

The Effects of Preceding Crops and Nutrients on the Growth and Seedling Diseases of Sugar Beets in Montana¹

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Earlier tests in the field and greenhouse indicated that preceding crops varied considerably in their effects on the amount of seedling diseases occurring in sugar beets. In general the amounts of disease were low following oats and corn, intermediate following beans and potatoes, and high following beets, alfalfa and fallow.

The object of the present investigation was to determine the effects on the growth and diseases of sugar beets of most of the important crops usually preceding sugar beets in Montana.

The land at the Huntley Branch Station used for this experiment was manured at the rate of 12 tons per acre and plowed in the fall of 1943. Beans were planted in 1944, but the yield was low due to severe hail damage early in the season.

The crops planted in 1945 were alfalfa (two plots), beans, corn, oats, potatoes and sugar beets. Summer fallow was included to compare it with the crops. Each crop was grown continuously on the same plot (14 acre) for five years to fix its effect upon the soil. The average yield of these crops for the five years were: alfalfa 5.47 and 5.11 tons, beans 1,277 pounds, corn 60.4 bushels, oats 78.4 bushels, potatoes 268.3 bushels, sugar beets 13.4 tons (the average yield for 1945, 1946 and 1947 was 16.3 tons and for 1948 and 1949 9.3 tons).

Sugar beets were planted in all of the plots in 1950. The plot five years in summer fallow was also planted. In the fall of 1949, each plot (14 acre) was divided into four equal sub-plots. One untreated sub-plot was used as a check, phosphorus (P) 86 pounds P_2O_5 per acre, P and manure (M) 16 tons per acre, and P, M and nitrogen (N) 36 pounds N per acre were added to each of the sub-plots, respectively. The third crop of alfalfa was removed (Alf. R) on one plot, and plowed under (Alf. P) on the other. The crop plowed under was approximately 1 1/2 tons.

In 1951 no amendments were added and all plots were planted to sugar beets to determine the residual effects of the amendments added in 1950.

In 1950 seedling diseases in the 14-acre plot (four sub-plots) were lowest in fallow and potatoes (17 percent), and highest in sugar beets (57 percent), and intermediate (25 to 29 percent) in the others. The highest amount of disease occurred in the sub-plot sugar beet PM (71.9 percent) and the lowest in fallow PM (10.6 percent). In 1951 seedling diseases in the 1/4-acre plots varied from 23 (oats) to 33.5 percent (Alfalfa R). The

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Table 1.—Effect of Preceding Crops on Sugar Beets—1950, 1951, Huntley Branch Station, Huntley, Montana.

	1 Stand percent		Yield tons		2 Seedling diseases (%)		Sugar percent		Top-to-root ratio			
	1950	1951	1950	1951	1950	1951	1950	1951	Tops (%)		Roots (%)	
Oats												
CK	115	92	13.2	11.9	18.3	19.2	16.7	18.4	30.5	36.5	69.5	65.5
P	110	90	14.0	13.6	28.1	21.6	17.3	18.1	33.2	34.6	66.8	65.4
PM	110	99	16.8	15.9	25.3	28.6	16.9	18.3	38.7	38.7	61.3	61.3
PMN	112	97	17.7	17.0	28.3	22.6	17.0	18.2	36.5	42.1	65.5	57.9
Corn												
CK	108	106	19.9	15.2	35.7	41.1	18.2	17.9	49.7	37.9	58.3	62.1
P	108	97	13.9	11.4	26.2	15.1	17.0	18.0	36.0	32.7	64.0	67.3
PM	108	108	19.0	20.0	28.8	24.5	16.9	18.7	43.5	35.1	56.5	64.9
PMN	119	104	18.1	15.7	19.9	25.0	16.9	18.8	47.9	38.1	52.1	61.9
Beans												
CK	98	97	15.9	15.7	34.3	33.3	15.9	18.7	58.9	45.1	41.1	54.9
P	108	115	17.3	17.7	20.9	18.5	15.6	18.4	58.5	41.0	41.5	59.0
PM	98	104	18.4	18.7	30.1	30.9	16.3	17.8	55.0	42.4	45.0	57.6
PMN	102	108	18.5	20.4	29.7	36.1	14.8	18.3	59.0	45.7	41.0	56.3
Potato												
CK	106	105	16.6	15.8	17.2	36.4	16.9	18.7	53.2	36.8	46.8	63.2
P	108	109	18.1	15.4	19.1	33.8	16.5	18.4	51.3	37.2	48.7	62.8
PM	115	100	20.1	16.2	20.9	27.3	17.4	18.1	51.5	38.1	48.5	61.9
PMN	108	103	18.8	17.6	15.4	27.4	17.0	18.8	52.3	38.3	47.7	61.7
Beet												
CK	75	103	8.5	10.9	57.3	44.7	17.6	17.7	44.5	36.6	55.5	51.4
P	94	97	11.5	11.2	44.5	24.7	17.6	17.9	35.2	37.6	64.8	62.4
PM	108	103	14.0	14.2	71.9	25.4	17.1	18.2	37.5	37.0	62.5	63.0
PMN	102	83	16.2	12.3	54.1	13.3	17.8	18.0	38.8	39.6	61.2	60.4
Alfalfa (3rd R)												
CK	106	90	11.2	13.2	31.2	54.0	18.5	41.2	49.0	58.8	51.0
P	102	94	14.8	17.7	23.0	28.0	18.8	18.6	38.2	45.5	61.8	54.5
PM	119	82	16.0	16.7	20.9	36.0	17.3	17.3	48.8	48.9	51.2	51.1
PMN	112	101	17.1	18.3	25.5	14.5	16.3	17.7	52.8	48.4	47.2	51.6
Alfalfa (3rd P)												
CK	94	101	13.6	15.1	28.4	27.6	17.4	17.4	45.2	50.4	54.8	49.6
P	98	86	13.6	15.1	36.5	34.7	17.6	17.9	43.1	47.2	56.9	53.8
PM	98	112	15.5	18.5	18.6	32.1	16.0	17.3	56.1	54.3	43.9	45.7
PMN	110	87	16.0	18.2	26.0	19.7	16.0	17.4	58.3	50.8	41.7	49.2
Fallow												
CK	110	91	16.7	19.5	23.0	31.0	12.9	14.2	71.6	59.9	28.4	40.1
P	108	90	17.3	19.0	15.2	36.4	11.1	13.2	72.4	59.2	27.6	40.8
PM	119	94	20.5	20.2	10.6	17.6	12.6	13.5	70.2	62.8	29.8	37.2
PMN	113	85	16.2	16.2	17.0	11.8	11.9	15.4	72.9	62.8	27.1	37.2

