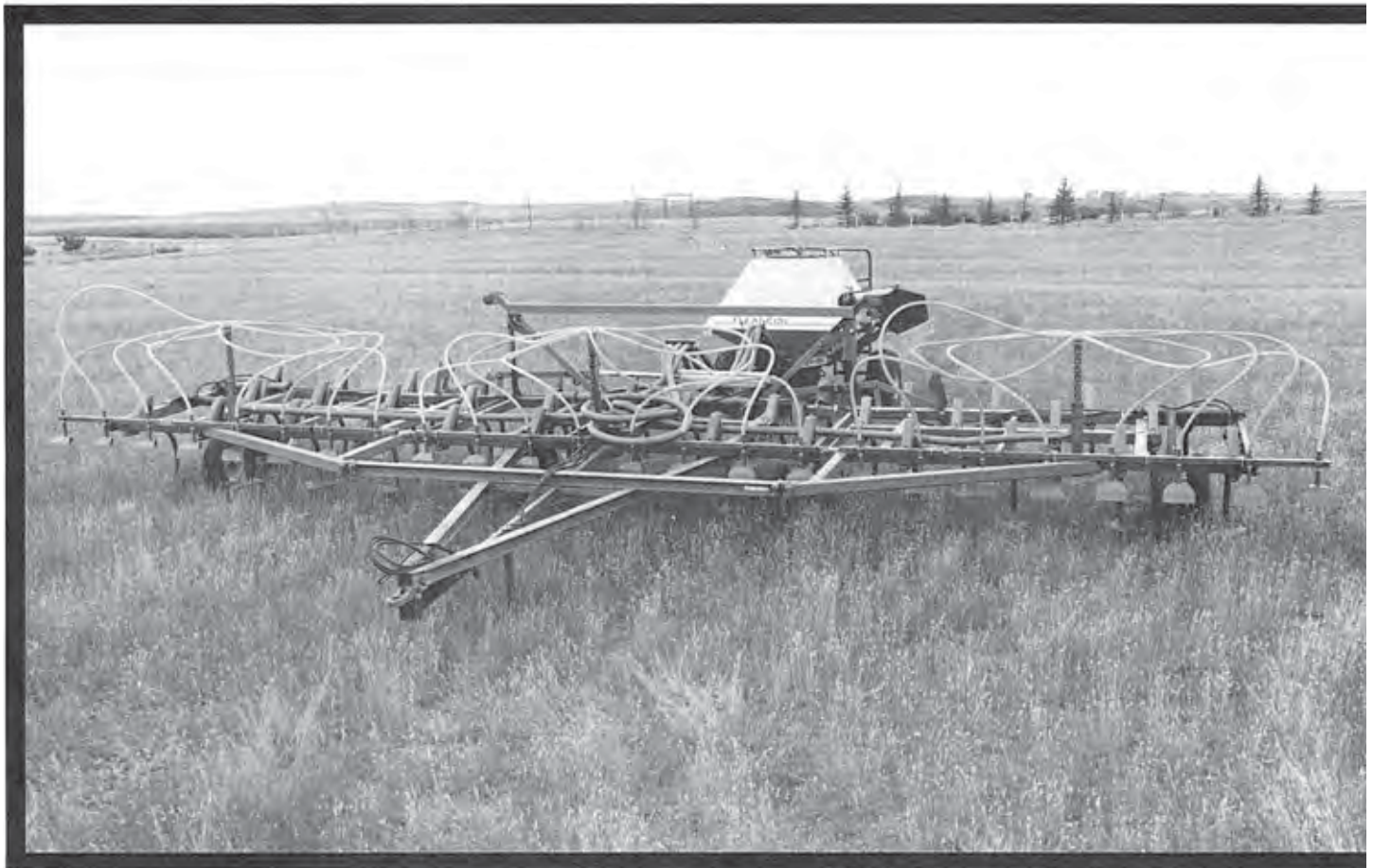


# Evaluation Report

# 625



## **Flexi-coil Granular Applicator Attachment**

A Co-operative Program Between



# FLEXI-COIL GRANULAR APPLICATOR ATTACHMENT

## MANUFACTURER AND DISTRIBUTOR:

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Telephone: (306) 934-3500

## RETAIL PRICE:

\$2,219.00 (March, 1990, f. o. b. Lethbridge, Alberta)

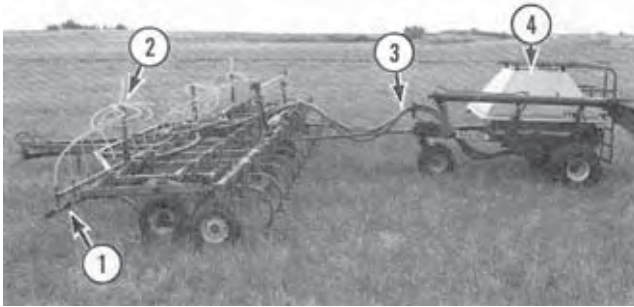


FIGURE 1. Flexi-coil Granular Applicator Attachment (1) Spreader, (2) Header, (3) Primary Hose and (4) Tank.

