A Study of the Effects of Some Different Sods and Fertilizers On Sugar Beet Yields[1]

C. M. GREGG AND C. M. HARRISON[2]

Differences oberved in growth behavior of sugar beets when planted on a field previously laid out in a pasture experiment led to the present experiment. The pasture plots were a twenty-fourth of an acre in size, and included eight replications of eleven different forage mixtures. It was possible to restake the original pasture plots by observable differences in the growth of the beets during their first two months of growth. In an attempt to see whether these observable differences could be measured and interpreted, the following experiment was set up.

The plots used in this test were seeded to grass and grass-legume mixtures in 1943.[3] The test plots were on a soil described as Conover light silt loam. There were sixteen different types of sods of which only ten will be considered in this paper. Sugar beets were grown on these plots two years in succession in order to better observe persistency of the effects of the different sods on the sugar beets. At harvest the beets were counted, weighed, and sucrose tests run on a representative sample from each plot. In 1948, physical measurements were made on beets in a section of each plot.

During the growing season observations were made as to the appearance of the beets. Penetrometer tests were made periodically through the growing season in 1949. Organic matter determinations were made on soil samples taken just before the land was plowed in both 1948 and 1949. Aggregation and clay analysis as well as pH tests were made on soil samples from these plots. Porosity determinations were made in 1949.

The beets from bromegrass, brome-alfalfa, orchard grass-alfalfa, and plots of both bluegrass sods showed better than average growth appearance, while beets on the timothy-red clover and both fescue plots were below average in their growth.

The rainfall was about 50 percent of normal during July and August in 1948, therefore the yields from all plots were rather low. The rainfall for the same two months in 1949 was about normal, consequently the average yield from all plots, combined, was about as high as in 1948 in spite of a decrease in average stand from 74 to 49 percent.

[1] Contribution from the Section of Farm Crops, Michigan Agricultural Experiment Station, East Lansing, Michigan, Journal Article No. 1140. Part of a thesis submitted by the senior author at Michigan State College in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

[2] Graduate assistant and professor, respectively, Farm Crops Department, Michigan State College. This research was supported in part by a grant from the Farmers and Manufacturers Beet Sugar Association of Michigan.

[3] Morrish, R. H., and Harrison, C. M. The Establishment and Comparative Wear Resistance of Various Grasses and Grass Legume Mixtures to Vehicular Traffic. Journal American Society of Agronomy, Vol. 40, No. 2, pp. 168-179, 1948.

The plots of beets following orchard grass, orchard-alfalfa bromegrass and brome-alfalfa sods gave highest average yields per acre both years, in spite of the fact that the beets on redtop and Canada bluegrass sods had higher percent stands in 1948 than any of the grasses except orchard grass.

TABLE 1. Average Yields and Stands of Sugar Beets of Different Sods

Sod plots	Average % Stand		Average Yield Tons/A.		Yield of Sugar Lbs./A.	
	1948	1949	1948	1949	1948	1949
Brome-Alfalfa	70.7	58.0	7.99	8.99	2,314	2,712
Timothy-Red Clover	56.6	31.4	4.88	3.80	1,316	1,135
Bromegrass	73.8	54.6	8.09	9.12	2,300	2.858
Kentucky Bluegrass	68.1	30.5	7.20	4.56	2,050	1,368
Chewings Fescue	70.0	15.6	5.95	5.97	1,758	1,799
Sheep Fescue	63.8	27.9	4.25	3.31	1,169	1,008
Redtop	81.6	38.9	7.78	5.07	2,355	1,512
Canada Bluegrass	81.9	44.0	7.17	6.17	2,129	1,957
Orchard-Alfalfa	79.1	77.9	9.33	9.81	2,682	2,617
Orchard grass	91.0	78.3	8.85	13.15	2,687	4,123

In 1949 the percent stands on these better yielding plots were much higher than on any of the other sods. Likewise, yields of sugar beets for both years averaged lowest following timothy-red clover and sheep fescue sods. Beets following sods of redtop and the two bluegrasses were very near the average in yields for all treatments in 1948, but the average from chewings fescue sod plots was below average. In 1949 beet yields following Kentucky' bluegrass and redtop sod dropped below that of the chewings fescue, which produced approximately the same yield per acre as in 1948. Yields of beets on Canada bluegrass, sheep fescue and timothy-red clover sods were lower in

