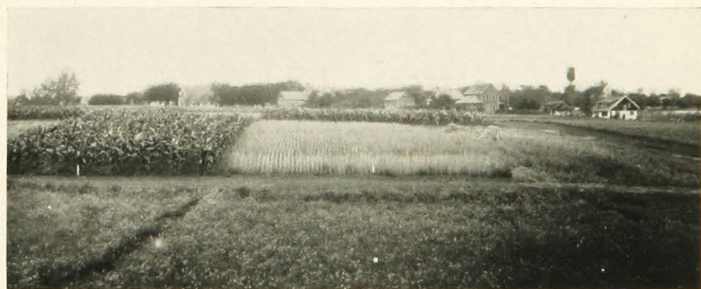


UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

ALFALFA AS A ROTATION CROP

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WEST CENTRAL SCHOOL AND STATION
MORRIS



UNIVERSITY FARM, ST. PAUL

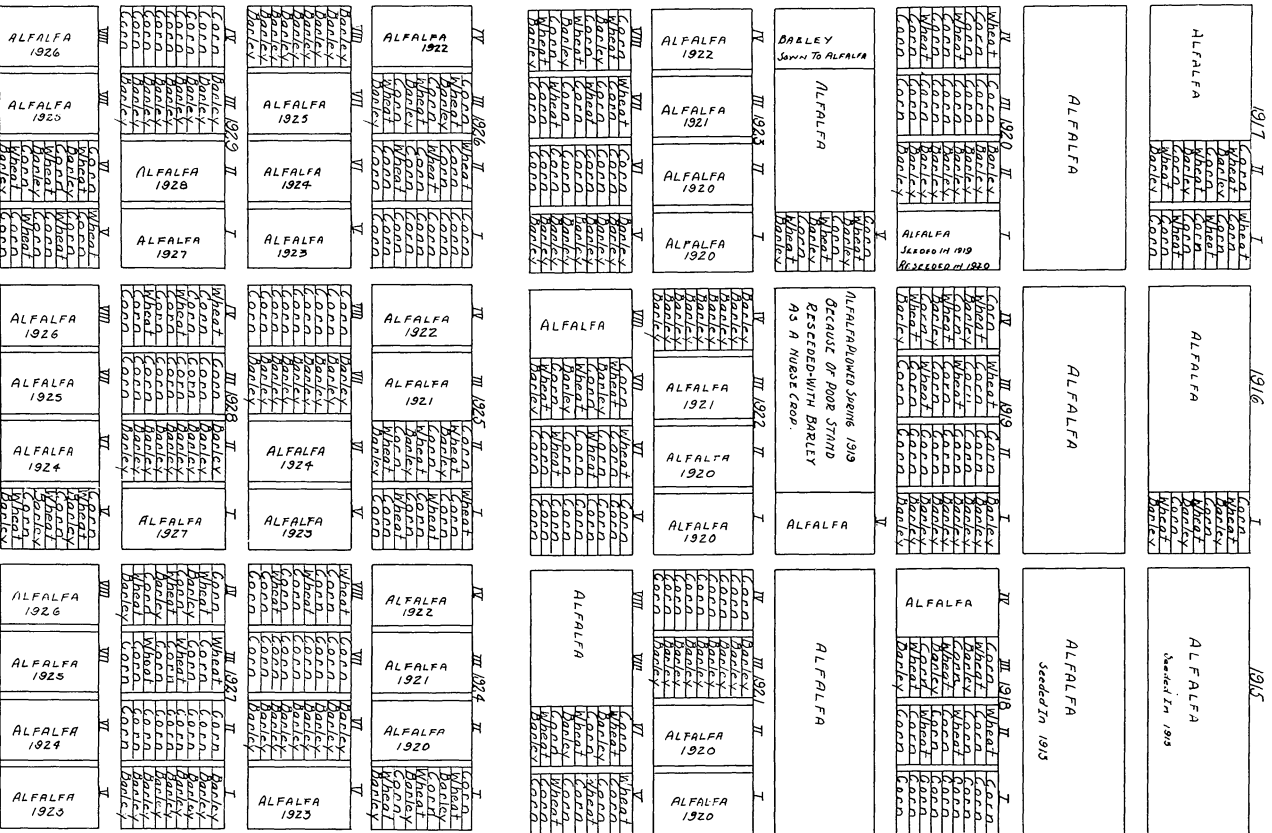


Fig. 1. Plan of Alfalfa Rotation Experiments Showing Sequence of Crops for Years 1915 to 1926

ALFALFA AS A ROTATION CROP

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INTRODUCTION

Alfalfa is rapidly becoming the leading forage crop on Minnesota farms on which livestock is an important enterprise. The development of hardy varieties, the increasing supply of hardy seed, the ease with which a successful stand may be obtained, and the more general appreciation on the part of farmers of the value of alfalfa as a forage crop are all making for a greatly increased acreage in all sections of Minnesota to which the legume is adapted. As the acreage increases and old stands are replaced, much alfalfa land each year will be put back into other crops.

When an old alfalfa stand is to be broken up, what is the best crop with which to follow alfalfa and what is the best sequence of crops for use in succeeding years? The use of alfalfa as a rotation crop, making possible the rotation of hay lands, is also a question of importance.

