UNIVERSITY OF MISSOURI

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View of the Jasper County Crop Experiment Field Showing Wheat Varieties in the Foreground and Corn and Oat Varieties in the Background.

Experiments With Farm Crops in Southwest Missouri

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EXPERIMENTS WITH FARM CROPS IN SOUTHWEST MISSOURI

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The Missouri Agricultural Experiment Station in 1909 began a series of experiments in Jasper County to study the adaptations of different varieties of the principal farm crops in Southwest Missouri, and particularly in Jasper County. These investigations were conducted in cooperation with the Jasper County Court which, by authority of the Nelson Act of 1907 providing for the establishment of county experiment farms, appropriated funds for the work. The experiments were planned and directed by the Missouri Agricultural Experiment Station while the rental of the land and the expense of labor was paid from the county funds.

The experiments were made on a field of twenty acres on the farm of George W. Downs, one-half mile south and three miles west of Carthage. This field is situated at the base of a limestone outcrop gently sloping to the south. The field has good drainage yet washes very little. It has been under cultivation for nearly sixty years and has been cropped chiefly to corn and wheat. Very little manure has been applied and it is in only a fair state of productivity. The soil is especially deficient in organic matter due to the continuous growing of grain. It is inclined to pack easily and dries out quickly in times of drought. Except where noted, no fertilizers were applied with the crops and hence the yields, in most cases, are not high.

The land is typical of the red limestone land of Jasper County and is classed as Crawford silt loam. It consists of a dark brown to reddish-brown or brown, mellow silt-loam which grades at a depth of from twelve to fifteen inches into a lighter-colored, crumbly, silty clay-loam. This is underlaid at from eighteen to twenty inches by chocolate-red or reddish brown, rather stiff brittle clay. In many places in the county this soil ranges in color from red to nearly black, the color depending largely upon the activity and extent of erosion and upon the proximity to limestone outcrops. The soil material is derived almost wholly from limestone and, as a rule, is well drained. It is well suited for the general farm crops of this section, but is primarily a wheat and corn soil. Alfalfa, just as red clover and cowpeas, grows very well with proper soil treatment.

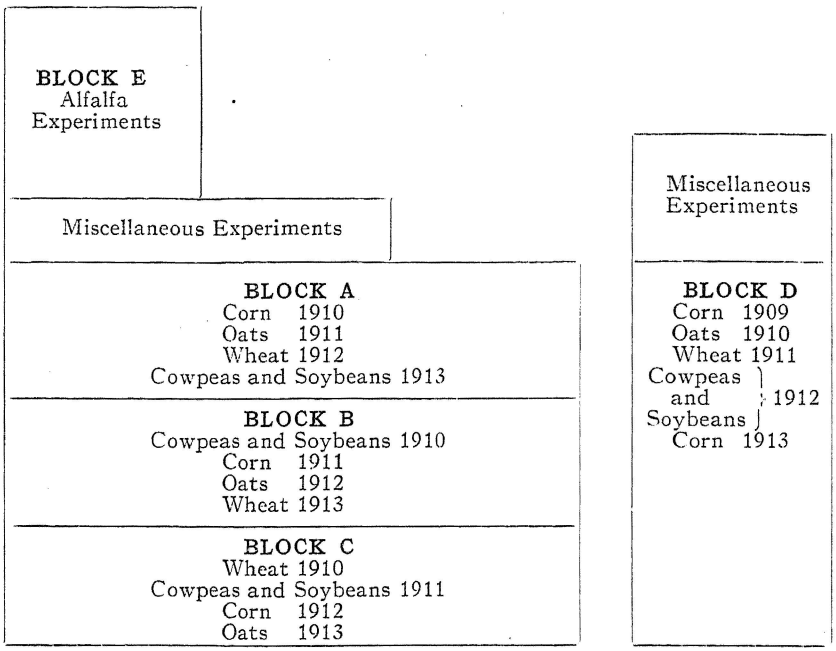


Diagram of the Jasper County Experiment Field Outlining the Rotation Used.

PLAN OF EXPERIMENTS

The field was divided into four main blocks of nearly equal size on which a definite four-year rotation was practiced. One block was devoted to corn, one to oats and barley, one to wheat, and one to cowpeas and soybeans, each year. The crops were rotated from block to block in the order named. This is a rotation very well suited for a general farm in Jasper County and was well adapted to the purposes of these experiments. The main blocks were devoted chiefly to the testing of the leading varieties of these different crops while miscellaneous experiments were conducted on some smaller blocks in the field.

EXPERIMENTS WITH CORN

Variety Tests of Corn. The variety tests of corn have included the following varieties: Commercial White, Reids Yellow Dent, Boone County White, Leaming, Hogues Yellow Dent, Cartner, Johnson County White, St. Charles County Yellow, St. Charles County White, Silvermine and Hildreths Yellow Dent. These

were planted in plots approximately one-fifth of an acre in size and checked in hills three feet and six inches each way with two or three kernels in a hill. The seed used was in most cases grown in the central part of the state, but some varieties not common to Missouri were brought from other states. Seed of Hogues Yellow Dent was obtained from eastern Nebraska, Silvermine and Leaming from Central Illinois, and Hildreths Yellow Dent from eastern Kansas. None of the seed was acclimated but, with the exceptions noted, the varieties were all moved approximately the same distance.

An individual ear germination test of the seed planted was made each year, and good stands were obtained. With the exception of the first year, when rains interfered, all varieties were planted the same day and under similar conditions. The dates of planting were as follows: 1909, April 19 to April 29; 1910, March 21; 1911, April 29; 1912, April 24; 1913, May 10. The yields of the different varieties for each year, based on 70 pounds of field-cured corn to the bushel, are given in Table 1.