## SUMMARY AND CONCLUSIONS

### QUALITY OF WORK

Laboratory tests were performed with Avadex BW and Treflan QR5. Metering accuracy was very good. The manufacturer's rate was accurate for Treflan QR5 and 9% high for Avadex BW at an average application rate. Operating the unit on uphill and downhill slopes did affect the metering rate. The meter could be accurately calibrated during a stationary meter rate check.

Uniformity of distribution of the application rate was good. At a rate of 12.3 lb/ac (13.8 kg/ha) with Avadex the application rates from the individual outlets varied from 10.2 to 13.8 lb/ac (11.4 to 15.5 kg/ha) resulting in a CV of 7.4%. At a rate of 19.6 lb/ac (22.0 kg/ha) with Treflan QR5, application rates from the individual outlets varied from 17.6 to 21.5 lb/ac (19.7 to 24.1 kg/ha) resulting in a CV of 4.9%. Increases in fan speed and metering rate increased the CV of the individual application rates for Treflan QR5,

Spreading uniformity was good. An unacceptable CV (greater than 10%) could be obtained at various combinations of fan speed, metering rate and spreader spacing while spreading Avadex BW. The CV was acceptable (less than 10%) for spreading Treflan QR5 at all fan speeds, metering rates and spreader spacings used during the test.

### EASE OF OPERATION AND ADJUSTMENT

Ease of filling and cleaning the granular material out of the tank was good. An optional auger supplied with the tank made filling convenient. Because of the high density of Treflan QR5 the tanks could not be completely filled or the load rating on the tires would be exceeded. Cleaning granular material out of the tanks was convenient through the clean out doors. The fill auger hopper or a container could be set below the clean out doors to collect the material.

Monitoring for the Granular Applicator Attachment was very good. The monitor gave a continuous read out for fan rpm, ground speed, meter shaft rpm or field area accumulation.

Ease of setting the application rate was very good. Changing from the coarse meter roller to the granular meter roller took one man approximately one half hour.

### EASE OF INSTALLATION

Ease of mounting the granular applicator headers and spreaders was good. Mounting the attachment on a 41 ft (12.5 m) John Deere Model 1600 heavy duty cultivator took two people one day to complete.

## POWER REQUIREMENTS

Maximum power take-off horsepower requirement for the centrifugal fan was 5.0 PTO hp (3.7 kW) at a fan speed of 3500 rpm.

## OPERATOR SAFETY

The Granular Applicator Attachment was safe to operate if normal safety precautions were observed, Safety equipment was used when filling or cleaning the tank to prevent exposure to granular material.

## OPERATOR'S MANUAL

The operator's manual was very good. It contained useful information on safety, operation, maintenance, trouble shooting, assembly and parts.

## MECHANICAL HISTORY

Seals were added to the cleanout doors and silicone was used to repair two leaks located near the meters. The metal container supplied for the meter calibration leaked granular material.

## RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing more information in the operator's manual on the proper fan speeds and spreader spacings for uniform spreading of Avadex BW at various meter settings.
2. Providing calibration charts in SI units as well as in Imperial units.
3. Sealing the corners on the metal calibration container so it will hold granular material.

## THE MANUFACTURER STATES THAT

With regard to recommendation number:

1. The manual is being edited to include additional information where possible to give effect to this recommendation.
2. Supply of meter calibration charts in SI (metric) units is not contemplated at this time.
3. The corners of the container will be adequately sealed.

## THE MANUFACTURER FURTHER STATES THAT

1. As of the fall of 1989, a manual crank option is available for use when performing stationary rate checks. This makes it necessary to jack up the frame of the seeder to perform this test.
2. As of the spring of 1990, a plenum diverter kit is available for mounting in the plenum of the model 1610 and 1110 seeders. This diverter allows reduction of air velocities in less heavily loaded lines under "double shoot" applications. It is recommended for use when "double shooting" granular products-together with medium and high rates of coarse grains or fertilizer.

