengage the clutch while moving and to engage the clutch without frequently breaking the shear pin.

Application rate was set by using the appropriate nozzle size and pump drive sprocket combination. It took one man about one and one half hours to change the application rate. This was considered inconvenient when compared with the quick-attach and self-aligning nozzle caps available today. Modifications are recommended to make nozzle changing faster and more convenient. A table showing the setup combinations for each application rate was given in the operator's manual. A similar decal was also conveniently located on the right side of the spray tank.

Reload System: The reload system (FIGURE 9) provided a convenient way to refill the tank, load chemical and flush out the plumbing system. The system required the use of an auxiliary, adequately sized, portable pump. The plastic ball valves were difficult to operate, usually requiring the use of two hands. Care had to be exercised to prevent fluid from the spray tank entering the water supply source when starting and finishing refilling. It was, therefore, important to carefully follow the procedure outlined in the operator's manual.

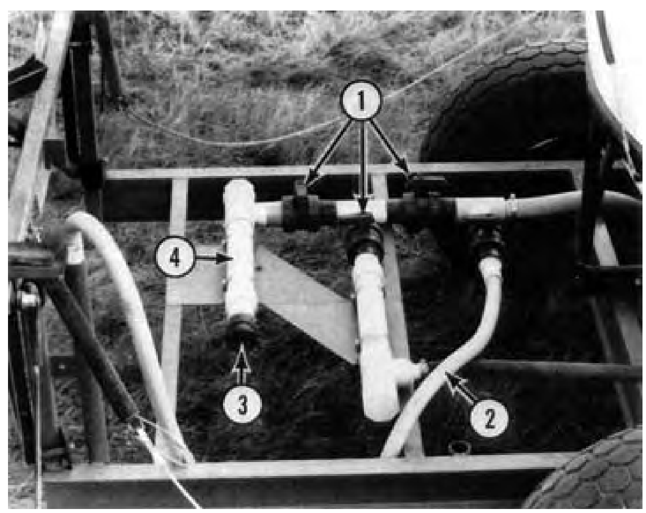

FIGURE 9. Reload and Chemical Inductor Systems: (1) Reload Valves, (2) Inductor Hose, (3) Reload Inlet, (4) Reload Strainer.

Chemical was loaded through the chemical inductor while the spray tank was being refilled with water (FIGURE 1). The chemical inductor was convenient and safe to operate. The inductor shut-off valve was usually not shut off between inducting two chemical containers, due to inconvenient access to the valve. The foaming as a result of the air being inducted into the tank was not a problem as long as air injection was kept to a minimum. The inductor left about 3 fl oz (85 mL) in the bottom on each chemical container. Since refilling the spray tank from the bottom provided the primary agitation, refilling from the top filler opening is not recommended.

The plumbing system was flushed out by closing the valve to the spray tank and opening the valve to the pump (FIGURE 1). With the selector control valve in the spraying position, the water was forced through the pump and flushed out at the small valves at the center and ends of the boom. By closing the small valve the spray pattern of each jet could be checked.

An average reload time for the Computorspray field sprayer was about 30 minutes. Reload time included refilling the spray tank, foam marker tank and loading chemical.

Maneuverability: The Computorspray towed and maneuvered well in both field and transport positions. Care had to be taken not to hit the foam marker tank with the rear tractor tire when making sharp left turns. Visibility to the rear for backing up was obstructed by the spray tank.

Hitching: The sprayer could be easily hitched to a tractor equipped with a clevis type hitch. The hitch stand (FIGURE 10) provided for convenient hitching by driving the sprayer on or off the stand. Raising or lowering the hitch stand was inconvenient since no handle was provided.

FIGURE 10. Hitch Stand.

The selector control valve had sufficient hose length so it could be mounted on the tractor. The rope operating the clutch had sufficient length to be mounted in a convenient location on the tractor.

Transport: The Computorspray sprayer was easily folded into transport (FIGURE 11) or placed into field position in about four minutes. If transporting long distances or at speeds greater than 12.4 mph (20 km/h), the wheel drive chain had to be removed. In field position the boom supports at the rear of the sprayer folded up against the back of the sprayer frame. The catch for holding the supports in their folded position was in the wrong location. The boom supports flopped around during spraying.

The Computorspray required a minimum turning circle diameter of about 46.6 ft (14.2 m) in transport position. Care had to be taken while backing up or transporting on roadways due to obstructed visibility to the rear.

Spray Tank: The 500 gal (2270 L) spray tank was adequate for normal application. Refilling the spray tank from the top filler opening was not recommended since pumping the water into the tank from the bottom provided the required primary agitation. However, the filler opening was large and easily accessible from the operator's platform in front of the tank. The platform was safe to use for loading chemical through the filler opening.

FIGURE 11. Computorspray in Transport Position.

The tank lid clamp was difficult to latch if the clamp was adjusted to hold the lid tight.

If the Computorspray was operated with the spray tank nearly full, the spray solution would splash against the lid, leak out, and down the outside of the tank. This made the outside of the spray tank messy.