Table I—Average Yield in Bushels per Acre of Eleven Varieties of Corn

Variety	1909	1910	1911	1912	1913	Average 1909-13
Commercial White	41.1	43.4	54.2	33.4	19.6	38.3
Reids Yellow Dent	36.0	42.5	42.6	36.6	17.3	35.0
Boone County White	32.9	40.2	49.1	35.3	15.7	34.6
Leaming	35.3	35.7	45.7	32.5	17.1	33.3
Hogues Yellow Dent	34.9	36.4	40.6	32.4	18.1	32.5
Cartner	31.5	39.2	39.4	30.5	19.1	31.9
Johnson County White	30.9	41.7	44.3	27.3	14.8	31.8
St. Charles County Yellow	31.5	38.8	39.6	30.0	17.6	31.5
St. Charles County White	30.5	41.3	42.5	22.7	15.5	30.5
Silvermine	27.1	33.5	26.6	30.9	17.9	27.2
Hildreths Yellow Dent	22.6	....	47.0	19.9	7.3	24.2*

*Four year average.

In addition to these varieties a white corn grown by J. F. Hoffmeister of Golden City, Missouri, was included in 1911 and 1912, yielding 59.7 and 30.3 bushels respectively for these two years. The average yield of this variety for these two years places it ahead of the other varieties for the same time. It should be noted however that the seed used was grown in the adjoining county and hence

more acclimated than the other varieties in the test. Tuckers Special, a small-eared white variety, developed by several years' selection from Boone County White, made a yield of 41.8 bushels in 1911, 25.3 bushels in 1912, and 17.4 bushels in 1913. The seed of this variety was grown in Perry County in approximately the same latitude but 300 miles eastward. The variety known as Calico was also included in 1913 and gave an acre yield of 17 bushels for the single trial. It should be remembered, however, that 1913 was a very poor corn year and this result should be compared only with the yields of the other varieties in the same season. Calico is a promising corn in Southwest Missouri and is being grown in this section of the state with good results. If more attention were given to its improvement it would doubtless become much more popular.

Of the ten varieties in the test for the full five-year period, Commercial White ranks first with an average yield of 38.3 bushels per acre. Boone County White and Reids Yellow Dent, which rank second and third respectively, have yielded practically the same and the yields have been fairly consistent throughout the five-year period.

Commercial White is a rank-growing, large-eared variety of white corn requiring 130 to 135 days for complete ripening and averaging about nine feet in height. The stalks are strong and stocky and it is especially suitable for silage. It possesses a fairly large cob which has a tendency to dry slowly. This characteristic results in a lower per cent of marketable corn than in either Reids Yellow Dent or Boone County White. It was the latest maturing of all of the varieties grown, and was usually too soft to shell readily when harvested. This partially accounts for its high yield. Commercial White has beeen developed in Southwest Missouri and hence is well adapted to that section of the state. With careful work on the part of corn breeders to improve its quality and shorten its growing period, it promises to become an important variety for that section.

Reids Yellow Dent is a medium early variety requiring 115 to 120 days to mature, while Boone County White matures about a week later. It averages about eight feet in height in Missouri and is only medium leafy. It has a decided tendency to mature well and is best adapted to lands above medium in fertility.

Boone County White produces strong, thick, stalks which grow to an average height of about eight and one-half feet in this state. The stalks are medium leafy and make good silage and fodder. The corn usually matures well in the field, yielding an exceptionally high per cent of marketable corn. Boone County White and Reids Yellow Dent are extensively grown throughout Southwest Missouri

and good seed is easily obtained. They are by far the most popular varieties of corn in Missouri and their use is to be generally recommended in this section.

Leaming and Hogues Yellow Dent are two yellow varieties very similar to Reids Yellow Dent in habit of growth. They have been very consistent in yields, but have usually ranked below the latter. It should be remembered, however, that every year the seed of these varieties has been moved a greater distance than that of the Reids Yellow Dent and was probably not as well acclimated as the latter. This may have been partly responsible for their lower yields.

Cartner is a small-eared late-maturing variety requiring 130 to 135 days for complete maturity. It is a very deep-grained corn, shelling out an unusually high per cent of corn to cob. The stalks grow tall and are only medium leafy. It has no particular advantage over the varieties mentioned above, and is not to be generally recommended for this section.

Johnson County White is a large, medium-late maturing variety requiring from 120 to 125 days to mature. It differs little in stalk and ear character from Boone County White and has not yielded as well in these experiments as has the latter variety.

St. Charles County Yellow and St. Charles County White are two native varieties of Missouri originating in St. Charles County, from which they take their name. They are late-maturing varieties requiring 125 to 130 days to ripen. They are strong, rank growers, ranging in height from eight and one-half to nine and one-half feet with broad, heavy leaves and heavy stalks. They are especially adapted to bottom and good upland soils, although St. Charles White gives good results on the thinner uplands in South Missouri. Both varieties are excellent for silage and are grown extensively throughout the country for this purpose.

Silvermine is the earliest maturing of all the varieties used in these experiments, generally requiring from 100 to 110 days to ripen. It is a small-growing variety of white corn planted extensively in southern Iowa and northern Illinois. It has not given consistent yields in this state and seldom yields as well as the other varieties mentioned except in dry seasons when its early maturity may permit its escaping a part of the drought. In normal seasons its earliness does not permit of its using the entire growing period, which may account for its comparatively low yields. It is not recommended for Southwest Missouri except for late planting or where an early maturing variety is needed for early feeding.