To answer some of these questions, with special reference to conditions in western Minnesota, the West Central branch of the Minnesota Experiment Station began in 1916 a series of alfalfa rotation experiments at Morris. These experiments were continued until 1929, when the project was brought to a close. The results secured are reported in this bulletin.

PLAN OF THE EXPERIMENTS

The plans for the experiments were made in 1915, and a suitable piece of ground having a good stand of Grimm alfalfa, which had been seeded in 1913, was selected for the work. One series of plots was broken up in the fall of 1915, and the following spring these were planted to three different crops: wheat, corn, and barley, each crop being grown on triplicate plots. The second year after breaking, the wheat and barley plots of the previous year were planted to corn and the corn plots were seeded to wheat. The third year following alfalfa, all plots were planted to corn and the fourth year they were all seeded to barley as a companion crop for the alfalfa. The fifth, sixth, seventh, and eighth years the series was in alfalfa, after which it was again plowed up and the rotation begun over again. By beginning a new series of plots each year and using eight series it has been possible to grow all crops in the rotation each year since 1919. A complete outline of the rotations used showing the sequence of crops for each year is given in Figure 1.

EXPERIMENTS ON HEAVY SOIL

These alfalfa rotation plots were on Clarion silt loam, a soil typical of a large area in western Minnesota. This is a black to dark brown silt loam on a yellow silty clay subsoil. It is well supplied with lime. In extensive liming experiments at the West Central Experiment Station neither alfalfa nor other crops have shown any increase in yield from the addition of lime. The soil is also naturally well supplied with nitrogen and potash. Phosphate is the most poorly provided plant nutrient. While good yields are usually obtained without the application of phosphate, a large proportion of the area, especially fields which receive no manure, will give increased yields of all crops and especially of alfalfa where a phosphate fertilizer is applied. The topography of the land upon which the plots were located is gently rolling and the natural drainage is ample.

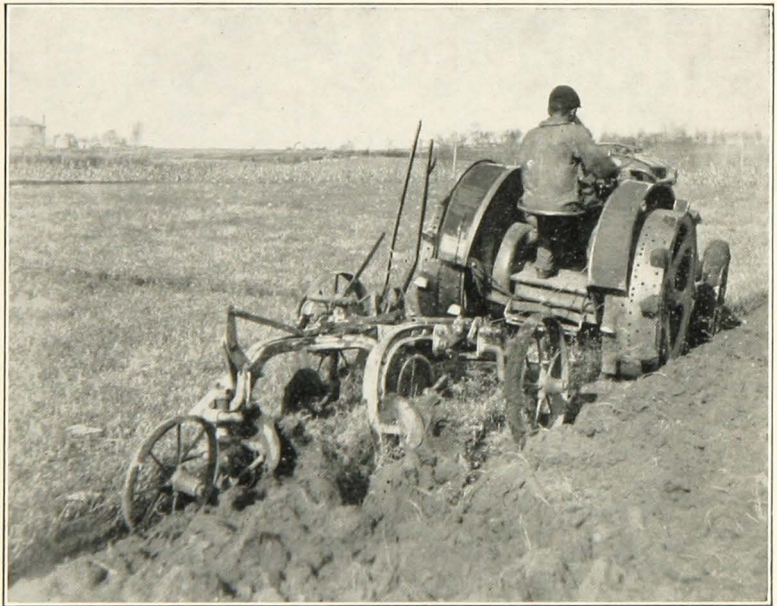


Fig. 2. Plowing the Four-Year-Old Alfalfa Sod

CULTURAL OPERATIONS

Throughout the experiments, Grimm alfalfa was used and in only two cases was the stand not a success. Failure to obtain an adequate stand in 1919 was caused by faulty seeding and in 1926 the extremely

dry weather during April, May, June, and July resulted in a thin stand which was plowed up the following year. There was very little winter-killing throughout the years the experiments were in progress. It will be noted from Table II, reporting the yields of alfalfa, that there was little difference in the total yield of the hay crop on account of the age of the stand. The alfalfa was seeded at the rate of 15



Fig. 3. In Plowing Old Alfalfa, Sharp Plows and Sufficient Power Are Necessary To Turn a Clean Furrow Slice

pounds per acre with 2 bushels per acre of Manchuria barley as a nurse crop. The alfalfa sod at the end of the fourth year was plowed in the fall, and when plenty of power and sharp plows were used good plowing was not at all difficult. Generally, however, some volunteer alfalfa appeared in the corn crop of the following year, and occasionally some of these plants held over into the crop of the succeeding year, as will be seen in Figure 4. Throughout the years of the experiments no commercial fertilizer or manure was applied, except in 1921 when the whole field was treated with 100 pounds of 45 per cent super-phosphate per acre. It is probable that had the land been fertilized more often, higher yields of both alfalfa and the other crops would have been obtained.



Fig. 4. Volunteer Alfalfa Appearing in Corn First Year After Breaking

RAINFALL AN IMPORTANT FACTOR

The rotation was begun in 1916 and was fully under way by 1920. It will be noted from a study of Table I that the rainfall for a number of years was limited and that most of the seasons between 1920 and 1929, when the rotation was in full operation, were below the normal in rainfall. This limitation of moisture proved to be the dominating factor in the yields obtained not only of alfalfa but of the grain crops in the years succeeding the breaking up of the alfalfa sod. The reader should keep in mind this fact. With a total annual rainfall of 20 to 22 inches, as was the case for several seasons during these trials, the subsoil moisture became so depleted that crops were entirely dependent upon seasonal rains.

