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The Effects of Various Legumes on the Yield of Corn

University of Tennessee Agricultural Experiment Station

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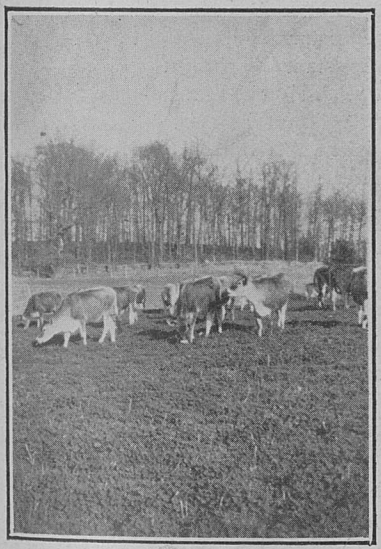

Crimson clo[illegible] pasture
Franklin C[illegible]unty

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THE EFFECTS OF VARIOUS LEGUMES ON THE YIELD OF CORN

By
C. A. Mooers
Director and Agronomist

INTRODUCTION

Under Tennessee conditions the size of the corn crop is chiefly determined by the rainfall and the soil fertility. The latter is by far the more important. That is, the yield is limited by the insufficient supply of plant-food; the average expectancy rainfall being ample for the production of very much larger crops than are being obtained—probably double, or even treble, the present average yield.

One of the marked differences between "old" and "new" land is in their content of soil nitrogen. As long as this element is abundant, the yields of corn are usually large, though in some sections the nitrogen cannot be utilized to good advantage without the addition of phosphate. In other words, the supply of phosphorus is of foremost importance.

At the present time nitrogenous fertilizers are comparatively cheap, but not so cheap as to make certain their profitable use on the corn crop. Fortunately, there are other means of increasing the soil supply of nitrogen. Farmyard manure is, of course, valuable for this purpose, but the supply is far too small. Legumes can be utilized as manure crops and should be grown much more extensively. The question, then, arises, what kinds give best returns? Such legumes as red clover, alfalfa, and sweet clover are truly great soil-improvers, but they require soils well supplied with lime. Since the yields of numerous other crops are increased by liming, it is very unfortunate that many farmers feel unable to make the initial investment that is required. Some legumes, however, may grow well on unlimed land. Chief among them are crimson clover and lespedeza. Cowpeas and soybeans are also grown on land poor in lime, though they, along with all the others, may be benefited, often greatly, by liming.

For a number of years this Station has been carrying on experiments with various legumes to determine their effects on the corn crops that followed them. Report has been made of long-continued experiments in a cowpea-corn rotation.* The present bulletin presents the findings from trials with other legumes that are vastly more effective as soil-improvers.

*Bulletin No. 137.

CRIMSON CLOVER

Experiments at the Knoxville Station

Experiments with crimson clover as a manure crop preceding corn were conducted at the Knoxville Station for a 5-year period, 1908-1912. The soils used were rather heavy loams, in good physical condition but of varying degrees of productivity. In all the trials care was taken, both in the soil preparation and in the planting, to make the conditions as much alike as possible, so that the one variable factor was in the clover crop. Table 1 gives the disposition of the clover crops and the yields of corn that followed.

TABLE 1—*Acre yields of corn following crimson clover*
Experiments conducted at the Knoxville Station, 1908-1912

