SOME TILLAGE METHODS FOR SUGAR BEETS ON BROOKSTON CLAY SOIL

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INTRODUCTION

Tillage studies in many of the sugar beet growing areas have compared basic fall and spring methods and have assessed the amounts of seed bed preparation (1) that is most satisfactory for this crop. In the eastern sugar beet growing areas such as Michigan, average data have shown some yield advantage from fall plowing (3) compared with spring plowing, although within local districts the difference may not be great. Minimum forms of seed bed preparation have been successful and are an accepted practice (2) (4) especially on medium textured soils.

There has been considerable interest regarding the application of minimum forms of tillage on the Brookston clay soil areas of Ontario, where a considerable portion of the beet production in this province is located. The Brookston clay soil is finer textured than most soils where minimal forms of tillage are presently practiced. The level topography and poor drainage characteristics of this soil are further factors that create a need for information regarding suitable methods of tillage for the sugar beet crop on this soil.

Tillage experiments for corn at Woodslee indicated the advantage of fall over spring plowing and showed that additional seed bed preparation was most satisfactory for the corn crop. A method of planting directly in plowing was of moderate success.

The present experiment was begun in 1960 to compare two basic tillage methods and to compare amounts of seed bed preparation for the sugar beet crop. Although considerable information is available on medium textured soils concerning tillage methods for this crop, there is not adequate information to support definite recommendations for the fine textured Brookston clay soil of southwestern Ontario. The minimum forms of tillage were of particular interest in this study since such methods could lead to earlier and faster planting and could reduce planting costs.

MATERIALS AND METHODS

The two tillage implements used in this experiment were the mold board plow and the one-way disk. Basic tillage treatments were established using these implements in the fall and spring. Normal seed bed preparation was applied on basic tillage and consisted of two diskings with tandem disks with spike-toothed harrows hooked behind the disks. A minimum form of tillage was applied to the plowing treatments by going over the plots once

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with the spike-toothed harrows, using approximately a two hundred pound weight on the harrows. In 1961 and 1962, the experiment included a more intensive level of seed bed preparation on fall and spring plowing where seven diskings were carried out simultaneously with seven levelings for a total of 14 tillage operations. The test was carried out on oat stubble seeded to alfalfa in 1961 and on corn stubble in 1960 and 1962.

Fertilization and seeding methods were in accordance with current recommendations for the area with regards to existing fertility conditions. A mixed fertilizer, 4-24-12, was applied to each experimental area at 600# per acre, half of this amount being applied in the fall and half in the spring. Additional nitrogen was side-dressed on the plots after thinning to increase the total nitrogen added to 80# per acre. Monogerm seed was planted at 1½" spacing within the rows that were spaced 28" apart and thinned to 22,000 plants per acre in 1960 and 1961. In 1962, the plant population was maintained at this rate, but the rows were spaced at 22".

Soil moisture was determined at planting on samples taken from the 0-4, 4-8 and 8-12 inch depths but only the moisture data from the 4-8" depth are reported here. Three-inch diameter core samples of soil were obtained during the early part of each growing season and were analyzed for aeration and total pore space.

Plant growth measurements included emergence counts and leaf area calculated from leaf dimensions. Leaf and petiole samples were obtained at thinning, during mid-season and prior to harvest and were analyzed for nitrate nitrogen, but these results were not reported since there were no differences for treatment. Measurements on the crop included root yields and yield of gross sugar. Per cent sucrose, per cent refractive purity and top weight were not significantly affected by treatment and are not reported here.

EXPERIMENTAL RESULTS

Tillage methods did have some influence on soil pore space within the 3-6 inch depth of measurement in 1960 and in 1961-62. In 1960 the lowest pore space followed on basic fall treatments of one-way disking and fall plowing. The lowest total pore space was measured on fall plowing with minimum tillage. In the 1961-62 period fall plowing with normal or excessive seed bed preparation or spring plowing with minimum, normal or excessive seed bed preparation resulted in higher average pore space than one-way disking with normal tillage. Fall plowing with minimum tillage also had lower total pore space, similar to that on the one-way disk methods.

Tillage influenced soil moisture in 1961-62. One-way diskings in the fall or spring, followed by normal seed bed preparation, gave the lowest moisture contents within the 4-8 inch

depth during this period. Minimum tillage on fall plowing also gave a low moisture content at planting time in 1961-62 although the moisture content on this treatment in 1960 was numerically greater than for all other methods in that year. All of these moisture values are high within the available moisture range for Brookston clay soil.

Plant emergence was not significantly affected by tillage in 1960 (Table 2) although all methods provided an adequate stand for thinning. In 1961-62 fall plowing with minimum tillage gave better emergence than all other methods and there were no differences in emergence between the other methods. Leaf area was numerically lower for one-way disking with normal tillage and for fall plowing with minimum tillage in 1961-62 than on the other treatments but the differences were not statistically significant.