TABLE 2. Weights per beet, percent sucrose and coefficients of apparent purity

Sod Plots	Wt. Per Beet Average		Average % Sucrose		Average Coefficient of Apparent Purity (%)	
	1948	1949	1948	1949	1948	1949
Brome-Alfalfa	1.20	1.65	16.1	16.7	86.75	86.85
Timothy-Red Clover	0.92	1.29	15.6	15.5	86.58	87.62
Bromegrass	1.17	1.78	16.8	16.8	85.80	88.68
Kentucky Bluegrass	1.11	1.56	16.2	16.2	86.44	88.56
Chewings Fescue	0.89	1.35	16.8	16.8	87.18	88.05
Sheep Fescue	0.70	1.25	15.6	15.9	86.52	89.11
Redtop	1.02	1.39	17.2	15.6	88.20	87.15
Canada Bluegrass	0.87	1.48	17.2	17.3	86.13	88.66
Orchard-Alfalfa	1.26	1.34	17.1	15.1	85.04	88.25
Orchard grass	1.04	1.60	17.4	17.2	87.90	90.79

1949 than in 1948. On the other hand, the beets following those sods which gave best yields in 1948 resulted in increased yields in 1949. Due to a high percent of sucrose and a high coefficient of apparent purity the beets following redtop produced a high average yield of pure sugar per acre in 1948. However, this condition did not prevail in 1949.

As shown in Table 2, beets from the sod plots of brome-alfalfa, bromegrass, orchard grass, orchard-alfalfa and Kentucky Bluegrass were heavier

than the average weight of beets from all plots in 1948. Beets of average weight were produced on the redtop sod plots while the other sods produced beets smaller than the average, with those from sheep fescue sod

TABLE 3. Summary of Soil Analysis Studies

	%	Organic Matter[1] %		Pore Space % Volume		Aggregates[2] % Water
		1948	1949	Total	Non-cap.	Stable
Brome-Alfalfa	7.54	15.0	2.80	3.05	55.4	20.3	82.4
Timothy-Red Clover	6.31	19.0	3.50	2.20	52.2	19.3	80.0
Bromegrass	6.74	18.2	3.20	1.82	53.5	16.2	74.3
Kentucky Bluegrass	6.41	21.3	4.35	2.88	55.4	17.1	77.9
Chewings Fescue	7.00	17.8	3.25	2.65	54.2	19.9	72.0
Sheep Fescue	6.61	19.0	3.80	2.87	50.9	15.8	76.1
Redtop	6.54	15.0	2.38	3.08	53.0	17.7	67.3
Canada Bluegrass	6.64	14.2	1.51	3.20	49.8	15.3	57.9
Orchard-Alfalfa	7.38	14.0	2.26	1.96	55.8	19.9	74.1
Orchard grass	7.82	13.5	2.00	1.75	56.0	20.4	63.5

[1] Graham, E. R. Determination of Soil Organic Matter by Means of a Photoelectric Colorimeter. Soil Science, Vol. 65, pp. 181-184, 1948.
[2] Particles less than 0.1 mm. remaining in aggregates determined by the Yoder method.

averaging smallest of all. In 1949 there was little change in the order of rank in size of beets, though all averaged larger than in 1948. The beets from the orchard-alfalfa plot averaged a little less, while those from Canada bluegrass plots were slightly above the average for beets from all the plots,

TABLE 4. Penetrometer Tests for Compaction Studies on Plots[1]
Pressure required to press penetrometer to six inch depth

Sod plots	Pounds pressure at different test dates			
	May 24	July 2	July 16	July 22
Brome-Alfalfa	37.0	31.0	38.3	74.0
Timothy-Red Clover	26.6	38.0	45.2	66.7
Bromegrass	29.6	33.5	37.2	72.9
Kentucky Bluegrass	28.9	33.7	42.7	54.7
Chewings Fescue	29.6	38.0	44.2	52.7
Sheep Fescue	27.1	32.5	47.7	67.3
Redtop	31.9	33.8	43.5	64.3
Canada Bluegrass	26.9	37.8	46.8	68.7
Orchard-Alfalfa	35.7	42.8	37.2	81.7
Orchard grass	37.2	42.0	41.0	78.0
Averages	31.0	36.3	42.4	68.1

[1] Determinations made with a penetrometer which was so constructed that it plotted pressure in pounds against inches in depth.

and beets from the sheep fescue and timothy-red clover plots still averaged smallest of all the plots. There was little difference in the coefficient of apparent purity among the different sod treatments, though it averaged a little higher in 1949.

