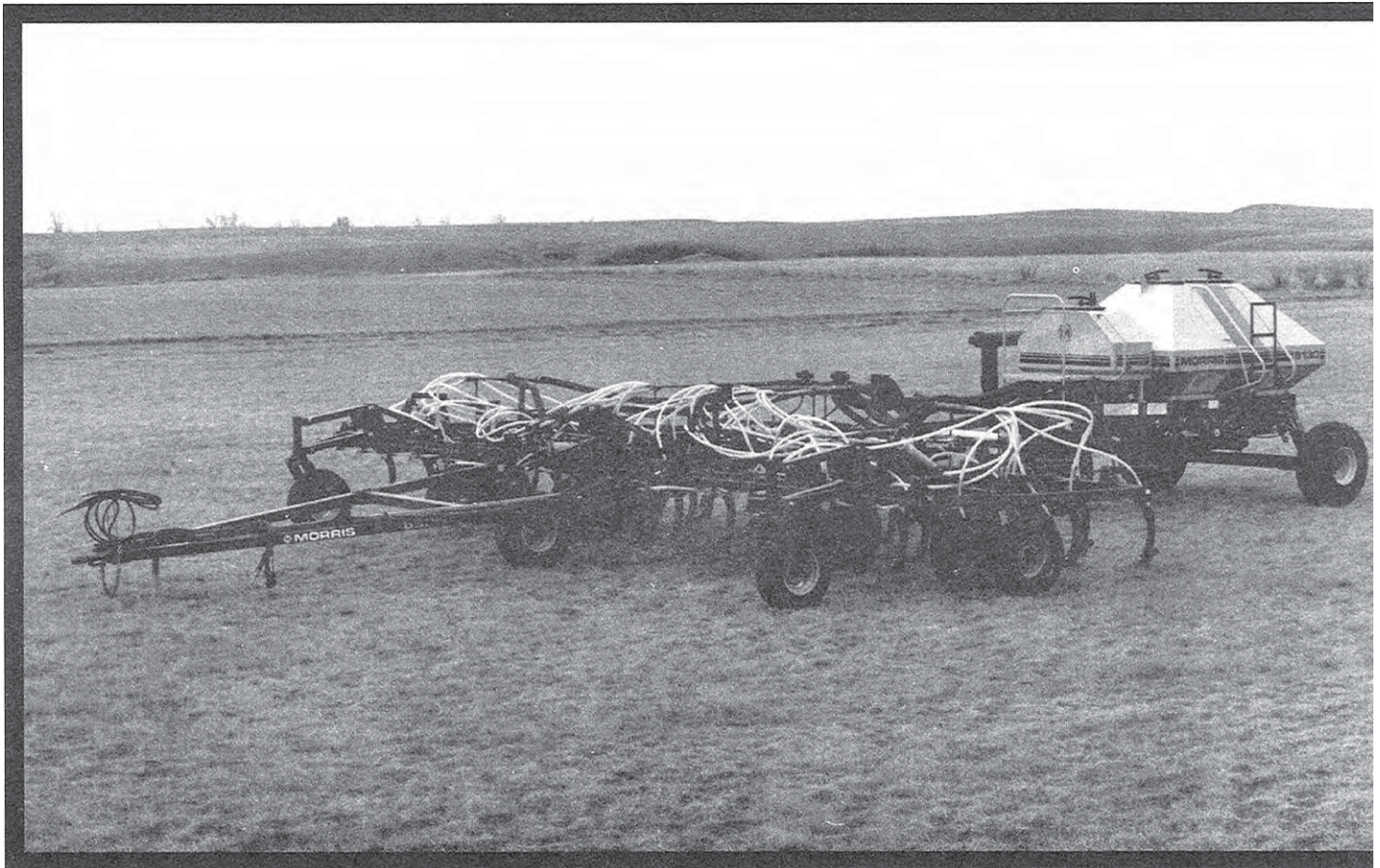


Evaluation Report

686



Morris 6028 Granular Herbicide Applicator

A Co-operative Program Between



MORRIS 6028 GRANULAR HERBICIDE APPLICATOR

MANUFACTURER AND DISTRIBUTOR

Morris Industries Ltd.
85 York Road
Yorkton Saskatchewan
S3N 2X2
Phone: (306) 783-8585

RETAIL PRICE

\$6,138.00 less setup (September, 1992 f.o.b. Lethbridge, Alberta, Morris 6028 granular herbicide applicator with 17 deflectors).

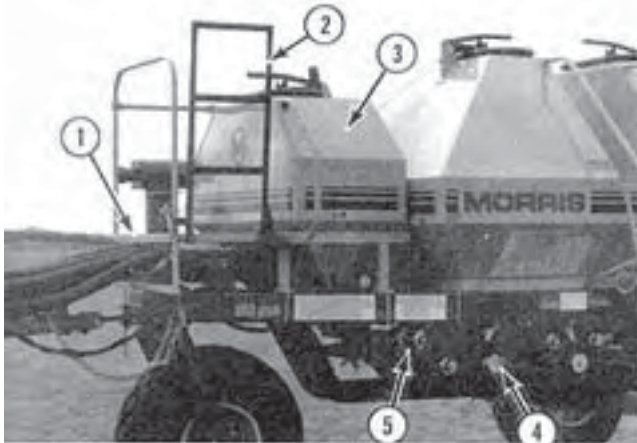


FIGURE 1. Morris 6028 granular herbicide applicator: (1) Platform, (2) Ladder, (3) Tank, (4) Metering Drive Transmission and (5) Meter.