## GENERAL DESCRIPTION

The Flexi-coil Granular Applicator Attachment is a granular applicator system designed to be used with a series 1100 or 1600 Flexi-coil Air Seeder and to fit on any piece of tillage equipment with a 4 x 4 in (102 x 102 mm) frame. The equipment can range in size from 21 ft (6.4 m) to 60 ft (18.3 m).

A special granular meter roller is used to meter the granules in the Flexi-coil Air Seeder. The meter rollers have two or three metering flutes depending on the number of headers required.

The centrifugal fan on the air seeder pneumatically conveys the granules through the primary hoses, headers and delivery hoses to the spreaders. The spreaders have two deflection plates, which spread the granules over the soil. The headers have eight or ten outlets.

By changing the length of a crank arm the application rate is adjusted. The meter roller is shut on and off by an electric clutch. The clutch is remotely controlled by a switch box in the tractor cab. A monitor also located in the tractor cab digitally displays the fan speed, ground speed, field area accumulation and meter shaft

speed. The Flexi-coil Granular Applicator Attachment was mounted on a 41 ft (12.5 m) John Deere Model 1600 cultivator and used with a Flexicoil 1110 Air Seeder tank. The centrifugal fan was hydraulically driven by the tractor. Three 8-port headers were used.

Figure 1 shows the location of major components while detailed specifications are given in Appendix 1.

### SCOPE OF TEST

The Flexi-coil Granular Applicator Attachment was tested in the laboratory for metering and distribution accuracy and the effect of field and machine variables on metering and distribution.

The applicator attachment was evaluated for quality of work, ease of operation and adjustment, power requirements, operator safety and suitability of the operator's manual.

The machine evaluated by the Alberta Farm Machinery Research Centre (AFMRC) was configured as described in the General Description, FIGURE 1 and the Specifications section of this report. The manufacturer may have built different configurations of this machine before or after AFMRC tests. Therefore, when using this report, be sure to first check that the machine you are considering is the same as the one shown here. If it is not, assistance can be obtained from the manufacturer or AFMRC in determining how this new machine will perform compared to the one tested.

## RESULTS AND DISCUSSION

### Quality of Work

**Metering Accuracy:** The Flexi-coil Granular Applicator Attachment was very good. The metering system was calibrated in the laboratory with Avadex BW and Treflan QR5. The calibration curves obtained by AFMRC and the manufacturer for the granular applicator with Avadex BW and Treflan QR5 are given in FIGURES 2 and 3. The manufacturer's rate was 9 percent higher than the rate obtained by AFMRC for Avadex BW at a normal operating meter setting of 40. The manufacturer's rate was the same as the rate obtained by AFMRC for Treflan QR5 at a normal operating meter setting of 30.

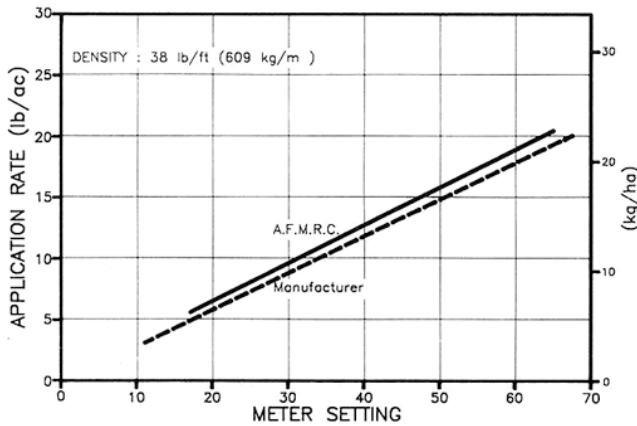


FIGURE 2. Metering Accuracy with Avadex BW.

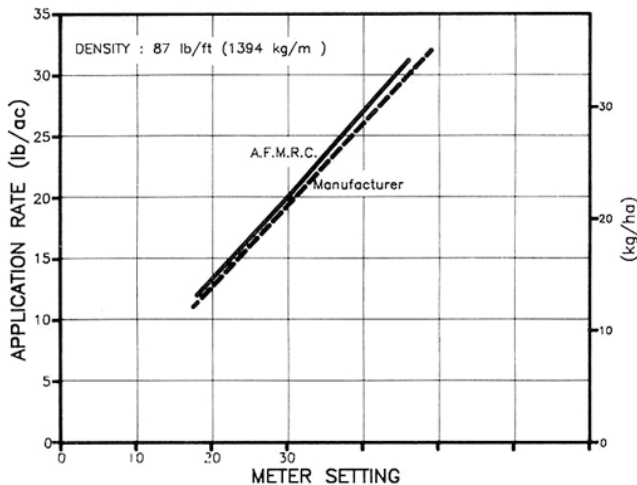


FIGURE 3. Metering Accuracy with Treflan QR5.