Range	Plot No.	Year of corn crop	Yields of clover hay	Disposition of clover crop	Yields of corn	
					Grain	Stover
			Tons		Bu.	Tons
1	14 & 16	1908	1.33	Removed	53.6	1.59
	15 & 17		1.33	Turned under	58.1	1.98
1	2, 5, & 9	1912		None grown	51.3	1.77
	1, 3, 4, 6, 7, & 8		1.73	Turned under	64.9	2.27
8	6-10	1912	1.88	Removed	48.6	1.85
	1-5 & 11-15		1.88	Turned under	56.8	1.99
A	5 & 8	1908		None grown	34.1	1.17
		1909		Do	40.2	1.21
		1910		Do	29.7	1.10
		1911		Do	25.3	1.28
		1912		Do	24.8	1.21
				Average	30.8	1.19
A	3 & 6	1908	Yields variable and seldom large	Removed	34.1	1.24
		1909		Do	58.9	1.69
		1910		Do	46.5	1.49
		1911		Do	32.9	1.51
		1912		Do	36.8	1.51
				Average	41.8	1.49
A	4 & 7	1908		Turned under	34.0	1.11
		1909		Do	59.4	1.65
		1910		Do	41.1	1.51
		1911		Do	44.0	1.64
		1912		Do	38.7	1.59
				Average	43.4	1.50

DISCUSSION

The three trials reported from ranges 1 and 8 were on land above the average in productivity, and excellent crops of both crim-

son clover and corn were obtained. In only one case was no clover grown in comparison with clover turned under. In this instance the clover raised the yield of corn from 51.3 bushels per acre to 64.9 bushels, an increase of 13.6 bushels, which is especially good, considering the naturally high productivity of the soil. In the two other trials the yields of corn where crimson clover was turned under were, on the average, 6.9 bushels higher than where the clover was harvested for hay.

On range A, which was relatively poor, corn was grown continuously for 5 seasons, both following crimson clover and where none was grown. All plots received annually 200 pounds of acid phosphate and 50 pounds of muriate of potash per acre. The corn crops were cut and removed, after which the land was disced and 4 plots, Nos. 3, 4, 6, and 7, were sown to crimson clover. Two other plots, Nos. 5 and 8, were left bare through the winter. The clover crops varied greatly from good to poor, but exerted a marked effect on the yield of corn. Where no clover was grown the average yield of corn for the 5 years was only 30.8 bushels per acre. Where the clover was removed as a hay crop the yields of corn averaged 41.8 bushels, an increase of 11 bushels to the acre. Where the clover was turned under the yield was 43.4 bushels, or only a little better than where the clover crops were removed.

Experiments at the Jackson Station

A very interesting series of experiments was conducted on range 5 at the West Tennessee Station, at Jackson, from 1911 to 1913. The soil was a poor brownish-gray silt loam, well supplied with both phosphate and potash, but which would be expected to produce only 20 to 30 bushels of corn to the acre. Various crops, both legumes and non-legumes, as given in table 2, were grown on 1/40-acre plots in the summer of 1912, and turned under. In the early fall, crimson clover was sown on 9 plots and rye on 6 plots, and 6 were left through the winter without a cover crop. The stands and growth of crimson clover and rye were good. About the middle of April, 1912, the entire range was plowed, well prepared, and planted to corn. Corn was grown again in 1913, no winter cover crop preceding it. The yields under the various conditions are reported in table 2.

DISCUSSION

The effects of the summer crops of 1911 on the corn crop of 1912 were noticeable but not great. In that year, on the three plots where cowpeas were grown the yield of corn was 34.8 bushels per acre; following velvet beans the yield was 34.6 bushels; where soybeans were grown the yield was 32.6 bushels. The yield of corn was in every case somewhat larger following the legumes than the non-

TABLE 2—*Acre yields of corn following various green-manure crops*
All crops of 1911-1912 previous to corn turned under—range 5, Jackson Station

