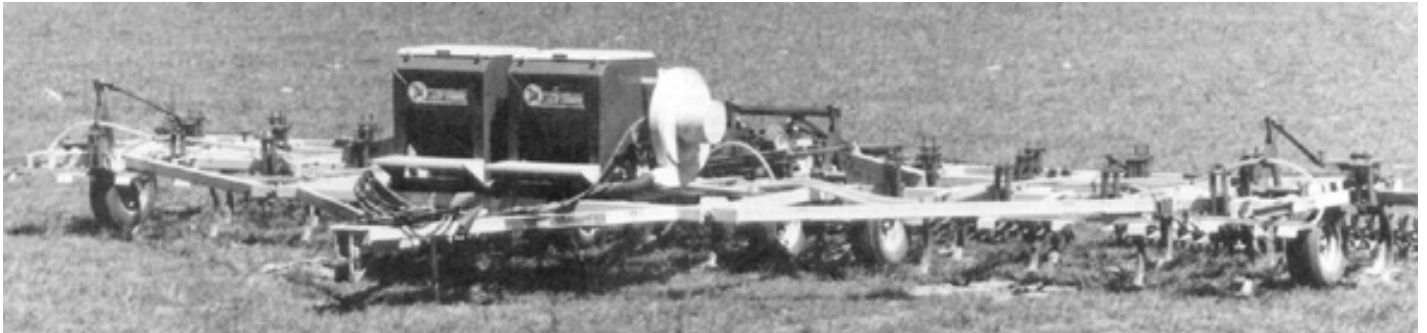


Evaluation Report

457



Beline Comptaire Granular Applicator

A Co-operative Program Between



ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE

PAMI

PRAIRIE AGRICULTURAL MACHINERY INSTITUTE

BELINE COMPUTAIRE GRANULAR APPLICATOR

MANUFACTURER AND DISTRIBUTOR:

Beline Manufacturing Company Limited
Box 1840
Kindersley, Saskatchewan
S0L 1S0

RETAIL PRICE:

\$8106.00 (November, 1985, f.o.b. Lethbridge, Alberta)

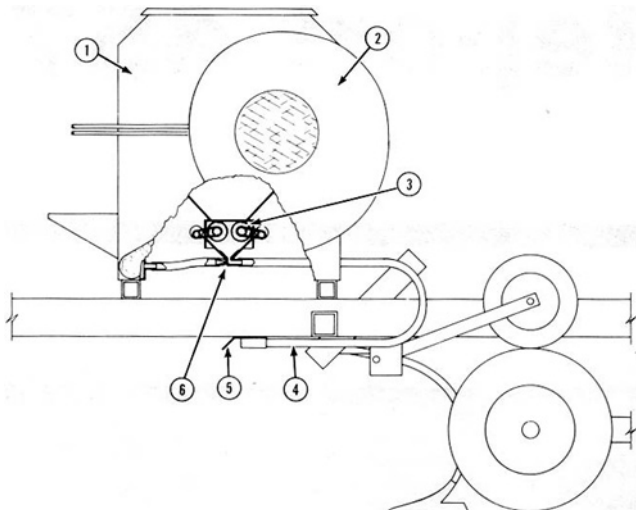


FIGURE 1. Schematic View of Beline Computaire Granular Applicator Mounted on Cultivator: (1) Hopper, (2) Fan, (3) Meter Feed Rotors, (4) Outlet Hose, (5) Deflector, (6) Venturi.

SUMMARY

Meter Calibration: The manufacturer's metering system calibration charts using the original hopper bottoms were about 19% low for Avadex BW and 11-51-00 fertilizer and about 8% low for Treflan QR5 and Heritage 5G over the normal range of application rates. An updated and improved set of hopper bottoms was supplied for retest. The manufacturer's metering system calibration charts using the second set of hopper bottoms were about 4% low for Avadex BW and from 4 to 12% high for Treflan QR5 over the normal range of application rates.

Metering Uniformity: Delivery rates across the machine width were uniform. Delivery rate from individual metering outlets of the original hopper bottoms varied from 13.1 to 18.9 lb/ac (14.7 to 21.2 kg/ha) when applying Avadex BW at 15.4 lb/ac (17.3 kg/ha) and 5 mph (8 km/h), resulting in a CV of 9.5%. Delivery rates from the individual metering outlets of the second set of hopper bottoms varied from 11.0 to 13.6 lb/ac (12.3 to 15.3 kg/ha) when applying Avadex BW at 12.1 lb/ac (13.6 kg/ha) and 5 mph (8 km/h), resulting in a CV of 5.6%. The variability in delivery rates from individual orifices was similar over the normal range of application rates.