Level of material in the tank, field roughness and variations in fan speed or ground speed had no significant effect on metering rates. Operating the granular applicator tank on side slopes did not affect metering rates but operating on uphill and downhill slopes did affect metering rates. A 10 degree uphill slope caused an 8 percent increase and a 10 degree downhill slope caused a 6 percent decrease in the metering rate with Avadex BW. A 10 degree uphill slope caused a 6 percent increase and a downhill slope had no significant effect on the metering rate with Treflan QR5.

The manufacturer supplied calibration charts with rates for various densities of granular material. A bulk density scale was supplied with the system to determine the density of the metering material.

The manufacturer recommended that two metering rate checks be performed before extended field operation. The first check was a stationary meter rate check. A metal container (FIGURE 4) was mounted below the meter to collect the material. The meter drive wheel was blocked off the ground so it could be rotated by hand. The drive wheel was then turned 30 times. The weight of the material collected was put into a formula found in the owner's manual to obtain the rate. This metering rate check was used in the laboratory and found to be accurate.

The second metering rate check was a field check. Bags were placed over each spreader deflector plate and tied securely. The unit was then operated over a calibrated distance to equal 1 ac (0.4 ha). The material was then weighed from each bag to obtain the rate. The second metering rate check was found to be accurate.

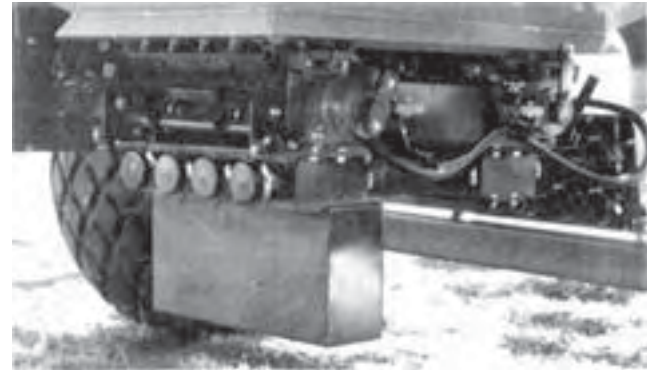


Figure 4. Collection Box to check Metering Rate.

**Distribution Uniformity:** Uniformity of distribution of the application rate for the Flexi-coil granular applicator was good. FIGURE 5 shows the delivery rate for each of the 24 outlets while applying Avadex BW at a rate of 12.3 lb/ac (13.8 kg/ha) and a fan speed of 3000 rpm. Application rates from the individual outlets varied from 10.2 to 13.8 lb/ac (11.4 to 15.5 kg/ha) resulting in a coefficient of variation<sup>1</sup> of 7.4 percent.

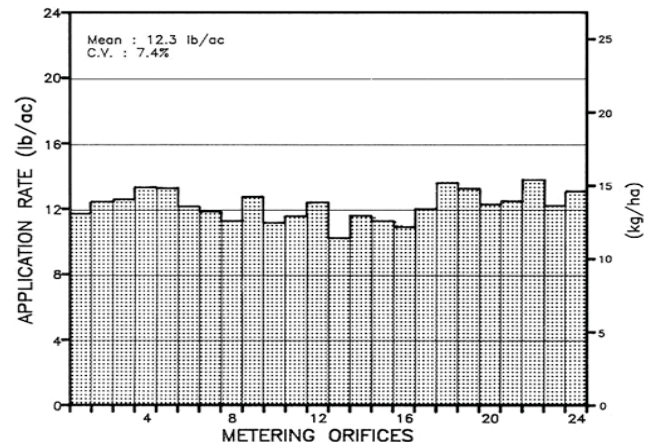


FIGURE 5. Variation in Delivery Rates from individual outlets when applying Avadex BW at 12.3 lb/ac (13.8 kg/ha) and a fan speed of 3000 rpm.

<sup>1</sup>The coefficient of variation (CV) is the standard deviation of the 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 percent. A CV of 10 percent is used through this report as a dividing point between acceptable and unacceptable uniformity.

