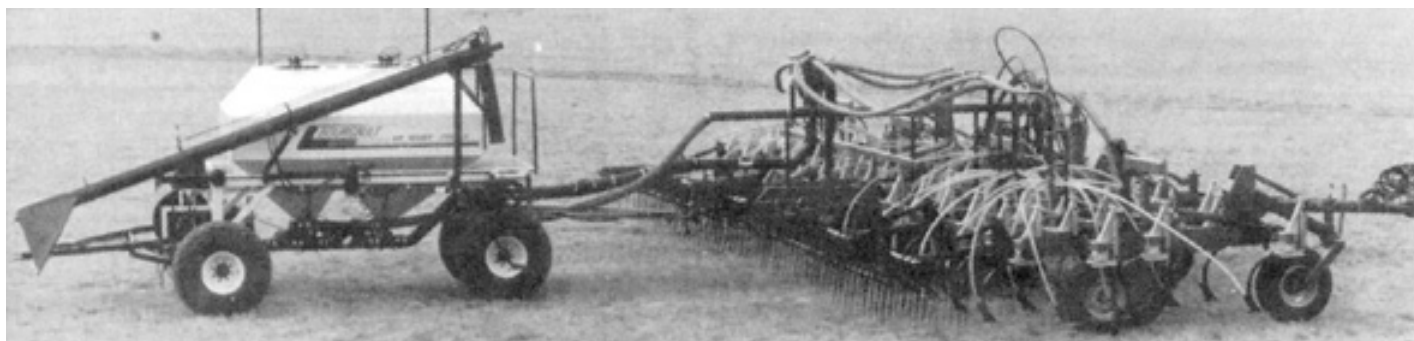


Evaluation Report

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Bourgault 2155 II Air Seeder

A Co-operative Program Between



BOURGAULT 2155 II AIR SEEDER

MANUFACTURER AND DISTRIBUTOR:

Bourgault Industries
P.O. Box 39
St. Brieux, Saskatchewan S0K 3V0
Phone:(306) 275-2300

RETAIL PRICE: \$32,421.00 (NOVEMBER, 1991, f.o.b. Lethbridge, Alberta) Bourgault 2155 II Air Seeder with 60 run air package, monitoring system, auger and dual shoot granular system

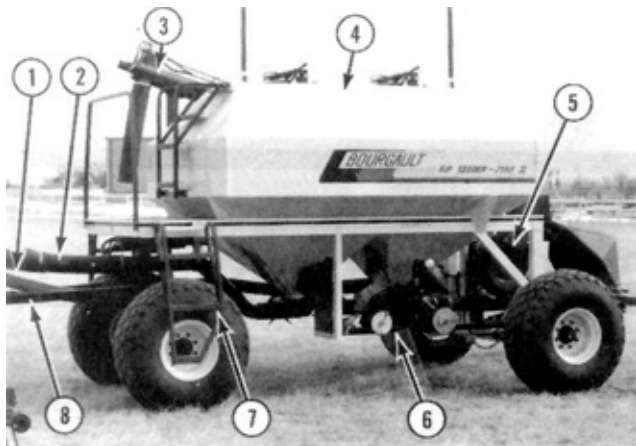


FIGURE 1. Bourgault 2155 II Air Seeder: (1) Granular Distribution Pipe, (2) Main Distribution Pipe, (3) Optional Auger, (4) Tanks, (5) Fan, (6) Metering System, (7) Access Ladders and (8) Hitch.

SUMMARY

QUALITY OF WORK:

The seed placement of the Bourgault 2155 II Air Seeder depended largely on the careful levelling of the cultivator frame and the type of seed boot used. Band width of the rows averaged 2.0 in (51 mm) in width. Metering accuracy of the 2155 II was very good. The metering rates for cereal grains, fertilizer, Treflan and Avadex were slightly affected by decreases in ground speed below 5 mph (8 km/h) and field side slope. The maximum 11-51-0 fertilizer application rate from the rear meter was 198 lb/ac (222 kg/ha).

The distribution uniformity was very good in wheat, barley, peas and canola. Rates of 11-51-0 fertilizer greater than 240 lb/ac (270 kg/ha) produced unacceptable distribution uniformities. Spreading uniformity was good in Avadex and Treflan. Increasing the spreader height increased the CV spreading uniformity in Treflan. Insignificant seed damage occurred providing proper fan speed settings were used.

EASE OF OPERATION AND ADJUSTMENT:

Maintenance of the system was very good with easy access to all lubrication points. Ease of filling and cleaning the applicator was very good. The optional auger allowed for fast filling and convenient emptying of the tanks. The applicator and cultivator were placed into transport position in five minutes. Since the applicator towed behind the cultivator, operator visibility was good.

Monitoring was very good with bin level, auger rotation and fan speed sensors supplied. Ease of setting the seeding, fertilizer and granular rates was very good. A slow speed sprocket for the rear auger was supplied. The 2155 II Air Seeder was equipped with an electronic calibration acreage meter and calibration boxes used for calibrating the application rate.

EASE OF INSTALLATION:

Ease of installing the distribution and monitoring systems was good. Installation of the systems took two experienced operators 8 hours, Installation of the granular distribution system was more convenient during initial setup rather than as an add-on option later. Installation of the granular system took an experienced operator 8 hours. Installation of only the distribution piping to the main air stream took the operator 45 minutes. Experienced operators would take less time.

POWER REQUIREMENTS:

The draft and horsepower requirements depended upon the size and type of cultivator used. Power take-off horsepower requirements to pull the applicator full of wheat in tilled loam soil ranged from 15.7 hp (11.7 kW) to 24.9 hp (18.6 kW). Average and maximum horsepower requirements for the centrifugal fan were 14.4 hp (10.7 kW) and 19.3 hp (14.4 kW).

OPERATOR SAFETY:

The Model 2155 was safe to operate if normal precautions were observed. Access ladders were provided for each side of the applicator and safety hand rails were provided for the lower and upper platforms. The tank lids were equipped with safety latches which prevented the lids from opening completely when the main latches were released.

OPERATOR'S MANUAL:

The operator's manual was good, containing useful information on adjustments, maintenance and operation. A distribution assembly manual and granular attachment manual were also provided.

MECHANICAL PROBLEMS:

Four grease nipples on the sprocket shafts, the front bin sensor and the tank lid seals were replaced.

RECOMMENDATIONS

It is recommended that the manufacturer consider:

1. Providing maximum allowable limits for Treflan QR5,
2. Supplying a scale that would record weight in both pounds and ounces to allow for easier entering of numbers into the meter.
3. Reorganizing the manual for a better flow of material, supplying pictures of the safety decals and supplying rate charts in Si units as well as in Imperial units to allow for easier use of the manual by the operator.

Manager: R.P. Atkins

*Project Engineer: L.W. Papworth
Project Technologist: G.A. Magyar*

THE MANUFACTURER STATES THAT:

Effective August 1, 1991, all Bourgault air seeders are capable of applying 350 lb/ac (393 kg/ha) of 11-51-0 fertilizer at 5 mph (8 km/h), while maintaining a CV of less than 10 per cent. This is compared to the 240 lb/ac (270 kg/ha) maximum achievable by the test unit.

The lid seals were damaged by the auger downspout. The protective cover on the outlet end of the downspout came off exposing the end of the wire helix found in the downspout spout tubing. We have developed an improved system of securing the protective cover to the discharge end of the downspout.

With regards to recommendation number:

1. Load limitations will be determined and displayed on the air seeder and in the operator's manual.
2. The program in the acre/calibration meter will be changed to accept pounds and tenths of pounds, for easier entering of numbers into the meter.
3. Your recommendations will be adopted to make the manual easier to use by the operator.