SUMMARY

QUALITY OF WORK

Laboratory tests were performed with Avadex BW and Treflan QR5. Metering accuracy was very good. At a normal application rate the manufacturer's rate was 6 percent higher in Avadex BW and 5 percent higher in Treflan QR5. Level of material in the tank, field roughness, variation in fan speed or ground speed and field slopes had no significant affect on metering rates for both Avadex BW and Treflan QR5.

Uniformity of distribution of the application rate was good. Variation from the individual outlets for Avadex BW resulted in a CV of 7.7 percent. Variation from the individual outlets for Treflan QR5 resulted in a CV of 6.6 percent. Distribution uniformity was affected by increases in metering rates and ground speed for both Avadex BW and Treflan QR5.

Spreading uniformity was good. The CV was acceptable for spreading Avadex BW and Treflan QR5 at a 24 in (610 mm) spreader spacing. The spreading uniformity was not significantly affected by variation in fan speed or metering rates. During dual operation the rate for the product applied by the air seeder was doubled in the overlap.

EASE OF OPERATION AND ADJUSTMENT

Ease of filling and cleaning the applicator was good. The access ladder and platform allowed for safe filling of the unit with bagged chemical. The applicator was conveniently filled with bulk chemical by using the air seeder auger. The fan/auger hydraulic selector lever was in an awkward location. The front clean out door was difficult to remove.

Monitoring was very good. The Morris 6000 series air seeder monitor and the granular pressure gauge monitored the system.

Ease of setting the application rate was very good. Rate was adjusted by changing the range and quick change sprockets. The air seeder sprockets were used for the granular system. The unit was equipped with a rate check box and calibration chart to calibrate the application rate.

EASE OF INSTALLATION

Ease of mounting the 6028 granular applicator attachment was good. Two people required seven hours to mount the granular

tank and metering system onto the 6000 series air seeder frame. Two people required six hours to mount the distribution system onto the tillage unit. Initial setup of the metering body was completed by the manufacturer. The cultivator shank did not permit the delivery hose to enter the deflector straight.

POWER REQUIREMENTS

The addition of the granular applicator to the 6130 air seeder did not increase the hydraulic flow requirements, Average and maximum horsepower requirements for the centrifugal fan were 10.9 hp (8.1 kW) and 18.1 hp (13.5 kW), respectively.

OPERATOR SAFETY

The 6028 granular applicator was safe to operate if normal safety precautions were observed. A fold-down ladder, side handrails and platform were provided for safe access to the applicator tank. Safety equipment was used when filling or cleaning the applicator tank to prevent exposure to granular chemical. Tire loads would exceed the Tire and Rim Association's maximum load rating when the granular and air seeder tanks were filled with material.

OPERATOR'S MANUAL

The operator's manual was very good. The manual contained useful information on safety, operation, maintenance and trouble shooting. An applicator setup section was also provided.

MECHANICAL PROBLEMS

No mechanical problems were encountered during the test.

RECOMMENDATIONS

The AFMRC recommends the manufacturer consider:

1. Warning the operator the application rate of the air seeder will be doubled in the required granular overlap.
2. Improving access to the hydraulic selector lever.
3. Modifying the tank screen to allow for complete filling of the tank.
4. Improving the ease of removing the front clean out door.
5. Modifying all wing nuts to allow for easier threading.
6. Modifying the rate check box to stop material from leaking.
7. Improving the alignment of the delivery hose to the deflector.
8. Supplying allowable granular and air seeder tanks capacities when both systems are used.
9. Supplying meter rate charts in SI (metric) units as well as Imperial units.

Manager: R.P. Atkins

Project Engineer: L.W. Papworth

Project Technologist: G.A. Magyar

THE MANUFACTURER STATES THAT:

With regards to recommendation number:

1. The manual will include a note informing the operator that the application rate of the air seeder will be doubled in the overlap area required by the granular applicator.
2. Current feedback indicates that access to the hydraulic selector valve is satisfactory, however we will be investigating new locations as demand indicates.
3. Modifications to the tank screen are being considered.
4. The threaded rods holding the clean out door can be adjusted rearward to give more clearance between the rods and the primary pipes. This allows for easier clean out door removal.
5. Modifications to the wing nuts are being pursued.
6. Manufacturing changes have been implemented to prevent material from leaking as outlined.
7. Revised mounting locations for improved delivery hose alignment are being considered and will be implemented when finalized.
8. The operator's manual will be modified to state allowable air seeder tank capacities when the granular tank is filled with various materials.
9. This recommendation will be considered for future production.