FIGURE 6 shows the delivery rate for each of the 24 outlets while applying Treflan QR5 at a rate of 19.6 lb/ac (22.0 kg/ha) and a fan speed of 3000 rpm. Application rates from the individual outlets varied from 17.6 to 21.5 lb/ac (19.7 to 24.1 kg/ha) resulting in a coefficient of variation of 4.9 percent.

Variations in fan speed, metering rate and field slopes had no significant effect on the delivery rates of individual outlets while applying Avadex BW. Variation in field slopes also had no significant effect on the delivery rates of individual outlets while applying Treflan QR5 but variations in the fan speed and metering rates did affect the delivery rates. An increase in fan speed from 2500 to 3500 rpm raised the CV from 4.5 to 8.2 percent at a metering rate of 22.0 lb/ac (24.6 kg/ha). As the metering rate increased the variation on the delivery rates increased at the individual outlets.

A variation in the length of the hoses between the header and the spreaders would also increase the variation of the delivery rates to the individual outlets. The manufacturer recommended that all delivery hoses be cut to the same length. Hoses used during the laboratory test were all the same length.

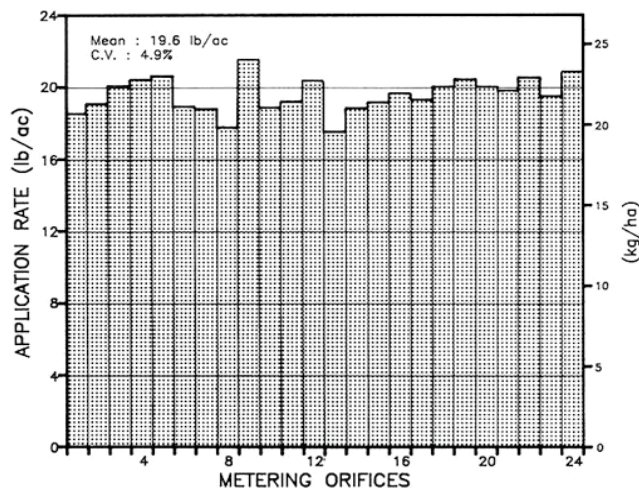


FIGURE 6. Variation in Delivery Rates from individual outlets when applying Treflan QR5 at 19.6 lb/ac (22.0 kg/ha) and a fan speed of 3000 rpm.

**Spreading Uniformity:** Spreading uniformity of the Flexi-coil Granular Applicator Attachment was good. The pneumatically conveyed granules were spread over the soil by a spreader consisting of two deflection plates (FIGURE 7). The spreaders could be spaced at various intervals ranging from 15.8 to 24.0 in (400 to 610 mm). The spacing depended on the width of the tillage implement. The manufacturer recommended a spreader height equal to the spreader spacing. The system was tested in the laboratory at 20.5, 22 and 24 in (521, 559 and 610 mm) spreader spacings.

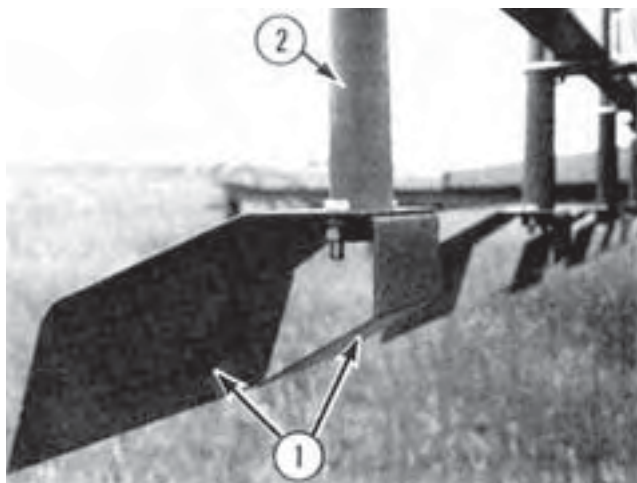


FIGURE 7. Spreaders: (1) Deflector Plates, (2) Tube.

FIGURE 8 shows a typical distribution of Avadex BW when applying 12.1 lb/ac (13.6 kg/ha) using a 22 in (559 mm) spreader spacing and a fan speed of 2500 rpm. Application rates varied from

9.6 to 15.0 lb/ac (10.8 to 16.8 kg/ha) across the width, resulting in a pattern with a CV of 9.9 percent.

