METHODS OF SEEDING CEREAL CROPS ON STUBBLE LAND IN MANITOBA AND SASKATCHEWAN

by

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INTRODUCTION

In the more humid regions of the prairies, increased use of intensive cropping systems with less summerfallow has shown the need for evaluating methods of seeding cereal crops on stubble land. An acceptable method of seeding should protect the soil, conserve moisture, provide weed control and effect good seed placement. The importance of maintaining a trash cover to prevent soil erosion has long been recognized. However, this often interferes with the placement of seed into firm moist soil and frequently farmers plow or burn their fields to remove this obstacle. The conservation of soil moisture in the spring is also necessary to ensure adequate germination and emergence of the crop. Weeds, a major problem on most farm fields, use moisture unless removed by tillage or herbicide applications.

In the drier regions of the brown and dark-brown soil zones the discer-seeder gave good yields of wheat and control of weeds. In Alberta, Anderson and Smith (1) found the discer-seeder was satisfactory when the trash cover varied from 1,500 to 4,000 lb/A (representing residues from wheat crops varying from 15 to 40 bu/A). Also, at Swift Current (5, 7), good results were obtained with the discer-seeder when the importance of correct adjustment for depth of seeding was emphasized. There was no advantage in using disc and hoe drills which required an additional cultural treatment before seeding. Yields with the wide-blade cultivator-seeder were lower than those from other methods (1).

On summerfallow in the black soil zone of Manitoba and Saskatchewan, the discer-seeder gave good results particularly on clay loam and silty clay soils (2).

The experiments reported here were conducted at Melfort and Brandon Research Stations to determine the effect on crops and soils of a number of methods of seeding wheat, barley and oats on stubble land under different soil and straw conditions. The treatments were evaluated on cereal crops in terms of their effect on yield, protein content and weight per bushel. In addition, the treatment effects on erosion factors such as soil aggregation and trash cover were determined.

Seeding Treatments

Pre-planting treatments included the disc and cultivator which maintain trash cover and the plow which buries all crop residue. The discer-seeder and the heavy-duty cultivator-seeder represented combined tillage and seeding while other methods required two separate operations. The cultivator-seeder was equipped with 16-inch shovels, spaced 12 inches apart. Seed attachments on the shovels gave a row spacing of 7 inches.

METHODS

Methods of planting, including tillage and seeding machines (table 1), were compared with and without fertilizer. The experiments were conducted in a randomized split-plot design with methods as main plots and fertilizer versus no fertilizer as subtreatments. The treatments were replicated four times in plots 12 x 120 feet at Melfort and 10 x 20 feet at Brandon.

Seeders were calibrated to seed 1.5 bushels of wheat and barley and 2.0

TABLE 1. METHODS OF SEEDING (TILLAGE AND SEEDING MACHINES) COMPARED AT BRANDON, MANITOBA, AND MELFORT, SASKATCHEWAN.

Pre-seeding tillage	Seeding machine	Row spacing inches	Post-seeding tillage
Brandon, Manitoba			
1. Moldboard plow	Single disc press drill	7	None
2. Cultivator and harrow	Single disc press drill	7	None
3. Cultivator and harrow	Hoe press drill	7	None
4. Cultivator and harrow	Double disc drill	6	Pack
5. None	Discer-seeder	7	Pack
6. None	Cultivator-seeder	7	Pack
Melfort, Saskatchewan			
1. Moldboard plow, harrow and pack	Double disc press drill	6	Harrow
2. Cultivator and harrow	Double disc press drill	6	Harrow
3. Cultivator and harrow	Hoe press drill	7	Harrow
4. Cultivator and harrow	Double disc drill	7	Pack and harrow
5. None	Discer-seeder	7	Pack
7. Discer and harrow	Double disc press drill	6	Harrow

Note: Harrows - Spike tooth drag harrows and spike tooth oscillating harrows were used at Brandon and Melfort, respectively.

bushels of oats per acre. Fertilized plots received 80 pounds of 23-23-0 and 70 pounds of 27-14-0 per acre with the seed at Melfort and Brandon, respectively. At Brandon, an area 3 feet by 10 feet in the centre of each plot was harvested with a mower, while at Melfort a swath 10 x 100 feet was obtained with a swather and combine. These harvested samples provided yield and grain data for evaluation of the treatments.

The rotary sieve method (3, 4) was used to determine the percentage of surface soil aggregates less than 0.84 mm in size. This fraction is the most susceptible to erosion. Soil aggregation was measured before and after seeding. Crop residue was determined after harvest in the fall and after seeding in the spring. Long straw was added to the plots at Brandon to build up the residue to 3250 lb/A. At Melfort, treatments were based on 2065 lb/A of stubble and chopped combine straw from the harvested crop.

At Brandon, Selkirk wheat was grown from 1960 to 1965 on two soils (Miniota sandy loam and Assiniboine clay loam). At Melfort, on Melfort silty clay soil, Selkirk wheat and Parkland barley were grown from 1960 to 1967 and Rodney oats were included from 1965 to 1967. Annual grass weeds such as wild oats and green foxtail were not a problem in these experiments. Broadleaved weeds in the crop were sprayed with MCPA or 2,4-D.