Plot No.	Summer crop 1911	Yields of green substance	Fall and winter crop 1911-12	Yields of corn			
				1912		1913	
				Grain	Stover	Grain	Stover
		Tons		Bu.	Tons	Bu.	Tons
1	Millet	2.98	Crimson clover	37.5	1.74	35.2	1.06
2	Cowpeas	13.32	Do	49.4	2.06	42.0	1.20
3	Sorghum	17.72	Do	38.9	1.90	42.1	1.26
4	Soybeans	7.41	Do	46.1	2.12	43.7	1.26
5	Corn	8.40	Do	45.0	2.00	41.0	1.30
6	Velvet beans	11.58	Do	44.3	2.20	45.3	1.44
7	Bare fallow		Do	43.8	1.84	37.5	1.26
10	Millet	4.10	None grown	27.5	1.58	34.9	.96
11	Cowpeas	10.54	Do	27.7	1.36	31.2	.96
12	Sorghum	15.88	Do	25.2	1.47	32.4	.92
13	Soybeans	4.54	Do	28.1	1.26	23.0	.90
14	Corn	6.66	Do	28.4	1.34	23.5	.72
15	Velvet beans	10.02	Do	33.7	1.68	27.5	.90
16	Bare fallow		Crimson clover	35.4	1.46	27.6	.90
19	Millet	4.04	Rye	24.5	1.08	26.4	.92
20	Cowpeas	10.44	Do	27.4	.98	30.0	.90
21	Sorghum	17.30	Do	18.9	.87	29.0	.92
22	Soybeans	7.48	Do	23.5	1.04	23.9	.76
23	Corn	8.10	Do	18.6	.82	21.9	.90
24	Velvet beans	11.38	Do	25.9	1.14	26.0	1.00
25	Bare fallow		Crimson clover	50.5	1.64	34.9	1.06
	AVERAGE YIELDS OF CORN						
	1. As affected by the summer crops						
	Cowpea plots			34.8	1.47	34.4	1.05
	Velvet bean plots			34.6	1.67	32.9	1.11
	Soybean plots			32.6	1.47	30.2	1.00
	Sorghum plots			27.7	1.42	34.5	1.05
	Millet plots			29.8	1.47	32.2	.98
	Corn plots			30.7	1.39	28.8	.97
	2. As affected by the winter crops						
	Crimson clover plots			43.4	1.88	38.8	1.22
	Bare-fallow plots			28.4	1.45	28.8	.89
	Rye plots			23.1	.99	26.2	.90

legumes; the corn plots yielding only 30.7 bushels per acre, the millet plots 29.8 bushels, and the sorghum plots 27.7 bushels. In 1913 there was less than one bushel per acre difference between the average yield of corn following the 3 legumes and that following the 3 non-legumes.

On the other hand, the effects of crimson clover in comparison with the rye and winter fallow are outstanding. In 1912 the average yield of corn for the 9 plots where crimson clover was grown was 43.4 bushels per acre, as compared with 23.1 bushels where rye was grown, and 28.4 bushels for the bare-fallow plots. The effects of crimson clover were also apparent in 1913, the average yield of corn

for the clover plots being 38.8 bushels per acre, as compared with 26.2 bushels for the rye plots and 28.8 bushels for the bare-fallow plots. In these experiments the effect of the rye crop was unfavorable.

General Summary from the Crimson Clover Experiments

The effects of crimson clover on a following corn crop were very favorable—much more so than the effects of any of the summer legumes tried.

The turning under of the crimson clover crop resulted in only a slightly higher yield of corn than was obtained where the crop was removed as hay. The utilization of the clover crop for pasture or hay is therefore indicated as more profitable than its use for manurial purposes only.

The effect of crimson clover on the production of corn is not limited to the first year. In the Jackson experiments the increased yield of corn the second year was two-thirds as much as for the first year.

SWEET CLOVER	1
SWEET CLOVER ORCHARD GRASS	2
LESPEDEZA	3
CORN	4
SWEET CLOVER	5
SWEET CLOVER ORCHARD GRASS	6
LESPEDEZA	7
CORN	8
SWEET CLOVER	9
SWEET CLOVER ORCHARD GRASS	10
LESPEDEZA	11
CORN	12
SWEET CLOVER	13

Fig. 1—Crops grown on range 12 in the summer of 1912—1/20-acre plots.