YIELDS OF ALFALFA

The yields of alfalfa are recorded by years in Table II beginning in 1921 when the first yields were taken. Throughout the period of the experiment they average about two tons to the acre. Without more fertilizer than was used in the experiments, and with from 20 to 22 inches of rainfall a season, this is about the yield of alfalfa that may be expected. With more moisture or with the application of manure or acid phosphate at regular intervals, larger yields are possible. There was little difference in the amount of hay harvested from alfalfa stands one, two, three, or four years old. This would indicate that winter-killing is not a serious factor in maintaining a successful stand of alfalfa at this station.

TABLE I
TEMPERATURE AND PRECIPITATION, 1916-29 AND 10-YEAR AND 21-YEAR AVERAGES

Month	Temperature														10-yr.	21-yr.
	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	av.	av.
	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
January	0	1	2	19	7	19	10	13	6	9	16	13	14	-1	11	8
February	6	1	16	13	16	24	5	7	23	11	11	11	19	5	13	12
March	22	26	39	26	30	34	30	21	29	33	25	33	32	34	30	28
April	40	42	43	43	37	50	46	43	44	51	38	40	38	46	43	44
May	53	43	58	46	57	58	65	57	49	54	58	53	60	53	56	56
June	60	61	66	67	66	70	68	70	62	64	60	65	61	66	65	65
July	77	72	70	72	70	74	68	75	69	68	72	67	71	72	71	70
August	69	65	70	67	69	70	73	66	67	70	69	66	69	70	69	68
September	57	58	55	61	63	60	64	64	57	64	56	62	57	57	60	65
October	43	37	49	40	53	46	52	50	54	36	40	51	47	48	48	47
November	31	36	34	23	31	22	37	38	30	30	25	26	34	26	30	41
December	6	5	18	8	19	18	14	26	6	15	11	2	23	15	15	14

Month	Precipitation														10-yr.	21-yr.
	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	av.	av.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
January	2.0	2.3	0.9	0.3	1.5	0.1	1.6	2.3	0.2	1.0	1.5	0.8	0.6	1.3	1.1	1.3
February	0.6	1.3	0.1	1.0	0.2	0.1	3.2	2.3	0.4	0.2	1.7	0.5	0.5	1.1	1.0	0.8
March	1.6	1.7	0.4	1.8	0.9	0.9	1.0	0.6	1.6	0.0	0.8	2.6	0.3	1.5	1.0	1.0
April	2.8	3.1	2.8	4.3	1.3	1.8	1.1	2.2	3.0	2.4	0.1	3.3	1.9	2.6	2.0	2.2
May	6.6	1.0	3.6	2.7	3.3	2.4	3.6	1.7	1.3	0.9	2.0	2.7	0.2	2.2	2.0	3.1
June	3.7	1.3	2.1	5.9	9.9	2.8	1.0	4.3	5.4	5.9	1.4	1.7	4.7	1.0	3.8	4.1
July	2.1	3.7	3.3	2.2	3.2	3.6	3.2	3.4	2.0	3.6	1.5	2.7	6.4	6.4	3.6	3.6
August	5.7	1.6	6.1	1.1	1.1	2.5	0.8	1.2	3.8	0.9	4.1	1.3	4.1	1.5	2.1	2.5
September	2.8	1.2	0.2	0.8	1.0	7.5	1.0	1.1	5.6	4.8	3.9	2.4	1.5	3.5	3.2	2.7
October	0.9	1.2	1.9	0.9	0.8	0.3	0.5	0.9	1.4	0.5	2.1	0.8	2.3	2.5	1.2	1.5
November	0.2	0.1	2.2	1.2	1.5	1.3	3.2	1.1	0.3	1.2	1.2	1.2	0.9	0.6	1.2	0.9
December	1.1	0.7	1.4	0.7	1.1	0.0	0.7	0.1	1.8	0.3	1.4	1.8	0.2	0.3	0.8	0.7
Total for year ..	30.1	19.2	25.0	22.9	25.8	23.3	20.9	21.2	26.8	21.7	21.7	21.8	23.6	24.5	23.0	24.4

TABLE II
YIELDS OF ALFALFA HAY IN A ROTATION OF FOUR YEARS OF ALFALFA AND
FOUR YEARS OF CORN AND GRAIN CROPS

Year	Alfalfa yields per acre					Precipitation	
	First year after seeding	Second year after seeding	Third year after seeding	Fourth year after seeding	Average yield per acre for season	For 12 months	For crop year, Apr. 1 to Sept. 1
	Tons	Tons	Tons	Tons	Tons	Inches	Inches
1921	3.86	....	....	....	...	23.26	13.12
1922	3.99	3.67	....	....	3.8	20.88	9.74
1923	2.93	2.82	2.59	....	2.8	21.27	12.87
1924	1.24	2.20	1.79	1.51	1.7	26.64	15.38
1925	2.02	2.19	2.36	1.91	2.2	21.60	13.75
1926	.71	.58	.77	.80	.7	21.63	9.10
1927	....	1.93	2.01	2.07	2.1	21.76	15.60
1928	1.65	....	1.70	1.97	1.8	23.56	17.30
1929	1.54	1.63	2.07	1.53	1.7	.....	13.57

BARLEY AS THE FIRST CROP AFTER ALFALFA

In the rotations used in these experiments, barley was the first crop to follow alfalfa in one rotation, and in all three of the rotations it was the fourth crop to follow alfalfa. In Table III are reported the yields of barley from 1916 to 1929, as the first crop following alfalfa.