GENERAL DESCRIPTION

The Bourgault Model 2155 II air seeder is a pneumatic seed, fertilizer and granular applicator designed for use with various makes and models of cultivators. The applicator is towed behind the cultivator and supported by four wheels. The rear wheels are mounted on a solid axle while the front wheels are mounted on a pivoting axle. The applicator can be used for seeding, fertilizing, granular applying or any combination of two of the operations.

Seed, fertilizer or granules are metered through variable speed metering augers mounted below each tank. The front tank is equipped with a double flight metering auger while the rear tank has a triple flight metering auger. The augers are driven by a series of sprockets and chains from the left rear applicator wheel. The front auger drive has three range selections while the rear auger drive has six range selections. A primary clutch is located at the drive wheel while an auxiliary clutch is located between the rear auger drive and the rear auger. The clutches are electronically controlled by the metering clutch switch mounted in the tractor cab.

The centrifugal fan air stream conveys the metered material through the distribution system. The fan also pressurizes the tanks to equalize the pressure across the meters. Power to the fan is provided by either a gasoline engine or the tractor hydraulics. The augers meter the seed and/or fertilizer into the air stream. A six-port primary manifold divides the material to the 6 ten-port secondary manifolds. Tubes from the secondary manifolds connect to the seed boots. Installation of the granular distribution system enables granules to be distributed from the rear tank separately from material in the front tank. Distribution pipe is installed from the rear auger to the granular manifold. The fan conveys the granules to the thirty-port granular manifold with tubes connecting to the thirty deflectors.

The monitoring system consists of shaft sensors located on each metering auger, bin level sensors located in each tank and display of the fan speed. The electronic acreage meter displays field acres, total acres or ground speed. The acreage meter is also used to calibrate the unit.

The loading/unloading auger is mounted on the right side of the Air Seeder. A flow control valve directs hydraulic flow to either the fan or auger.

Model 2155 is equipped with hydraulic line extensions and a hitch to pull the Bourgault wing type packer.

The test machine came equipped with a hydraulically driven fan. Optional equipment included a rear auger metering clutch, a dual shoot granular herbicide attachment, metering shaft sensors, bin level sensors, a loading/unloading auger and hydraulic line extensions and a packer drawbar hitch. The test machine was used with a Bourgault model FH 536-42 multi-purpose 330 series cultivator. The five row cultivator was 40 ft (12.2 m) wide with 60 shanks spaced at 8 in (203 mm). A tractor with three remote hydraulics was required to operate the test unit.

Detailed specifications for the Air Seeder are given in APPENDIX I, while FIGURE 1 shows the location of major components.

SCOPE OF TEST

The Bourgault 2155 II air seeder was operated in the conditions shown in TABLE 1 for 137 hours while seeding 2517 ac (1019 ha). The metering systems were tested in the laboratory for metering and distribution accuracy and the effect of field and machine variables on metering and distribution. The Bourgault air seeder 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 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 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.

TABLE 1. Operating Conditions

| MATERIAL | SOIL TYPE AND CONDITION | FIELD AREA ac (ha) | HOURS |
|--------------|--|--------------------|------------|
| Spring Wheat | Silt Loam to Silty Clay Loam Secondary | 851 (344) | 47 |
| Spring Wheat | Loam Secondary | 65 (26) | 5 |
| Soft Wheat | Loam Secondary | 444 (180) | 30 |
| Durum | Loam Secondary | 147 (60) | 8 |
| Winter Wheat | Clay to Clay Loam Primary | 610 (274) | 26 |
| Winter Wheat | Silt Loam Primary | 180 (73) | 6 |
| Barley | Loam Secondary | 115 (47) | 8 |
| Barley | Silt Loam Primary | 55 (22) | 4 |
| Canola | Loam Secondary | 50 (20) | 3 |
| TOTAL | | 2517 (1019) | 137 |

RESULTS AND DISCUSSION

QUALITY OF WORK

Seed Placement: The seed placement of Model 2155 depended largely on the careful levelling of the cultivator frame and the type of seed boot used. The Bourgault seed boot (FIGURE 2) was secured to the bottom of the cultivator shank. Uniform seed depth placement was best obtained by comparing the seed depth of several shanks across the cultivator width and comparing the front and rear shank rows.

At an average seed depth of 2.5 in (64 mm) most of the seed was placed within 0.4 in (10 mm) of the average seed depth. The 8 in (203 mm) cultivator shank spacing and the 2.0 in (51 mm) average band width resulted in an average 6.0 in (152 mm) spacing between rows.

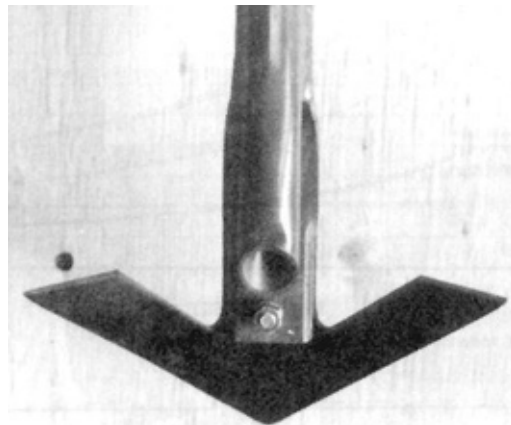


FIGURE 2. Bourgault Seed Boot.

Metering Accuracy: Metering accuracy of Model 2155 was very good. The metering rates were varied by changing the sprocket ratio for the metering augers. The calibration curves obtained by AFMRC and the manufacturer for the 2155 II Air Seeder in wheat, barley, canola and 11-51-0 fertilizer are given in FIGURES 3 to 6. FIGURE 7 shows AFMRC's calibration curve for Radley peas. The manufacturer supplied calibration curves for other varieties of peas. AFMRC and the manufacturer's calibration curves for Avadex BW and Treflan QR5 are given in FIGURES 8 and 9. Any differences between the calibration curves obtained by AFMRC and those given by the manufacturer are probably due to different seed or granular size, density and moisture content. The densities obtained by AFMRC are indicated on the graphs. The calibration charts supplied by the manufacturer did not indicate the densities.

The manufacturer indicated that the charts are to be used as guidelines and the operator should calibrate the air seeder for the particular product that will be used. The manufacturer also suggested that when applying granular products the application rate should be checked periodically to ensure the density of the product has not changed.

Level of material in the tank, field roughness and variations in fan speed had no effect on metering rates. Variations in ground speed did affect the metering rates. A decrease in speed from 5 to 4 mph (8 to 6.4 km/h) had no effect in metering rates. Decreasing the speed to 3 mph (4.8 km/h) caused a 10 per cent decrease in the metering rate of wheat and fertilizer and a 6 per cent decrease in the meter-

ing rate of Avadex BW and Treflan QR5. Increasing the speed above 5 mph (8 km/h) had no effect on the metering rates.

Operating the Model 2155 on uphill and downhill slopes did not affect metering rates but operating on side slopes did. Travelling on a 5 degree left side slope resulted in a slight decrease in the metering rate for wheat and 11-51-0 fertilizer. Avadex BW and Treflan QR5 showed decreases of 9 and 5 per cent in their metering rates respectively, while travelling on a 5 degree left side slope. Travelling on a 5 degree right side slope increased the metering rate 5 per cent in wheat, 8.5 per cent in 11-51-0 fertilizer, 6.5 per cent in Avadex BW and 3 per cent in Treflan QR5.