RESULTS AND DISCUSSION

Yields of Wheat, Oats and Barley

On clay loam and silty clay soils once-over seeding with the discer-seeder and packer gave yields equal or superior to those from all other methods. On sandy loam soils discer seeding did not equal seeding on a plowed seedbed (tables 2, 3).

The double disc drill and packer after cultivating gave the lowest yield at Melfort and only fair returns at Brandon. Results were better when this drill was equipped with a press attachment. As reported earlier, difficulty in obtaining good seed placement in moist soil, particularly through trash cover of more than 2,000 lb/A, was encountered with this method (1).

The other combined tillage and seeding machine, the cultivator-seeder and packer, gave the poorest re-

TABLE 2. THE EFFECT OF METHOD OF SEEDING ON YIELDS OF WHEAT AT BRANDON, MANITOBA.

Pre-seeding tillage and seeding machines	Yield bu/A: Sandy loam soil 1960, 1962-1965	Clay loam soil 1960-1965
1. Plow and single disc press drill	24.4 a	29.1 ab
2. Cultivator, harrow and single disc press drill	20.3 b	27.8 bc
3. Cultivator, harrow and hoe press drill	19.3 bc	26.9 bcd
4. Cultivator, harrow, double disc drill and packer	19.8 b	26.0 cd
5. Discer-seeder and packer	20.9 b	30.4 a
6. Cultivator-seeder and packer	17.5 c	25.1 d
Mean (treatments x years)		
Fertilized	23.3 a	29.1 a
Unfertilized	17.5 b	26.0 b

Note: Means followed by the same letter are not significantly different at the 5% level of probability.

TABLE 3. THE EFFECT OF METHOD OF SEEDING ON YIELDS OF WHEAT, BARLEY AND OATS AT MELFORT, SASKATCHEWAN.

Pre-seeding tillage and seeding machines	Yield bu/A — Silty clay loam soil: Wheat 1960-1967	Barley 1960-1967	Oats 1965-1967
1. Plow, harrow, packer, double disc press drill and harrow	28.7 ab	37.3 ab	93.0 a
2. Cultivator, harrow, double disc press drill and harrow	30.0 a	39.6 a	93.8 a
3. Cultivator, harrow, hoe press drill and harrow	29.5 ab	41.2 a	95.9 a
4. Cultivator, harrow, double disc drill, packer and harrow	27.2 b	34.0 b	84.8 b
5. Discer-seeder and packer	30.6 a	39.1 a	97.6 a
7. Discer, harrow, double disc press drill and harrow	30.8 a	37.5 ab	95.3 a
Mean (treatments x years)			
Fertilized	30.1 a	39.4 a	94.5 a
Unfertilized	28.8 b	36.8 b	92.3 b

Note: Means followed by the same letter are not significantly different at the 5% level of probability.

sults on both soils at Brandon. Stands of wheat lacked uniformity, probably because of poor depth control with this implement.

On sandy loam soil, the press drill after plowing gave higher yields of wheat than the discer-seeder or the cultivator and disc press drill. Burying the trash by plowing may have permitted better packing of the soil after seeding. However, the differences between the plow and discer and plow and cultivator methods were less on fertilized (2.0 and 3.3 bu/A) than on unfertilized plots (5.1 and 5.0 bu/A).

Fertilizer significantly increased yields of wheat, barley and oats (tables 2, 3). Fertilizer responses were above average on sandy loam and clay loam soils when the discer-seeder was used but were below average with the double disc drill.

The discer-seeder required careful adjustment to obtain a satisfactory depth of seeding. Modifications in design of equipment to improve the placement of seed would be beneficial.

Bushel Weight and Percent Protein

Bushel weight and percent protein measurements on wheat were similar under the different methods of seeding. Fertilizer increased the weight per bushel slightly. Although there were some significant effects on barley and oats, these differences were not large.

Trash Cover and Soil Aggregation

The plow press drill significantly reduced trash cover (table 4). This is important on the sandy loam soil where protection from erosion is usually needed. Other methods retained adequate trash cover (6). While the plow caused a serious depletion of crop residue, a significant reduction in erodible soil also occurred (table 5.) However, on the sandy soil there still remained a relatively high (63.4%) fraction of soil particles susceptible to erosion. In this experiment, the discer-seeder and cultivator-seeder also improved soil structure, significantly. Effects of the different implements on aggregation were similar to those presented in other reports (2, 6, 8).

TABLE 4. THE EFFECT OF METHOD OF SEEDING ON TRASH COVER AT BRANDON, MANITOBA AND MELFORT, SASKATCHEWAN.