GENERAL DESCRIPTION

The Morris 6028 granular herbicide applicator attachment is designed to be used with the Morris 6000 series air seeder. The distribution system is designed to fit any implement from 28 to 60 ft (8.5 to 18.3 m). The applicator mounts on the front frame of the 6000 series air seeder.

Granular chemical and fine seeds are metered through variable speed spiral fluted metering wheels mounted below the tank. The size of each spiral fluted metering wheel corresponds to the divider heads mounted on the implement. The granular metering system is ground driven by the air seeder. The primary clutch engages the granular metering system. A secondary (zapper) clutch, located before the primary clutch, is used to increase or decrease the application rate. The clutches are electronically controlled by a rocker switch mounted in the tractor cab.

The air seeder centrifugal fan pneumatically conveys the metered material through the granular distribution system. The fan also pressurizes the tank to equalize the pressure across the meter. Flat fan manifolds distribute the metered material to the individual deflectors. The manifolds are available with seven, eight, nine and ten outlets. The deflector spacing can vary between 22.5 and 25.5 in (572 and 648 mm).

The monitoring system consists of a pressure gauge and the 6000 series air seeder monitor. Shaft rotation, bin level, ground speed and fan speed are monitored.

The Morris 6028 granular herbicide applicator attachment was mounted on the Morris 6130 series air seeder. A two outlet primary metering body and an eight and nine outlet flat fan dividers were mounted on a Morris 8900 floating hitch cultivator for field testing.

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

SCOPE OF TEST

The Morris 6028 granular herbicide applicator attachment was operated for 30 hours while spreading Fortress on 320 ac (130 ha) and Edge on 280 ac (113 ha). The applicator was evaluated for quality of work, ease of operation and adjustment, ease of installation, power requirements, operator safety and suitability of the operator's manual. The quality of work was measured in the laboratory.

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 and 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 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: Metering accuracy of the Morris 6028 granular herbicide applicator attachment was very good. The metering system was calibrated in the laboratory with Avadex BW and Treflan QR5. The calibration curves at a 24 in (610 mm) deflector spacing obtained by AFMRC and the manufacturer for the 6028 granular applicator in Avadex BW and Treflan QR5 are given in FIGURES 2 and 3. The manufacturer's rate was 6 percent higher than the rate obtained by AFMRC for Avadex BW at a meter setting of 15, in the high range. The manufacturer's rate was 5 percent higher than the rate obtained by AFMRC for Treflan QR5 at a meter setting of 35, in the low range. The manufacturer indicated the charts are to be used as guidelines and the operator should calibrate the granular applicator for the particular product used.

Level of material in the tank, field roughness, variation in fan speed or ground speed and field slopes had no significant affect on metering rates for both Avadex BW and Treflan QR5.

Distribution Uniformity: Uniformity of distribution of the application rate for the Morris granular applicator was good. FIGURE 4 shows the delivery rate for each of the 20 outlets while applying Avadex BW at a rate of 11.8 lb/ac (13.3 kg/ha). Application rates from the individual outlets varied from 10.4 to 13.3 lb/ac (11.7 to 14.9 kg/ha), resulting in a coefficient of variation (CV¹) of 7.7 percent.

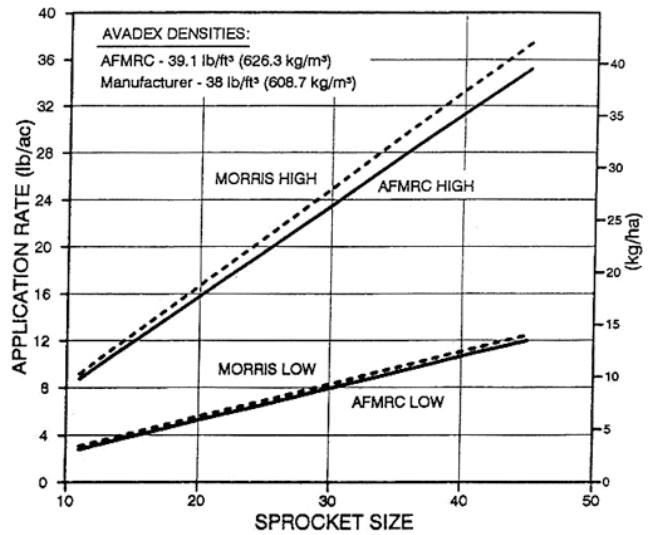


FIGURE 2. Metering accuracy in Avadex BW.