ALFALFA	1
ALFALFA	2
ALFALFA	3
RED CLOVER	4
RED CLOVER	5
RED CLOVER	6
CLOVER & GRASS	7
CLOVER & GRASS	8
CLOVER & GRASS	9
Plots 10-18 not included in this experiment	
ALFALFA	19
ALFALFA	20
ALFALFA	21
RED CLOVER	22
RED CLOVER	23
RED CLOVER	24
CLOVER & GRASS	25
CLOVER & GRASS	26
CLOVER & GRASS	27

Fig. 2—Range 6 as seeded in the fall of 1917—1/40-acre plots.

SWEET CLOVER, LESPEDEZA, AND ORCHARD GRASS

Experiments to determine the effects of sweet clover, lespedeza, and orchard grass on the yields of corn that followed were begun at the Jackson Station in 1920. The plan of the experiments as begun that year is shown in Fig. 1.

The soil was a silt loam of good productiveness at the outset, but with no large store of nitrogen, so that under continuous cropping in corn the yields decreased rapidly to a low level. The plots were 1/20 acre each, and the range was considered to be fairly uniform in fertility.

First Round of the Rotation

The entire range was limed at the outset, at the rate of 2 tons of ground limestone per acre. The seedings were at the following rates per acre:

Sweet clover	20 lbs.
Lespedeza	1½ bu.
Orchard grass	1½ bu.

Where sown with orchard grass, the sweet clover was reduced to 15 pounds. Excellent stands of all crops were obtained.

Sweet clover on range 12

TABLE 3—*Acre yields of corn as influenced by different preceding crops*
First round of the rotation, 1920-1923—range 12—1/20-acre plots

Plots averaged	Crops grown in 1920 and 1921	Yields of corn				Remarks
		1922		1923		
		Grain	Stover	Grain	Stover	
		Bu.	Tons	Bu.	Tons	
1,5,9,13	Sweet clover	79.9	2.01	49.3	1.88	Crops grown in 1920 and 1921 were cut and removed only in 1921, except the corn, which was removed each year.
2,6,10	Sweet clover and orchard grass	59.6	1.57	47.3	1.72	
3,7,11	Japan clover	61.4	1.61	40.5	1.59	
4,8,12	Corn	48.2	1.46	31.7	1.38	

No crops were cut in 1920 except the corn on plots 4, 8, and 12. On these plots the entire crop was removed every year, as also was the corn on the other plots, whenever grown. The average acre yield of corn for the 3 plots that year was 62.3 bushels, with 1.69 tons of stover. In June of 1921 hay was harvested from the sweet clover plots, both where sown alone and with orchard grass. The sweet clover died soon after being cut. In the fall of that year the lespedeza and the orchard grass, both when sown alone and with sweet clover, were cut for hay. The average acre yields for the crops harvested in 1921 were as follows:

Corn on plots 4, 8, 12.....42.2 bushels grain, 1.83 tons stover
Sweet clover on plots 1, 5, 9, 13.....2.67 tons hay
Sweet clover and orchard grass on plots 2, 6, 10.....3.10 tons hay
Lespedeza on plots 3, 7, 11.....2.89 tons hay

In both 1922 and 1923, corn was grown on the entire range, with acre yields as given in table 3.

DISCUSSION

The most pronounced effects on the yield of corn came from the sweet clover. In 1922 the sweet clover plots outyielded the continuous-corn plots by 21.7 bushels of corn per acre; the lespedeza plots came second, with an increase of 13.2 bushels; and the mixed orchard grass and sweet clover ranked third, with an increase of 11.4 bushels. In 1923 the sweet clover plots again outyielded the others, with an increase over the continuous-corn plots of 17.6 bushels per acre; the mixed orchard grass and sweet clover plots came second, with an increase of 15.6 bushels; and the lespedeza plots came last, with an increase of 8.8 bushels.