Distribution Uniformity: Distribution uniformities using the original set of hopper bottoms were unacceptable for all granular products tested. Distribution uniformities improved slightly with the second set of hopper bottoms. Increasing the length of straight hose preceding the deflector plates did not improve distribution pattern uniformity. Variations in deflector plate discharge height, application rates and fan speed did not seriously influence distribution uniformity.

Effect of Field Variables: Field bounce, field side slopes or level of material in the hopper did not affect

metering rates. Application rate was independent of forward speed.

Mounting on Tillage Tool: The Beline Computaire mounted easily on a Friggstad 39 ft (11.9 m) heavy duty cultivator. It took 2 people about 4 hours to initially mount the Computaire. No problems occurred when transporting the cultivator and Computaire.

Hoppers: The hoppers were convenient to fill with an auger. Manual loading was not as convenient. Each hopper held about 620 lb (282 kg) of Avadex BW. The hoppers emptied uniformly but were inconvenient to clean. The hoppers were weathertight. No moisture entered the hoppers during the test.

Ease of Operation and Adjustment: Application rate was easily set by entering the appropriate information in the electronic computer controller. The meters could be controlled from the tractor cab. There was no meter rotation indicator. The fan speed could be adjusted by adjusting the hydraulic oil flow rate, however, there was no fan speed indicator.

Operator Safety: The Computaire was safe to operate provided normal safety procedures were followed. All moving parts were well shielded.

Operator's Manual: The operator's manual clearly outlined applicator operation, maintenance and set up and contained a well-illustrated comprehensive parts list. All calibration charts supplied were in Imperial units of measure.

Mechanical Problems: No mechanical problems occurred during the 60 hours of testing.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Modifications to provide convenient hopper clean out.
2. Providing a meter shaft rotation indicator.
3. Supplying a fan speed indicator.

Manager/Senior Engineer: E. H. Wiens

Project Engineer: M. V. Eliason

THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. When thorough cleaning of the hopper is desired, the entire metering channel assembly can be released by means of over-centre latches. The chemical can be caught in a tarpaulin. A clean-out door is being considered for future Beline models.
2. A metering shaft rotation monitor is being investigated as an accessory option. All Beline controls monitor motor rotation.
3. A manifold pressure monitor is available as an option. This will indicate any loss in manifold pressure due to the air duct becoming disconnected or a drop in fan speed.

MANUFACTURER'S ADDITIONAL COMMENTS

The calibration procedure for the metering channels has been revised. This improvement is reflected in the test results for the updated metering channels.

GENERAL DESCRIPTION

The Beline Computaire is an implement mounted granular applicator designed for tillage implements up to 54 ft (16.5 m) in width. Granules are metered from two 15 ft³ (0.43 m³) hoppers through holes located in the hopper bottoms. Granules are released into 24 venturi assemblies by two meter feed rotors. A hydraulically driven fan located at the side of the hoppers provides air which pneumatically conveys granules from the venturies to 24 outlet hoses. Granules from each hose are spread by deflectors located across the width of the implement. The deflectors can be spaced at 24 or 27 in (610 or 686 mm), resulting in spreading widths up to 54 ft (16.5 m).

Application rate is controlled by adjusting the feed rotor speed. Two 12 volt electric motors located on the side of the hopper bottoms drive the feed rotors. Feed rotor speed is set with a computer controller located in the tractor cab. A speed sensor wheel, driven off an implement tire, provides forward speed input to the computer controller. Stopping the rotors or lifting the cultivator, which in turn raises the speed sensor wheel, stops the application. Fan speed is controlled by a hydraulic flow control valve.

The computer control console contains keys which include "go", "stop", "zapper on", "zapper off", "sel", "up" and "dn". "Motor" keys provide individual on-off control for up to five meter feed rotor motors. A digital display is provided for monitoring system information. Power to the computer controller is controlled by two switches located on top of the console.

Optional hopper bottoms with larger metering holes are available for applying granular fertilizer.

The test machine was mounted on a 39 ft (11.9 m) Friggstad heavy duty cultivator using a 24 in (610 mm) deflector spacing.

FIGURE 1 shows a schematic view of the hoppers while detailed specifications are given in APPENDIX 1.

SCOPE OF TEST

The Beline Computaire applicator was operated for about 60 hours while spreading Avadex BW on 600 ac (243 ha) and Treflan QR5 on 560 ac (227 ha).

The applicator was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual. Metering and distribution accuracy and the effect of field and machine variables on metering and distribution were evaluated in the laboratory.

A second set of updated and improved hopper bottoms and a new computer controller were also evaluated for metering and distribution uniformity in Avadex BW and Treflan QR5.

RESULTS AND DISCUSSION

QUALITY OF WORK

Calibration Accuracy: The original metering system was calibrated in the laboratory with Avadex BW, Treflan QR5, Heritage 5G and 11-51-00 fertilizer. The manufacturer's original computer controller calibration for Avadex BW and 11-51-00 fertilizer was about 19% low over the normal range of application rates. The manufacturer's original computer controller calibration for Treflan QR5 and Heritage 5G was about 8% low over the normal range of application rates.