The maximum rate for 11-51-0 fertilizer was 198 lb/ac (222 kg/ha) from the rear auger.

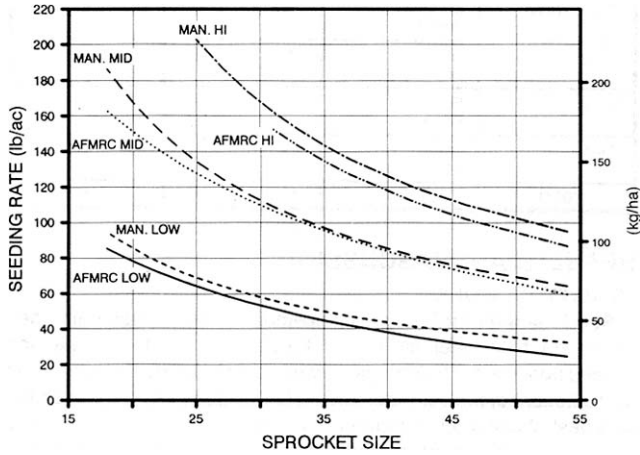


FIGURE 3. Metering Accuracy in Wheat at 5 mph (8 km/h).

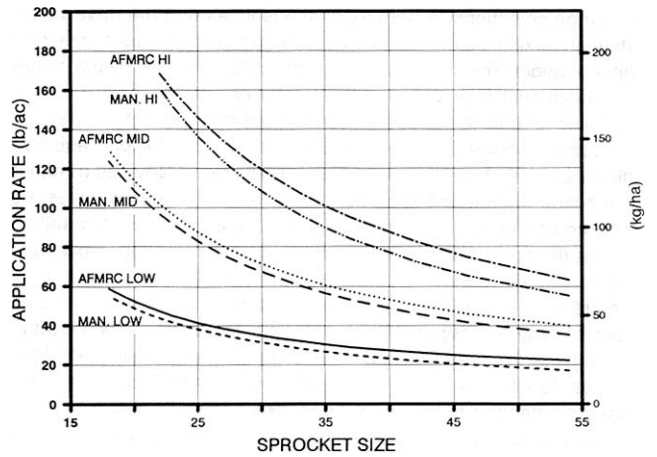


FIGURE 6. Metering Accuracy in 11-51-0 Fertilizer at 5 mph (8 km/h).

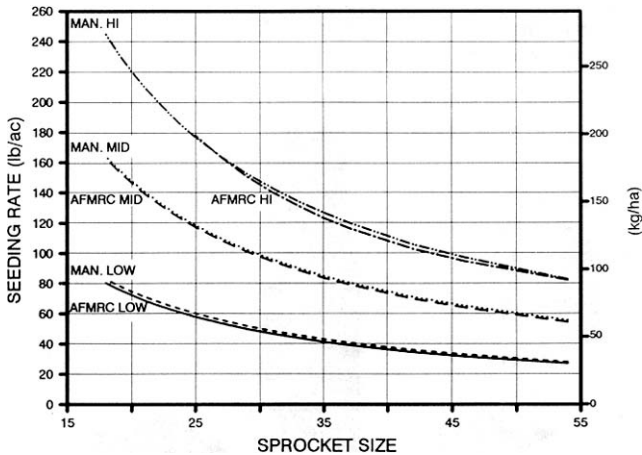


FIGURE 4. Metering Accuracy in Barley at 5 mph (8 km/h).

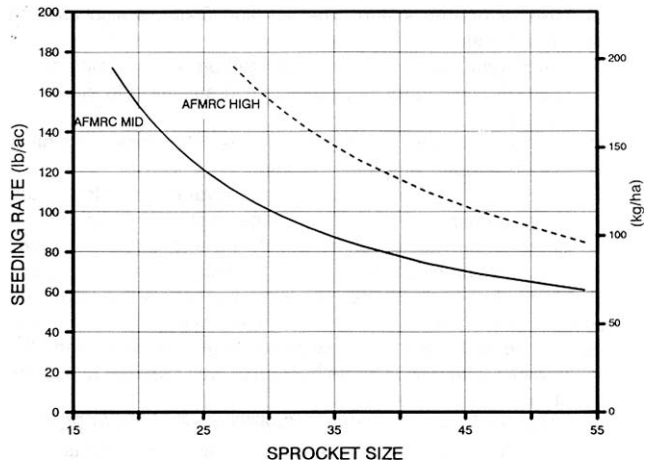


FIGURE 7. Metering Accuracy in Radley Peas at 5 mph (8 km/h).

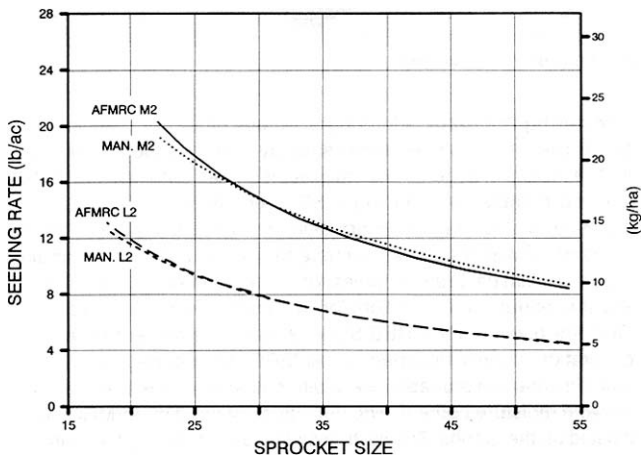


FIGURE 5. Metering Accuracy in Canola at 5 mph (8 km/h).

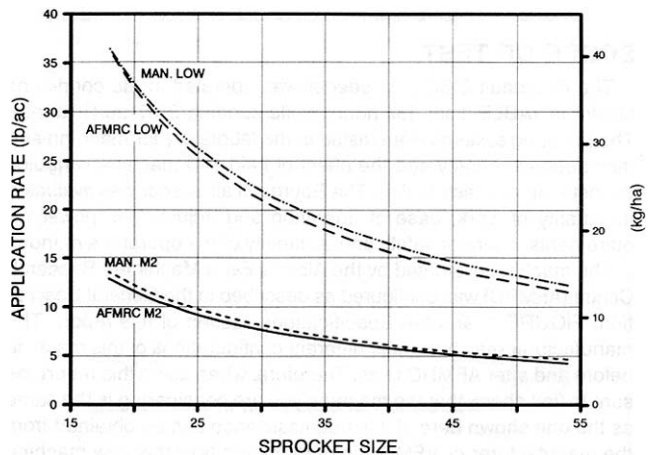


FIGURE 8. Metering Accuracy in Avadex BW at 5 mph (8 km/h).

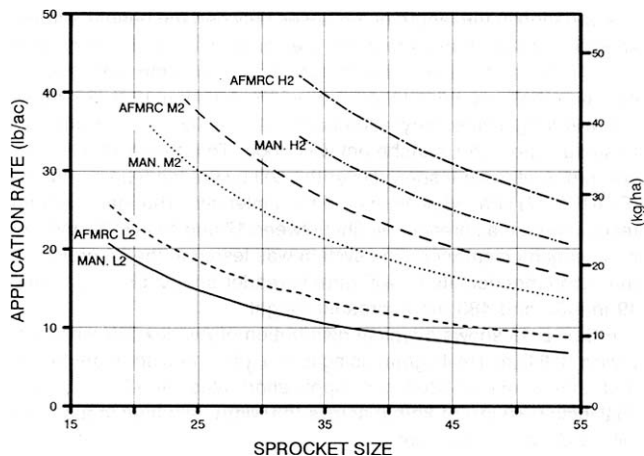


FIGURE 9. Metering Accuracy in Treflan QR5 at 5 mph (8 km/h).