Crop residue cwt/A (1)

Pre-seeding tillage and seeding machines	Brandon		Melfort
	Sandy loam soil 1962-1965	Clay loam soil 1962-1965	Silty clay loam soil 1960-1965
1. Plow and disc press drill (2)	0.68 c	2.06 c	2.30 c
2. Cultivator, harrow and disc press drill (2)	13.72 ab	10.04 b	7.43 ab
3. Cultivator, harrow and hoe press drill	12.66 b	11.31 ab	6.92 b
4. Cultivator, harrow, double disc drill and packer	13.55 ab	12.48 ab	8.16 a
5. Discer-seeder and packer	12.42 b	11.22 ab	8.09 a
6. Cultivator-seeder and packer	14.66 a	13.06 a	-
7. Discer, harrow and double disc press drill and harrow	-	-	6.62 b
Mean (before seeding)(3)	32.50	32.50	20.65

Note: (1) Crop residue after seeding.
(2) Single disc press drill at Brandon, double disc press drill at Melfort; (for further details of methods see table 1).
(3) Crop residue after harvest in the fall, before spring seeding.
(4) Means followed by the same letter are not significantly different at the 5% level of probability.

CONCLUSIONS

On stubble land the discer-seeder and packer gave good yields of wheat, oats and barley on medium and heavy textured soils. There were no significant advantages in using other methods which required two machines and two field operations for tillage and seeding, rather than one with this implement.

On sandy loam soil, the plow and single disc press drill produced more wheat than the discer-seeder. However, fertilizer reduced this difference, so that the discer-seeder with fertilizer would be the preferred method when economy of operation, conservation of trash cover and control of erosion are considered.

An above average response from fertilizer was obtained with the discer-seeder. Trash cover, soil aggregation, bushel weight and percent protein results were satisfactory. Changes in design of the machine for better placement of seed and packing of soil should further improve the results obtained with this method.

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TABLE 5. THE EFFECT OF METHOD OF SEEDING ON SOIL AGGREGATION AT BRANDON, MANITOBA AND MELFORT, SASKATCHEWAN.

Percent of surface soil less than 0.84 mm in size (1)

Pre-seeding tillage and seeding machines	Brandon Sandy loam soil 1963, 1965	Brandon Clay loam soil 1961,1963-1965	Melfort Silty clay loam soil 1960-1967
1. Plow and disc press drill (2)	63.4 c	23.5 b	27.0 c
2. Cultivator, harrow and disc press drill (2)	73.4 a	30.4 a	40.7 ab
3. Cultivator, harrow and hoe press drill	71.2 a	34.2 a	40.5 ab
4. Cultivator, harrow, double disc drill and packer	75.0 a	30.5 a	39.3 b
5. Discer-seeder and packer	65.6 bc	29.5 a	43.1 a
6. Cultivator-seeder and packer	68.2 b	31.0 a	-
7. Discer, harrow, double disc press drill and harrow	-	-	41.5 ab
Mean (before seeding) (1)	71.0	47.9	30.0

Note: (1) Soil fraction most susceptible to erosion by wind (before and after seeding).
(2) Single disc press drill at Brandon, double disc press drill at Melfort; (for further details of methods see table 1).
(3) Means followed by the same letter are not significantly different at the 5% level of probability.

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ability of experienced staff. Some training centres operate in rural areas but these serve only a small part of the population. Several special training projects by non-government organizations have met with good success, partly because of flexibility in programming to suit particular needs, not being restricted by established wage and salary scales, and the motivation of private initiative. The private sector can and does provide an effective medium for initiating many development and extension type programs by circumventing the complications introduced by operating through government agencies.

Elements of agricultural engineering have only recently come to be appreciated as part of the agricultural production input, along with soil and plant science. The influence of engineering must be included in programs of the major institutions servicing agriculture. This will come about gradually as the formal scientific groups extend their interests to the broader aspects of agricultural enterprises. The private sector including machinery and equipment manufacturers, product processors and service industries will probably provide the broadest medium for introducing engineering principles to improve a growing agricultural industry.

The magnitude of inputs for the agricultural revolution that must take place in India seems to dwarf any effect a Canadian contribution in agricultural engineering might have. There is, however, a substantial number of well educated engineers in India who, with a reasonable amount of guidance in applied technology, can provide leadership in this field. The major problem is one of changing philosophies and breaking traditions, both of which may be resisted by political expediency.

In general these engineers have not had the opportunity to experience the western concept of engineering in agriculture. This they might acquire from Canadian specialists on assignments or by a term of conscientious study and experience in Canadian institutions and in agricultural operations.

A few Canadian engineers in influential positions in universities, training programs and development projects can do a great deal to motivate change. Those nationals who have the opportunity to spend some time in Canada or U.S.A. can assimilat new ideas which can be modified to fit their home situation. Their greatest contribution, and probably that of Canadians working in India, will be in introducing systematic management into present and proposed programs, encouraging the principle of demonstrating recommended practices and placing greater emphasis on delegation of responsibility and authority to those who are implementing new programs.

The progress of Indian agriculture requires the combined efforts of all elements of scientific agriculture. Agricultural engineering is an essential ingredient which must be included in any development program. At present its significance may not be considered of major consequence, but with continued practical application of engineering principles wherever an opportunity presents itself the benefits will receive increased recognition. One of the major contributions here, as in many other countries, will be the capability of agricultural engineers to bring other disciplines together in a joint effort to solve the complex problems associated with commercial agriculture.