Meter calibrations for the second set of hopper bottoms and computer controller were obtained for Avadex BW and Treflan QR5. Improved metering calibrations were obtained. The manufacturer's calibration for Avadex BW was about 4% low over the normal range of application rates. The manufacturer's calibration for Treflan QR5 varied from 12% high at 12.4 lb/ac (14.0 kg/ha) to 4% high at 22.1 lb/ac (24.8 kg/ha). Although metering calibrations for new fertilizer hopper bottoms and the new controller were not obtained for 11-55-00 fertilizer, it is assumed improved calibrations could also be obtained for fertilizer. Application rates were not seriously affected by field roughness, field slopes, or level of material in the hopper.

Since the speed sensor wheel measured forward speed, for input into the computer controller, application rate was independent of forward speed. This was considered a desirable feature, since application rate remained constant, regardless of forward speed.

Metering Uniformity: Delivery rates across the width of the machine were uniform for all granular materials used throughout the test. FIGURE 2 shows typical delivery rates from 24 metering outlets of the original hopper bottoms while applying 15.4 lb/ac (17.3 kg/ha) of Avadex BW at 5 mph (8 km/h). Application rates from individual outlets varied from 13.1 to 18.9 lb/ac (14.7 to 21.2 kg/ha), resulting in a coefficient of variation¹ of 9.5%. The variability in delivery rates from individual outlets was similar over the normal range of application rates.

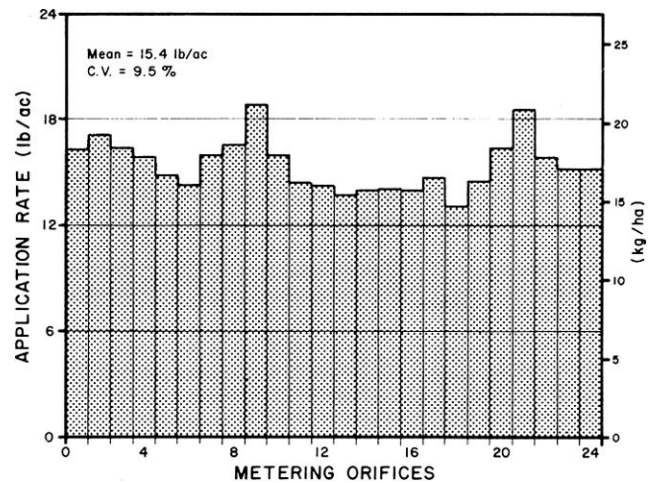


FIGURE 2. Typical Variation in Delivery Rates from Individual Outlets with the Original Set of Hopper Bottoms while Applying Avadex BW at 15.4 lb/ac (17.3 kg/ha) and 5 mph (8 km/h).

When using the second set of hopper bottoms, metering uniformity improved. FIGURE 3 shows typical delivery rates from the 24 metering outlets of the second set of hopper bottoms when applying 12.1 lb/ac (13.6 kg/ha) of Avadex BW at 5 mph (8 km/h). Application rates varied from 11.0 to 13.6 lb/ac (12.3 to 15.3 kg/ha), resulting in a coefficient of variation of 5.6%. The variability in delivery rates from individual outlets was similar over the normal range of application rates.

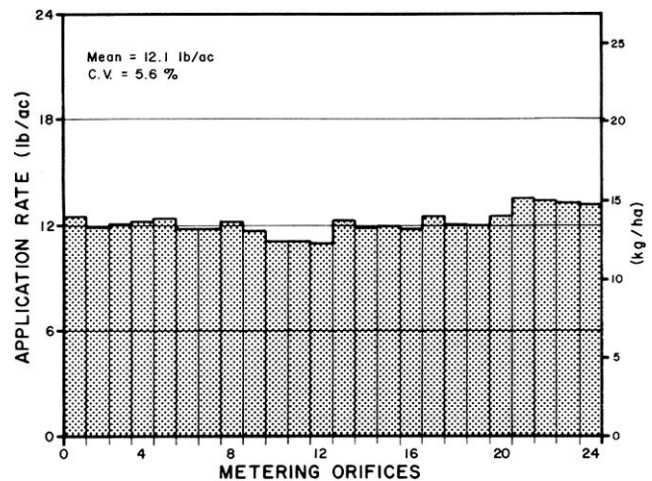


FIGURE 3. Typical Variation in Delivery Rates from Individual Outlets with the Second Set of Hopper Bottoms when Applying Avadex BW at 12.1 lb/ac (13.6 kg/ha) at 5 mph (8 km/h).