The tank liquid level in the indicator tube was visible from the tractor seat with most spraying solutions. The tank frame and pump assembly blocked the operator from seeing the liquid level below a quarter tank. The liquid level numbers painted on the side of the tank gave only a rough indication of the amount of liquid in the tank. The numbers were in litres and indicated about 10% higher than the actual volume.

The spherical shape of the tank bottom provided the pump with liquid in all topographic conditions encountered and made tank draining convenient. The tank was easily drained through the chemical inductor.

Boom Adjustments: The boom support cables were adjustable. The cables were adjusted so the weight of the boom wheels did not exceed 1 lb (0.5 kg). The cables could be adjusted with pliers.

Boom height was not readily changed. Boom height was adjustable from 22 in (560 mm) to 40 in (1015 mm), however this required the boom mounting frame to be repositioned on the trailer frame. The boom wheels were not useful as gauge wheels at boom heights above 22 in (560 mm), however the booms could be set up and operated without the boom wheels.

The nozzles could not be angled forward. This is essential when spraying wild oats or grassy weeds. The booms conveniently folded back while travelling through a gully or when a field object was hit and quickly returned to their normal position once passed. The nozzles and their assemblies were located behind the boom, protecting them from being easily damaged.

Strainers: The large suction line and reload strainers were easily removed for cleaning (FIGURE 1). A large wrench was required. A large bottle brush or compressed air was needed to thoroughly clean the strainers. The smaller plastic strainer in the secondary agitation line was easily removed by hand. If the spray tank was not empty, spray solution would drain back out of the line at the strainer connection. The small strainer could be easily cleaned with the nylon toothbrush provided for cleaning the nozzles.

Nozzles: The thimble strainers were difficult to remove from the nozzle nuts for cleaning or changing nozzles. The strainers required only occasional cleaning if the plumbing system was flushed out daily. The number 3 and 4 nozzles rarely plugged. The number 1 and 2 nozzles were not extensively evaluated in the field.

Lubrication: The Computorspray had 6 grease fittings. The clutch sprocket and the pump required daily greasing. The trailer wheel hubs required only seasonal greasing. The operator's manual also recommended daily oiling of the boom wheels and weekly oiling of the drive chains.

OPERATOR SAFETY

The Computorspray was equipped with an induction system, providing for minimized handling when adding chemical to the tank. This was considered a desirable safety feature.

The Computorspray field sprayer was not equipped with a slow moving vehicle sign or a mounting bracket. It is recommended that a slow moving vehicle sign be supplied as standard equipment.

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 adequately outlined sprayer operation, trouble shooting, maintenance, optional equipment and other useful information. A complete parts list was provided. No specific safety instructions were included.

MECHANICAL PROBLEMS

TABLE 5 outlines the mechanical history of the Computorspray 647 field sprayer during 82 hours of operation while spraying about 2947 ac (1193 ha). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

TABLE 5. Mechanical History.

Item	Operating Hours	Equivalent Field Area ac	(ha)
Spray Tank			
-the tank lid clamp came loose and was repaired at	7, 38.5	173, 1166	(70, 472)
-the tank lid gasket came off and was reglued at	38.5	1166	(472)
Pump Drive			
-the drive wheel chain broke and was repaired at	73.5	2469	(1072)
-the clutch sprocket shear pins broke and were replaced at	7, 11, 16	173, 331, 479	(70, 134, 194)
Plumbing System			
-the air chamber plug was leaking, requiring replacement at		beginning of test	
-several hose and sprayline connections were leaking and the washers were replaced at	3	87	(35)
Transport Boom Supports			
-the foam rubber pad on the right boom support came off and was reglued at	56	1841	(745)
Foam Marker			
-the air pump crank pulled apart and was repaired at	2	54	(22)
-the small hose connection on top of the tank leaked foam and was resealed at	16	455	(184)
-the bottom tank support and clamp were damaged by the rear tractor tire tand were repaired a		end of test	

APPENDIX I
SPECIFICATIONS

MAKE:	Computorspray
MODEL:	647
SERIAL NUMBER:	84085
MANUFACTURER:	Australian Agricultural Machinery Group P.O. Box 157 Belmont, West Australia 6104
OVERALL DIMENSIONS:	
-wheel tread	
-trailer	64 in (1625 mm)
-boom	560 in (14,224 mm)
-wheel base	33 in (840 mm)
-transport height	7.4 ft (2260 mm)
-transport length	30.3 ft (9250 mm)
-transport width	8.4 ft (2550 mm)
-field height	7.4 ft (2260 mm)
-field length	19.7 in (6010 mm)
-field width	59.2 ft (18,040 mm)
-clearance height	1.0 ft (320 mm)
-turning radius	13.5 ft (4120 mm)
TIRES:	4, 9.00 x 13, 6 ply, 18 psi (125 kPa) 2, 2.125 x 20 bicycle tires

WEIGHT: Transport Position	Empty	Loaded
-left trailer wheels	833 lb (375 kg)	3178 lb (1430 kg)
-right trailer wheels	878 lb (395 kg)	3222 lb (1450 kg)
-hitch	378 lb (170 kg)	733 lb (330 kg)
Total	2089 lb (940 kg)	7133 lb (3210 kg)