Root and sugar yields are shown in Table 3. In 1960 spring plowing with normal tillage resulted in higher root yield than on all other treatments except on fall disking with normal tillage. There was no one treatment that was consistently better than on other methods during the three-year period on the basis of root or sugar yields. Fall basic tillage appeared to be slightly better than spring basic tillage in the 1961-62 period.

SUMMARY

Soil physical differences attributable to tillage methods were small in this experiment. One-way disking appeared to be less satisfactory than the other methods on the basis of pore space and soil moisture. However, soil moisture and pore space seemed adequate for good emergence and growth on this treatment. Although all treatments provided suitable emergence, fall plowing with minimum seed bed preparation gave better emergence in the 1961-62 period than did other treatments.

Yield data indicated that all methods produced fairly high yields during the period under study. It is possible that the rather uniform and adequate precipitation received during these three seasons may have contributed to the consistently high yields for these tillage methods. Minimum tillage on fall plowing produced a low yield in 1960 but resulted in yield equal to other treatments in 1961-62. There are certain advantages from minimum tillage that may not be evident in a tillage test where seed bed preparation and planting are carried out on the same day. It appeared that minimum tillage could be carried out on fall plowing at an earlier date which should be advantageous during most seasons.

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Brookston Clay Soil

Literature Cited

(1) Cook, R. L.

1950 Tillage Practices and Sugar Beet Yields. Proc. Am. Soc. Sugar Beet Tech. 286-293.

(2) Cook, R.L., McColly, H.F., Robertson, L.S. and Hansen, C.M.

1958 Minimum Tillage. Michigan State University Ext. Bull. 352.

(3) Cook, R. L., Davis, J. F. and Frakes, M. G.

1960 1958 Production Practices of Michigan Sugar Beet Farmers. Michigan State University Agr. Expt. Sta. Bull. 42 No.2, 1959.

(4) Frakes, M. G.

1950 Minimum Seed Bed Preparation. Proc. Am. Soc. Sugar Beet Tech. 281-290

Table 1. Effect of Tillage Methods on Soil Mositure and Pore Space on Brookston Clay Soil.

Tillage Method	1960		1961-62	
	Soil moist. 4-8"	Total pore 3-6"	Soil moist. 4-8"	Total pore 3-6"
	%	%	%	%
Fall plow + minimum	28.1	47.3	26.6	47.1
Spring plow + minimum	25.8	51.9	27.6	49.0
Fall plow + normal	26.8	50.0	28.0	49.5
Spring plow + normal	26.3	52.6	28.1	49.3
Fall plow + excess			27.6	49.0
Spring plow + excess			28.5	49.3
Fall one-way disk + normal	26.3	48.6	24.5	46.6
Spring one-way disk + normal	26.4	50.7	25.6	47.0
L.S.D. (0.05)	N.S.	2.7	1.8	1.6
(0.01)	N.S.	3.9	2.4	2.2

Table 2. Effect of Tillage Methods on Sugar Beet Growth on Brookston Clay Soil.

Tillage Method	1960	1961-62	
	Emergence No. of plants per yard.	Emergence No. of plants per yard.	Leaf area $(cm)^2$
Fall plow + minimum	21.6	18.8	53.0
Spring plow + minimum	16.4	14.5	56.8
Fall plow + normal	21.3	14.3	63.5
Spring Plow + normal	26.3	13.2	60.9
Fall plow + excess		13.4	55.7
Spring plow + excess		12.4	58.8
Fall one-way disk + normal	18.1	14.4	54.7
Spring one-way disk + normal	19.8	12.3	53.7
L.S.D. (0.05)	N.S.	2.3	N.S.
(0.01)	N.S.	3.1	N.S.

Table 3. Effect of Tillage Methods on Sugar Beet Yield on Brookston Clay Soil

Tillage Method	1960		1961-62	
	Root yield	Gross sugar	Root yield	Gross sugar
	tons/ac.	lb./ac.	tons/ac.	lb./ac.
Fall plow + minimum	16.7	5,772	21.5	7,431
Spring plow + minimum	18.3	6,373	21.4	7,513
Fall plow + normal	17.9	6,204	22.7	7,706
Spring plow + normal	20.9	7,261	21.0	7,409
Fall plow + excess			21.9	7,788
Spring plow + excess			20.5	7,355
Fall one-way disk + normal	19.8	6,770	21.7	7,662
Spring one-way disk + normal	18.3	6,411	20.5	7,348
L.S.D. (0.05)	2.5	881	1.3	N.S.
(0.01)	3.5	1220	1.8	N.S.