Distribution Uniformity: Uniformity of distribution of the application rate for Model 2155 was very good. FIGURE 10 shows the seeding distribution uniformity for the unit in wheat, barley and Radley peas. Distribution was uniform over the full range of seeding rates. For example, at a seeding rate of 66.3 lb/ac (74.5 kg/ha), the coefficient of variation¹ (CV) was 4.2 per cent for wheat. At a barley seeding rate of 82.8 lb/ac (93 kg/ha) the CV was 5.7 per cent while at a seeding rate of 99.9 lb/ac (112.2 kg/ha) the CV was 4.5 per cent for peas. FIGURE 11 shows a typical seeding distribution pattern obtained in wheat at a seeding rate of 66.3 lb/ac (74.5 kg/ha). The seeding rate for each opener across the width of the air seeder varied from 60.9 to 73.5 lb/ac (68.4 to 82.6 kg/ha). This resulted in acceptable distribution uniformity with a CV of 4.2 per cent.

FIGURE 12 shows a typical distribution pattern obtained in canola at a seeding rate of 6.4 lb/ac (7.2 kg/ha). The seeding rate for each opener across the width of the air seeder varied from 5.7 to 7.2 lb/ac (6.4 to 8.1 kg/ac), which resulted in acceptable distribution uniformity with a CV of 4.3 per cent. Distribution uniformity was acceptable over the full range of canola seeding rates with CV's varying from 4.3 to 5.0 per cent (FIGURE 13).

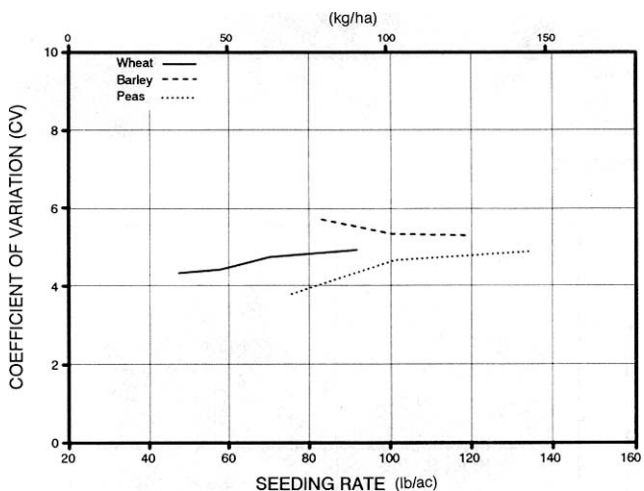


FIGURE 10. Distribution Uniformity in Wheat, Barley and Peas over a Range of Seeding Rates at 5 mph (8 km/h).

¹The coefficient of variation (CV) is the standard deviation of application rates from individual outlets expressed as a per cent of the average application rate. A low CV represents uniform application whereas a high CV indicates non-uniform application. An acceptable variation for seeding grain or applying fertilizer is a CV value not greater than 15 per cent. One granular herbicide manufacturer has suggested that the acceptable variation for applying granules is a CV value not greater than 10 per cent.

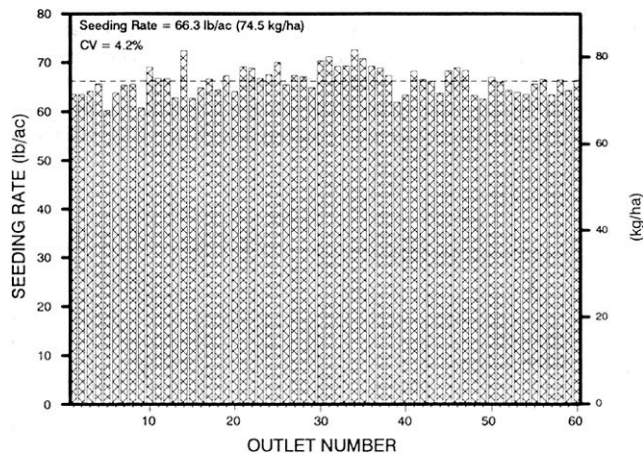


FIGURE 11. Distribution Uniformity Pattern in Wheat at 66.3 lb/ac (74.5 kg/ha) and 5 mph (8 km/h).

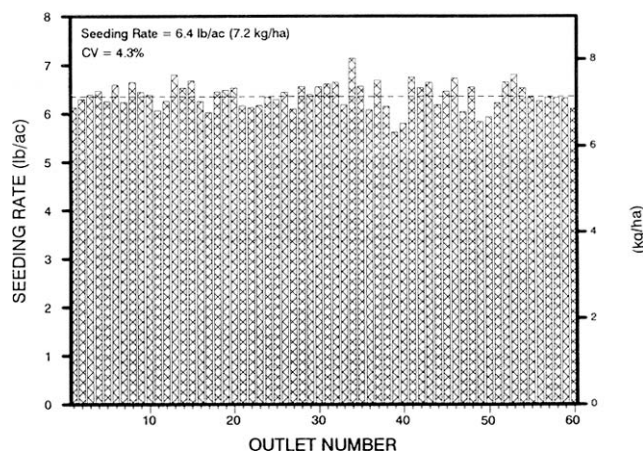


FIGURE 12. Distribution Uniformity Pattern in Canola at 6.4 lb/ac (7.2 kg/ha) and 5 mph (8 km/h).

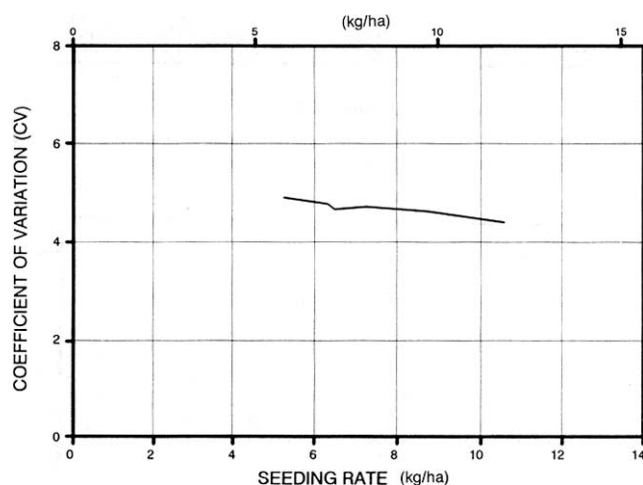


FIGURE 13. Distribution Uniformity in Canola over a Range of Seeding Rates at 5 mph (8 km/h).

Distribution uniformity in 11-51-0 fertilizer was acceptable at application rates below 240 lb/ac (270 kg/ha) as shown in FIGURE 14. The CV's varied from 8.0 to 16.7 per cent. The manufacturer claimed that acceptable CV's could be expected using 46-0-0 fertilizer at higher application rates.

FIGURE 15 shows the delivery rate for each of the 30 outlets while applying Avadex BW at a rate of 12.1 lb/ac (13.6 kg/ha) and a fan speed of 3800 rpm. Application rates from the individual outlets varied from 10.1 to 13.9 lb/ac (11.4 to 15.6 kg/ha) resulting in a CV of 8.2 per cent.

FIGURE 16 shows the delivery rate for each of the 30 outlets while applying Treflan QR5 at a rate of 21.3 lb/ac (23.9 kg/ha) and a fan speed of 3790 rpm. Application rates from the individual outlets varied from 17.2 to 24.5 lb/ac (19.3 to 27.5 kg/ha) resulting in a CV of 8.6 per cent.

