

KENTUCKY
AGRICULTURAL EXPERIMENT STATION

OF THE
STATE COLLEGE OF KENTUCKY.

BULLETIN No. 55.

FIELD EXPERIMENTS WITH FERTILIZERS.

- 1.—CORN.
- 2.—POTATOES.
- 3.—TOBACCO.
- 4.—HEMP.

LEXINGTON, KENTUCKY.

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Experiments in Detail.

THE SEASON.—The season of 1894 was unfavorable for all crops, with the exception of wheat, principally on account of the dry weather and the very backward spring. The following table gives the summary of rainfall, the mean temperature and the average per cent. of sunshine during the time specified:

MONTH.	Rainfall. Inches.	Degrees Mean Temperature.	Per cent Sunshine
April.....	4.19	54.0	40
May.....	3.81	62.4	41
June.....	4.44	74.6	47
July.....	0.87	75.6	45
August.....	3.67	76.	52
September.....	4.05	71.	47
October.....	1.40	57.6	55

THE SOIL.—The soil is derived from the Lower Silurian limestone, and is rich in phosphoric acid. The

land is worn, having been in cultivation many years. The subsoil is a light-colored clay, so retentive as to make the soil deficient in natural drainage.

Explanations—The leading elements of plant food are nitrogen, phosphoric acid and potash Plants feed on other soil-elements besides these, and they are just as essential to plant life as these three, but generally speaking all but these ingredients are furnished to plants in abundance, and therefore in studying what to put on our soils to make them more productive, we need concern ourselves with only these three. Commercial fertilizers are manufactured and sold for the purpose of supplying nitrogen, phosphoric acid and potash, and the market prices depend upon these ingredients. Some fertilizers contain one of these ingredients, some two, and some all. Generally speaking, a commercial fertilizer is a mixture containing two of these ingredients, and sometimes all; the proportions varying greatly in the various brands and often in the same brand. It is at once seen to be a very difficult, if not an impossible task, to test all the various brands sold on a given soil in order to find out those that produce the best effect. It is an easy matter, however, to find out whether a given soil needs potash, phosphoric acid or nitrogen or any combination of these elements for a given crop. Having found out this by experiment, we have only to look to the analyses of the various fertilizers to tell which brands, if any, could be used to advantage on the soil and crop tested. If the experiment proved that potash was all that was needed on a given soil for the corn crop, all those fertilizers whose analyses show little or no potash would not produce favorable results, under whatever name sold.

1.—Corn Experiments.

The field used for the fertilizer experiments was the same as that used for the experiments heretofore. The plots receiving no fertilizers the past years received none this year, and likewise the plots receiving fertilizers during the past years received the same kind in each case this year. The field in question is nearly level, slightly sloping lengthwise of the plots. Size of plots, one-tenth of an acre.

The plots were treated exactly alike except as to fertilizers, care being taken to plow the entire acre the same day at every working. The hills were thinned to two stalks, and were $3\frac{1}{2}$ feet each way.

The following table shows the kind of fertilizers applied to the various plots, their amount calculated per acre, the number of pounds of leading elements of plant food applied per acre, and the per cent. of these elements in the various fertilizers:

TABLE 1—Showing fertilizers applied and per cent of ingredients.

NUMBER.	FERTILIZERS USED.	Number of Pounds.	Number of pounds of the leading elements of plant food.			Per cent. of the leading elements of plant food in fertilizers used.		
			Phosphoric Acid.	Potash.	Nitrogen.	Phosphoric Acid.	Potash.	Nitrogen.
2	No Fertilizer.....							
3	Acid Phosphate.....	140						
	Muriate of Potash....	160	57	80	25.6	12.4	17.	5.5
	Nitrate of Soda.....	160						
4	Acid Phosphate.....	140						
	Muriate of Potash....	160	57	80	0	12.4	17.	0
	Soil.....	160						
5	Acid Phosphate.....	140						
	Nitrate of Soda.....	160	57	0	25.6	12.4	0	5.5
	Soil.....	160						
6	Muriate of Potash....	160						
	Nitrate of Soda.....	160	0	80	25.6	0	17.	5.5
	Soil.....	140						
7	No Fertilizer.....							
8	Muriate of Potash....	160						
	Soil.....	300	0	80	0	0	17.	0
9	Acid Phosphate.....	140						
	Soil.....	320	57	0	0	12.4	0	0
10	Nitrate of Soda.....	160						
	Soil.....	300	0	0	25.6	0	0	5.5