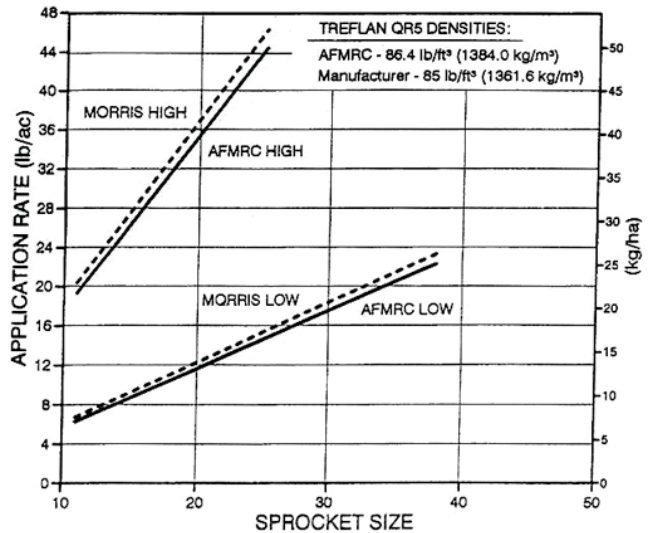


FIGURE 3. Metering accuracy in Treflan QR5.

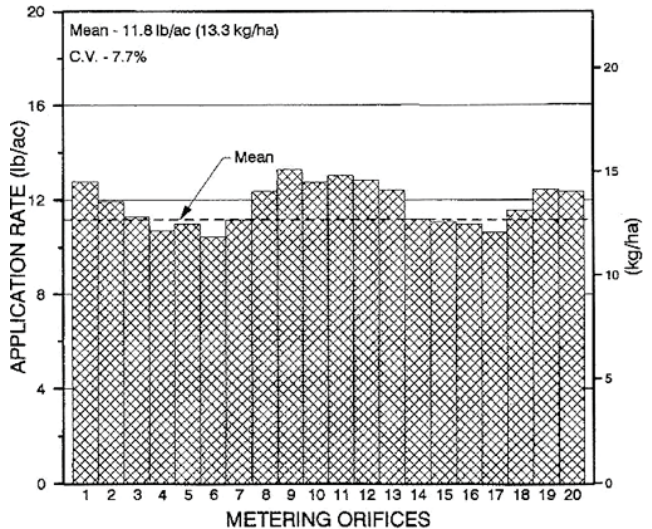


FIGURE 4. Variation in delivery rates from individual outlets when applying Avadex BW at 11.8 lb/ac (13.3 kg/ha) and a fan speed of 4180 rpm.

FIGURE 5 shows the delivery rate for each of the 20 outlets while applying Treflan QR5 at a rate of 20.5 lb/ac (23 kg/ha). Application rates from the individual outlets varied from 18 to 22.6

¹The 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. A CV of 10 percent is used through this report as a dividing point between acceptable and unacceptable uniformity.

lb/ac (20.2 to 25.4 kg/ha), resulting in a CV of 6.6 percent.

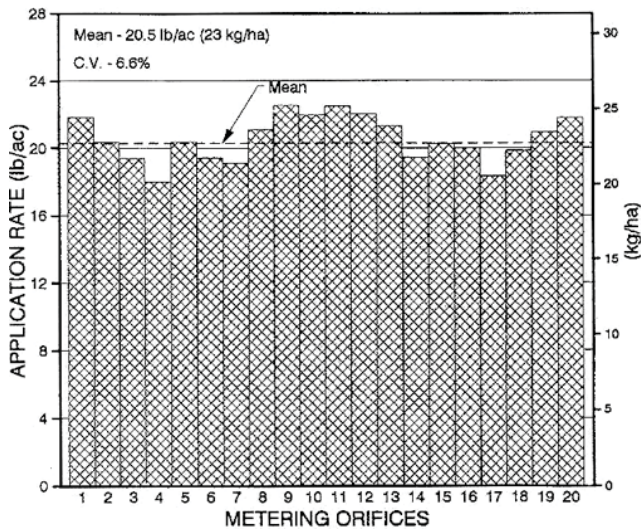


FIGURE 5. Variation in delivery rates from individual outlets when applying Treflan QR5 at 20.5 lb/ac (23 kg/ha) and a fan speed of 4180 rpm.

Field roughness, variation in fan speed and field slopes had no effect on distribution uniformity for both Avadex BW and Treflan QR5. Distribution uniformity was affected by increases in metering rates and ground speed for both Avadex BW and Treflan QR5. An increase in the metering rate from 11.8 to 19.6 lb/ac (13.3 to 22 kg/ha) for Avadex BW raised the CV to 10 percent. An increase in the metering rate from 20.5 to 35.4 lb/ac (23 to 39.8 kg/ha) for Treflan QR5 raised the CV to 10.9 percent. An increase in ground speed from 5 to 7.5 mph (8 to 12 km/h) raised the CV to 9.2 percent for Avadex BW and 9.7 percent for Treflan QR5.

Spreading Uniformity: Spreading uniformity of the Morris 6028 granular applicator was good. The pneumatically conveyed granules were spread over the soil by a deflector (FIGURE 6). Each deflector consisted of a single plate with a downward bend and a tube holder. The manufacturer supplied deflector spacings for each model and size of Morris cultivator. The manufacturer recommended a spreader height equal to the spreader spacing plus the working depth. The Morris 37 ft (11.3 m) cultivator (Evaluation Report #682) used a 24.75 in (628.65 mm) deflector spacing. The distribution system was laboratory tested at a 24 in (610 mm) spreader spacing and height.