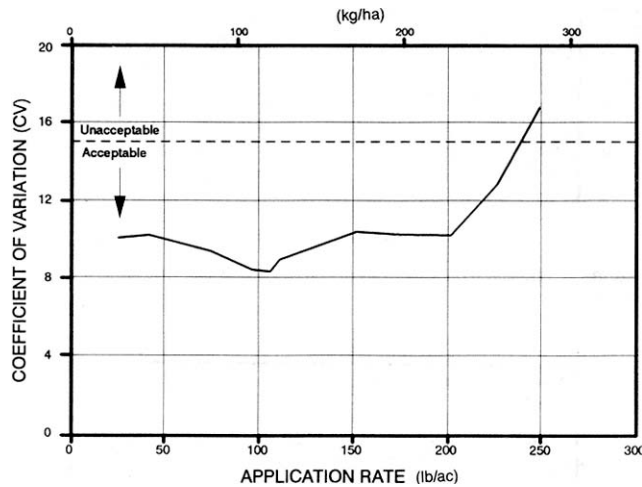


FIGURE 14. Distribution Uniformity in 11-51-0 Fertilizer over a Range of Application Rates at 5 mph (8 km/h).

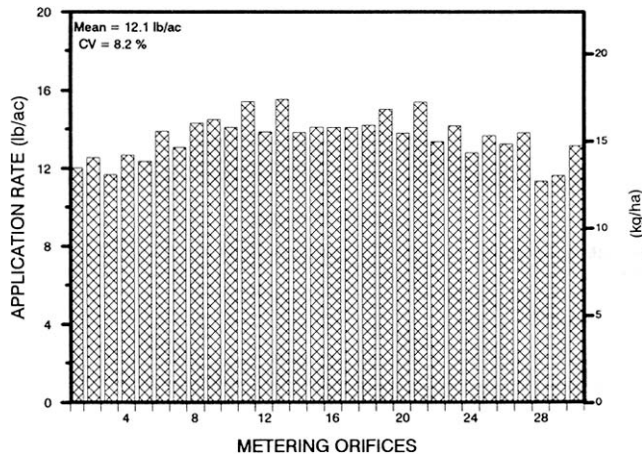


FIGURE 15. Variation in Delivery Rates from individual outlets when applying Avadex BW at 12.1 lb/ac (13.6 kg/ha), 5 mph (8 km/h) and a fan speed of 3800 rpm.

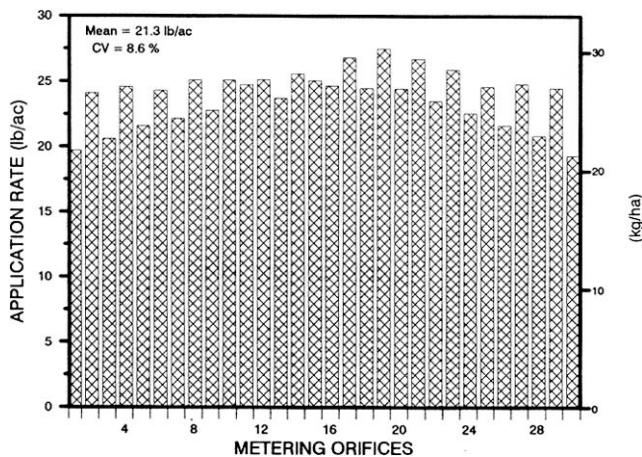


FIGURE 16. Variation in Delivery Rates from individual outlets when applying Treflan QR5 at 21.3 lb/ac (23.9 kg/ha), 5 mph (8 km/h) and a fan speed of 3790 rpm.

Variations in fan speed, metering rates and field slopes had no significant effect on the delivery rate of individual outlets while applying Avadex BW or Treflan QR5.

A variation in the length of the hoses between the header and the spreaders caused an increase in the variation of the delivery rates to the individual outlets. The manufacturer recommended that the minimum delivery hose length be no shorter than 12 ft (3.7 m).

Spreading Uniformity: Spreading uniformity of the Bourgault Granular Applicator Attachment was good. The pneumatically conveyed granules were spread over the soil by flat fan type spreaders (FIGURE 17) spaced at 16 in (406 mm) intervals. The manufacturer recommended a spreader height between 17 and 19 in (432 and 483 mm) working clearance. The system was tested in the laboratory at the recommended 16 in (406 mm) spreader spacing and a 17 and 19 in (432 and 483 mm) spreader height.

FIGURE 18 shows a typical distribution of Avadex BW when applying 12.8 lb/ac (14.4 kg/ha) using a 17 in (432 mm) spreader height and a fan speed of 3800 rpm. Application rates varied from 11.6 to 15.2 lb/ac (13.0 to 17.1 kg/ha) across the width, resulting in a pattern with a CV of 6.9 per cent.

The spreading uniformity of Avadex BW was not significantly affected by variations in fan speed, metering rate or spreader height. A fan speed of 3500 rpm resulted in a pattern with a CV of 6.5 per cent. Increasing the application rate to 16.9 lb/ac (19.0 kg/ha) resulted in CV of 7.1 per cent while changing the spreader height to 19 in (483 mm) did not change the CV.

FIGURE 19 shows a typical distribution of Treflan QR5 when applying 19.4 lb/ac (21.8 kg/ha) using a 17 in (432 mm) spreader height and a fan speed of 3770 rpm. Application rates varied from 17.1 to 23.9 lb/ac (19.2 to 26.9 kg/ha) across the width, resulting in a pattern with a CV of 7.9 per cent.

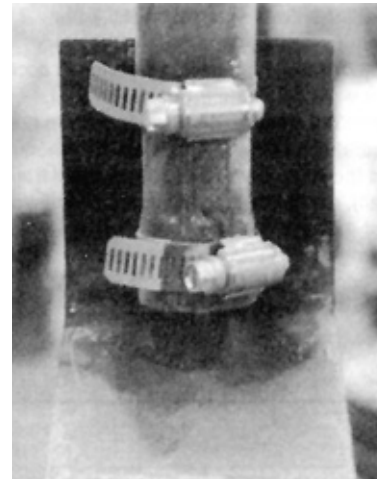


FIGURE 17. Flat Fan Spreader.

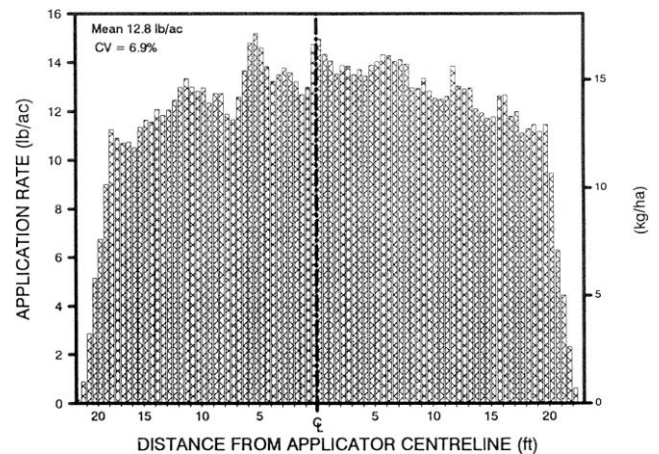


FIGURE 18. Distribution Pattern when Applying 12.8 lb/ac (14.4 kg/ha) of Avadex BW using a 17 in (432 mm) spreader height, 5 mph (8 km/h) and a fan speed of 3800 rpm.