¹The coefficient of variation (CV) is the standard deviation of the application rates expressed as a per cent of the mean application rate. A low CV represents uniform application whereas a high CV indicates non-uniform application. One granular herbicide manufacturer has suggested that the CV should be no greater than 10%. A CV of 10% is used throughout this report as a dividing point between acceptable and unacceptable uniformity.

FIGURE 4 shows typical delivery rates from 24 metering outlets when applying 81 lb/ac (91 kg/ha) of 11-51-00 fertilizer using the optional fertilizer hopper bottoms. Application rates from individual outlets varied from 68 to 91.5 lb/ac (77 to 103 kg/ha), resulting in a coefficient of variation of 7.0%. The variability in delivery rates from individual outlets was similar over the normal range of application rates.

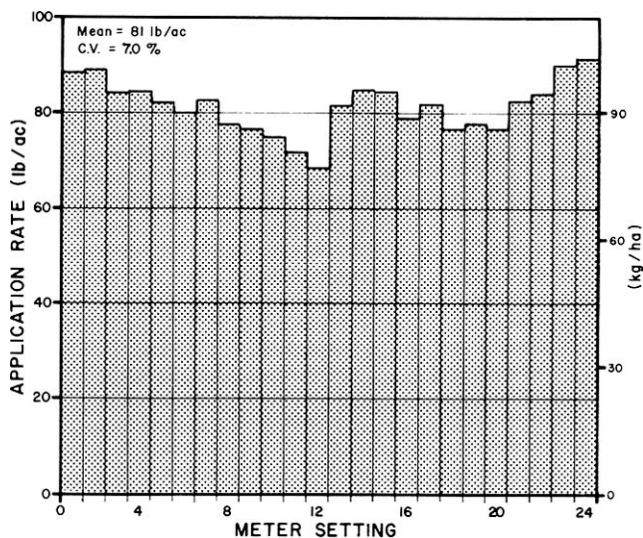


FIGURE 4. Typical Variation in Delivery Rates from Individual Outlets when Applying 11-51-00 Fertilizer at 81 lb/ac (91 kg/ha) and 5 mph (8 km/h).

Spreading Uniformity: Granules delivered by the 24 outlets were pneumatically conveyed across the width of the machine and were discharged onto deflector plates (FIGURE 5). The deflector plates could be spaced at 24 or 27 in (610 or 686 mm) intervals, depending on the width of the tillage implement. Recommended deflector plate discharge height was 24 in (610 mm).

The deflector plates could be mounted either horizontally or vertically, depending on the mounting requirement of the particular tillage implement. When the deflectors were mounted horizontally at a 24 in (610 mm) spacing and a 24 in (610 mm) discharge height, satisfactory distribution pattern uniformity (i.e. CV less than 10%) could not be obtained with the original hopper bottoms. Increasing the deflector spacing to 27 in (686 mm) did not improve distribution uniformity. When the deflectors were mounted vertically, distribution uniformity was also unsatisfactory for all deflector plate spacings tested. Deflector plate discharge height, application rate and fan speed did not seriously influence distribution uniformity.

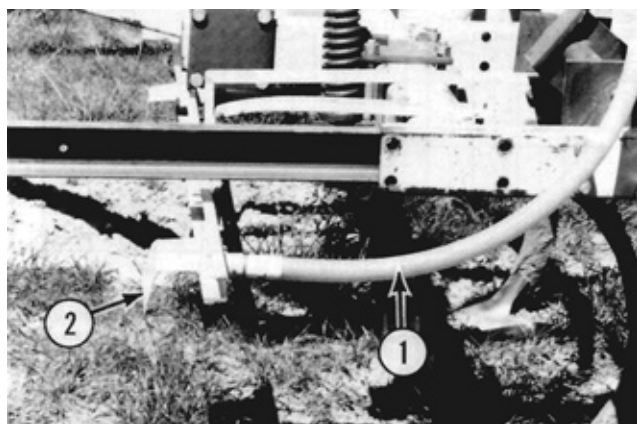


FIGURE 5. Distribution System: (1) Outlet Hose, (2) Deflector Plate (Mounted Horizontally).

FIGURE 6 shows a typical distribution of Avadex BW using the original hopper bottoms when applying 13.1 lb/ac (14.7 kg/ha) at 5 mph (8 km/h) using a 24 in (610 mm) deflector spacing and a 24 in (610 mm) discharge height. Application rates varied from 8.6 to 16.6 lb/ac (9.7 to 18.6 kg/ha) across the spreading width, resulting in a CV of 10.9%, only slightly above the desired CV of 10% or less. Spreading uniformity of Avadex BW was not influenced by the application rate over the normal range of application rates.