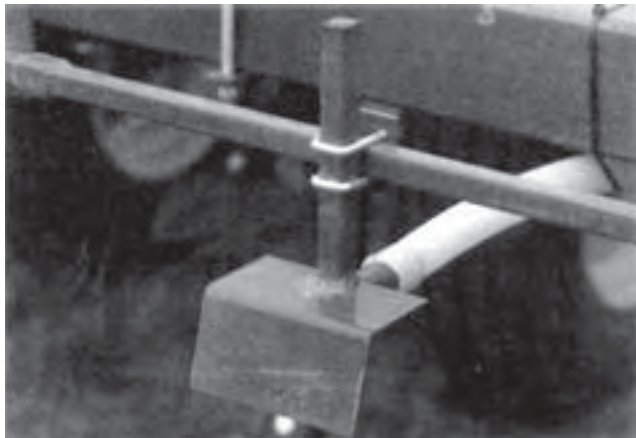


FIGURE 6. Single Plate Deflector.

FIGURE 7 shows a typical distribution of Avadex BW when applying 11.6 lb/ac (13 kg/ha) using a 24 in (610 mm) spreader spacing and a fan speed of 4160 rpm. Application rates varied from 11.2 to 14.8 lb/ac (12.6 to 16.6 kg/ha) across the width, resulting in a pattern with a CV of 6.9 percent. The spreading uniformity of Avadex BW was not significantly affected by variations in fan speed or metering rates.

FIGURE 8 shows a typical distribution of Treflan QR5 when applying 20.7 lb/ac (23.3 kg/ha) using a 24 in (610 mm) spreader spacing and a fan speed of 4200 rpm. Application rates varied from

19.5 to 26.3 lb/ac (21.9 to 29.6 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 or metering rates.

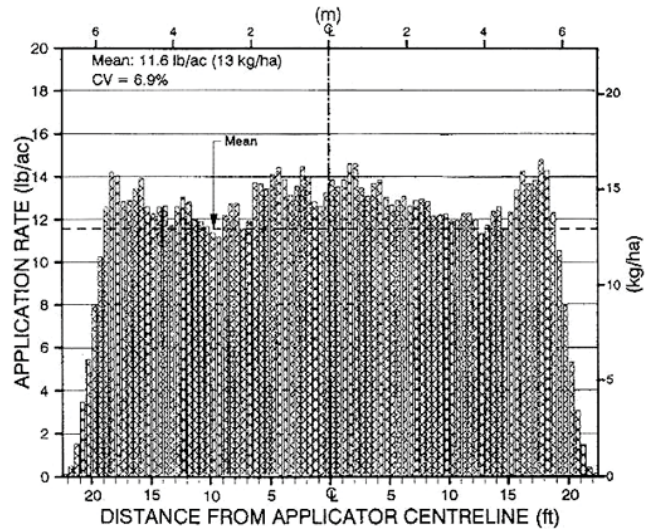


FIGURE 7. Distribution pattern when applying 11.6 lb/ac (13 kg/ha) of Avadex BW using a 24 in (610 mm) spreader height, 5 mph (8 km/h) and a fan speed of 4160 rpm.

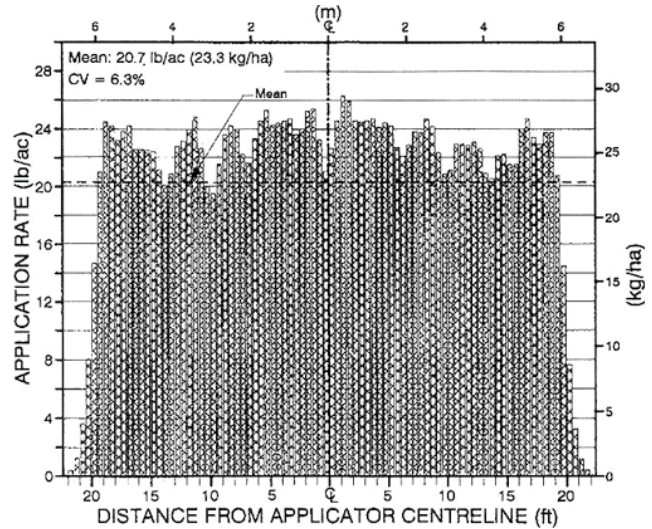


FIGURE 8. Distribution pattern when applying 20.7 lb/ac (23.3 kg/ha) of Treflan QR5 using a 24 in (610 mm) spreader height, 5 mph (8 km/h) and a fan speed of 4200 rpm.

The manufacturer stated that for a proper chemical spread pattern the tillage unit must overlap the previous pass. The manufacturer supplied charts showing the required working overlap relative to machine size, shank spacing and deflector spacing. The required working overlap for the Morris 37 ft (11.3 m) cultivator with a 9 in (229 mm) shank spacing was 23 in (584 mm). During dual operation the rate for the product applied by the air seeder was doubled in the overlap. The doubling of the air seeder rate could be a problem in certain conditions. The AFMRC recommends the manufacturer consider warning the operator the application rate of the air seeder will be doubled in the required granular overlap.