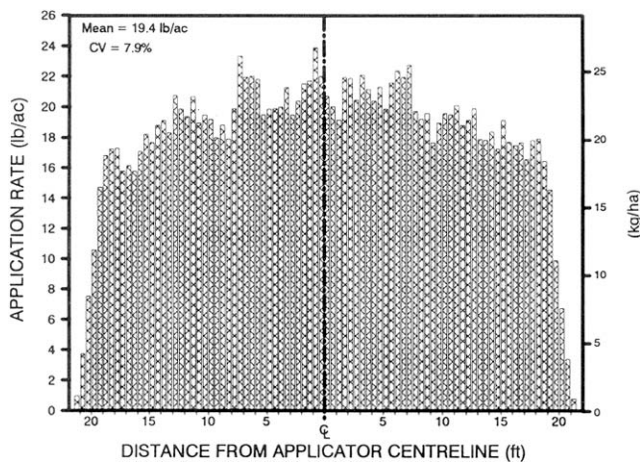


FIGURE 19. Distribution Pattern when Applying 19.4 lb/ac (21.8 kg/ha) of Treflan QR5 using a 17 in (432 mm) spreader height, 5 mph (8 km/h) and a fan speed of 3770 rpm.

The spreading uniformity of Treflan QR5 was not significantly affected by variations in fan speed or metering rates but was affected by spreader height. A fan speed of 3570 rpm resulted in a pattern with a CV of 7.6 per cent while an application rate of 28.2 lb/ac (31.7 kg/ha) resulted in a CV of 8.2 per cent. Changing the spreader height to 19 in (483 mm) resulted in a pattern with a CV of 9.3 per cent.

Seed Damage: Damage by the metering and distribution system in wheat at an average seeding rate of 60.0 lb/ac (67.4 kg/ha) and a fan speed of 3800 rpm was 0.7 per cent. Increasing the fan speed to 4000 rpm increased damage to 0.9 per cent, while reducing the fan speed to 3500 rpm showed no change in damage. The damage in Radley peas at an average seeding rate of 75.0 lb/ac (84.3 kg/ha) and a fan speed of 3800 rpm was 2.8 per cent. Increasing the seeding rate to 100.0 lb/ac (112.4 kg/ha) decreased damage to 2.3 per cent. The damage in canola at an average seeding rate of 6.3 lb/ac (7.1 kg/ha) and a fan speed of 3000 rpm was 0.2 per cent. Increasing the fan speed to 3200 rpm increased damage to 0.5 per cent, while decreasing the fan speed to 2800 rpm decreased damage to 0.1 per cent. These values were similar to conventional grain drill metering systems.

EASE OF OPERATION AND ADJUSTMENT

Maintenance: Ease of performing routine maintenance on the Bourgault air seeder was very good. All 21 grease fittings were easily accessible. Grease fittings were provided for all the wheel hubs. A service schedule was supplied in the operator's manual. Daily greasing took one person five minutes. The manufacturer recommended that the secondary manifolds be periodically checked for foreign material in the outlet ports.

Filling/Cleaning: Ease of filling and cleaning Model 2155 was very good. The optional 7 in (178 mm) auger supplied with the test unit allowed for fast filling and convenient emptying of the tanks. The time to fill both tanks was 30 minutes. The auger was hydraulically driven from the tractor. A hydraulic selector valve diverted the hydraulic flow from the fan to the auger motor. Auger reversal was possible by repositioning the spool valve lever on the hydraulic valve. Auger plugging was not a problem throughout the evaluation,

One person could easily place the auger into transport or working position. A hopper and safety screen were provided with the auger. The hopper could be inverted for clean out.

The large 18 x 18 in (457 x 457 mm) tank openings allowed ample room to maneuver the auger spout during filling. The tank lids were held closed by over-center latches. The lids were equipped with a rubber seal for an air and moisture tight seal.

The front tank held 90 bu (3346 L), while the rear tank held 62 bu (2255 L) of wheat. The rear tank when used for granular application could hold approximately 3000 lb (1364 kg) of Avadex BW, assuming a density of 38 lb/ft³ (609 kg/m³). The rear tank could hold approximately 7000 lb (3182 kg) of Treflan QR5 assuming a density of 88 lb/ft³ (1410 kg/m³). Depending on the product in the front tank the

load rating of the tires could be exceeded. It is recommended that the manufacturer consider providing maximum allowable limits for Treflan QR5.

Access to the meter augers required emptying the tanks. Each tank was equipped with a cleanout door. Cleaning large amounts of material out of the tanks was convenient using the unloading auger (FIGURE 20). Positioning the auger under the tank cleanout doors required the operator to leave the front tires of the air seeder in a turned position to allow the hopper to clear the right tire. Capacity of the cleanout system with wheat was 234 bu/h (6.4 t/h). The time required to empty a full 90 bu (3346 L) tank of wheat was 25 minutes. The metering auger could be turned by hand to remove any remaining grain through the auger clean-out ports.

The hopper and hopper screen were easily removed from the auger to allow for cleanout of the hopper.



FIGURE 20. Unloading Material From Bourgault Tank.

Transporting: Ease of transporting the applicator was very good. The applicator was easily attached to the trailing hitch mounted on the Bourgault cultivator. Hook-up of six hydraulic lines and three electronic couplers was required.

The applicator was equipped with an optional wing packer hitch. This required the hook-up of two hydraulic lines when the packer was pulled behind the applicator. The optional loading/unloading auger was easily placed into transport position by one person after filling the applicator.

Since the applicator towed behind, visibility of the cultivator was very good. The applicator and cultivator were difficult to maneuver while backing up. The Bourgault applicator and cultivator were easily placed into transport position (FIGURE 21) in less than five minutes. The meter drive clutches were conveniently engaged and disengaged electronically from the tractor. Overall transport height and width were 15.7 ft (4.8 m) and 22.1 ft (6.7 m) respectively, requiring care when travelling on public roads.



FIGURE 21. Transport Position.

Monitoring: Monitoring on Model 2155 was very good. The Bourgault electronic monitoring system was able to monitor fan speed, front and rear tank bin levels and front and rear auger shaft rotation. The digital display continuously showed fan speed in increments of 10 r.p.m, and an alarm sounded when the fan speed dropped below 3000 r.p.m. When material in the front tank (fbin) or the rear tank (rbin) dropped below the bin sensor an alarm sounded and the monitor displayed the appropriate bin sensor. The operator could enable or

disenable the auger alarms by turning the position switch located on the front of the monitor. When the monitoring system detected no motion from the front auger (faug) or rear auger (raug) the monitor displayed the appropriate auger sensor and the alarm sounded. A magnetic clutch was mounted on the main drive and an auxiliary clutch was mounted on the rear auger drive. The clutches were controlled by a rocker switch mounted in the tractor cab.

The unit was also equipped with an electronic acreage meter. The operator entered the implement width (feet) and the pulse number (1760) for Model 2155. Pressing the function button the meter displayed either field acres, total acres or ground speed. The digital display showed values to the nearest tenth of an acre or mph. The acreage meter was accurate with values averaging 0.1 per cent high. The acreage meter was also used to calibrate the air seeder.

Application Rates: Ease of setting the application rates was very good. The seeding, fertilizing and granular rates were set by determining the main range and quick change sprockets (FIGURE 22) required from the sprocket selection charts. A 54-tooth sprocket (low range), 27-tooth sprocket (medium range) and 18-tooth sprocket (high range) were used on the main range selector shaft. The main range sprocket selected must be the same for each tank. Sprocket sizes ranging from 18 to 54 teeth were used on the quick change sprocket shafts. To change the main range and quick change sprockets the locking wing nuts were removed and the required sprockets installed. The Model 2155 was equipped with spring loaded pins by each shaft. The pins secured the shafts, allowing for easy removal and tightening of the locking wing nuts. The idler sprocket was adjusted until the drive chain was snug.