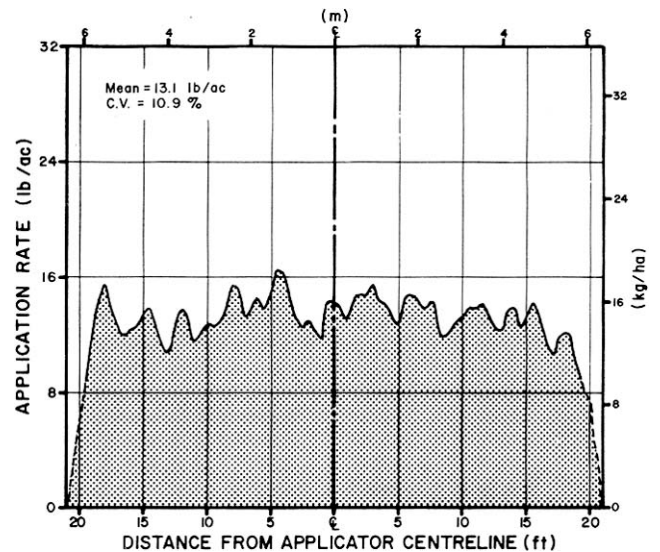


FIGURE 6. Typical Distribution Pattern using the Original Hopper Bottoms when Applying 13.1 lb/ac (14.7 kg/ha) of Avadex BW at 5 mph (8 km/h) using a 24 in (610 mm) Deflector Spacing and a 24 in (610 mm) Deflector Discharge Height.

FIGURE 7 shows a typical distribution pattern of Treflan QR5 using the original hopper bottoms when applying 20.4 lb/ac (22.9 kg/ha) at 5 mph (8 km/h) using a 24 in (610 mm) deflector spacing and 24 in (610 mm) deflector discharge height. Application rates varied from 13.1 to 27.1 lb/ac (14.7 to 30.4 kg/ha) across the spreading width, resulting in a CV of 13.4%. Distribution uniformity was not influenced by the application rate over the normal range of application rates.

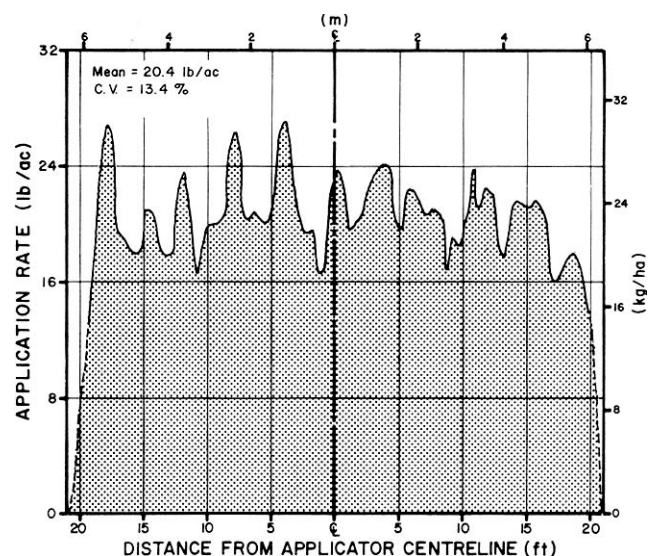


FIGURE 7. Typical Distribution Pattern using the Original Hopper Bottoms when Applying 20.4 lb/ac (22.9 kg/ha) of Treflan QR5 at 5 mph (8 km/h) using a 24 in (610 mm) Deflector Spacing and a 24 in (610 mm) Deflector Discharge Height.

The effect on distribution uniformity of hose length and position with respect to the deflector plate was also evaluated. The distribution patterns in FIGURE 6 and 7 represent patterns

which could be expected with hoses positioned like they would be when the Beline Computaire was mounted on a cultivator. Using longer lengths of straight hose before each deflector plate did not result in improved distribution uniformity. For example, FIGURE 8 shows a typical distribution pattern using the original hopper bottoms while applying Treflan QR5 at 20.7 lb/ac (23.2 kg/ha), at 5 mph (8 km/h) and using 72 in (1830 mm) of straight outlet hose before each deflector plate. Application rates varied from 16.0 to 30.7 lb/ac (17.9 to 34.4 kg/ha) across the spreading width, resulting in an unacceptable distribution pattern with a CV of 13.3%.