EASE OF OPERATION AND ADJUSTMENT

Filling/Cleaning: Ease of filling and cleaning the Model 6028 granular applicator was good. The access ladder, platform and 11.2 x 25.7 in (285 x 653 mm) tank opening made filling the applicator tank with bagged chemical convenient. The tank was also conveniently filled with bulk chemical by using the air seeder loading/unloading auger. A hydraulic selector valve diverted the hydraulic flow from the fan to the auger motor. The location of the granular tank on the air seeder frame made access to the selector lever difficult (FIGURE 9). The AFMRC recommends the manufacturer consider improving access to the hydraulic selector lever. The v-shaped tank screen reduced tank capacity. The AFMRC recommends the manufacturer

consider modifying the tank screen to allow for complete filling of the tank. The manufacturer recommended when using the loading/unloading auger to run the auger slow because granular product will not auger at high speeds.

The tank lid was held closed by an over-centre latch. The lid was equipped with an air and moisture tight rubber seal. The applicator tank held approximately 1000 lb (454 kg) of Avadex BW assuming a density of 39.1 lb/ft³ (626 kg/m³) and 2300 lb (1044 kg) of Treflan QR5 assuming a density of 86.4 lb/ft³ (1384 kg/m³).

Access to the metering wheels required emptying the tank. Cleaning large amounts of material out of the tank was convenient using the loading/unloading auger. Complete clean out of the applicator tank required removal of the front clean out door. Clearance between the 2.5 in (64 mm) steel delivery lines and the threaded rod (FIGURE 9) made removal of the front clean out door difficult. The AFMRC recommends the manufacturer consider improving the ease of removing the front clean out door.

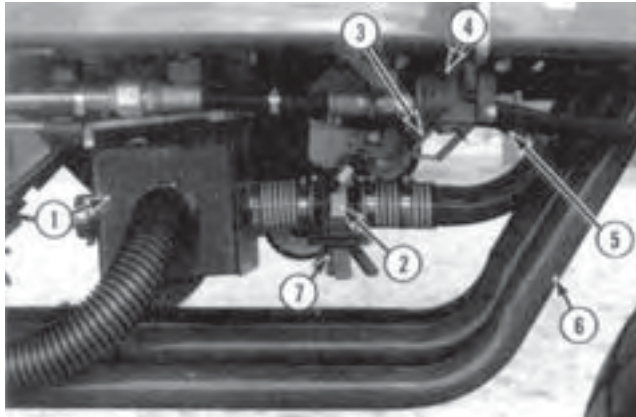


FIGURE 9. Metering Body: (1) Plenum, (2) Collector, (3) Clean Out Door, (4) Hydraulic Selector Lever, (5) Threaded Rod, (6) Steel Delivery Lines and (7) Collector Bottom.

Monitoring: Monitoring on the Morris 6028 granular herbicide applicator was very good. The Morris 6000 series air seeder monitor and the granular pressure gauge were used to monitor the granular system. The electronic monitoring system monitored fan speed, auxiliary meter shaft rotation, auxiliary bin level and ground speed. When material in the granular tank (Abin) dropped below the bin sensor an alarm sounded and the monitor displayed the alarm condition. When no motion was detected from the granular meter shaft (ASFt) an alarm sounded and the monitor displayed the alarm condition. The alarm audio for the appropriate sensor could be cancelled by pressing the reset button. The selected function was displayed for ten seconds then the alarm condition was displayed for one second. When the alarm condition was corrected the monitor cleared the alarm warning.

The pressure gauge setting was determined by the application rate. The setting was raised or lowered by changing the fan speed. The primary magnetic clutch was mounted on the range meter shaft drive. The secondary clutch (zapper) was mounted parallel with the primary clutch. The clutches were controlled by a three position rocker switch mounted in the tractor cab. The air seeder main clutch was engaged before the granular clutches would work.

Application Rate: Ease of setting the application rate was very good. Granular chemical or fine seed rates were set by determining the range shaft and quick change sprockets (FIGURE 10) required from the rate charts supplied. The range shaft had a 45tooth (low range) and a 15-tooth (high range) sprocket. Sprocket sizes from 11 to 45 teeth were used on the quick change sprocket shaft. The air seeder sprockets were used for the quick change sprockets. To change the range shaft sprocket the machine nut was removed and the required range sprocket installed. To change the quick change sprocket the locking nut was removed and the required sprocket installed. The clutches were engaged to allow the nuts to be loosened or tightened. The wing nuts that secured the quick change sprockets were difficult to thread onto the shaft. The collector bottom and front clean out door wing nuts were also difficult to thread. The AFMRC recommends the manufacturer consider modifying all wing nuts to allow for easier threading.