Hildreths Yellow Dent is a late maturing variety grown rather extensively in eastern Kansas where it yields well. In these experi-

ments it was found to be a very tall, rank-growing, corn, seldom maturing well and producing coarse, sappy ears. It is not to be recommended for this section.

Conclusions from Corn Experiments. From the results of these investigations it may be said that Reids Yellow Dent and Boone County White are the two best varieties of corn for Southwest Missouri. Both are popular varieties producing good yields of corn of good quality. More attention, however, should be given to the improvement of these varieties through systematic methods of corn breeding. Good opportunities are afforded for several men to develop a seed corn business in Southwest Missouri.

EXPERIMENTS WITH OATS

Varieties of Oats. The oat variety test has extended over a period of four years and has included seven principal varieties. The yield of each variety during each of the four years is given in the following table:

Table II—Yields of Oat Varieties Grown for Four Years Showing Yield in Bushels Per Acre

Variety	1910	1911	1912	1913	Average 1910-13
White Tartar	64.8	8.4	20.8	6.9	24.5
Texas Red Rust Proof	57.5	11.3	17.5	11.7	24.5
Kherson	55.5	11.3	14.8	15.9	24.4
Lincoln	66.8	7.0	11.3	9.0	23.5
Swedish Select	59.0	5.6	16.6	8.0	22.3
Victor	52.6	8.4	11.9	7.7	20.2
Silvermine	....	....	23.9	7.6	16.7*

*Two year average.

In addition to these varieties, Early Champion, a small, early-maturing, white oat grown extensively in the north was included in 1913. It made a yield of 15.0 bushels to the acre.

It will be seen from Table II that White Tartar, Texas Red Rust Proof and Kherson varieties gave the largest average yields.

White Tartar is a large, medium early-maturing, northern white oat, while the Texas Red Rust Proof and the Kherson, the former a red and the latter a yellow variety, are early oats most commonly grown in the Central and Southern states. They are

grown more extensively perhaps, than any other varieties in Missouri, especially in the central and southern part of the state where their early maturity permits their ripening before the hot weather of midsummer. Lincoln, Swedish Select, Victor, and Silvermine are medium late maturing varieties and unless sown very early are apt to be affected by the hot weather, especially in dry seasons. This is well illustrated by the very low yields of these varieties in 1911 and 1913, two very dry years, when the droughts began early in the spring and made the seasons very unfavorable for oats.

White Tartar is also a medium late variety. In these experiments, however, northern grown seed of this variety was used each year which has doubtless enabled it to reach maturity earlier than would have been possible with native seed. The average yield of this variety for the four years has been equal to that of the Texas Red Rust Proof and the Kherson. A study of the yields of the various years, however, shows that it has not been a consistent producer. In 1910, and 1912, two seasons favorable for oats, White Tartar has out-yielded these varieties but in the other two years when the seasons were unfavorable the yield has been much less.

It is evident that the season of 1910 has been by far the best oat year of all. All varieties did well that year. The later maturing ones with but one exception, yielded better than the Texas Red Rust Proof and the Kherson. In 1912, although the season was much less favorable for oats than 1910, the White Tartar and Silvermine yielded more than either of the early varieties and Swedish Select more than the Kherson. In the two years of extreme drought, 1911 and 1913, the early maturing varieties were by far the best yielders.

Native Versus Northern Seed. The data in Table II may also be studied from the standpoint of the practice of sending north for seed oats in preference to using native seed. While northern-grown seed has not been compared with native seed of the same variety except in the unfavorable season of 1913, when northern-grown seed of the White Tartar variety made 6.9 bushels to the acre and the seed of the same variety grown on this field in 1912 made 5.2 bushels to the acre, the results of the oat variety test seem to indicate that in favorable seasons northern-grown oats may yield more than the best native varieties. In less favorable seasons, however, the reverse will doubtless be true. While varietal adaptations enter into the question some further indications of the truth of this statement may be seen in the following table where the yields of White Tartar oats are compared with the average yield of other late varieties each year.

Table III—Native vs. Northern-Grown Seed Oats

Variety	Yield in Bushels per Acre.				
	1910	1911	1912	1913	Average 1910-13
White Tartar (Northern)	64.8	8.4	20.8	6.9	25.2
Average of six other late-maturing varieties (native)	56.1	7.0	15.9	8.0	21.7

In only one season, that of 1913, has native seed of the other oat varieties out-yielded northern seed of White Tartar. This is of course but one trial and no great emphasis can be placed on these results.

Drilling v. Broadcasting Oats. Many farmers broadcast oats instead of drilling. To obtain data on the relative value of these two methods of seeding, plots of Texas Red Rust Proof were drilled and others broadcasted at the rate of two and one-half bushels per acre. The yields of the two methods in three different years are given in Table IV.

Table IV—Drilling vs. Broadcasting Oats

Method of Seeding	Yield in Bushels per Acre			
	1910	1911	1912	Average 1910-12
Drilled	57.5	11.3	17.5	28.8
Broadcasted	51.1	11.3	16.0	26.0
Increase by drilling	6.4	0.0	1.5	2.8

In an average of three years drilling has given an increase of 2.8 bushels an acre over broadcasting, the greatest increase occurring in the most favorable oat season. While the average increase is not large, it is enough to cover the cost of drilling. Drilling insures a more even distribution of seed and the seed is placed in the furrows where it is better covered and where germination can take place more promptly. One of the important means of increasing the yield of oats in Missouri is to practice drilling instead of broadcasting the seed.