The spreading uniformity of Avadex BW was affected by variations in fan speed, metering rate and spreader spacing.

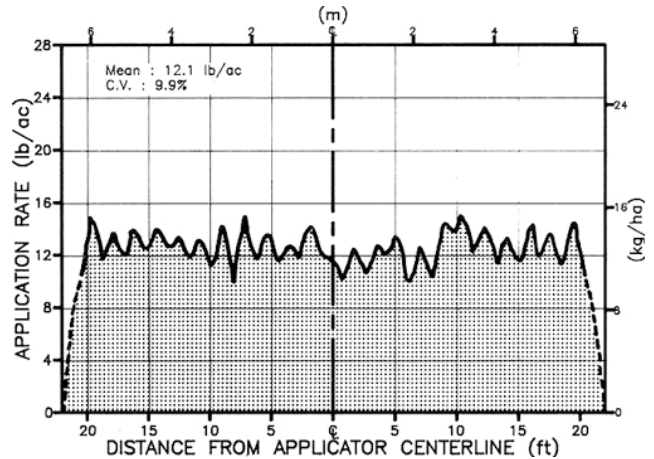


FIGURE 8. Distribution Pattern when Applying 12.1 lb/ac (13.6 kg/ha) of Avadex BW using a 22 in (559 mm) spreader spacing and a fan speed of 2500 rpm.

FIGURE 9 shows how an increase in fan speed increased the CV at an application rate of 12.1 lb/ac (13.6 kg/ha) and a spreader spacing of 22 in (559 mm). The CV was acceptable at fan speeds of 2500 rpm or less.

An increase in application rate of Avadex BW also increased the CV. An increase in application rate from 12.1 to 17.6 lb/ac (13.6 to 19.7 kg/ha) increased the CV from 7 to 14 percent at a fan speed of 2000 rpm and a spreader spacing of 22 in (559 mm).

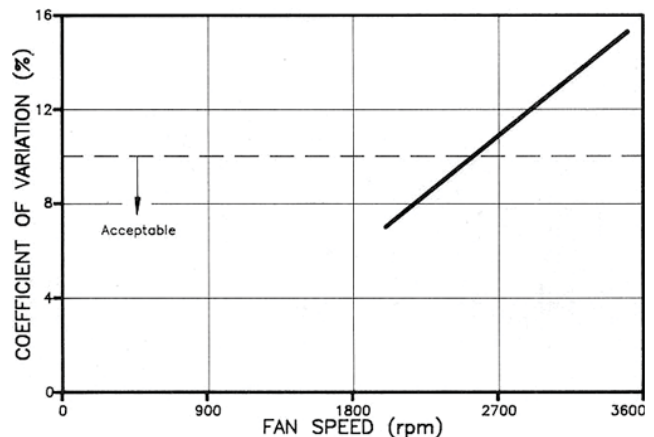


FIGURE 9. Regression of CV's for various fan speeds at an application rate of 12.1 lb/ac (13.6 kg/ha) and a spreader spacing of 22 in (559 mm) for Avadex BW.

At a spreader spacing of 24 in (610 mm), an increase in fan speed from 2000 to 2500 rpm decreased the CV from 10.1 to 8.8 percent for an application rate of 12.1 lb/ac (13.6 kg/ha) of Avadex BW. The opposite trend occurred at a spreader spacing of 20.5 in (521 mm). An increase in fan speed from 2000 to 3000 rpm increased the CV from 7.4 to 11.2% at an application rate of 11.9 lb/ac (13.3 kg/ha).

A Coefficient of Variation (CV) of 10% or higher may occur at various fan speeds, metering rates and spreader spacings while spreading Avadex BW. It is recommended that the manufacturer consider providing more information in the operator's manual on the proper fan speeds and spreader spacings for uniform spreading of Avadex BW at various meter settings.

FIGURE 10 shows a typical distribution of Treflan QR5 when applying 19.5 lb/ac (21.8 kg/ha) using a 22 in (559 mm) spreader spacing and a fan speed of 3000 rpm. Application rates varied from 17.0 to 22.6 lb/ac (19.0 to 25.3 kg/ha) across the width, resulting in a pattern with a CV of 6.3 percent.

The spreading uniformity of Treflan QR5 was not significantly affected by variations in fan speed and spreader spacing. A fan speed of 2500 rpm gave a pattern with a CV of 6.1 percent while

a 3500 rpm fan speed gave a pattern with a CV of 7.4 percent when applying 19.5 lb/ac (21.8 kg/ha) at a 22 in (559 mm) spreader spacing. Increasing the spreader spacing to 24 in (610 mm) did not increase the CV.