By reference to the table, it will be seen that acid phosphate containing 40.7 per cent. of available phosphoric acid was used to supply that ingredient, muriate of

potash containing 50 per cent. of potash, for potash and nitrate of soda containing 16 per cent. of nitrogen to supply nitrogen.

Field Notes.

All plots were planted the same day, May 4. Observations on May 14th showed the corn to be up in all plots. The snow storm of May 20th retarded the growth of the corn for some time.

PLOT 2. June 1st, growth fair. July 15, very poor. July 24, beginning to tassel. August 1, growth short. September 15, poor. Cut October 10th.

PLOT 3. June 1, very good. July 24, tasseling. August 1, fair. September 15, ears rather large.

PLOT 4. June 1, fair. July 24, tasseling. August 1, fair.

PLOT 5. June 1, fair. July 24, tasseling. August 1, short growth. September 15, poor.

PLOT 6. June 1, fair. July 24, tasseling. September 15, looking well.

PLOT 7. June 1, fair. July 24, barely tasseling. August 1, very small. September 15, not looking well; very small ears.

PLOT 8. June 1, fair. July 24, tasseling. August 1, height fair. September 15, very fair.

PLOT 9. June 1, looking well. July 15, poor. July 24, barely tasseling. September 15, very poor.

PLOT 10. June 1, very fair. July 15, poor. July 24, tasseling. August 1, very irregular in height. September 15, very small ears.

TABLE 2.—Showing results of fertilizers on corn.

NO. PLOT.	FERTILIZER USED.	No. of lbs of Fertilizer applied per acre.	Yield of Ear Corn per Acre in Bushels of 70 lbs.	Yield of Fodder in pounds per Acre	Increased Yield of Corn in Bushels per Acre.	Increased Yield of Fodder in pounds per Acre.
2	No Fertilizer.....		13.3	1650		
3	Nitrate of Soda.....	160	35.4	2980	21.2	1210
	Acid Phosphate.....	140				
	Muriate of Potash..	160				
4	Muriate of Potash..	160	30.1	2830	15.9	1060
	Acid Phosphate.....	140				
5	Nitrate of Soda.....	160	15.4	2030	1.2	260
	Acid Phosphate.....	140				
6	Muriate of Potash..	160	35.1	3130	20.9	1360
	Nitrate of Soda.....	160				
7	No Fertilizer.....		15.0	1890		
8	Muriate of Potash...	160	30.4	3650	16.2	1880
9	Acid Phosphate.....	140	13.1	1770	0	0
10	Nitrate of Soda.....	160	17.6	2220	3.4	450

While the yield of corn was materially reduced by the unfavorable season, yet about the same proportionate yield is maintained on the several plots as in former years.