TABLE III
YIELDS OF BARLEY PER ACRE FOLLOWING ALFALFA

Year	Barley as first crop following alfalfa	Barley as fourth crop following alfalfa	Precipitation, April 1 to August 1
	Bu.	Bu.	Inches
1916	31.1	....	20.96
1917	35.6	....	10.64
1918	29.9	....	11.78
1919	38.3	....	15.13
1920	35.6	32.9	17.79
1921	34.7	50.0	10.61
1922	37.9	41.9	8.90
1923	39.4	53.0	11.66
1924	35.2	53.2	11.63
1925	37.7	49.4	12.87
1926	8.2	31.7	4.98
1927	26.3	53.1	10.35
1928	36.0	50.1	13.18
1929	22.6	38.2	12.07
Average	31.4*	45.4*	

*Average for years 1920-29.

In all of these years, an average yield of 31.4 bushels of barley per acre was obtained. When barley was the fourth crop in these rotations it made an average yield of 45.4 bushels per acre, or 14 bushels more per acre than when it followed alfalfa immediately. It appears probable that the four years of the continuous growing of alfalfa so depleted

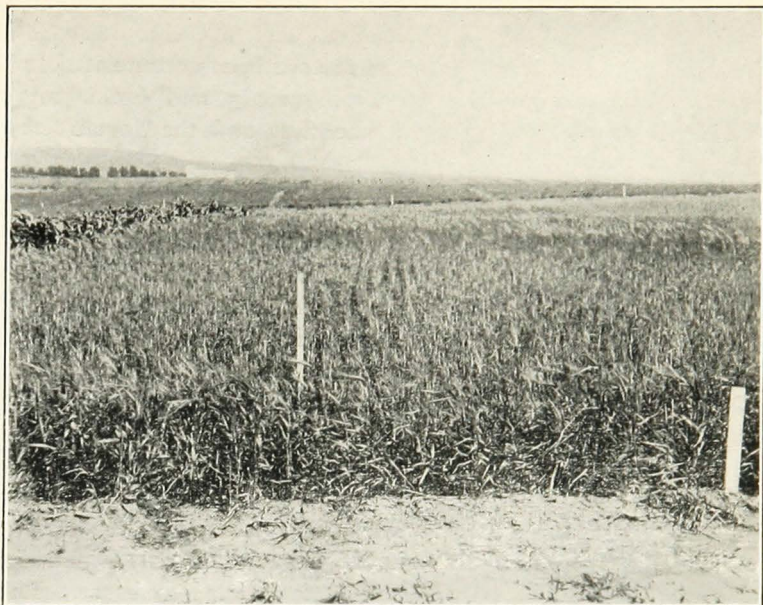


Fig. 5. Barley as First Crop After Alfalfa
A poor crop as compared with Figure 6. Both pictures were taken the same day.

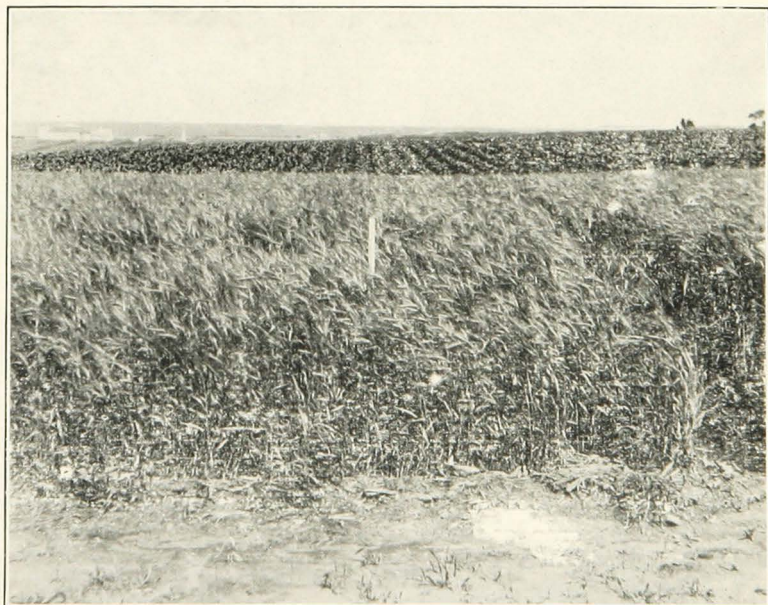


Fig. 6. A Heavy Stand of Barley Grown on Alfalfa Land the Fourth Year After
Breaking. Compare with Figure 5

the soil moisture that the barley crop suffered, and that not until four years later had a sufficient moisture reserve been accumulated to produce a maximum crop of barley. Figures 5 and 6 illustrate the comparative growth of barley as the first and the fourth crop to follow alfalfa.