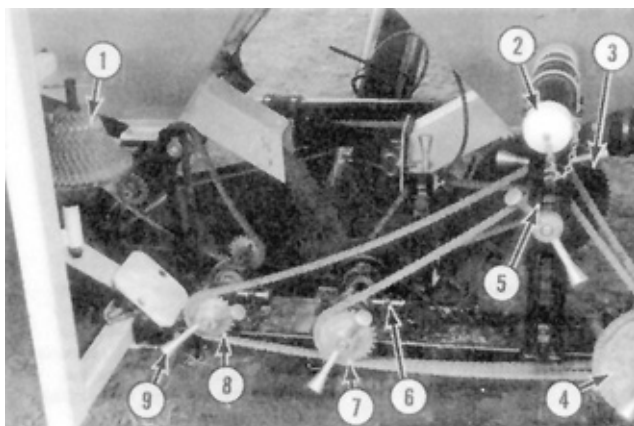


FIGURE 22. Seed, Fertilizer and Granular Rate Adjustment: (1) Quick Change Sprockets, (2) Slow Speed Drive Chain Location, (3) Rear Tank Slow Speed Sprocket, (4) Main Range Sprocket, (5) Idler Sprockets, (6) Spring Loaded Pins, (7) Rear Auger Quick Change Sprocket, (8) Front Auger Quick Change Sprocket, and (9) Locking Wing Nuts.

The rear auger was equipped with a slow speed sprocket (70-tooth) to allow for small seeds and granular product to be metered from the rear tank. Installing the slow speed kit required removal of the normal speed auger drive chain and installation of the slow speed auger drive chain. Installation of the slow speed kit took one person five minutes.

The rear tank was used in a double shoot system to apply granular product. Changing the Bourgault air seeder to a double shoot system (FIGURE 23) took one person 45 minutes. Experienced operators would take less time.

The manufacturer recommended when applying product from the rear tank only, that either the metal cap be placed on the pipe pressurizing the front tank or a small volume of product be placed into the front tank. When using product in the front tank as a seal, the front meter drive chain should be disconnected to prevent the auger from turning.

The electronic acreage meter was used to calibrate the air seeder. The clean-out covers were removed from the end of the auger shafts and the calibration boxes suspended below each opening. The CAL button on the meter was pressed until the acreage meter entered the calibration mode. Product was metered through each auger and collected in the calibration boxes. The samples were weighed with

the supplied scale. The CAL button was pressed on the acreage meter and the weight of the product entered. The meter required the weight to be entered in pounds and ounces. The scale did not read the weight in ounces. It is recommended that the manufacturer consider supplying a scale that would record weight in both pounds and ounces to allow for easier entering of numbers into the meter. The CAL button was pressed again and the product rate was displayed in pounds per acre. This calibration procedure was accurate.

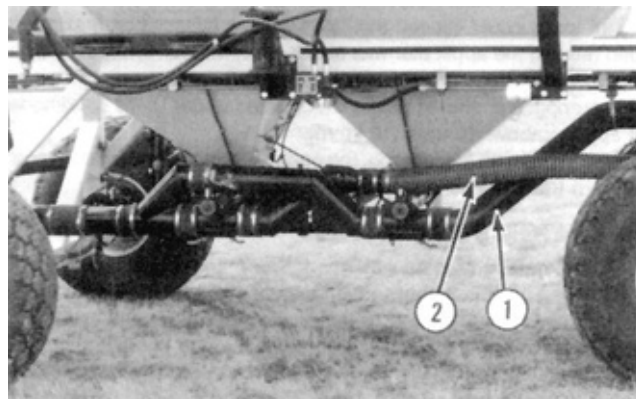


FIGURE 23. Double Shoot System: (1) Main Distribution Piping and (2) Double Shoot Piping.

EASE OF INSTALLATION

Ease of installing the distribution and monitoring system was good. Installation of the double shoot package on the tillage unit was more convenient during initial set-up rather than as an add-on option later. The installation of the seed and fertilizer distribution system included mounting the primary and secondary manifolds, mounting the seed boots, mounting the electronic acreage meter and monitor, connection of the 5 in (127 mm) main distribution hose, routing the 2.5 in (64 mm) primary hoses, routing the 1 in (25 mm) secondary hoses and routing the electrical harnesses. The installation of the distribution system took two experienced operators 8 hours.

Installation of the granular (double shoot) distribution system included mounting the primary manifold, mounting the deflectors, connection of the distribution pipe to the main air stream and routing the 0.75 in (19 mm) double shoot hoses. Installation of the double shoot system took an experienced operator 8 hours. Installation of only the distribution piping to the main air stream took the operator 45 minutes.

POWER REQUIREMENTS

Draft Characteristics: The draft (drawbar pull) and corresponding tractor horsepower requirements depended on the size and type of cultivator used. Refer to AFMRC/PAMI reports on cultivators for estimates of draft and horsepower requirements. The amount of draft depends on field preparation, soil type and moisture content, ground speed and the amount of seed, fertilizer or granular product in the tanks. Average tank draft, with the tanks full of wheat at a normal seeding depth and at 5 mph (8 km/h), in a tilled loam soil ranged from 658 lb (2.9 kN) to 1042 lb (4.6 kN).

Hydraulic: Maximum hydraulic flow requirements for the centrifugal fan was 9.2 gal/min (42 L/min) at 2400 psi (16547 kPa). This was measured at a fan speed of 4400 rpm. Flow requirements for the centrifugal fan varied according to the fan speed. At an average fan speed of 3800 rpm the hydraulic flow requirement was 7.5 gal/min (34 L/min) at 2200 psi (15168 kPa).

Tractor Size: Power take-off horsepower requirements to pull the air seeder full of wheat in tilled loam soil ranged from 15.7 hp (11.7 kW) to 24.9 hp (18.6 kW). Average and maximum horsepower requirements for the centrifugal fan were 14.4 hp (10.7 kW) and 19.3 hp (14.4 kW), respectively.

OPERATOR SAFETY

The Model 2155 was safe to operate if normal safety precautions were observed. An access ladder was provided on each side of the lower platform and a safety railing provided for the lower and upper

platforms. Two lock pins were provided to secure the loading auger in transport position. The main clutch was disengaged electronically from the tractor cab. A safety cable was provided to go from the applicator hitch to the cultivator hitch. The tank lids were equipped with safety latches which prevented the lids from opening completely when the main latches were released.

Safety equipment was used when filling or cleaning the tank to prevent exposure to granular chemical. A slow moving vehicle decal was located on the rear of the applicator.

Tire loads could exceed the Tire and Rim Association maximum load rating if the applicator was transported with full tanks of 11-51-0 fertilizer at speeds greater than 10 mph (16 km/h).

The applicator should not be transported under these conditions at speeds above 10 mph (16 km/h).

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

OPERATOR'S MANUAL

The operator's manual was good. The manual contained useful information on adjustments, maintenance and operation. A distribution assembly manual and granular attachment manual were also provided. No parts list was provided. Calibration charts for the required cultivator width were provided in the operator's manual and granular attachment manual. Items were repeated and some topics were difficult to find in the manual. Pictures of the safety decals, rates in SI units and seed densities were not given. It is recommended that the manufacturer consider reorganizing the material in the manual, supplying pictures of the safety decals, supplying rate charts in SI units and indicating seed densities on the rate charts to allow for easier use of the manual by the operator.