Winter Oats. Considerable interest is being manifested in winter oats by farmers in southern Missouri. In order to determine the adaptation of this crop to this region a few of the most promising varieties were included in these experiments each year. In the fall of 1909 three varieties, Winter Turf, Snoma, and Dun Winter were seeded. All were winter killed. In 1910 only the Winter Turf was sown. This again was winter killed. Snoma, Winter Turf, and Culberson were tried in 1911-12. In the spring of 1912 about a half stand of Winter Turf remained while the Snoma and Culberson had been badly winter killed and only a few scattering plants were left. These few plants were carefully saved and enough seed obtained from them for seeding in the fall of 1912. That year they came through the winter in much better condition. The yields of these and the two early varieties of spring oats, Kherson and Texas Red Rust Proof, are compared in the following table.

Table V—Winter Oats Compared With Spring Oats, 1913

WINTER OATS		SPRING OATS	
Variety	Bu. per acre	Variety	Bu. per acre
Snoma	37.8	Kherson	15.9
Winter Turf	36	Texas Red Rust Proof	11.7
Culberson	29.2		
Average	34.3	Average	13.8

From the results of these experiments it would seem that winter oats is a rather questionable crop in this region, succeeding in only one season out of the four. It is quite probable, however, that by drilling as early as the first of September on a well prepared seedbed and carefully saving those plants which come through the winter a hardy strain may be produced which will be adapted to this region. In the light of our present knowledge, however, winter oats are not to be recommended in this region except in an experimental way.

EXPERIMENTS WITH BARLEY

Varieties of Barley. In order to determine the value of barley as a crop in Southwest Missouri a few of the varieties which have given best results on the Agricultural Experiment Station field at

Columbia were sown in 1910 and 1911 in connection with the oat varieties. Two varieties, White Hulless and Success Beardless were seeded in 1913, but because of the severe drought did not grow tall enough to harvest. Tennessee Winter barley was also included in the test in 1911, 1912, and 1913. It came through the winter each year in fair condition but in 1911 and 1913 did not make sufficient growth to harvest. The yields of the various varieties each year are given in Table VI.

Table VI—Varieties of Barley

Variety	Yield in Bushels per Acre		
	1910	1911	1912
Six Rowed	28.6	4.7	...
Success Beardless	26.8	5.6	8.1
Manchuria	28.5	3.7	9.4
Champion Beardless	24.6	6.5	...
White Hulless	24.8	...	...
Black Hulless	....	3.7	...
Oderbrucker	....	...	7.8
Tennessee Winter	....	...	5.6

From these results it may be concluded that barley is not a profitable crop for Southwest Missouri except in the most favorable seasons. Barley, like oats, requires a long, cool growing season with abundant moisture. It is even more seriously affected by hot dry weather than oats, and in a normal season in this section cannot mature fully before hot summer weather begins.

EXPERIMENTS WITH WHEAT

Varieties of Wheat. When these investigations were started, six varieties of wheat which had given good results at Columbia were included in the wheat variety test. In the third year eight more were added. During the last year nineteen varieties and strains were grown. For purposes of comparisons the yields of these varieties have been grouped in two tables, those in the test for four years being given in Table VII and those for the last two years in Table VIII.

Table VII—Wheat Varieties Grown for Four Years Showing Average Yield in Bushels Per Acre

Variety	1910	1911	1912	1913	Average 1910-13
Fulcaster	21.3	11.3	17.0	14.9	16.1
Nigger	20.4	7.6	11.9	19.8	14.9
Mealy	16.9	11.1	12.1	17.5	14.4
Early Ripe	9.8	9.9	17.0	17.8	13.6
Fultz	11.1	13.2	14.9	14.8	13.5
Turkey	8.9	8.8	13.7	16.7	12.0

Table VIII—Wheat Varieties Grown For Two Years Showing Average Yield in Bushels Per Acre

Variety	1912	1913	Average 1912-13
Red Prolific	17.8	18.9	18.3
Rudy	18.6	17.4	18.0
Early Ripe	17.0	17.8	17.4
Lebanon	15.9	17.1	16.5
Fulcaster	17.0	14.8	15.9
Mediterranean	15.6	16.2	15.9
Nigger	11.9	19.8	15.8
Turkey	13.7	16.7	15.2
Fultz	14.9	14.8	14.8
Lebanon No. 20	17.3	12.4	14.8
Mealy	12.1	17.5	14.8
Hickman	13.7	15.3	14.5
Poole	12.7	16.3	14.5
Michigan Wonder	14.7	9.2	11.9

In 1913 three improved strains, developed at Columbia, and one more standard variety were added. The yields of these were as follows:

Missouri Early Ripe No. 29	18.0 bu. per acre.
Missouri Poole B. No. 15	15.2 bu. per acre.
Missouri Fulcaster No. 15	15.3 bu. per acre.
Deitz	14.6 bu. per acre.

These yields are to be compared with those of 1913 in Table VIII.

Of the varieties grown for four years, Fulcaster leads with an average yield of 16.1 bushels an acre. This is a white-chaffed, bearded wheat with long and rather large kernels. It has a fairly hard kernel although it usually grades as red winter wheat on the market. The straw is medium in length, fairly stiff and usually stands well.

Harvesting Wheat Varieties on the Jasper County Crop Experiment Field

The differences in yields between the other varieties are not great but it is interesting to note that Fultz, an old and popular variety, stands next to the last in the list, while another rather popular variety, Turkey, is last.

In Table VIII the varieties are ranked in order of their average yield for two years. It will be seen that Red Prolific ranks first with Rudy a close second. The former is a smooth-headed, red-chaffed variety very commonly grown in Jasper County and Southwest Missouri in general. Rudy is a bearded, white-chaffed variety very similar to Fulcaster. The third variety is Early Ripe with an average yield of 17.4 bushels. This is a red-chaffed, beardless wheat resembling the Red Prolific. Lebanon, which ranks fourth with a yield of 16.5 bushels, is another variety belonging to the same varietal type as Fulcaster and Rudy. Fulcaster, Mediterranean, and Nigger have given similar yields on the average. The same is true of

Turkey, Fultz, Missouri Lebanon No. 20, Mealy, Hickman and Poole. The lowest yielding variety in the list is Michigan Wonder which has averaged less than 12 bushels to the acre. This variety is one of the best in about seventy varieties under test at Columbia.

