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1. ABSTRACT

An experiment was conducted at Naicam and Foam Lake to determine the effectiveness of incorporating broadcast canola in no-till conditions using a rotary harrow. The rotary harrow/packer provided adequate no-till emergence and yield under typical soil moisture and weather conditions at the Naicam site. At Foam Lake under hot, windy conditions at seeding, the various combinations of rotary harrows/packers resulted in very poor germination and emergence following the corporation. The hot, dry conditions that occurred at seeding at Foam Lake were atypical of the seeding conditions in the canola adapted area of the province. Consequently, the poor results at this site should not be used to conclude that the rotary harrow should not be used for the incorporation of surface broadcast canola. However, weather conditions should be considered in the decision to use rotary harrows for seeding canola.

2. INTRODUCTION

Canola has typically been produced using soil incorporated herbicides and extensive seedbed preparation, often followed by post seeding packer/harrow operations. Excess tillage results in seedbed quality problems and potential soil erosion, as well as added costs in fuel, machinery wear and operator time.

A device known as the rotary harrow has recently been introduced to the Canadian prairies. It's unique action produces aggressive, although shallow soil pulverization and mixing. It operates effectively in the presence of large amounts of surface residue and does not mix the residue with the soil, but leaves it on the soil surface. The rotary harrow presents an opportunity to develop a seeding machine that is energy efficient.

This seeding system would not allow use of soil incorporated pre-emergent herbicides, which require deep incorporation. However, the recent development and coming introduction of herbicide tolerant canola cultivars would allow post-emergent control of weeds. The combination of effective no-till seeding with the rotary harrow, along with the introduction of herbicide tolerance in canola, present an opportunity for producers to reduce the cost of production by energy savings while greatly enhancing soil conservation in the production of canola.

3. MATERIALS AND METHODS

The study was conducted during 1992 at the Canola Productivity Centres at Naicam and Foam Lake. Those sites were seeded into standing cereal stubble and nutrient deficiencies were corrected prior to seeding using broadcast granular fertilizer at Foam Lake and spoke wheel injection of liquid fertilizer at Naicam. Volunteer crop and weeds were controlled with the pre-seed application of Roundup prior to seeding. A randomized complete block design with four replicates was used at both locations with plot dimensions of 30 ft (9 m) by 400 ft (122 m). Horizon Polish Canola treated with Vitavax RS and mixed with Furadan was surface broadcast using a Valmar granular applicator at a seeding rate of 10 lb/ac (11.2 kg/ha) on all plots, except the hoe drill treatments which were seeded conventionally. Speed for all seeding and incorporating operations was 5 mph (8 km/h). Seeding date was May 30 at Naicam and June 9 at Foam Lake. The Brandt rotary harrow/coil packer and Flexi-Coil 5 bar tine harrow/coil packer were used for the incorporation treatments.

Eight seeding methods were compared in this study (TABLE 1).

TABLE 1. Seeding Methods at Naicam and Foam Lake.

Rotary harrow with coil packers	Single pass
Rotary harrow with coil packers	Two passes
Hoedrill	
Conventional 5 bar tine harrows with coil packers	One pass
Rotary harrow	Single pass
Rotary harrow	Two passes
Coil packers	One pass
Check	No incorporation
All rotary harrow treatments at 35° gang angle.	

Emergence counts were taken on June 23 and June 25 at Naicam and Foam Lake respectively. Four metre square emergence counts were taken in each plot (FIGURE 1).

FIGURE 1. Grid Pattern Used for Emergence Counts.

All plots at Naicam were swathed with a 20 ft (6.1 m) self-propelled swather by swathing a single strip down the centre of each plot. individual plots were combined with a self-propelled combine and yields determined using a weigh wagon. The plots at Foam Lake were not harvested.

4. RESULTS AND DISCUSSION

The main concern with surface broadcast and incorporated seed is poor germination and high seedling mortality rates due to dry soil conditions in the top 1 in (2.5 cm) of soil. However, seeding in no-till conditions in standing stubble should increase germination and seedling survival due to the moist soil surface conditions and the reduction in evaporation due to standing stubble.

Emergence differences at the Naicam site were highly significant (0.01 probability level) with the highest emergence for the hoedrill followed by the rotary harrow/packer 2x treatment (TABLE 2).