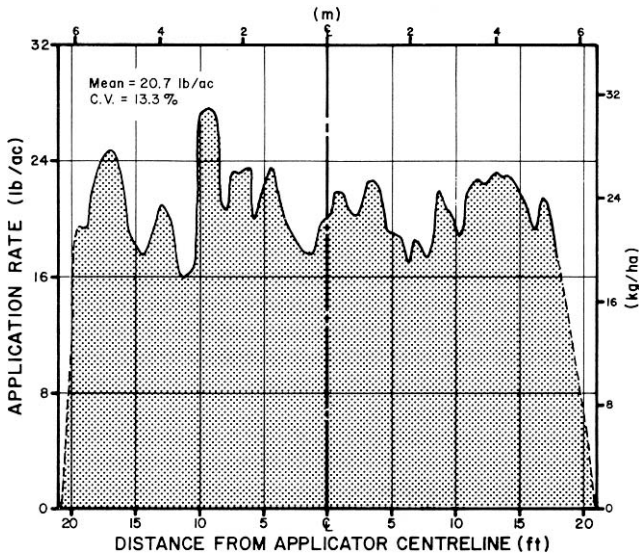


FIGURE 8. Typical Distribution Pattern with 72 in (1830 mm) of Straight Outlet Hose Before Each Deflector, when Applying 20.7 lb/ac (23.2 kg/ha) of Treflan QR5 at 5 mph (8 km/h) using a 24 in (610 mm) Deflector Spacing and a 24 in (610 mm) Deflector Discharge Height and the Original Hopper Bottoms.

FIGURE 9 shows a typical distribution of Avadex BW using the second set of hopper bottoms when applying 13.7 lb/ac (15.4 kg/ha) at 5 mph (8 km/h) using a 24 in (610 mm) deflector spacing and a 24 in (610 mm) discharge height. Application rates varied from 9.5 to 16.4 lb/ac (10.6 to 18.4 kg/ha) across the spreading width, resulting in an improved CV of 9.3%.

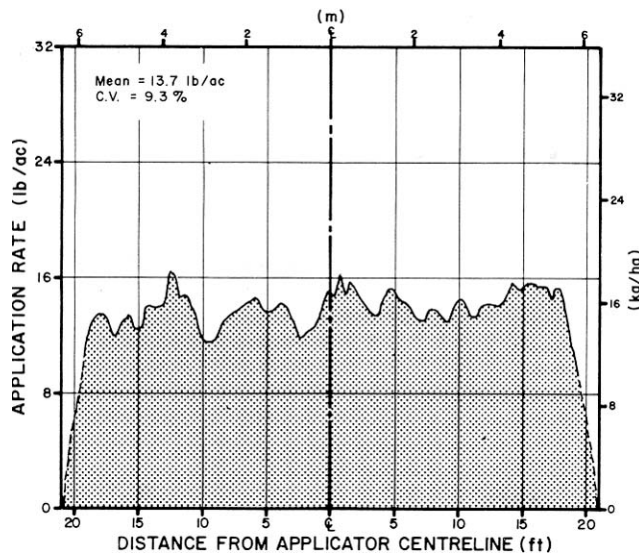


FIGURE 9. Typical Distribution Pattern using the Second Set of Hopper Bottoms when Applying 13.7 lb/ac (15.4 kg/ha) of Avadex BW at 5 mph (8 km/h) using 24 in (610 mm) Deflector Spacing and a 24 in (610 mm) Deflector Discharge Height.

FIGURE 10 shows a typical distribution of Treflan QR5 using the second set of hopper bottoms when applying 15.9 lb/ac (17.9 kg/ha) at 5 mph (8 km/h) using a 24 in (610 mm) deflector spacing and a 24 in (610 mm) discharge height. Application rates varied from 11.5 to 20.2 lb/ac (12.9 to 22.6 kg/ha) across the spreading width, resulting in a CV of 11.7%.

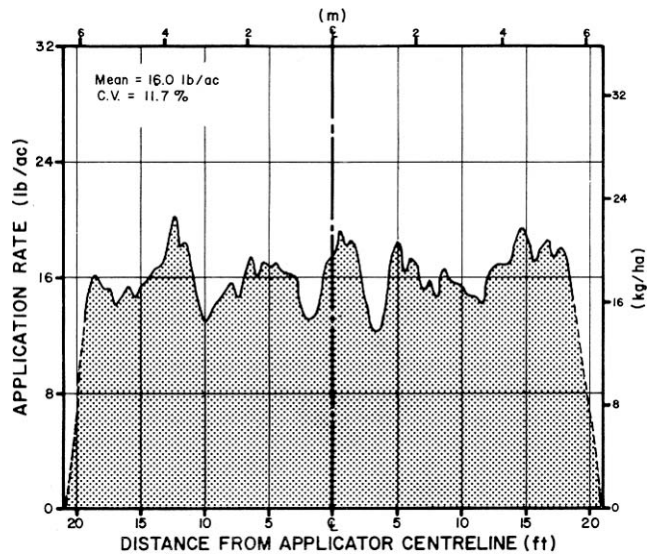


FIGURE 10. Typical Distribution Pattern using the Second Set of Hopper Bottoms when Applying 15.9 lb/ac (17.9 kg/ha) of Treflan QR5 at 5 mph (8 km/h) using 24 in (610 mm) Deflector Spacing and a 24 in (610 mm) Deflector Discharge Height.