Conclusions from Wheat Experiments. Summarizing the results of the wheat variety tests, it may be said that the best beardless varieties for this section of the state are Red Prolific and Early Ripe. The best bearded varieties are Rudy, Fulcaster, Lebanon and Mediterranean.

In this connection a word should be said regarding hard wheat. In recent years Turkey Red, a hard winter wheat grown extensively in Kansas, Nebraska, and Iowa, has been introduced into many parts of Missouri. It is being grown to some extent in Southwest Missouri but is not as well suited there as the softer varieties. Not only has it proven to be a poor yielder on the Jasper County Experiment field when compared with some of the varieties of soft wheat, but millers usually discriminate against it, frequently paying from five to eight cents a bushel less for it than for the soft wheat. Most hard wheat is produced in regions of less than 35 inches of rainfall and where early summers are subject to drought. When hard wheat is grown under the more humid climate of Missouri and the Eastern States the berry becomes much softer in texture. There is a tendency to develop a large per cent of soft yellow kernels known to the trade as "yellow berries." This mixture of hard and soft kernels is difficult to mill properly and hence wheat of this kind never commands as high a price on the market as either hard or soft wheat. Flour produced from the soft wheat in Southwest Missouri sells at a premium and there is an increasing demand for soft wheat on the part of the millers. Since the softer varieties have given better yields it would seem best for all concerned that the hard wheat be discarded and more attention be given to the improvement of the best varieties of soft wheat.

COWPEA AND SOYBEAN EXPERIMENTS

A number of varieties of cowpeas and soybeans were grown as the fourth crop in the rotation on the main blocks. The growth each year was small and they were turned under for green manure instead of being harvested.

Cowpeas. The cowpea is an important crop in Southwestern Missouri where it is used both for a feed crop and for green manuring purposes. Where grown for feed it may be seeded from the first week in June to the middle of July but usually the earlier seeding will give

best results. As a catch crop it is frequently sown as late as the middle of July, but when seeded in midsummer it usually suffers from the dry weather. If there is sufficient moisture in the soil to give the peas a good start they are able to stand considerable dry weather, and finish their growth after the early fall rains.

When grown for hay, cowpeas are best drilled solid with an ordinary grain drill at the rate of four or five pecks of seed to the acre. They should never be broadcasted as this method is wasteful of seed and uncertain as to a stand. They may be sown for seed with the corn planter or with enough of the holes of a grain drill closed to put them in rows thirty to thirty-six inches apart and then cultivated two or three times during the season. They are sometimes double rowed with a corn planter but when seeded in this manner are very difficult to cultivate. If no cultivation is done the weeds and grass reduce the yield materially.

A comparison of these methods of seeding may be seen in Table IX which gives the results of a single trial in 1910.

Table IX—A Comparison of Methods of Planting Cowpeas

	Pounds of cured hay per acre
Single rowed with corn planter and cultivated, one peck per acre.	3235
Double rowed with corn planter, no cultivation, two pecks per acre	3225
Broadcasted, four pecks per acre	4025
Drilled, four pecks per acre	4475

Among the best varieties for hay for Southwest Missouri are the Whippoorwill, the Black, the New Era and the Clay. The first two varieties are good general purpose peas being medium early maturing, and medium stocky. On soils of fair fertility and in favorable seasons however, they vine considerably. The New Era is an early-maturing variety and a rather heavy seed producer. It is more upright in habit of growth than the Whippoorwill or the Black and makes a very good variety for pasturing. Because of its early maturity it is especially suitable for planting in corn at the last cultivation. The Clay is a rather heavy vining pea but on lands of medium fertility can usually be handled without difficulty.

Cowpeas are frequently used for a catch crop in corn. They may be seeded at the last cultivation or they may be planted in the row when the corn is planted. In the first case they are best drilled

in with a one-horse drill at the rate of about two pecks to the acre just after the corn is laid by. If the stand of corn is heavy it should be laid by about a week or ten days earlier than usual, so that the peas may get well started before the corn is large enough to shade them badly. Even with this precaution in dry seasons the peas will not make much growth except where the corn is thin. Peas planted in the corn in this way tend to decrease the yield of corn from one to five bushels to the acre. The extra feed and the beneficial effect on the soil, however, will more than compensate for the loss. A better growth is usually had when the peas are planted in the row with the corn. The planting should be delayed until the ground is thoroughly warmed in order that the growth of the peas will not be retarded by cold weather. For this method of planting a cowpea attachment to the corn planter is necessary. It requires about one gallon of seed to the acre. The Black, Clay, and Whippoorwill are used for this purpose. Peas planted in this way usually make more seed than when planted between the rows. This is desirable where the corn and peas are to be hogged down. They also seem to decrease the corn yield somewhat less. If a vining variety like the Clay is used the peas will vine around the corn stalks and the corn and peas may be cut together for silage or fodder.

Soybeans. The soybean is a comparatively new crop in Southwest Missouri. In habit of growth and method of cultivation it is very much like the cowpea. It differs particularly in bein more stocky in appearance and in producing much more seed, and is therefore better suited for pasturing, especially with hogs. Where drilled solid with a grain drill at the rate of four or five pecks to the acre it makes a very good hay but a more common method of seeding is to drill in rows, 30 to 32 inches apart and cultivate. Where planted in this way about two pecks of seed to the acre are required. They are cut either with the mower and made into hay or a self-binder may be used and the beans fed in the bundle or threshed.