Second Round of the Rotation

In the spring of 1924, reseedings were made of the clover, lespedeza, and grass, as in 1920, with the single change that on plots 2,

6, and 10 the orchard grass was sown alone; that is, the sweet clover was omitted. The sweet clover on plots 1, 5, 9, and 13 were, by mistake, cut for hay in the summer of 1924. The average yield was 1.01 tons per acre. The average yield of corn for that year on plots 4, 8, and 12 was only 17.7 bushels of grain and 1.30 tons of stover per acre. May 6, 1925, the sweet clover was again cut for hay. Also the orchard grass was harvested for hay. The cutting of the sweet clover in the summer of 1924 injured the stand, so that the spring crop produced only 1.12 tons of hay to the acre. The yield of the 1925 hay crop of orchard grass was light, 0.4 ton per acre, but there was a good stand of bunchy grass. The stand of lespedeza obtained in 1924 was good, but the crop was not harvested. The entire range was prepared and planted to Neal Paymaster corn May 26, 1925. Corn was planted again in 1926. The yields are given in table 4.

TABLE 4—*Acre yields of corn as influenced by different preceding crops*
Second round of the rotation, 1924-1926—range 12—1/20-acre plots

Plots averaged	Crops grown in 1924	Yields of corn				Remarks
		1925		1926		
		Grain	Stover	Grain	Stover	
		Bu.	Tons	Bu.	Tons	
1,5,9,12	Sweet clover	50.2	1.44	46.0	1.93	Hay crops harvested from sweet clover and orchard grass plots, but not from lespedeza.
2,6,10	Orchard grass	32.3	.91	42.0	1.92	
3,7,11	Lespedeza	53.2	1.46	43.0	1.89	
4,8,12	Corn	26.0	.91	30.3	1.29	

DISCUSSION

Hay crops were removed from all the 1920 seedings of clovers and grass, but following the 1924 seedings hay was removed from the sweet clover and orchard grass plots, but not from the lespedeza plots. This appears to have produced materially different effects, for the yield of corn on the lespedeza plots for the two years is identical with that from the sweet clover plots, the average increase over the continuous-corn plots being 19.9 bushels per acre in each case. The average increase for the same two years for the orchard grass plots was 9.0 bushels per acre. There was a marked decline in the productivity of the continuous-corn plots, which averaged only 28.2 bushels per acre.

Third Round of the Rotation

In 1927, seedings were again made of clovers and grass, but the sweet clover was a failure. The entire range was plowed in the fall and seeded again in the spring of 1928. Good stands were obtained from all seedings, but the growth of sweet clover for that year was only fair. Plots 1 and 5 became "grassy" in the course of

the season. The sweet clover and lespedeza plots were cut for hay in the fall, but the orchard grass was too short to be cut. The average yields per acre were as follows:

Sweet clover	1.86 tons
Lespedeza	2.21 tons

The entire range was plowed March 19,1929, well prepared, and planted to corn April 27. The yields are reported in table 5.

TABLE 5—*Acre yields of corn as influenced by different preceding crops*
Third round of the rotation—1927-1929—range 12—1/20-acre plots

Plots averaged	Crops grown in 1927 and 1928	Yields of corn in 1929		Remarks
		Grain	Stover	
		Bu.	Tons	
1,5,9,12	Sweet clover	47.0	1.65	Sweet clover was a failure in 1927, and growth was only fair from 1928 seeding. Hay crops removed from sweet clover and lespedeza plots, but not from orchard grass.
2,6,10	Orchard grass	39.4	1.63	
3,7,11	Lespedeza	43.3	1.43	
4,8,12	Corn	18.7	1.07	

DISCUSSION

The highest yields of corn in 1929 were from the sweet clover plots, which averaged 47.0 bushels per acre, as compared with 18.7 bushels for the continuous-corn plots, or an increase of 28.3 bushels per acre attributable to the growing of sweet clover. The lespedeza plots came second, with an increase of 21.6 bushels per acre; and the orchard grass was third, with an increase of 20.7 bushels per acre. It is evident that throughout the series sweet clover has shown a decided superiority over lespedeza as a soil-improving crop. Only when the lespedeza crop was turned under and the sweet clover hay removed both years, as in the second round of the rotation, were the yields of corn on a parity.