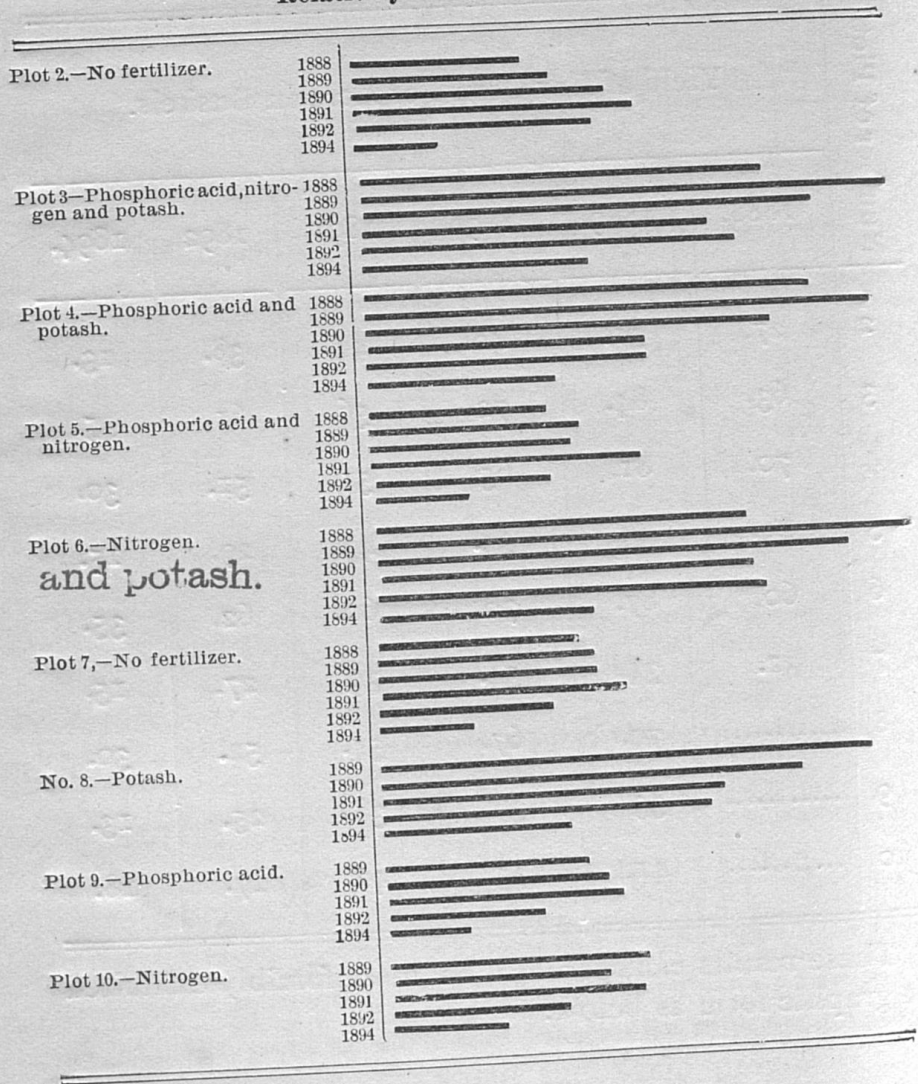
The table below is given to illustrate this point. Unfortunately our records in 1893 were lost by fire:

TABLE 3.—Showing effect of fertilizers on corn.

Number of Plot.	Yield of Ear Corn Per Acre in Bushels.					
	1888.	1889.	1890	1891.	1892.	1894.
2	27.	31.	40.	44.	38.	13.
3	63.	84.	72.	56.	61.	35.
4	70.	81.	65.	51.	51.	30.
5	29.	35.	33.	43.	29.	15.
6	60.	87.	76.	60.	62.	35.
7	32.	34.	34.	39.	27.	15.
8	.....	79.	67.	54.	52.	30.
9	.....	33.	36.	38.	25.	13.
10	.....	41.	35.	40.	27.	18.

These results can, perhaps, be more forcibly exhibited in graphic form as below:

Relative yield of Ear Corn.



Financial Results, 1894.

The Financial Results obtained by the use of the fertilizers in various combinations may be seen in the following table. The acid phosphate costs at the rate of \$3.30 per acre, the muriate of potash \$3.60 and nitrate of soda \$3.60. In these estimates the corn is rated at 40 cents per bushel:

TABLE 4.—Showing Financial Results.

FERTILIZER USED.	Cost of Fertilizer used per Acre.	Value Corn per Acre.	Value of Increased Yield of Corn per Acre.	Profit or Loss.
2 No Fertilizer.....	.....	\$5 32	.....	.....
3 Nitrate of Soda..... Acid Phosphate..... Muriate of Potash.....	\$10.50	14.16	\$8.48	\$2.02*
4 Muriate of Potash..... Acid Phosphate.....	6.90	12.04	6.36	.54*
5 Nitrate of Soda..... Acid Phosphate.....	6.90	6.16	.48	6.42*
6 Muriate of Potash..... Nitrate of Soda.....	7.20	14.04	8.36	1.16
7 No Fertilizer.....	.....	6.00	.....	.....
8 Muriate of Potash.....	3.60	12.16	6.48	2.88
9 Acid Phosphate.....	3.30	5.24	.....	3.30*
10 Nitrate of Soda.....	3.60	7.04	1.36	2.24*

* Loss.