Variations in the metering rate did affect the spreading uniformity of the Treflan QR5. Increasing the rate from 19.5 to 36.0 lb/ac (21.8 to 40.3 kg/ha) increased the CV from 6.3 to 8.3 percent at a fan speed of 3000 rpm and a spreader spacing of 22 in (559 mm).

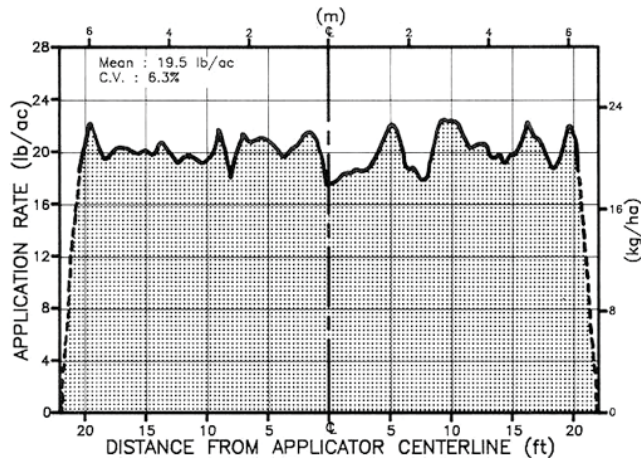


FIGURE 10. Distribution pattern when Applying 19.5 lb/ac (21.8 kg/ha) of Treflan QR5 using a 22 in (559 mm) spreader spacing and a fan speed of 3000 rpm.

## EASE OF OPERATION AND ADJUSTMENT

### Filling/Cleaning

Ease of filling and cleaning the granular material out of the Flexi-coil 1110 tank was good. An optional auger supplied with the tank made filling convenient. Filling the tank by hand was inconvenient because the tank openings were located 8.4 ft (2.6 m) above the ground. The front tank held approximately 3080 lb (1390 kg) and the rear tank 2130 lb (960 kg) of Avadex BW assuming a density of 38 lb/ft<sup>3</sup> (609 kg/m<sup>3</sup>). The tanks could not be completely filled with Treflan QR5 because the load rating of the tires would be exceeded. The manufacturer recommended a maximum of 4550 lb (2050 kg) for the front tank and 3150 lb (1420 kg) for the rear tank with Treflan QR5 with a density of 88 lb/ft<sup>3</sup> (1410 kg/m<sup>3</sup>).

Cleaning granular material out of the tanks was convenient through the cleanout doors. The fill auger hopper or a container could be set below the clean out doors to collect the granular material. A vacuum was required to thoroughly clean the tanks. Access to the inside of the tanks was good with the large openings and steps down the inside of the tanks.

Treflan QR5 accumulated on the inside of the manifold after a short period of operation as shown in FIGURE 11. This material was cleaned out by removing the cover on the bottom of the manifold. This accumulation did not affect the metering rate and did not occur with Avadex BW. Both types of granular material did accumulate on the top of the bottom manifold cover so this area needed to be cleaned when the tank was cleaned.



FIGURE 11. Accumulation of Treflan QR5 on the inside of the manifold.

## Monitoring

Monitoring for the Granular Applicator Attachment was very good. The meters were turned on and off from the tractor cab by a switch box controlling an electric clutch. The monitor gave a continuous read out for fan rpm, ground speed, meter shaft rpm or field area accumulation. The monitor had an alarm, which sounded when the fan speed dropped below a set rate, the ground speed dropped below 2 mph (3.2 km/h), a meter shaft dropped below 4 rpm or the bin level dropped below the bin sensors.

## Application Rate

Ease of setting the application rate was very good. The application rate was changed by loosening the lock bolt on the meter crank arm and then moving the crank arm to lengthen or shorten the turning radius. The meter setting numbers were determined from the calibration charts. The crank arm scale ranged from 0 to 69 in single unit markings.

Installing the granular meter roller (FIGURE 12) took one man approximately one half hour. The roller could not be installed with any material in the tank.

Air velocity from the fan was varied by changing the fan speed. The fan speed was controlled by the flow of hydraulic oil from the tractor.



FIGURE 12. Granular Meter Roller.