Summary of Yields of All Crops for the 10-year Period

Tables 6, 7, and 8 summarize the yields per acre of all harvested crops. As shown in table 6, the 5 corn crops following sweet clover reached a total of 272.4 bushels. Lespedeza came second, with 241.4 bushels; orchard grass third, with 220.6 bushels; and the continuous-corn last, with 154.9 bushels. The yields of hay harvested are given in table 7. The totals are 6.66 tons for the sweet clover plots, 3.50 tons for the orchard grass plots, and 5.10 tons for the lespedeza plots.

Table 8 gives the yields of corn on the continuous-corn plots for 10 years, 1920-1929. The total production per acre was 314.0

bushels, or only 41.6 bushels more than the 5 crops from the sweet clover plots. In this connection, emphasis is laid on the fact that the continuous-corn plots were greatly depleted in fertility by the close of 1929, while the others were in condition to promise excellent yields for 1930.

For comparison with the corn yields in the experiments reported there are included in table 8 the yields of corn grown continuously on range 1, which received farmyard manure at the rate of 5 tons per acre annually, and 150 pounds of nitrate of soda, the latter ap-

TABLE 6—*Summary of acre yields of corn in the experiments on range 1*

Year	Yields of corn following—							
	Sweet Clover		Orchard grass*		Lespedeza		Corn	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons
1922	79.9	2.01	59.6	1.57	61.4	1.61	48.2	1.46
1923	49.3	1.88	47.3	1.73	40.5	1.59	31.7	1.38
1925	50.2	1.44	32.3	.91	53.2	1.46	26.0	.91
1926	46.0	1.93	42.0	1.92	43.0	1.89	30.3	1.29
1929	47.0	1.63	39.4	1.63	43.3	1.43	18.7	1.07
Total	272.4	8.91	220.6	7.75	241.4	7.98	154.9	6.11

*Sweet clover and orchard grass were sown the first round of the rotation.

TABLE 7—*Acre yields of hay crops on range 12*

Year	Sweet clover (Plots 1, 5, 9, 13)	Orchard grass (Plots 2, 6, 10)	Lespedeza (Plots 3, 7, 11)
	Tons	Tons	Tons
1921	2.67	3.10	2.89
1924	1.01	Not harvested	Not harvested
1925	1.12	.40	Not harvested
1928	1.86	Not harvested	2.21
Total	6.66	3.50	5.10

TABLE 8—*Acre yields of corn from the continuous-corn plots of range 12 and of range 1**

Year	Range 12		Range 1*	
	Grain	Stover	Grain	Stover
	Bu.	Tons	Bu.	Tons
1920	63.2	1.69	65.9	1.56
1921	42.2	1.83	51.5	2.51
1922	48.2	1.46	61.4	1.77
1923	31.7	1.38	53.9	1.88
1924	17.7	1.30	37.3	2.09
1925	26.0	.91	55.7	1.62
1926	30.3	1.29	42.5	2.74
1927	18.1	1.28	47.8	2.13
1928	17.9	1.18	63.9	2.50
1929	18.7	1.07	65.4	1.87
Total	314.0	13.39	545.3	20.67

*Received 5 tons of manure and 150 pounds of nitrate of soda per acre annually

plied as a top-dressing when the corn plants were small. It may be noted that the yields of corn following sweet clover, as reported in table 6, compare well with the yields for the same years on range 1.