WHEAT FOLLOWING ALFALFA

Wheat was used in two rotations following alfalfa. In one it was the first crop to follow alfalfa, and in another it was the second crop after alfalfa and immediately followed corn. As will be seen by the data reported in Table IV, an average yield of 17.2 bushels per acre was obtained over a 13-year period when wheat immediately followed alfalfa. For the same period, an average yield of 21.8 bushels per acre was obtained when wheat was the second crop following alfalfa. An increase of 4.6 bushels per acre was obtained by growing a crop of corn before introducing wheat into this rotation. While the wheat crop made a more favorable showing than did barley immediately following alfalfa, it also suffered from a lack of moisture. This is clearly indicated by the illustrations shown in Figures 7 and 8.

TABLE IV
YIELDS OF WHEAT PER ACRE FOLLOWING ALFALFA

Year	Wheat as first crop following alfalfa	Wheat as second crop after alfalfa, following corn	Precipitation, April 1 to August 1
	Bu.	Bu.	Inches
1917	27.7	32.6	10.64
1918	19.0	35.5	11.78
1919	15.5	17.7	15.13
1920	15.2	17.5	17.79
1921	14.9	20.0	10.61
1922	26.2	28.2	8.90
1923	18.4	16.9	11.66
1924	23.2	33.2	11.63
1925	15.1	16.9	12.87
1926	4.7	8.3	4.98
1927	17.9	23.5	10.35
1928	11.1	13.8	13.18
1929	14.4	19.2	12.07
Average	17.2	21.8	

CORN FOLLOWING ALFALFA

In the rotations used in these experiments, corn was grown after alfalfa as the first crop, as the second crop immediately following wheat or barley, and also as the third crop. The results with corn are reported in Table V. Over a period of 12 years corn made a yield of 42.4 bushels per acre, as the first crop following alfalfa; 46.5 bushels per acre, as the second crop following alfalfa; and 48.6 bushels as the

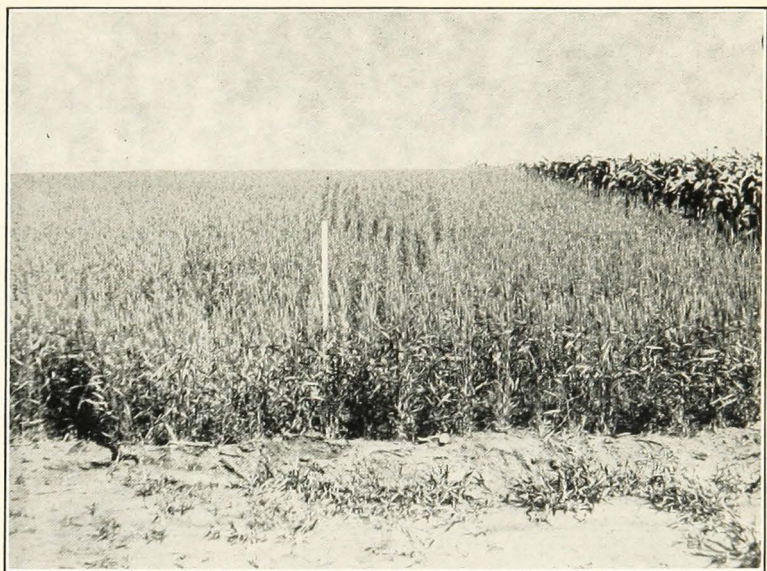


Fig. 7. Wheat Grown as First Crop After Alfalfa
Compare short growth of this wheat with that of Figure 8.

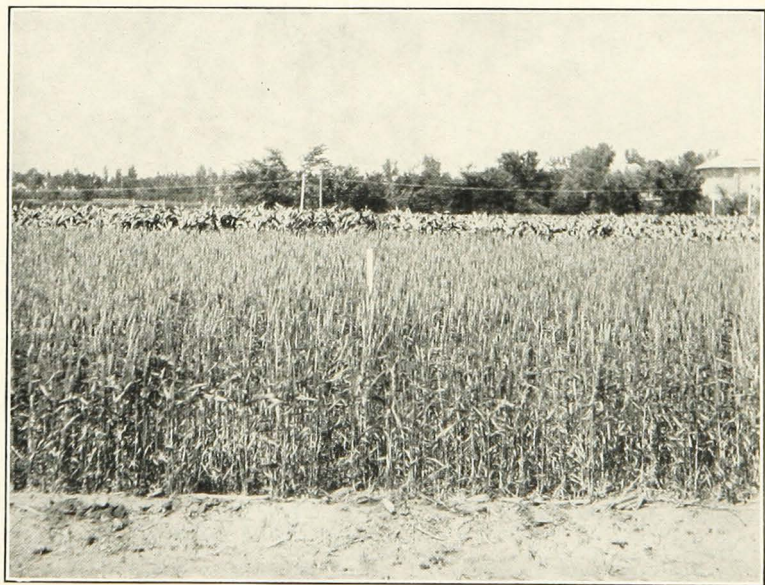


Fig. 8. Wheat Grown as Second Crop After Alfalfa
Note much more vigorous growth than that in Figure 7 taken the same day.

third crop following alfalfa. While there was some reduction in yield when corn was used early in the rotation, it was not nearly so pronounced as in the case of barley and wheat. Figures 9, 10, and 11 show the growth of corn according to its place in the rotation.