Among the leading varieties of soybeans to be recommended for southwest Missouri are: Medium Early Yellow (or Mongol), Austin, Morse, Peking (or Sable), and Mammoth Yellow. The latter is a late maturing variety seldom maturing seed in this locality and is to be recommended only for hay.

EXPERIMENTS WITH ALFALFA

A block of one and one-half acres was set aside for experiments with alfalfa, the idea being to determine the best means of obtaining a profitable stand on this soil. The block was divided into four plots of equal size as indicated in the accompanying diagram.

Plan of Alfalfa Experiment

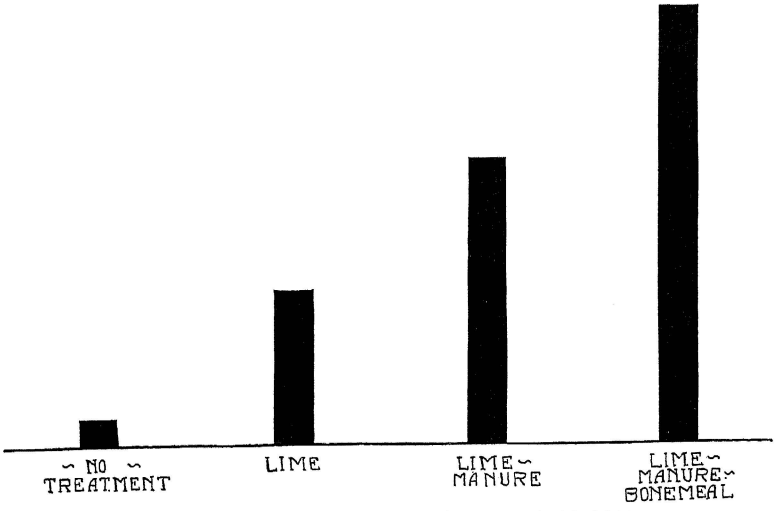
Not Inoculated	Inoculated
Plot 1 No treatment	
Plot 2 Limestone 4500 pounds per acre	
Plot 3 Limestone 4500 pounds per acre Manure 27000 pounds per acre	
Plot 4 Limestone 4500 pounds per acre Manure 27000 pounds per acre Bonemeal 300 pounds per acre	

Plot 1 was given no soil treatment. Ground limestone was applied to plot 2 at the rate of 4500 pounds an acre. Plot 3 received a similar application of limestone and stable manure at the rate of 27000 pounds to the acre. Plot 4 received the same treatment as plot 3 and in addition steamed bone meal at the rate of 300 pounds per acre. Besides these soil treatments two thirds of the entire plot was inoculated with soil from an old alfalfa field. The inoculated soil was applied across the other plots as indicated in the diagram. The manure was applied and plowed under early in the summer of 1909 just after a crop of wheat had been harvested. The limestone which was obtained from a crusher near Carthage was applied after the ground was plowed and worked into the soil as the seedbed was prepared. The bone meal was applied in a similar manner. The inoculated soil was applied just before seeding and covered by harrowing.

The plot was seeded at the rate of twenty pounds of seed per acre September 15, 1909. The stand was killed by winter freezing and heaving the following winter. In the spring of 1910 the whole block was plowed and New Era cowpeas drilled in at the rate of a bushel to the acre. These were harvested for hay. Then the seedbed was prepared by disking and harrowing and alfalfa seeded again the latter part of August. An excellent stand was obtained which was still in a productive state when the field was discontinued.

In 1911 three cuttings were made but unfortunately the weights of hay were not recorded. At the third cutting the chief growth in plots 1 and 2 was crab grass but a good grade of hay was harvested from plots 3 and 4.

Effect of Soil Treatment on the Yield of Alfalfa



Pounds of Hay per acre. Average 1912-1913

778	4085	7455	11698

During the season of 1912 three cuttings were made and in 1913 four crops harvested. The yields of each plot for each cutting are given in Table X.

It will be seen from Table X that lime, manure, and bonemeal have all increased the yield of alfalfa considerably. The average yearly increase on the limed plot for the two years has been 2416 pounds of field-cured hay while manure has given an increase of 3453 pounds and bonemeal an increase of 4245 pounds.

A very good stand was obtained on all four plots but many plants died on the plot receiving no treatment during the first year, so that the increased yield of hay was due not only to a better growth of the plants but to a better stand as well.

It is evident from this data that alfalfa can be made a very profitable crop on this land when the proper soil treatment is given. The average yield of hay on the plot receiving lime, manure and bonemeal has been a little more than five and one-half tons of field cured hay to the acre each year. Figuring limestone at $3.00 a ton, which includes labor of application, bone meal at $1.50 a hundred, and manure at 85 cents a ton for hauling, the initial cost of the treat-

Table X—Effect of Soil Treatment on the Yield of Alfalfa

Soil Treatment	Pounds of Field Cured Hay Per Acre										
	First Cutting		Second Cutting		Third Cutting		Fourth Cutting		Total		Average total yield for 2 yrs.
	1912	1913	1912	1913	1912	1913	1912	1913	1912	1913	1912-1913
No treatment	461	256	422	147	crab grass	102		218	833	723	778
Lime	3340	1120	1690	771	crab grass	608		640	5030	3139	4085
Lime and Manure	3648	2675	3485	1830	1148	1165		922	8317	6592	7455
Lime and Manure and Bonemeal	6605	4032	4096	2656	3229	1600		1178	13930	9466	11698

ment is $23.15 an acre. If we estimate the probable life of the stand at five years and the average yearly yield at but four tons to the acre the total yield amounts to twenty tons of hay. Figuring alfalfa hay at $15.00 a ton the gross returns are $60.00 a year. If the land is valued at $75.00 an acre, interest figured at 6 per cent, and the cost of making the hay is $2.00 a ton, the cost of growing alfalfa including the initial cost of soil treatment amounts to approximately $20.00 an acre annually. This leaves a net profit of $40.00 an acre which is considerably more than can be expected from either corn or wheat, the two most important grain crops of this region.