The manufacturer recommended the granular applicator be

calibrated when the material or rate was changed. The manufacturer supplied a rate check box and calibration chart to calibrate the applicator. The meter collector bottom (FIGURE 9) was removed and the rate check box positioned below the collector. The air seeder hand crank was turned the required number of turns for half an acre as determined from the calibration chart. The material was then weighed with the air seeder spring scale. The container weight was subtracted from the total weight. The material weight was multiplied by two to give the application rate. Granular material leaked from the bottom corners of the rate check box. The AFMRC recommends the manufacturer consider modifying the rate check box to stop material from leaking.

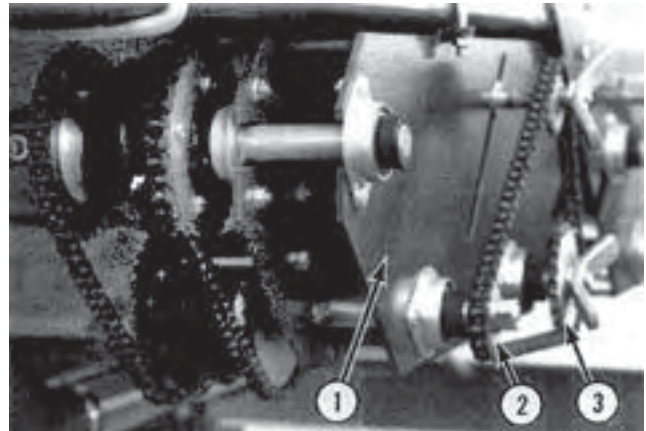


FIGURE 10. Granular rate adjustment: (1) Transmission, (2) Range Sprocket and (3) Quick Change Sprockets.

EASE OF INSTALLATION

Ease of mounting the 6028 granular applicator attachment was good. Two people required seven hours to mount the granular tank and metering system onto the 6000 series air seeder frame. Installation included attaching the metering body, plenum, granular transmission, ladder and walkway, pressure gauge and steel delivery tubes. The metering body was matched to the number of delivery outlets. The manufacturer supplied charts indicating the size of metering wheels for the required tillage unit. Initial setup of the metering body was completed by the manufacturer.

Two people required six hours to mount the distribution system onto the tillage unit. Installation included mounting the flat fan dividers, the deflector mounting bars and deflectors, routing the 2.5 in (64 mm) primary hoses, the 1 in (25 mm) secondary hoses and the electrical harness. The manufacturer supplied charts indicating the proper routing and length of delivery hoses and proper deflector spacing. The manufacturer stated the delivery hose must have a 12 in (305 mm) straight section before entering the deflector. FIGURE 11 shows the routing of the delivery hose to the deflector. The cultivator shank prevented the delivery hose from entering the deflector straight. The AFMRC recommends the manufacturer consider improving the alignment of the delivery hose to the deflector.

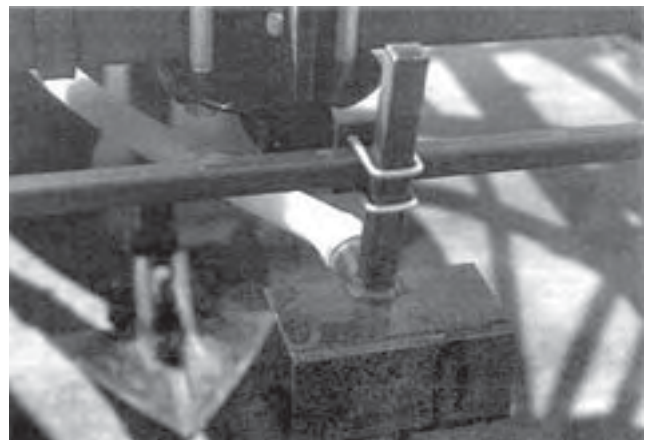


FIGURE 11. Delivery Hose Alignment.

POWER REQUIREMENTS

Hydraulic: The addition of the granular applicator to the 6130 air seeder did not increase the hydraulic flow requirements. Maximum hydraulic flow requirements for the centrifugal fan was 11.5 gal/min (52 L/min) at 1800 psi (12411 kPa). This was measured at a fan pressure of 21 in wg (5.2 kPa). Flow requirements for the centrifugal fan varied according to fan speed. At an average fan pressure of 15 in wg (3.7 kPa) the hydraulic flow requirements were 9.6 gal/min (44 L/min) at 1300 psi (8963 kPa).

Tractor Size: Average and maximum horsepower requirements for the centrifugal fan were 10.9 hp (8.1 kW) and 18.1 hp (13.5 kW), respectively.

OPERATOR SAFETY

The Morris 6028 granular applicator was safe to operate if normal safety precautions were observed. A fold-down ladder, side handrails and platform were provided for safe access to the applicator tank. Safety equipment was used when filling or cleaning the applicator tank to prevent exposure to granular chemical.

Tire loads would exceed the Tire and Rim Association's maximum load rating when the granular and air seeder tanks were filled with material. For example, when applying Edge [40 lb/ft³ (641 kg/m³)] and a fertilizer blend [59 lb/ft³ (945 kg/m³)] the unit weight was 10 percent above the allowable weight for the applicator tires. The AFMRC recommends the manufacturer consider supplying allowable granular and air seeder tanks capacities when both systems are used.