TABLE V
YIELDS OF CORN PER ACRE FOLLOWING ALFALFA

Year	Corn as first crop following alfalfa	Corn as second crop following alfalfa	Corn as third crop following alfalfa	Precipitation, April 1 to September 1
	Bu.	Bu.	Bu.	Inches
1916	46.1	....	....	20.96
1917	49.0	41.1	....	10.64
1918	47.0	50.8	54.1	17.91
1919	48.8	51.6	51.8	16.21
1920	48.6	49.0	47.1	18.00
1921	56.5	59.2	64.7	13.12
1922	52.5	46.4	52.5	9.74
1923	37.6	39.4	42.7	12.87
1924	33.9	53.4	46.9	15.38
1925	27.3	33.6	43.6	13.75
1926	29.2	33.1	38.4	9.10
1927	47.0	50.0	43.1	11.65
1928	41.9	48.2	53.7	17.30
1929	38.4	42.9	48.2	13.57
Average	42.4*	46.5*	48.6*	

* Average is for years 1918-29.



Fig. 9. Corn Grown as First Crop Following Alfalfa
Compare short growth with that in Figures 10 and 11, taken same day.



Fig. 10. Corn Grown as Second Crop After Alfalfa Immediately Following Grain Compare with Figures 9 and 11, taken same day.



Fig. 11. Corn Grown as Third Crop Following Alfalfa Note growth as compared with Figures 9 and 10.

THREE DIFFERENT ROTATIONS USED

In these experiments, three different four-year rotations were used. In Tables VI, VII, and VIII are reported the yields of these rotations by years. In Table IX a summary of the yields for the different cropping systems for the 11-year period is reported. As will be noted from this table, a rotation of corn, wheat, corn, barley, following alfalfa, gave very satisfactory returns for all crops. A rotation of wheat, corn, corn, barley also gave very satisfactory returns, altho wheat as the first crop in the rotation yielded almost four bushels less than it did when it was the second crop in the rotation. The third rotation, barley, corn, corn, barley, did not prove so advantageous as far as the first year of barley was concerned. There was a difference of about 14 bushels per acre in the yield of barley depending upon its place in the rotation. A complete history of the experiment is given in Table X in which the yields for all crops from 1916 to 1929 are reported.

TABLE VI
CROP YIELDS IN A ROTATION OF WHEAT, CORN, CORN, BARLEY,
FOLLOWING FOUR YEARS OF ALFALFA

Year	Sequence of crops following four years of alfalfa			
	Wheat	Corn	Corn	Barley
	Bu. per acre	Bu. per acre	Bu. per acre	Bu. per acre
1917	27.7	40.5	....	....
1918	19.0	53.8	54.9	....
1919	15.5	49.9	52.3	....
1920	15.2	49.9	47.5	34.2
1921	14.9	58.2	66.6	50.3
1922	26.2	46.9	50.8	45.1
1923	18.4	40.0	45.9	52.5
1924	23.2	51.8	45.7	55.9
1925	15.1	33.6	45.3	49.8
1926	4.7	30.3	40.2	31.0
1927	17.9	48.7	47.0	55.8
1928	11.05	48.4	54.2	53.1
1929	14.4	40.2	49.7	37.8
Average*	16.1	44.8	49.3	46.6

* Average includes only years 1920 through 1929.

TABLE VII
CROP YIELDS IN A ROTATION OF BARLEY, CORN, CORN, BARLEY,
FOLLOWING FOUR YEARS OF ALFALFA

Year	Sequence of crops following four years of alfalfa			
	Barley	Corn	Corn	Barley
	Bu. per acre	Bu. per acre	Bu. per acre	Bu. per acre
1916	31.1	....	....	....
1917	35.6	41.8	....	....
1918	29.9	47.8	54.5	....
1919	38.3	53.4	51.7	....
1920	35.6	48.1	47.7	34.2
1921	34.7	60.3	64.4	51.2
1922	37.9	46.0	53.7	38.4
1923	39.4	38.9	45.0	53.6
1924	35.2	55.0	48.0	53.8
1925	37.7	33.6	41.6	52.1
1926	8.2	35.9	37.9	32.9
1927	26.3	51.4	41.4	50.6
1928	36.0	48.0	55.5	52.4
1929	22.6	45.3	45.8	40.7
Average*	31.4	46.3	48.1	46.0

* Average includes only years 1920 through 1929.