These results show that in an unfavorable season the chances of enhanced profits by the use of fertilizers are greatly lessened or altogether wiped out. There is this much to be said, however—the greater portion of the phosphoric acid and potash applied is retained in the soil, and is available to future crops.

2.—Potato Experiments.

The plots used in studying the effect of fertilizers on potatoes in 1894 were the same as have been used for this purpose heretofore.

The surface of the ground is comparatively level and the soil of the same general character as that on which the corn was grown. Size of plots one-tenth acre each. Potatoes used for seed were Northern grown Early Rose, and were planted 14 inches apart in the row, and rows three feet apart. After the ground was well prepared with plow and harrow, the rows were marked out with a small plow. Fertilizers used were scattered in the row by hand and afterwards slightly mixed with the earth by a brush. The fertilizers were applied and the potatoes planted April 7th. The season was very unfavorable.

The nitrate of soda, superphosphate, and muriate of potash were the same as used on corn. See table 1 on page 42.

TABLE 5.—Field Notes.

	Date of Observation.							
	April 25.	May 7.	June 1.	Color of Vines.	June 15.	July 1.	July 15.	Aug. 1.
Plot 1.	Com'g up.	Up.	Looking well	Dark Green	Looking well.	Vines beginning to die.	Vines nearly all dead.	Vines all dead.
Plot 2.	do.	do.	do.	Light Green	Vines large and th'ifty	do.	do.	do.
Plot 3.	do.	do.	do.	do.	do.	do.	do	do.
Plot 4.	do.	do.	do.	do.	do.	Vines th'ifty Not dying.	Vines beginning to die.	Ne'rly all dead.
Plot 5.	do.	do.	Vines large.		Vines very good.	Vines most all dead.	Vines nearly all dead.	All dead.

The following table gives the name and amount of fertilizer used and the yield of potatoes, calculated to the acre, for each plot:

TABLE 6 — Effect of Fertilizers on Potatoes.

No. of Plot.	FERTILIZER USED	Amt. per acre, pounds.	Yield per acre, bushels.	Comparative Scale.
1	No Fertilizer. ....	.....	39.5	
2	Nitrate of Soda.....	160	66.1	
3	Acid Phosphate.....	140	48.4	
4	Muriate of Potash...	160	82.7	
5	No Fertilizer .....	.....	48.6	
6	Nitrate of Soda.....	160	75.6	
	Acid Phosphate.	140		
7	Nitrate of Soda.....	160	92.7	
	Muriate of Potash...	160		
8	Acid Phosphate.....	140	121.4	
	Muriate of Potash..	160		
9	Nitrate of Soda.....	160	126.7	
	Acid Phosphate.....	140		
	Muriate of Potash...	160		
10	No Fertilizer.....	.....	65.2	

The yield of potatoes on these plots for the past five years is given in the table which follows:

TABLE 7.—Effect of Fertilizers on Potatoes.

No. of Plot.	Yield of Potatoes Per Acre in Bushels.				
	1888.	1889.	1891.	1892.	1894.
1	72	87	76	72	40
2	82	104	85	72	66
3	86	87	96	61	48
4	127	158	144	102	83
5	89	143	113	77	49
6	73	161	130	66	76
7	117	268	173	110	93
8	133	287	195	125	121
9	126	319	210	165	127
10	.....	136	114	86	65

3.—Tobacco Experiments.

The experiment was made on five 1-10 acre plots. The soil is of the same character as the other soil. In 1888 the land was sown to timothy. In 1889 it received a top dressing of tobacco stems at the rate of one ton per acre. In the spring of 1891 the timothy was ploughed up and the ground was sown to millet. In the fall of 1891 it was again sown to timothy. In 1892 tobacco stems were put

on at the rate of 1,000 lbs per acre. In the fall of 1893 the timothy sod was broken.