TABLE 2. Canola Emergence at Naicam.

TREATMENT	Plants/m^2
Hoedrill	257 a
Rotary harrow/packer 2x	133 b
Rotary harrow 2x	69 c
Rotary harrow/packer 1x	36 cd
Rotary harrow 1x	28 cd
Harrow/packer 1x	3 d
Check	3 d
Coil packers	2 d
Means with the same letter are not significantly different (95%).	

The hoedrill and rotary harrow/packer both exceeded the minimum 60 plants/m^2 (54 plants/yd^2), which is required for maximum yields. Due to a calibration error, the seeding rate was higher for the hoedrill treatment. However, that only counted for part of the differences in emergence. Most of the difference in emergence was due to superior germination and emergence with the hoedrill system. All of the remaining treatments had significantly lower emergence compared to the rotary harrow/packer 2x and all but the rotary harrow 2x had emergence below the acceptable level. The conventional harrow/packer 1x and packers 1x did not improve germination and emergence beyond the non-incorporated check, with emergence counts below 5 plants/m^2 (4 plants/yd^2).

Yield differences at the Naicam site were highly significant (0.01 probability level) with highest seed yields for the hoedrill, rotary harrow/packer 2x and the rotary harrow 2x (TABLE 3).

TABLE 3. Canola Seed Yields at Naicam.

TREATMENT	Yield in kg/ha
Hoedrill	1,510 a
Rotary harrow/packer 2x	1,474 a
Rotary harrow 2x	1,340 ab
Rotary harrow/packer 1x	1,159 bc
Rotary harrow 1x	1,128 c
Harrow/packer 1x	778 d
Coil packer	716 d
Check	417 e
Means with the same letter are not significantly different (95%).	

There were no significant yield differences at Naicam among the hoedrill, rotary harrow/packers 2x and the rotary harrow 2x treatments. These results confirm the emergence counts, where these treatments were the only treatments that provided adequately plant population for optimum yield. All of the rotary harrow treatments yielded significantly higher than the conventional harrow packer and coil packer. The non-incorporated check yielded less than 1/3 of the yield of the top three treatments.

Emergence differences at the Foam Lake site were highly significant (0.01 probability level) with satisfactory emergence for the hoedrill and below acceptable emergence for the remaining treatments (TABLE 4).

TABLE 4. Canola Emergence at Foam Lake.

TREATMENT	Plants/m^2
Hoedrill	158 a
Rotary harrow 2x	11 b
Rotary harrow/packer 2x	10 b
Rotary harrow/packer 1x	4 b
Rotary harrow 1x	1 b
Harrow/packer 1x	0.3 b
Coil packer 1x	0.3 b
Check	0.3 b
Means with the same letter are not significantly different (95%).	

Emergence of all treatments except the hoedrill were a failure at the Foam Lake site. Fair soil moisture conditions combined with 30° C temperatures and high winds at seeding dried out the soil in the shallow incorporated treatments, resulting

in essentially zero emergence in the two weeks following the incorporation. The improved emergence with the hoedrill was due to the combination of slightly deeper seed depth and on-row packing which allowed the conservation of available moisture and normal emergence. Rainfall, which occurred approximately one month after seeding, resulted in the germination and emergence of the canola in the non-hoedrill treatments. The delay in emergence resulted in large differences in maturity (FIGURE 2).

FIGURE 2. Differences in Maturity Between the Hoedrill and Rotary Harrow Treatments.

An attempt to straight combine the site was made on October 10, however, due to a combination of late seeding date and severe frost damage, the harvest was abandoned.

5. CONCLUSIONS

The rotary harrow/packer provided adequate no-till germination, emergence and yield of canola under good moisture conditions typical of seeding conditions in the canola adapted areas of Saskatchewan.

Under hot, dry, windy conditions at seeding time, the incorporation of broadcast canola using various combinations of rotary harrows/packers resulted in almost no germination and emergence of canola until rainfall occurred about one month following the seeding operation.

The hot, dry conditions that occurred at the Foam Lake site were atypical of seeding conditions in the canola adapted areas of Saskatchewan. Consequently, the poor results at this site should not be used to conclude that the rotary harrows should not be used for the incorporation of surface broadcast canola. However, these results do indicate that weather conditions should be considered in the decision to use the rotary harrow for seeding canola.