TABLE VIII
CROP YIELDS IN A ROTATION OF CORN, WHEAT, CORN, BARLEY IN AN 8-YEAR ROTATION
INCLUDING FOUR YEARS OF ALFALFA

Year	Sequence of crops following four years of alfalfa			
	Corn	Wheat	Corn	Barley
	Bu. per acre	Bu. per acre	Bu. per acre	Bu. per acre
1916	46.1	....	....	....
1917	49.0	32.6	....	....
1918	47.0	35.5	53.0	....
1919	48.8	17.7	51.4	....
1920	48.6	17.5	46.2	31.0
1921	56.5	20.0	63.2	48.5
1922	52.5	28.2	52.9	42.3
1923	37.6	16.9	37.2	53.0
1924	33.9	33.2	47.0	49.9
1925	27.3	16.9	44.0	46.2
1926	29.2	8.3	37.0	31.1
1927	47.0	23.5	41.0	52.9
1928	41.9	13.8	51.5	44.8
1929	38.4	19.2	49.0	35.9
Average*	41.3	19.8	46.9	43.6

* Average includes only years 1920 through 1929.

TABLE IX
SUMMARY OF CROP YIELDS FOR YEARS 1920 THROUGH 1929 OF THREE ROTATIONS EACH
FOLLOWING FOUR YEARS OF ALFALFA

Rotation I	Yield per acre	Rotation II	Yield per acre	Rotation III	Yield per acre
	Bu.		Bu.		Bu.
Corn	41.3	Wheat	16.1	Barley	31.4
Wheat	19.8	Corn	44.8	Corn	46.3
Corn	46.9	Corn	49.3	Corn	48.1
Barley	43.6	Barley	46.6	Barley	46.0

TABLE X
AVERAGE YIELDS OF CORN, GRAIN, AND HAY PER ACRE IN ALFALFA ROTATION, 1916-29

Plots	1916		1917		1918		1919		1920		1921		1922	
	Crop	Yield Bu.	Crop	Yield Bu.	Crop	Yield Bu.	Crop	Yield Bu.	Crop	Yield Bu.	Crop	Yield Tons	Crop	Yield Tons
Series I														
1-4-7	Corn	46.1	Wheat	32.6	Corn	53.0	.....	.....	Barley	31.0	Alfalfa	3.90	Alfalfa	3.34
2-5-8	Wheat	16.3	Corn	40.5	Corn	54.9	.....	.....	Barley	33.6	Alfalfa	3.81	Alfalfa	3.63
3-6-9	Barley	31.1	Corn	41.8	Corn	54.5	.....	.....	Barley	34.2	Alfalfa	3.99	Alfalfa	3.60
Series II														
1-4-7	Alfalfa	.....	Corn	49.0	Wheat	35.5	Corn	51.4	.....	.....	Alfalfa	3.79	Alfalfa	3.73
2-5-8	Alfalfa	.....	Wheat	27.7	Corn	53.8	Corn	52.3	.....	.....	Alfalfa	3.99	Alfalfa	3.73
3-6-9	Alfalfa	.....	Barley	35.6	Corn	47.8	Corn	51.7	.....	.....	Alfalfa	3.81	Alfalfa	3.55
Series III														
1-4-7	Alfalfa	.....	Alfalfa	.....	Corn	47.0	Wheat	17.7	Corn	46.2	Barley	48.5	Alfalfa	3.93
2-5-8	Alfalfa	.....	Alfalfa	.....	Wheat	19.0	Corn	49.9	Corn	47.5	Barley	50.3	Alfalfa	4.03
3-6-9	Alfalfa	.....	Alfalfa	.....	Barley	29.9	Corn	53.4	Corn	47.7	Barley	51.2	Alfalfa	4.00
Series IV														
1-4-7	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Corn	48.8	Wheat	17.5	Corn	63.2	Barley	42.3
2-5-8	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Wheat	15.5	Corn	49.9	Corn	66.6	Barley	45.1
3-6-9	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	38.3	Corn	48.1	Corn	64.4	Barley	38.4
Series V														
1-4-7	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Corn	48.6	Wheat	20.0	Corn	52.9
2-5-8	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Wheat	15.2	Corn	58.2	Corn	50.8
3-6-9	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	35.6	Corn	60.3	Corn	53.7
Series VI														
1-4-7	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	.....	Alfalfa	.....	Corn	56.5	Wheat	28.2
2-5-8	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	.....	Alfalfa	.....	Wheat	14.9	Corn	46.9
3-6-9	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	.....	Alfalfa	.....	Barley	34.7	Corn	46.0
Series VII														
1-4-7	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	.....	Alfalfa	.....	Alfalfa	.....	Corn	52.5
2-5-8	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	.....	Alfalfa	.....	Alfalfa	.....	Wheat	26.2
3-6-9	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Barley	.....	Alfalfa	.....	Alfalfa	.....	Barley	37.9
Series VIII														
1-4-7	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Potatoes	.....	Barley	.....	Alfalfa	.....	Alfalfa	.....
2-5-8	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Potatoes	.....	Barley	.....	Alfalfa	.....	Alfalfa	.....
3-6-9	Alfalfa	.....	Alfalfa	.....	Alfalfa	.....	Potatoes	.....	Barley	.....	Alfalfa	.....	Alfalfa	.....