The object of selecting this particular piece of ground was to try the effect of the fertilizers on the richest ground we had.

Field Notes.

Experiments on w. $\frac{1}{2}$ of acre G.

Each plot 1-10 acre, except 5a. and 5b., which were 1-20 each, plot 5 being divided through the middle cross-ways.

Tobacco plants set out May 23.

June 1. All plots looking well.

July 1. All plots looking about alike and in fine condition.

August 1. Fireing somewhat for want of rain, plot 1 being affected more than any of the other plots in this respect.

September 7. All plots cut.

Here follows a table showing the kind and amount of fertilizer used and the yield of tobacco, calculated to the acre, for each plot:

TABLE 8.—Effect of Fertilizers on Tobacco.

No. Plot.	FERTILIZERS USED.		Yield of Tobacco in Pounds Per Acre.			
	NAME.	Amount per acre.	Long Red.	Short Red.	Trash.	Total.
1	None.		610	480	455	1545
2	Nitrate of Soda.....	160				
	Double Superphosphate.....	140	640	540	515	1695
3	Carbonate of Potash & Magnesia..	300				
	Double Superphosphate.....	140	655	525	455	1635
4	Carbonate of Potash and Magnesia....	300				
	Nitrate of Soda.....	160	635	510	505	1650
5a	Carbonate of Potash and Magnesia....	300				
	Nitrate of Soda.....	160	740	440	620	1800
	Double Superph'ate	140				
5b	Muriate of Potash...	160				
	Nitrate of Soda.....	160				
	Double Superphosphate.....	140	790	470	550	1810

4.—Hemp Experiments.

The experiment was made on ten 1-20 acre plots. The land had been in English blue-grass (*Festuca elatior*) in 1889-91, in 1892 in corn, 1893 potatoes. The hemp was planted April 19th.

The following gives a summary of the field notes:

	May 1.	May 15	June 1.	July 1.	Aug. 1.	Sept. 1.
Plot 1.	1½ inch high.	6 inch	2 feet.	5 feet.	5¾ feet.	Good.
Plot 2.	Looking well.	6 inch.	15 inch.	Nearly 5 feet.	5 feet.	Good.
Plot 3.	do.	6 inch.	28 inch	5½ feet.	6½ feet.	Fine.
Plot 4.	do.	6 inch.	15 inch	3½ feet.	4½ feet.	.....
Plot 5.	do.	6 inch.	21 inch.	5 feet.	.....	Good.
Plot 6.	do.	6 inch.	24 inch.	5½ feet.	6½ feet.	Good.
Plot 7.	do.	6 inch.	22 inch.	5½ feet.	6½ feet.	Good.
Plot 8.	do.	6 inch.	21 inch.	5 feet.	6½ feet.	Good.
Plot 9.	do.	6 inch.	12 inch.	4½ feet.	5 feet.	Fair.
Plot 10.	do.	6 inch.	23 inch.	5½ feet	.....	Good.

The following table gives the kind and amount of fertilizer used and the yield of fiber:

TABLE 9. —Effect of Fertilizers on Hemp.

No. of Plot.	FERTILIZERS.	AMOUNT PER ACRE.	YIELD OF FIBER IN POUNDS PER ACRE.
	NAME.		
1	None.	.....	960
2	None.	.....	670
3	Nitrate of Soda.....	160	1060
4	Double Superphosphate.....	140	860
5	Muriate of Potash.....	160	1130
6	Muriate of Potash..... Nitrate of Soda.....	160 160	1170
7	Nitrate of Soda..... Double Superphosphate.....	160 160	1070
8	Muriate of Potash..... Double Superphosphate.....	160 140	1160
9	None.	.....	665
10	Muriate of Potash..... Nitrate of Soda..... Double Superphosph'te	160 160 140	1080

The results strongly indicate that Nitrogen and Potash were needed on the plots for hemp.