Selecting Land for Alfalfa. It should be noted in this connection that all of the land in Jasper County is by no means as well suited for alfalfa as that upon which these experiments were conducted. While it can doubtless be grown in nearly every section of the county there are rather large areas especially in the northeastern part of the county where its profitable production may be seriously questioned.

Alfalfa grows best on a deep, rich, loose, and well-drained soil, containing plenty of lime and organic matter, and which is in a good state of fertility. While it often grows on medium to thin lands, it takes good land to grow it without considerable care. It seldom pays to attempt to grow alfalfa in Missouri on land that will not produce at least forty bushels of corn in average seasons. Manure will often bring success on the thinner lands but unless a man is handling a

small acreage of alfalfa, sufficiently heavy manuring may not be feasible or economical. As a rule the best alfalfa lands in this part of Missouri are the well drained fertile loam soils found in the bottom lands along the rivers and creeks. Such soils are rich in plant food and underlaid with a porous subsoil which affords good under drainage and through which the roots can readily penetrate. The second bottom lands are usually especially good for alfalfa. In the first bottoms, however, some difficulty frequently is experienced with overflows. Alfalfa can stand considerable overflow in the winter or spring provided the water does not freeze on it. During the growing season floods are injurious if surface water stands on the alfalfa for any great length of time or if sediment is washed on the plants. Overflows of small creeks or branches that last only a few hours seldom do much damage except where the growth is well advanced and it is washed down and covered with sediment. Poorly drained bottom lands where the water table is permanently within two or three feet of the surface of the ground, or low places where surface water stands are not suitable for alfalfa.

It is more difficult to grow alfalfa on most uplands in Jasper County than on the best bottom lands since they are usually less fertile and since they are often underlaid with tight clay subsoils. This is especially true of the gray prairie lands that are found to quite an extent throughout the county. It is therefore necessary to use considerable precaution in selecting upland for alfalfa if one is to make it a success.

As a rule the best upland alfalfa soil of this section is the red limestone land, particularly where the topography is rolling enough to provide good drainage and where the lands have not been worn by heavy grain cropping. An old feed lot or other especially rich spot is usually an ideal place to try alfalfa. Such lands will usually grow it without further treatment than inoculation and the preparation of a good seedbed. If such land is not available a small plot of well-drained soil with a loose open subsoil should be manured, limed, and inoculated for a trial. It is always well to start growing alfalfa with a small acreage. This may be increased after it has been clearly demonstrated that the land is suitable for this crop.

Seeding Alfalfa. Alfalfa is usually best seeded in late summer or early fall. The ground should be plowed fairly deep early in July. If manure is used it should be applied and disked into the soil before plowing. Most uplands that have never grown alfalfa require inoculation. This may be done with bacterial cultures, or with soil taken from an old alfalfa field or from the roadsides or railroad right-of-ways where sweet clover grows wild. The seed may be

broadcasted or drilled at the rate of fifteen to twenty pounds to the acre.*

MISCELLANEOUS EXPERIMENTS

Some small blocks on the field were used for trials of miscellaneous crops such as rape, winter vetch, and crimson clover.

Experiment with Rape. Rape is a succulent forage plant closely related to cabbage and resembles a headless cabbage plant. It makes an excellent green forage for cattle, hogs and sheep although some care must be taken in pasturing with cattle and sheep to avoid bloating.

Rape does best in a cool, moist climate and on a rich soil. In these experiments it has given rather poor returns due, doubtless, to the warm, dry climate and to the fact that it was sown on odd blocks on the field where the soil was rather thin. It should be seeded early in the spring on good soil as soon as the ground is dry enough to work. It can be broadcasted or drilled solid at the rate of three or four pounds of seed to the acre. It may also be drilled in rows 30 to 32 inches apart, using about two pounds of seed to the acre. In this case it should be cultivated two or three times during the season.

Experiments with Crimson Clover and Hairy Vetch. A leguminous winter cover crop is badly needed in southern Missouri. Crimson clover and hairy or winter vetch are promising crops for this purpose and are being grown experimentally in a number of localities in southern Missouri. In this experiment two seedings were made of each, one in the fall of 1910 and the other in 1911. Neither trial proved successful. From experiments conducted in other south Missouri counties it is believed that these crops can be made to grow here successfully. They are not to be recommended at present, however, except in an experimental way.

Crimson clover is a winter growing annual. It is usually seeded alone in late summer or early fall at the rate of 15 to 20 pounds of good seed per acre. It may be pastured in the spring, turned under for a green manuring crop, or cut for hay. Only one crop of hay is cut which is usually ready for harvest about the first of June. It would thus be possible to follow it with cowpeas, soybeans, millet, or sorghum.

Vetch is best seeded about the first of September on land prepared as for wheat. When seeded alone about 25 or 30 pounds of

*For more detailed directions for seeding alfalfa see Missouri Agricultural Experiment Station Circular 40, "The Seeding of Alfalfa."

seed to the acre is required. It is frequently seeded with wheat or rye, the stems of which hold it off the ground and make cutting and curing more easily accomplished. When seeded in this manner about 15 to 20 pounds of vetch seed and a half bushel of wheat and rye are required. The mixture may be turned under for green manuring or pastured off or cut for hay.