The distribution patterns shown in FIGURES 6 to 10 represent operation on smooth level fields on calm days. High winds could result in patterns different than those shown. Deflector height variation due to rough fields was not a problem with the cultivator mounted applicator.

Distribution in the direction of travel was uniform with no detectable surging.

EASE OF OPERATION AND ADJUSTMENT

Mounting the Applicator: Mounting the Beline Computaire on a Friggstad heavy duty cultivator (FIGURE 11) took 2 people about 4 hours. Removal and subsequent mounting would take less time. The applicator was easily mounted using the bar clamps provided. The deflectors were spaced at 24 in (610 mm) and at a 22 in (560 mm) discharge height resulting in a 40 ft (12.2 m) spreading width. Although 5 deflector mounting bars were provided, only 4 were required. The deflector bars were mounted using the hanger straps and bar clamps provided.

The manufacturer supplied 450 ft (137 m) of plastic distribution tubing. This was ample to mount the Beline Computaire on the Friggstad heavy duty cultivator. Distribution tubes were secured to the deflectors with screws.

The hydraulic hoses supplied with the Beline Computaire were of ample length for use with the Friggstad heavy duty cultivator. Required hydraulic hose length will depend on the particular tillage implement and the hopper mounting location.

Sufficient electrical wiring was supplied for the meter feed rotor electric motors. The wiring was easily installed. The computer control was easily mounted in the tractor cab.

Transporting: The Beline Computaire could be easily folded into transport or unfolded into field position. Care had to be taken during initial mounting and assembly to eliminate any interference between the cultivator and discharge tubing.

Hoppers: The hoppers were convenient to fill with an auger. Loading by hand was not as convenient. The operator had to walk over the frame of the cultivator. Steps were mounted on the front of the hoppers to aid filling. A mesh screen in the

hopper openings prevented foreign material such as paper from entering the hopper.

The hoppers held about 1240 lb (564 kg) of Avadex BW which was sufficient to apply granules to about 104 ac (42 ha), before refilling, when applying 12 lb/ac (13.5 kg/ha). The Beline Computaire could be used to apply two chemicals simultaneously. Dividers in the hoppers prevented mixing of the two chemicals. Additional meter feed rotor motors and sprockets were required to apply two chemicals. Application rate of the second chemical was adjusted by the meter feed rotor motor drive sprocket combinations. Changing the motor drive sprockets was easy but required tools.

The hoppers emptied uniformly but not completely. Hopper clean out was inconvenient. A vacuum cleaner with a nozzle extension was required to completely clean the hoppers. Modifications to permit convenient hopper clean out are recommended.

The hopper lids were weathertight. No leakage of rain into the hoppers occurred during the test.

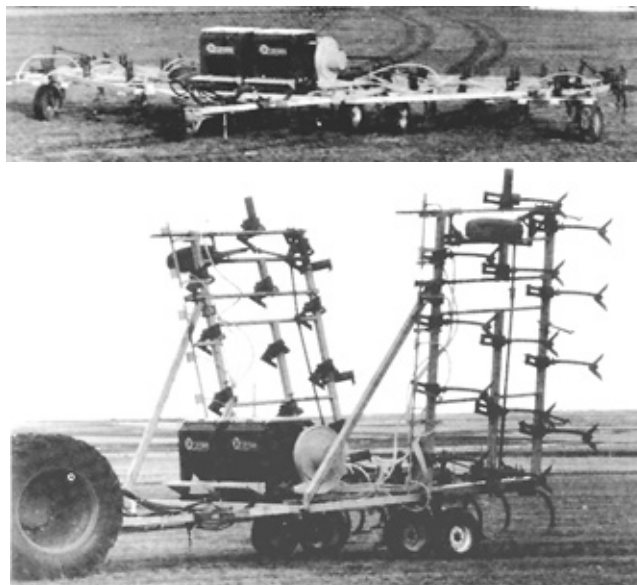


FIGURE 11. Beline Computaire Mounted on a Friggstad Heavy Duty Cultivator (Upper: Field Position, Lower: Transport Position).

Setting the Application Rate: The application rate was easily adjusted by entering the appropriate information in the computer control (FIGURE 12).

Information was keyed in to the computer control using the "sel" key. Input values for eight functions were required to set the controller, input values for each function were incremented using the "up" and "dh" keys. Functions included "application rate", "speed display", "chemical group", "acre tally", "motor sprocket", "roller sprocket", "implement width" and "speed sensor". The "go" and "stop" keys started and stopped the feed rotors. The "zapper on" and "zapper off" keys allowed the operator to increase the application rate by about 20% for problem weed areas. The "motor" keys provided individual manual control for the meter feed rotor motors.