¹ Based on 100 beets in 100-foot row at harvest, rows spaced 20 inches.

² Seedling in four to six leaf stage.

highest amount of disease was 54.9 (Alf. R untreated) and the lowest 15.1 percent (corn P).

The yield in 1950 varied from 8.5 (sugar beet untreated) to 20.2 tons (fallow PM), and in 1951 from 10.9 (sugar beet untreated) to 20.4 tons (bean PMN).

In 1950 the maximum production of beets following all crops was in the sub-plot where either PM or PMN was added. Comparing the highest yield of the fertilized sub-plots with the untreated sub-plot in each 1/4 acre, the increase varied from 2.6 (beans PMN) to 7.7 tons (sugar beet PMN).

The 7.7 tons represented an increase of 91 percent of the untreated sugar beet sub-plot.

A similar comparison for yield in 1951 varied from 1.8 (potato PMN) to 5.1 tons (Alfalfa R—PMN and oats PMN) or an increase of 39 percent in the alfalfa R sub-plot and 43 percent in the oat PMN.

The results of previous work with sugar beets at the Huntley Branch Station indicate that a proportion of 35 to 40 percent of tops and crowns to 65 to 60 percent of roots at harvest time is satisfactory and usually signifies a balanced fertility of the land. In this investigation the top-to-root ratio exceeded these figures in 1950 in all 1/4-acre plots except oats. This would indicate that the season of 1950 was not long enough for the beets to complete their normal development under the specific environment. There was probably an excess of nitrogen which caused increased leaf development and delayed root development.

In 1951 the top-to-root ratio was within the satisfactory zone in the 1/4-acre plot of oats, corn, potatoes and sugar beets, and only slightly in excess in the bean plot. The ratio was approximately 50:50 in the alfalfa plots and 60:40 in the fallow. The 1950 yield in general was slightly more than in 1951. The yield results would indicate that a combination of phosphorus and nitrogen was a beneficial amendment for this particular soil. In 1950 and 1951 the sugar percentage was reduced 2 to 4 percent in the fallow 1/4-acre plot, but the yield was considerably higher when compared with the beet plot.

Summary

The object of this investigation was to study the effect of preceding crops, alfalfa, bean, corn, oats, potatoes and sugar beets, and summer fallow, on sugar beets. The preceding crops were grown for five years, then the plots were divided into four sub-plots. One sub-plot was used as a check and to the others P, PM and PMN were added, respectively. The following year the residual effects of the amendments were determined. In 1950 seedling diseases varied from 71.9 to 10.6 percent, and in 1951 from 34.9 to 15.1 percent.

The yield in 1950 varied from 8.5 to 20.2 tons, and in 1951 from 10.9 to 20.4. The maximum production occurred where PM or PMN was added, indicating that these amendments were beneficial in this particular soil.