There was a positive correlation at the five percent level between the pH of the soil, as shown in Table 3, and the yield in tons of sugar beets per acre on the plots. There was a positive correlation between pH and the percent stand of beets at harvest time in the 1949 crop.

Percent clay showed a significant negative relation to percent of stand of beets at the one percent level in 1947, but the relation was at the two percent level in 1949. In both years percent of clay had a negative correlation to yield at the five percent level. Percent of organic matter showed no significant relation to yield of sugar beets on these plots. There was no correlation between percent of aggregation and stand or yield of beets in these plots. Neither total pore space nor non-capillary pore space showed any correlation to yield in these tests.

In the compaction studies on these plots the first tests were made May 24, but due to excessive rainfall there were no tests made in June. Tests were made through the month of July and a final test was made August 15. Some of the results of the penetrometer tests are given in Table 4.

TABLE 5. Fertilizer Studies

Fertilizer Used Kind	Amounts Used on Plots (Per Acre) A	B	C	D	E	F
20-0-0	120	240	....	480	480	...
3-12-12	396	792	....	.	1,584	2,028
Yield in Tons of Beets Per Acre						
1948	6.92	7.47	5.59	6.19	8.04	8.70
1949	7.03	7.25	3.85	4.58	8.19	11.24
Percent Stand of Beets						
1948	78.2	75.7	71.9	57.5	71.9	79.7
1949	44.0	46.5	31.1	31.6	52.4	67.8

These determinations showed that the bromegrass, brome-alfalfa, orchard grass, and orchard-alfalfa sod plots, though relatively firm at first, were less compact than all the others July 16, and required less than average pressure to penetrate to a six-inch depth. The tests on July 22 showed a reversal in that the soils of these four treatments which had remained mellow to July 16 had become more compact than any of the other plots, requiring considerably more than the average pressure to penetrate to the six-inch depth. The tests August 15 were made just three days after a rainfall of 1.15 inches and there was little change except that all plots were less compact than at the July 22 test.

All of the sod plots were cross-checked with five different fertilizer treatments and a check strip receiving no fertilizer as shown in Table 5.

In 1948 there was very little benefit in yield from use of heavier applications of fertilizer. The yields from all the plots were low, evidently due to the very low rainfall in July and August. Only strip A produced enough above the unfertilized check C to pay for the fertilizer used in 1948. The percent of stand of beets on strip D which received only nitrogen fertilizer was very low compared to the other treatments.

Results for 1949 varied much more widely between treatments, both in percent stand at harvest time and yield in tons of beets per acre. Again treatment D was at the bottom in percent stand but this time strip C, the check, was equally as low. In 1949 only strip D failed to increase the yield above that of the unfertilized check enough to pay for the fertilizer used.

In the other treatments percents of stand and yield were increased when the amount of 3-12-12 fertilizer was increased. The beets on the plots receiving heavier applications of 3-12-12 fertilizer emerged more quickly and grew more vigorously than those receiving the smaller amounts or none of this fertilizer.

Summary

1. A difference was found in the yield of sugar beets following the different grass sods studied.

2. Of the sods tested orchard grass and bromegrass, with or without alfalfa, gave best percentages of stand of beets and yield in tons per acre. The fescues and timothy gave poorest results, while the bluegrass and redtop were intermediate.

3. This study indicated that increased amounts of 3-12-12 fertilizer resulted in higher percent stands of beets than those receiving only nitrogen fertilizer.

4. There was a close correlation between the yields of sugar beets on these plots and the root growth habits of the grasses which had grown in the sods.

5. Observations indicated that a soil should remain mellow for at least the first half of the growing season for best growth and production of sugar beets and that, of the grasses used in this study, orchard grass and bromegrass promoted this condition best.

6. There was no correlation between the aggregation or the pore space of the soil and the yield of sugar beets.

7. There was a significant negative correlation of clay content of the soils to percent stand and to yield of sugar beets.

8. Under conditions of this study the addition of nitrogen fertilizer was not profitable.