Fertilizer Hopper Bottoms: Installing the optional fertilizer hopper bottoms was easy. Removal and subsequent remounting of the meter feed rotor motors onto the fertilizer hopper bottoms was easy but required tools.

Field Operation: The Beline Computaire performed well in all field conditions. The deflector bars remained stable throughout the test with little movement due to field vibration.



FIGURE 12. Computer Control Located in Tractor Cab.

Each half of the applicator could be conveniently stopped or started by using the feed rotor control switch located in the tractor cab. This was useful to avoid double application when finishing fields or turning on headlands. Neither the granules falling from the deflectors or the feed rotors were visible from the tractor cab. It is recommended that the manufacturer provide a meter shaft rotation indicator as a convenient field check on applicator operation.

Fan speed was easily adjusted with the hydraulic flow control valve when used with an open center hydraulic system. When using a closed center hydraulic system it was necessary to close the valve and use the tractor flow control to adjust the fan speed. No fan speed indicator was supplied. It is recommended that a fan speed indicator be supplied.

The plugs in the ends of the air manifold had to be removed occasionally to clear the chamber of dust and debris.

Lubrication: The roller chains on the meter feed rotor electric motors had to be oiled periodically.

POWER REQUIREMENTS

The power required to drive the distribution fan was about 10 hp (7.6 kW). The two meter feed rotor electric motors required approximately 1.0 amp when operating under normal conditions.

OPERATOR SAFETY

The Beline Computaire was safe to operate if normal safety procedures were followed. All moving parts were adequately shielded. The shields were easily removed and installed.

OPERATOR'S MANUAL

The operator's manual clearly outlined operating, maintenance and set up procedures and contained a well-illustrated comprehensive parts list.

Calibrations were provided for a variety of chemicals including Avadex BW, Treflan QR5 and Heritage 5G. All calibrations were in Imperial units of measure.

MECHANICAL PROBLEMS

The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. No mechanical problems occurred during 60 hours of operation.

**APPENDIX I
SPECIFICATIONS**

MAKE:	Beline Computaire Granular Applicator
MODEL:	Computaire
SERIAL NUMBER:	442
OVERALL DIMENSIONS:	
Hoppers- height	47 in (1195 mm)
- width	106 in (2700 mm)
- length	42 in (1070 mm)
METERING SYSTEM:	
- type	holes in hopper bottom on to feed rotors
- drive	chain from electric motors
- adjustment	feed rotor speed
- transfer to ground	outlet hoses to deflectors
- number of discharge tubes	24
- deflector spacing	24 or 27 in (610 or 686 mm)
- deflector height	18 to 24 in (460 to 610 mm)
- effective spreading width	up to 54 ft (16.5 m)
WEIGHTS:	
- hopper	970 lbs (440 kg)
- hopper with accessories	1160 lbs (526 kg)
HOPPER CAPACITY:	15 ft ³ (0.42 m ³) each
NUMBER OF LUBRICATION POINTS:	1

**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	= meters (m)
horsepower (hp) x 0.75	= kilowatts (kW)
inches (in) x 25.4	= millimetres (mm)
miles/hour (mph) x 1.61	= kilometers/hour (km/h)
pounds (lb) x 0.45	= kilograms (kg)

**SUMMARY CHART
BELINE COMPUTAIRE GRANULAR
APPLICATOR**

RETAIL PRICE:	\$8106.00 (November, 1985, f.o.b. Lethbridge)
METER CALIBRATION:	
- 11-51-00 fertilizer	- 19% low over normal range
- Avadex BW	- 19% low over normal range with original hopper bottoms
- Treflan QR5	- 4% low over normal range with second set of hopper bottoms
	- 8% low over normal range with original hopper bottoms
	- 4 to 12% high over normal range with second set of hopper bottoms
- Heritage 5G	- 8% low over normal range with original hopper bottoms
METER UNIFORMITY:	
	- CV = 9.5% with original hopper bottoms while applying Avadex BW at 15.4 lb/ac (17.3 kg/ha) and 5 mph (8 km/h)
	- CV = 5.6% with second set of hopper bottoms while applying Avadex BW at 12.1 lb/ac (13.6 kg/ha) and 5 mph (8 km/h)
DISTRIBUTION UNIFORMITY:	
	- unacceptable with original hopper bottoms
	- improved with second set of hopper bottoms
EFFECT OF FIELD VARIABLES ON METER RATES:	
- bounce	- no effect
- level of material in hopper	- no effect
- field slopes	- no effect
- ground speed	- no effect
MOUNTING ON TILLAGE TOOL:	- 2 people about 4 hours
HOPPER:	
	- conveniently filled with auger
	- weathertight
	- emptied uniformly
EASE OF OPERATION AND ADJUSTMENT:	- application rate was easily adjusted
OPERATOR SAFETY:	- all parts were well shielded
OPERATOR'S MANUAL:	- complete and informative



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