ALFALFA, RED CLOVER, AND CLOVER AND GRASS

Range 6 at the Jackson Station was prepared in the summer of 1917, and early fall seedings were made of alfalfa, red clover, and red clover and orchard grass, according to the plan indicated in Fig. 2. The entire range had been recently limed with ground limestone at the rate of 2 tons per acre. The soil, a brownish silt loam, was naturally well supplied with phosphoric acid and potash, but was depleted in nitrogen. Excellent stands were obtained from all seedings, and the crops were harvested for hay in 1918. The yields, when calculated to the acre basis, were as follows:

Alfalfa	2.15 tons
Red clover	1.90 tons
Clover and grass	2.03 tons

First Series

Alfalfa plots 1 and 19, red clover plots 4 and 22, and clover-and-grass plots 7 and 25 were plowed, well prepared, and planted to corn in 1919. They were continued in corn every year for the next 4 years, the last crop being that of 1923. The average yields of corn when calculated to the acre basis are given in table 9.

TABLE 9—*Acre yields of corn following* (1) *alfalfa,* (2) *red clover, and* (3) *red clover and orchard grass, grown in* 1917-1918—*plots* 1, 4, 7, 19, 22, *and* 25

Year	Yields of corn following—					
	Alfalfa		Red clover		Clover and grass	
	Grain	Stover	Grain	Stover	Grain	Stover
	Bu.	Tons	Bu.	Tons	Bu.	Tons
1919	66.6	2.20	60.8	1.98	41.6	1.67
1920	68.3	1.59	54.4	1.24	52.5	1.22
1921	56.6	2.01	47.2	1.95	46.3	2.00
1922	37.9	1.11	34.8	1.00	32.9	1.13
1923	33.5	1.05	28.3	1.08	27.5	1.16
Average	52.6	1.59	45.1	1.45	40.2	1.44

DISCUSSION

The results show that the alfalfa plots appreciably surpassed the red clover plots, which in turn outyielded the clover-and-grass plots. The first year's corn crop was 66.6 bushels per acre after alfalfa, 60.8 bushels after red clover, and only 41.6 bushels after

the clover and grass. The alfalfa plots continued to outyield the
clover plots, and at the end of the 5 years had produced a total
38 bushels per acre more than the clover. After the first corn cr
the clover-and-grass plots produced nearly as much as the clo
plots.

Second Series

Alfalfa plots 2 and 20, red clover plots 5 and 23, and clove
and-grass plots 8 and 26 were prepared for corn in 1920, and co
was grown continuously on them for 4 years. The yields per ac
are given in table 10.

TABLE 10—*Acre yields of corn following* (1) *alfalfa,* (2) *red clover, an*
(3) *red clover and orchard grass, grown from* 1917 *to* 1919—*plo*
2, 5, 8, 20, 23, *and* 26

Year	Yields of corn following—					
	Alfalfa		Red clover		Clover and grass	
	Grain	Stover	Grain	Stover	Grain	Stover
	Bu.	Tons	Bu.	Tons	Bu.	Tons
1920	73.2	1.64	58.4	1.40	42.0	1.25
1921	63.0	2.15	51.3	1.96	55.9	2.03
1922	45.5	1.24	34.8	1.01	37.5	1.20
1923	34.5	1.20	28.3	1.05	31.1	1.13
Average	54.1	1.56	43.2	1.36	41.6	1.40

The results of the second series are similar to those of th
first, in that alfalfa proved superior to red clover as a crop preced
ing corn, and the red clover was superior to the clover and gras
In this case the clover-and-grass plots outyielded the clover plot
after the first corn crop. The difference in outcome may well be
only the result of a difference inherent in the plots themselves; that
is, the data do not show conclusively any difference between the
effects of clover and of clover and grass after the first year.

Third Series

Alfalfa plots 3 and 21, and clover-and-grass plots 9 and 27
were planted to corn in 1921 and for 2 years thereafter. The red
clover plots are omitted from consideration in this set because the
crop had died out by the fall of 1919. The yields of corn are given
in table 11.