## EASE OF INSTALLATION

Ease of mounting the granular applicator headers and spreaders was good. Mounting the attachment on a 41 ft (12.5 m) John Deere Model 1600 heavy duty cultivator (FIGURE 1) took two people one day to complete. Tubing to hold the spreaders was mounted to the front of the cultivator frame with spreader bar brackets (FIGURE 13).



FIGURE 13. Tubing and Spreader Bar Brackets Mounted on Cultivator.

## POWER REQUIREMENTS

### Hydraulic

Maximum hydraulic flow requirement for the centrifugal fan was 6.3 gal/min (28.6 L/min) at 910 psi (6270 kPa). This was measured at a fan speed of 3500 rpm. Flow requirements for the centrifugal fan decreased as the fan speed decreased.

### Tractor Size

Maximum horsepower requirement for the centrifugal fan was 5.0 hp (3.7 kW) at a fan speed of 3500 rpm.

## OPERATOR SAFETY

The Flexi-coil Granular Applicator Attachment was safe to operate if normal safety precautions were observed. Safety

equipment was used when filling the tank or cleaning out the manifold and tank to prevent exposure to granular chemical.

**OPERATOR'S MANUAL**

The operator's manual was very good. It contained useful information on safety, operation, maintenance, trouble shooting, assembly and parts. Calibration charts were provided for alfalfa, canola, Avadex, Fortress, Rival and Treflan at various densities. The application rates and densities were only given in Imperial units. It is recommended that the manufacturer consider providing calibration charts in SI units as well as in Imperial units.

**MECHANICAL HISTORY**

The intent of the test was the evaluation of functional performance. An extended durability test was not conducted. All the mechanical problems that did occur during the laboratory evaluation were related to air leaks on the tank and meter. Seals were added to the cleanout doors and silicone was used to repair two leaks located near the meters. The metal container supplied to collect granular material during meter calibration leaked material out of all four corners. The corners of the container had to be sealed with silicone. It is recommended that the manufacturer consider sealing the corners on the metal calibration container so it will hold granular material.

**APPENDIX I  
SPECIFICATIONS**

<b>MAKE:</b>	Flexi-coil Granular Applicator Attachment
<b>PRINCIPLE OF OPERATION:</b>	Pneumatic conveyance. Designed to be used with Flexi-coil 1110 and 1610 Airseeders and mount on any make of cultivator.
<b>TUBING:</b>	2.5 in (64 mm) from meter to header 1.0 in (25 mm) from header to spreader
<b>OPERATING WIDTHS:</b>	21 to 32 ft (6.4 to 9.8 m) with 2 eight port headers 33 to 40 ft (10.1 to 12.2 m) with 2 ten port headers 41 to 48 ft (12.5 to 14.6 m) with 3 eight port headers 49 to 60 ft (14.9 to 18.3 m) with 3 ten port headers 12 in (305 mm) increments for width
<b>SPREADER SPACING:</b>	from 15.75 to 24 in (400 to 610 mm) at various increments
<b>SPREADER MOUNTING TUBE:</b>	2.0 x 2.0 in (51 x 51 mm)
<b>SPREADER BAR BRACKETS:</b>	Mounts to 4.0 x 4.0 in (102 x 102 mm) tubing

**SUMMARY CHART**

**FLEXI-COIL GRANULAR APPLICATOR ATTACHMENT**

<b>RETAIL PRICE:</b>	\$2,219.00 (March, 1990, f.o.b. Lethbridge, Alberta)
<b>QUALITY OF WORK:</b>	
Metering Accuracy:	<b>very good</b> ; easy to calibrate
Distribution Uniformity:	<b>good</b> ; acceptable for both Avadex BW and Treflan QR5
Spreading Uniformity:	<b>good</b> ; unacceptable CV's could be obtained with Avadex BW
<b>EASE OF OPERATION AND ADJUSTMENT:</b>	
Filling/Cleaning:	<b>good</b> ; fill auger convenient for filling and cleaning
Monitoring:	<b>very good</b> ; continuous readout for many variables
Application Rate:	<b>very good</b> ; one half hour to install granular meter roller
<b>EASE OF INSTALLATION:</b>	<b>good</b> ; two people one day to install on conventional cultivator
<b>POWER REQUIREMENTS:</b>	maximum 5.0 PTO hp (3.7 kW) required for centrifugal fan at 3500 rpm
<b>OPERATOR SAFETY:</b>	safe; safety equipment used when filling and cleaning
<b>OPERATOR'S MANUAL:</b>	<b>very good</b> ; useful information
<b>MECHANICAL HISTORY:</b>	repaired air leaks near meters and on clean out doors



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