Field Position	Empty	Loaded
-left trailer wheels	733 lb (330 kg)	3049 lb (1380 kg)
-right trailer wheels	744 lb (335 kg)	3089 lb (1400 kg)
-boom wheels	1 lb (0.5 kg)	1 lb (0.5 kg)
-hitch	611 lb (275 kg)	900 lb (430 kg)
Total	2089 lb (940 kg)	7133 lb (3210 kg)

SPRAY TANK:	
-material	fiberglass
-capacity	500 Imperial gal (2270 L)
-agitation	hydraulic
-shape s	pherical
-saddle	circular support frame
FILLER OPENING:	
-shape	round
-size	16.5 in (420 mm) I.D.
-location	top, center
-height above ground	7 in (2210 mm)
-platform	39 in (990 mm)
-type of seal r	ubber gasket
STRAINERS:	
-primary	1, 16/20 mesh
-suction line	1, 16/120 mesh
-secondary agitation line	1, 40 mesh (approx.)
-nozzle thimbles	36, 120 mesh
PUMP:	
-make	Husky
-type	piston
-operating speed	57 to 428 rpm
-type of drive	chain, ground driven
-drive protection	sprocket arrangement matched to nozzle size, throwout clutch shear pin
CONTROLS:	
-pump drive clutch	rope operated throw-out clutch
-agitate/spray control	directional control valve, brass
-bottom fill system valves	3, ball valves, plastic
-chemical injector valve	1, ball valve, plastic
BOOMS:	
-material	steel
-shape	formed tubing, 3.5 in (90 mm) O.D.
-mounting	rubber pads
-suspension	cable and spring
-height adjustment	22 to 40 in (560 to 1015 mm)
-angle adjustment	none
-supply hose	1 in (25.4 mm) rubber
-boom hoses	1/2 in (12.7 mm) rubber
-effective spraying width	60 ft (18.3 m)
-boom protection	booms readily fold back and up
NOZZLE ASSEMBLIES:	
-number	36
-material	nozzle bodies - plastic nozzles - brass
-check valves	spring loaded diaphragm
-spacing	20 in (508 mm)
-nozzle sizes	Number 1 - 1.3 gal/ac (15 L/ha) Number 2 - 2.7 gal/ac (30 L/ha) Number 3 - 4.5 gal/ac (50 L/ha) Number 4 - 8.9 gal/ac (100 L/ha)
LUBRICATION POINTS:	
-pump	1
-clutch	1
-chains	2
-wheel bearings	4
-boom wheels	2

APPENDIX II
MACHINE RATINGS

The following rating scale is used in PAMI Evaluation Reports:

Excellent	Very Good
Good	Fair
Poor	Unsatisfactory

APPENDIX III
CONVERSION TABLE

acres (ac) x 0.40	= hectares (ha)
feet (ft) x 0.305	= metres (m)
horsepower (hp) x 0.75	= kilowatts (kW)
Imperial gallons (gal) x 4.55	= litres (L)
Imperial gallons per acre (gal/ac) x 11.23	= litres/hectare (L/ha)
inches (in) x 25.4	= millimetres (mm)
inches water gauge (in wg) x 249.1	= pascals (Pa)
miles/hour (mph) x 1.61	= kilometres/hour (km/h)
pounds force per square in(psi) x 6.89	= kilopascals (kPa)
pounds mass (lb) x 0.45	= kilograms (kg)

SUMMARY CHART
COMPUTORSPRAY MODEL 647 FIELD SPRAYER

RETAIL PRICE:	$9762.00 (April, 1985, f.o.b. Lethbridge)
QUALITY OF WORK:	
Weed Control	
recommended rates	**very good,** complete control, similar to that of conventional flat fan nozzles normally used on the prairies **fair,** in the vicinity of the sprayer wheels
low water rates	**good,** however not as complete
low chemical rates	acceptable, although control was slow and not complete; results depend on timely application, climatic and growing conditions
Application Rate	remained constant over a range of forward speeds
Distribution Patterns	**poor,** at low speeds; good, at highspeeds
Strainers	effective
FOAM MARKER PERFORMANCE:	useful aid
RATE OF WORK:	
Speed	up to 9.3 mph (15 km/h)
Workrate	20 to 49 ac/h (8 to 20 ha/h)
PUMP PERFORMANCE:	
Output	proportional to ground speed
Agitation	lower than normally recommended rates
EASE OF OPERATION AND ADJUSTMENT:	
Controls	control valve was simple and easy to use disengaging the pump clutch was difficult
Application Rate	changing rates was time consuming
Refilling	easy and convenient; required an auxiliary pump
Hitching	easy
Transporting	easily folded into transport or placed into field position
Spray Tank	easily emptied
Boom	adjusting boom height was inconvenient; nozzles could not be angled forward
OPERATOR SAFETY:	safe normal precautions should be taken when handling chemical
OPERATOR'S MANUAL:	complete, including parts list
MECHANICAL PROBLEMS:	clutch shear pin broke frequently when engaging the pump

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