TABLE 11—*Acre yields of corn following* (1) *alfalfa, and* (2) *clover and*
grass, grown from 1917 *to* 1920—*plots* 3, 9, 21 *and* 27

Year	Alfalfa		Clover and grass	
	Grain	Stover	Grain	Stover
	Bu.	Tons	Bu.	Tons
1921	62.5	2.20	54.3	1.92
1922	47.3	1.30	41.1	1.23
1923	34.3	1.25	33.8	1.13
Average	48.0	1.58	43.1	1.09

DISCUSSION

As in the other trials, the alfalfa plots surpassed the clover-and-grass plots every year. In this connection it may be mentioned that white clover came into the grass plots, and to a certain extent took the place of the red clover.

Hay Yields

Both as relating to these experiments and as a matter of general interest, the yields of the various hay crops are given in table 12.

TABLE 12—*Acre yields of hay crops harvested on range 6*

Crop	Plot	Year of harvest		
		1918	1919	1920
		Tons	Tons	Tons
Alfalfa	1	3.58	.....	.....
	2	3.48	4.91	.....
	3	3.27	4.40	2.36
Red clover	4	2.90	.....	.....
	5	2.80	3.36	.....
	6	2.77	3.73	.35
Clover and grass	7	2.91	.....	.....
	8	2.58	3.73	.....
	9	2.19	3.62	.63
Like plots 1, 2 & 3	19	1.25	.....	.....
	20	1.13	2.76	.....
	21	.92	3.27	2.05
Like plots 4, 5 & 6	22	1.33	.....	.....
	23	1.09	2.88	.....
	24	1.17	3.01	.00
Like plots 7, 8 & 9	25	1.37	.....	.....
	26	2.19	3.69	.....
	27	2.18	3.80	.72

SUMMARY

1. An insufficient supply of plant-food—nitrogen in particular—limits the yield of corn in Tennessee. The rainfall is sufficient for two or three times the average yield now obtained.

2. Experiments with corn following crimson clover were conducted at the Knoxville Station for 5 years and at the Jackson Station for 2 years.

3. Crimson clover, after the removal of the hay crop, increased the average yield of corn by 11 bushels to the acre at the Knoxville Station.

4. Turning under the crimson clover crop increased the yield of corn the first season 12.6 bushels per acre at the Knoxville Sta-

tion, and 15 bushels at the Jackson Station. The increase the second season at the Jackson Station was 10 bushels per acre.

5. Cowpeas, soybeans, and velvet beans, turned under for green manure, gave better yields of corn the following year than did the non-legumes, corn, sorghum, and millet, when turned under. The average yield of corn was 34.0 bushels per acre after the legumes and only 29.4 bushels after the non-legumes. The yield of corn the second year was less than a bushel per acre greater on the legume than the non-legume plots.

6. Data were obtained for a 10-year period at the Jackson Station on the comparative effects of sweet clover, lespedeza, and orchard grass on the yield of corn following. The yield of corn on plots where it was grown continuously served as a check, or standard of comparison.

7. Sweet clover, which was always cut at least once for hay, proved the most effective. The total yield per acre for the 5 corn crops on the sweet clover plots was 272.4 bushels, for the lespedeza plots 241.4 bushels, for the orchard grass plots 220.6 bushels, and for the continuous-corn plots for the same 5 years only 154.9 bushels.

8. A good crop of lespedeza unharvested produced about the same effect as a poor crop of sweet clover that was cut twice for hay—once in the fall and again the following spring.

9. Experiments with alfalfa, red clover, and clover and grass were carried out at the Jackson Station for 6 years, 1917-1923. Hay was cut from all plots regularly. After the sods were plowed, corn was grown continuously for 3 to 5 years.

10. Corn after alfalfa gave the highest average yield, 52.6 bushels per acre, for the 5-year period 1919-1923. The average from the red clover plots for the same period was 45.1 bushels, and from the clover-and-grass plots 40.2 bushels. In the second set the 4-year average from the alfalfa plots was 54.1 bushels, from the red clover plots 43.2 bushels, and from the clover-and-grass plots 41.6 bushels.

11. The effects of the preceding alfalfa, clover, and clover-and-grass crops were plainly in evidence for at least 3 years after the plowing of the sod.