RECOMMENDATIONS FOR THE MANAGEMENT OF CROPS IN THIS REGION

The profitable production of farm crops in any region depends upon the fundamental principle of maintaining the productiveness of the soil. The gross acre income from grain crops is comparatively low and their extensive and continued culture can be carried on only where the soil naturally furnishes most of the mineral elements without excessive cost. The soil must be kept in such a condition of tilth that these elements are made available in quantities sufficient at all times to meet the requirements of the plants. With highly specialized crops such as potatoes or other truck crops, considerable expense in the way of fertilizers is justified since the gross returns are large. With general farm crops the returns are not large enough to justify any great outlay for fertilizers.

The continued profitable production of corn, oats, wheat, and hay depends primarily upon the natural fertility of the soil judiciously supplemented by the use of manure and fertilizers. A good cropping system is therefore the first essential toward maintaining crop yields. Such a system should be planned to include a wide use of legumes in the rotation, both as regular and catch crops. This is to maintain the nitrogen and humus supply of the soil and to keep the soil in good physical condition. Crop residues, manure and an occasional catch crop turned under will aid materially in setting free the mineral elements of plant food and in keeping the soil in condition to give maximum yields. A good cropping system also favors large yields by aiding in the control of insects, weeds, and crop diseases, which under the continued culture of one or two crops may become so prevalent as to seriously reduce yields.

SUGGESTED CROPPING SYSTEMS

A proper rotation should include a cultivated crop like corn which will serve as a cleansing crop to aid in the control of weeds, a small grain crop like wheat or oats for cash or feed and to serve as a nurse crop for grass and clover, and a resting or humus building crop like clover, cowpeas or soybeans. The rotation to be recommended for any farm will depend upon a number of factors such as

the character of soil, the kind of farming, the labor supply, the size of the farm and the arrangement and size of fields. No one rotation is best for all farms even in the same region. However, for a general farm of 160 to 200 acres in this region a four-year rotation of corn, oats (or cowpeas), wheat and clover, may generally be used to good advantage. It may at least be made the working basis and adjusted to meet the needs of any individual farm. If more corn is desired, a second year of corn may be inserted making the rotation corn, corn, cowpeas (or oats), wheat and clover. If more hay is needed or it is desired to provide more pasture the rotation may be lengthened by including timothy with the clover and allowing the mixed meadow of clover and timothy to stand for two or three years.

In such rotations cowpeas may be seeded with the corn as previously mentioned and used for pasture or for soil improvement. Where two years of corn are grown it will suit many farmers best to cut up one of the corn crops and sow the land to rye for winter and spring pasture. Where cowpeas are grown the third year the rye may be seeded after the second crop of corn and pastured until the latter part of April and then turned under before planting the peas. Where oats is grown the rye will go in after the first crop of corn. In this case care should be taken to turn it under fairly early so as to avoid delaying corn planting or causing the soil to dry out badly the second year.

A three-year rotation of corn, wheat, and clover, or corn, wheat and cowpeas is also to be recommended. To provide more corn this may be changed to corn, corn, wheat and clover (or cowpeas), or to provide more wheat, to corn, wheat, wheat and clover (or cowpeas).

Wheat following corn as in this rotation prevents the seeding of cowpeas in the corn and usually necessitates the cutting of the corn. Where no clover is grown it is possible to follow the wheat with cowpeas the same season if the wheat can be removed early and the ground is sufficiently moist to plow. Cowpeas sown by the tenth of July after wheat will make good hay in an average season in this section and will be of much benefit to the land. Peas may also follow oats especially where the oats are cut for hay and in favorable seasons may be removed in time to seed to rye, if winter and spring pasture is desired.

A good rotation where both oats and wheat are desired is one of corn, one or two years, oats, wheat, and cowpeas. Where it is desired to build up the land rapidly peas may be seeded in the corn and also after the wheat if the plowing can be done early enough. This gives a crop of peas on the ground every year except the one in which oats is grown. The last year of this rotation may be given

to clover, where clover grows well, although this will prevent the sowing of peas after the wheat.

It should also be noted that on much of the land in this section of the state, especially the level prairies, alsike clover is much better adapted than red clover and for a mixed meadow of timothy and clover is to be recommended. It has a rather low lime requirement and grows well on soil that is too wet and sour for red clover.

The rotations mentioned above are for the main fields on a farm. It is frequently desirable to maintain a secondary rotation on a series of smaller fields. Such a rotation is usually best used to provide crops which may be pastured off thus leaving the crops on the main fields to be harvested. There are often small irregular fields on the farm which may be cropped most economically in this manner.

GENERAL SUMMARY

1. The leading varieties of white corn for Southwest Missouri as indicated by these experiments are Commercial White and Boone County White, and the leading varieties of yellow corn, Reids Yellow Dent and Leaming.

2. In three years out of four the early maturing varieties of oats have produced higher yields than the large late-maturing varieties. Kherson and Texas Red Rust Proof are the varieties to be generally recommended.

3. The leading wheat varieties are: Beardless—Red Prolific, Early Ripe; Bearded—Fulcaster, Rudy and Lebanon. Soft winter varieties have given better yields than hard winter wheats.

4. Among the best varieties of cowpeas are Whippoorwill and Black; soybeans, Medium Early Yellow, Peking, Austin and Morse.

5. Alfalfa can be profitably grown on much of the red limestone land of Southwest Missouri wherever drainage is good and the proper soil treatments are given. The essential soil treatments are manure and inoculation and in many cases lime.

6. Crimson clover and winter vetch are worthy of a trial.