MECHANICAL HISTORY

The Bourgault 2155 II air seeder was operated for 137 hours while seeding 2517 ac (1019 ha). The intent of the test was evaluation of functional performance. An extended durability evaluation was not conducted. TABLE 2 outlines the mechanical problems that did occur during the functional testing.

TABLE 2. Mechanical History

| ITEM | OPERATING HOURS | EQUIVALENT FIELD AREA - ac (ha) |
|--|-----------------|---------------------------------|
| Replaced four grease nipples on metering shafts at | 58 | 1040 (421) |
| Replaced front bin sensor at | 65 | 1190 (482) |
| Replaced seals around tank lid openings at | 90 | 1507 (610) |

DISCUSSION OF MECHANICAL PROBLEMS

Tank Seals: The auger spout was equipped with a protective covering at the discharge. When the covering became separated from the spout the rough edges of the spout produced tears in the seals surrounding the tank openings. The protective covering would not stay in place and eventually the seals on both tanks were replaced. It is recommended that the manufacturer consider improvements to the auger spout hose to prevent damaging the tank seals.

APPENDIX I

SPECIFICATIONS

| | | |
|---------------------------|---|----------|
| MAKE: | Bourgault Air Seeder | |
| MODEL: | 2155 II H | |
| SERIAL NUMBER: | 3192 | |
| MANUFACTURER: | Bourgault Industries P.O. Box 39 St. Brieux, Saskatchewan S0K 3V0 (306) 275-2300 | |
| DIMENSIONS: | | |
| -width | 9.5 ft | (2.9 m) |
| -length | 24.3 ft | (7.4 m) |
| -height | 11.1 ft | (3.4 m) |
| -maximum ground clearance | 11.1 in | (282 mm) |
| -wheel tread | | |
| -front | 6.0 ft | (1.8 m) |
| -rear | 9.2 ft | (2.8 m) |

METERING SYSTEM:

| | |
|----------------------|--|
| -type | double and triple flight cross auger |
| -number of meters | 2 |
| -drive | chain driven through a series of sprockets from the left rear applicator tire |
| -adjustment | |
| -coarse | 18 tooth high range, 27 tooth medium range, 54 tooth low range |
| -fine | sprockets ranging from 18 to 54 tooth 70 tooth slow speed sprocket on rear tank for fine seeds and granular |
| -airstream loading | pressurized tank |
| -transfer to openers | pneumatic conveyance through divider headers and plastic tubes |
| -hose sizes | |
| -primary | 5.0 in (127 mm) seed and fertilizer, 4.0 in (102 mm) granular |
| -secondary | 2.5 in (64 mm) seed and fertilizer |
| -delivery | 1.0 in (25 mm) seed, fertilizer and granular |

TANK CAPACITIES:

| | |
|-------------|----------------|
| -front tank | 90 bu (3273 L) |
| -rear tank | 62 bu (2255 L) |

FAN:

| | |
|------------------|--|
| -type | radial blade centrifugal |
| -make | Bourgault Air Seeder Div. |
| -operating range | 2700 to 4700 rpm |
| -drive | hydraulically driven from tractor remote |

HITCH:

| | |
|----------------------------|---------------|
| -vertical adjustment range | no adjustment |
|----------------------------|---------------|

WHEELS:

| | |
|--------|------------------------|
| -front | two, 16.5L-16.1, 6 ply |
| -rear | two, 16.5L-16.1, 6 ply |

NUMBER OF LUBRICATION POINTS: 22 grease fittings

AUGER:

| | |
|--------|---------------------------------|
| -size | 7 in (178 mm) diameter |
| -drive | hydraulically driven by tractor |

GRANULAR ATTACHMENT:

| | |
|-------------------|-----------------------------------|
| -metering | slow speed sprocket on rear auger |
| -spreader type | double overlap pattern |
| -spreader spacing | 16 in (406 mm) |

OPTIONS INCLUDED ON TEST MACHINE:

| | |
|--|--|
| | 7 in (178 mm) diameter hoppe auger, dual shoot granular attachment, rear auger metering clutch, rear bin level sensors, meter shaft alarms, electronic calibration and acre meter and low hitch and hydraulic lines for Bourgault wing type packer |
|--|--|

OTHER AVAILABLE OPTIONS:

| | |
|--|---|
| | 64 and 72 tooth sprockets and engine driven fan |
|--|---|

WEIGHTS:

| | TANKS EMPTY | TANKS FULL OF WHEAT |
|--------------|-------------------|---------------------|
| -hitch | 80 lb (36 kg) | 80 lb (36 kg) |
| -left front | 995 lb (451 kg) | 3380 lb (1534 kg) |
| -right front | 985 lb (447 kg) | 3340 lb (1515 kg) |
| -left rear | 975 lb (442 kg) | 3300 lb (1497 kg) |
| -right rear | 1365 lb (619 kg) | 3700 lb (1679 kg) |
| TOTALS | 4400 lb (1995 kg) | 13800 lb (6261 kg) |

APPENDIX II

MACHINE RATINGS

The following rating scale is used:

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

SUMMARY CHART

BOURGAULT 2155 II AIR SEEDER

| | |
|--|---|
| RETAIL PRICE: | \$32,421.00 (November, 1991, f.o.b. Lethbridge) with 60 run air package, monitoring system, auger and dual shoot granular system. |
| QUALITY OF WORK: | |
| -Seed Placement: | 2.0 in (51 mm) band width |
| -Metering Accuracy: | very good; grains, fertilizer, Treflan and Avadex slightly affected by changes in ground speed and field slope. |
| -Distribution Uniformity: | very good |
| -Spreading Uniformity: | good; Treflan affected by spreader height |
| EASE OF OPERATION AND ADJUSTMENT: | |
| -Maintenance | very good; easily accessible |
| -Filling/Cleaning: | very good; optional auger convenient for filling and emptying the tanks |
| -Transporting: | very good; placed in transport in five minutes |
| -Monitoring: | very good; bin level, auger rotation and fan speed sensors supplied |
| -Application Rates: | very good; electronic acreage meter and calibration boxes provided for calibration |
| EASE OF INSTALLATION: | good; instructions were supplied for specific tillage unit; granular attachment instructions supplied |
| POWER REQUIREMENTS: | PTO horsepower requirements ranged from 15.7 hp (11.7 kW) to 24.9 hp (18.6 kW). Average and maximum horsepower requirements for the centrifugal fan were 14.4 hp (10.7 kW) and 19.3 hp (14.4 kW). |
| OPERATOR SAFETY: | Access ladders and safety hand rails provided. |
| OPERATOR'S MANUAL: | good; contained useful information |
| MECHANICAL HISTORY: | Four grease nipples on the sprocket shafts, the front bin sensor and the tank lid seals were replaced. |



**ALBERTA
FARM
MACHINERY
RESEARCH
CENTRE**

3000 College Drive South
Lethbridge, Alberta, Canada T1K 1L6
Telephone: (403) 329-1212
FAX: (403) 329-5562
<http://www.agric.gov.ab.ca/navigation/engineering/afmrc/index.html>

Prairie Agricultural Machinery Institute

Head Office: P.O. Box 1900, Humboldt, Saskatchewan, Canada S0K 2A0
Telephone: (306) 682-2555

Test Stations:

P.O. Box 1060

Portage la Prairie, Manitoba, Canada R1N 3C5

Telephone: (204) 239-5445

Fax: (204) 239-7124

P.O. Box 1150

Humboldt, Saskatchewan, Canada S0K 2A0

Telephone: (306) 682-5033

Fax: (306) 682-5080