With the remote centrifugal fan location, the operator station noise level in modern tractor cabs was unaffected by fan noise.

OPERATOR'S MANUAL

The operator's manual was very good. The manual contained useful information on safety, operation, maintenance and trouble shooting. An applicator setup section was also provided. No parts list was provided. A calibration chart and meter rate charts were supplied in the operator's manual. The AFMRC recommends the manufacturer consider supplying meter rate charts in SI (metric) units as well as Imperial units.

MECHANICAL HISTORY

No mechanical problems were encountered during 30 hours of field operation. The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted.

**APPENDIX I
SPECIFICATIONS**

MAKE:	Morris
MODEL:	6028 Granular Herbicide Applicator
SERIAL NUMBER:	311
MANUFACTURER:	Morris Industries Ltd. 85 York Road Yorkton, Saskatchewan S3N 2X2 Phone: (306) 783-8585
PRINCIPLE OF OPERATION:	pneumatic conveyance; designed to be used with Morris 6000 series air seeders and mount on any implement
METERING SYSTEM:	
-- type	spiral fluted urethane metering wheels
-- number of meters	one
-- drive	Posi-drive transmission driven from air seeder metering system
-- adjustment	
-coarse	15-tooth high rate, 45-tooth low rate
-fine	sprockets ranging from 11 to 45-tooth
-- air stream loading	pressurized tank
-- transfer system	pneumatic conveyance through divider headers and plastic tubes
-- hose sizes	
-primary	2.5 in (64 mm)
-delivery	1.0 in (25 mm)
OPERATING WIDTHS:	
	29 to 33 ft (8.8 to 10.1 m) with one 7 and one 8 port divider
	35 to 37 ft (10.7 to 11.3 m) with one 8 and one 9 port divider
	39 to 41 ft (11.9 to 12.5 m) with one 9 and one 10 port divider
	43 to 45 ft (13.1 to 13.7 m) with three 7 port dividers
	47 to 49 ft (14.3 to 14.9 m) with one 7 and two 8 port dividers
	51 to 53 ft (15.5 to 16.2 m) with two 8 and one 9 port dividers
	55 to 57 ft (16.8 to 17.4 m) with three 9 port dividers
	59 ft (18 m) with one 9 and two 10 port dividers
SPREADING SYSTEM:	
-- spreader type	single plate deflectors
-- deflector spacing	21.5 to 25.5 in (546 to 648 mm) at various increments
-- deflector height	equal to the deflector spacing plus tillage depth
-- mounting tube	0.75 x 0.75 in (19 x 19 mm)
-- bar brackets	mounts to 4 x 4 in (102 x 102 mm) tubing
HOPPER CAPACITY:	28 cubic feet (0.78 cubic meters)
WEIGHTS:	
-- hopper	620 lb (281 kg)
-- accessories	150 lb (68 kg)
Total	770 lb (349 kg)
NUMBER OF CHAIN DRIVES:	3
OPTIONS INCLUDED ON TEST MACHINE:	-- two primary outlet metering body; eight and nine outlet flat fan dividers
OTHER AVAILABLE OPTIONS:	-- three primary outlet metering body; seven and ten outlet flat fan dividers

**APPENDIX II
MACHINERY RATINGS**

The following rating scale is used in Alberta Farm Machinery Research Centre Evaluation Reports.

-Excellent	-Very Good
-Good	-Fair
-Poor	-Unsatisfactory

SUMMARY

MORRIS 6028 GRANULAR HERBICIDE APPLICATOR

RETAIL PRICE:	\$6,138.00 less set-up (September, 1992 f.o.b. Lethbridge, Alberta, Morris 6028 granular herbicide applicator with 17 deflectors)
QUALITY OF WORK:	
- Metering Accuracy	very good; 6 percent high in Avadex BW and 5 percent high in Treflan QR5 at normal application rates
- Distribution Uniformity	good; CV of 7.7 percent for Avadex BW and 6.6 percent for Treflan QR5
- Spreading Uniformity	good; uniformity not significantly affected by variation in fan speed or metering rates
EASE OF OPERATION AND ADJUSTMENT:	
- Filling/Cleaning	good; access ladder and platform allowed for safe filling
- Monitoring	very good; 6000 series air seeder monitor and pressure gauge monitored system
- Application Rate	very good; adjusted by changing sprockets
EASE OF INSTALLATION:	good; two people required 13 hours to mount the tank and distribution system
POWER REQUIREMENTS:	applicator did not increase hydraulic flow requirements for the 6130 air seeder; average and maximum horsepower requirements for the centrifugal fan were 10.9 hp (8.1 kW) and 18.1 hp (13.5 kW)
OPERATOR SAFETY:	safe; safety equipment was used when filling or cleaning applicator
OPERATOR'S MANUAL:	very good; contained useful information
MECHANICAL HISTORY:	no mechanical problems were encountered during the test



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