TABLE X—Continued
 AVERAGE YIELDS OF CORN, GRAIN, AND HAY PER ACRE IN ALFALFA ROTATION, 1916-29

Plots	1923		1924		1925		1926		1927		1928		1929	
	Crop	Yield	Crop	Yield	Crop	Yield	Crop	Yield	Crop	Yield	Crop	Yield	Crop	Yield
Series I		Tons		Bu.		Bu.		Bu.		Bu.		Tons		Tons
1-4-7	Alfalfa	2.25	Corn	33.9	Wheat	16.9	Corn	37.0	Barley	52.9	Alfalfa	1.66	Alfalfa	1.45
2-5-8	Alfalfa	2.32	Wheat	23.2	Corn	33.6	Corn	40.2	Barley	55.8	Alfalfa	1.60	Alfalfa	1.72
3-6-9	Alfalfa	2.28	Barley	35.2	Corn	33.6	Corn	37.9	Barley	50.6	Alfalfa	1.69	Alfalfa	1.73
Series II				Tons								Bu.		
1-4-7	Alfalfa	2.50	Alfalfa	1.48	Corn	27.3	Wheat	8.3	Corn	41.0	Barley	44.8	Alfalfa	1.45
2-5-8	Alfalfa	2.60	Alfalfa	1.56	Wheat	15.1	Corn	30.3	Corn	47.0	Barley	53.1	Alfalfa	1.55
3-6-9	Alfalfa	2.66	Alfalfa	1.48	Barley	37.7	Corn	35.9	Corn	41.4	Barley	52.4	Alfalfa	1.63
Series III						Tons								Bu.
1-4-7	Alfalfa	2.95	Alfalfa	1.76	Alfalfa	1.93	Corn	29.2	Wheat	23.5	Corn	51.5	Barley	35.9
2-5-8	Alfalfa	2.81	Alfalfa	1.79	Alfalfa	1.80	Wheat	4.7	Corn	48.7	Corn	54.2	Barley	37.8
3-6-9	Alfalfa	2.70	Alfalfa	1.83	Alfalfa	2.00	Barley	8.2	Corn	51.4	Corn	55.5	Barley	40.7
Series IV								Tons						
1-4-7	Alfalfa	2.98	Alfalfa	2.30	Alfalfa	2.56	Alfalfa	0.75	Corn	47.0	Wheat	13.8	Corn	49.0
2-5-8	Alfalfa	2.93	Alfalfa	2.11	Alfalfa	2.23	Alfalfa	0.78	Wheat	17.9	Corn	48.4	Corn	49.7
3-6-9	Alfalfa	2.89	Alfalfa	2.00	Alfalfa	2.30	Alfalfa	0.86	Barley	26.3	Corn	48.0	Corn	45.8
Series V		Bu.								Tons				
1-4-7	Barley	53.0	Alfalfa	1.32	Alfalfa	2.36	Alfalfa	0.88	Alfalfa	2.20	Corn	41.9	Wheat	19.2
2-5-8	Barley	52.5	Alfalfa	1.19	Alfalfa	2.04	Alfalfa	0.68	Alfalfa	1.93	Wheat	11.05	Corn	40.2
3-6-9	Barley	53.6	Alfalfa	1.22	Alfalfa	2.17	Alfalfa	0.75	Alfalfa	2.09	Barley	36.0	Corn	45.3
Series VI				Bu.								Tons		
1-4-7	Corn	37.2	Barley	49.9	Alfalfa	1.80	Alfalfa	0.55	Alfalfa	2.13	Alfalfa	1.95	Corn	38.4
2-5-8	Corn	45.9	Barley	55.9	Alfalfa	2.22	Alfalfa	0.64	Alfalfa	2.01	Alfalfa	1.84	Wheat	14.4
3-6-9	Corn	45.0	Barley	53.8	Alfalfa	2.03	Alfalfa	0.55	Alfalfa	1.89	Alfalfa	2.13	Barley	22.6
Series VII						Bu.								Tons
1-4-7	Wheat	16.9	Corn	47.0	Barley	46.2	Alfalfa	0.67	Alfalfa	2.00	Alfalfa	1.77	Alfalfa	1.61
2-5-8	Corn	40.0	Corn	45.7	Barley	49.8	Alfalfa	0.68	Alfalfa	1.83	Alfalfa	1.56	Alfalfa	1.45
3-6-9	Corn	38.9	Corn	48.0	Barley	52.1	Alfalfa	0.78	Alfalfa	1.96	Alfalfa	1.76	Alfalfa	1.54
Series VIII								Bu.						
1-4-7	Corn	37.6	Wheat	33.2	Corn	44.0	Barley	31.1	Alfalfa	....	Alfalfa	....	Alfalfa	2.15
2-5-8	Wheat	18.4	Corn	51.8	Corn	45.3	Barley	21.0	Alfalfa	....	Alfalfa	....	Alfalfa	2.02
3-6-9	Barley	39.4	Corn	55.0	Corn	41.6	Barley	32.9	Alfalfa	....	Alfalfa	....	Alfalfa	2.07

SUMMARY AND CONCLUSIONS

The purpose of these experiments was to obtain information to determine the most profitable sequence of both corn and grain crops following alfalfa. The results indicate quite clearly that under climatic conditions similar to those at the West Central Experiment Station corn is the most satisfactory crop with which to follow alfalfa. The depleted reserve of subsoil moisture apparently effects this crop less than either wheat or barley. It is obvious that the place for grain crops following alfalfa is during the later years of the rotation. These experiments also show that it is quite possible to use alfalfa as a rotation crop, and that under average Minnesota conditions it is not difficult to obtain a successful stand with a companion crop.