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# Effects of Soil, Soil Treatment, Seasonal Variation, and Variety on Yield and Composition of Corn Crops Grown on Kentucky Soil Fertility Plots

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# Effects of Soil, Soil Treatment, Seasonal Variation, and Variety on Yield and Composition of Corn Crops Grown on Kentucky Soil Fertility Plots

By M. E. WEEKS and E. N. FERGUS

PLANTS of a given species vary greatly in content of nutrients essential to animal life. It is generally believed that this variation is due chiefly to differences in soil and climatic conditions under which the plants have grown. Soil is considered the dominant factor in determining the quality of the food product, a rich soil supposedly producing a more nutritious food or fodder than a poor one. This theory is plausible and many published investigations support it, but the specific effects of soil productivity and other environmental conditions on the chemical composition of crops are not yet well enough understood.

Investigators, including those at this Station, have long been interested in the effect of soil, fertilizer treatment, and climatic conditions on the chemical composition of crops. More recently they have also studied varietal differences in composition. Beeson (1),\* Browne (2) and Vandecaveye (10) have reviewed much of the work of this nature done prior to 1940. While comparatively little of this earlier work pertains specifically to the corn crop, it appears that very few relationships have been found to exist between the chemical composition of corn and any one aspect of the environment affecting the growth of the crop. However, the results do tend to support the conclusion that composition of the corn crop varies principally because of soil composition, soil treatment, climate, and variety. When all but one of these factors are controlled it is possible to determine definite relationships between variations in this factor and certain chemical constituents in the plant.

Wimer's experiments, published in 1937 (14) but not included in the reviews cited, were concerned with the composition of corn stover produced on several soil fields in Illinois. He found that composition varied either with the feeding power or with the translocation physiology, or both, of the given variety. His data also indicate that returning crop residues to most Illinois soils markedly increased yields of grain and stover but in most cases decreased phosphorus concentration of stover and affected nitrogen, potassium, and calcium inconsistently, though as an average for all fields, all mineral nutrients were decreased in concentration where residues were returned. Liming a soil gener-

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\* Italic numerals in parentheses refer to literature cited on page 52.

ally increased the phosphorus content of the stover if it also markedly increased grain yield. Superphosphate generally was distinctly more effective than rock phosphate in increasing the phosphorus content of stover, but neither caused a consistent increase.

Stubblefield and DeTurk (9) have recently reported studies on the composition of corn grown on variously treated plots of two soil fields in Illinois. These data indicate, first, that in percentage of nitrogen, phosphorus, and potassium the corn grain produced on untreated poor soil is as high as, or higher than, that produced on untreated good soil. Second, with similar fertilizer treatments on poor soil and on good soil, the composition of corn grain produced on the poor soil is much more variable than that produced on the good soil. Third, the composition of stover varies much more than that of grain, apparently because it contains the excess of nutrients, if any, not used by the developing seed.

More recently Lucas, Scarseth, and Sieling (3) reported the results of a three-year study in Indiana on the composition of corn grown on two soil types with various fertilizer treatments. In the main their results support the conclusions of the previously mentioned workers.

In this bulletin four different studies on the chemical composition of corn crops grown on Kentucky soils are reported. In each of these studies some of the materials analyzed were grown on soils or plots where growth and yields were governed by one or more nutrients that limited growth and that could be supplied in fertilizers. In this way it was possible to consider the effect of different amounts of these elements on composition, and at the same time to study the influence of other factors at different levels of soil fertility.

## EARLIER STUDIES IN KENTUCKY

### 1888 and 1889 Experiments

A study of the relationship between composition of the corn plant and fertilizer practice was made at the Kentucky Station in 1888 and 1889 by Scovell and Peter (6, 7, 8). The corn crops were grown in fertilizer tests on bluegrass soil that has since been mapped as Loradale silt loam. This land had been heavily cropped for many years before being used for this experiment. The crops were analyzed for nitrogen, phosphorus, and potassium. As the results were considered rather briefly in the original reports, they are given somewhat further study here.

In the 1888 experiments the fertilizers were broadcast early in May

on two series of plots of 1/10-acre each. Ammonium sulfate, superphosphate, and potassium sulfate fertilizers were applied at rates to supply 31 pounds of nitrogen, 19.2 pounds of phosphorus, and 44 pounds of potassium per acre. In 1889, on another series of plots, nitrate of soda, acid black, and muriate of potash were applied at rates to provide 25.6 pounds of nitrogen, 25 pounds of phosphorus, and 67 pounds of potassium per acre.

**Yield.**— The yields of corn produced on the various plots, as tabulated in the original reports, are shown in Table 1, along with plot treatments. In the 1888 experiment nitrogen and phosphorus fertilizers used together (plot 4) increased the total yield of corn by 8 percent over the untreated plot; nitrogen and potassium fertilizers used together (plot 5) caused a 70-percent increase, and phosphorus and potassium fertilizers (plot 3) used together caused an 85-percent increase in total yield. The increase for all three fertilizer elements (plot 2) amounted to 88 percent. It is apparent that potassium fertilization was very effective in increasing yield in this test whereas phosphorus and nitrogen fertilization had little effect. The increase in yield of 113 percent on plot 19 over the check plot was doubtless due in large part to the great amount of potassium (199 pounds) added in the 2 tons of tobacco stems applied to this plot. The same may be said of the results on plot 16 that received manure in liberal amount. Gypsum applied at the rate of 1,000 pounds per acre (plot 6) increased yields over the check by nearly 8 percent.

In 1889 the fertilizer treatments increased yields considerably more than in 1888 (Table 2). Nitrogen and phosphorus together (plot 15) increased the total yield about 31 percent over the average of the untreated plots; nitrogen and potassium together (plot 16), 157 percent; phosphorus and potassium together (plot 14), 165 percent, and all three elements, 145 percent. Again, potassium was far more effective than nitrogen and phosphorus in increasing corn yields on this particular bluegrass soil. That phosphorus fertilization was not more effective is not surprising because the soil probably contained 6,000 pounds or more of the element per acre in the surface 7 inches. Nitrogen in the soil was probably well above 3,000 pounds per acre.<sup>1</sup>

<sup>1</sup> The land occupied by the plots was partially tile-drained in 1891, and used for pasture from 1898 until 1914. During this period the soil had an occasional light application of manure. In 1914 experiments were renewed on part of this land (4) and it was found that the effect of potassium and nitrogen fertilizers in increasing crop yields was much less pronounced than in the 1888 and 1889 experiments. Doubtless this was due partly to the tile drainage, and partly to the fact that the soil was kept in grass and moderately grazed for a period, giving it a chance to build up somewhat in organic matter and replaceable potassium.

**Table 1.—Composition of corn crops grown on the Experiment Station farm at Lexington in 1888<sup>a</sup>**  
(Stated as percent, moisture-free.)

Plot	Treatment <sup>b</sup>	Yield			Nitrogen			Phosphorus			Potassium			Ash		
		Stover	Grain	Whole crop	Stover	Grain	Whole crop	Stover	Grain	Whole crop	Stover	Grain	Whole crop	Stover	Grain	Whole crop
1	None	2 810	1 120	3 930	1.05	1.95	1.31	.25	.34	.27	.50	.38	.46	4.10	1.60	3.40
2	NPK	4 588	2 831	7 419	1.03	1.72	1.30	.35	.34	.36	.47	.36	.42	4.66	1.50	3.39
3	PK	4 227	3 062	7 289	.80	1.80	1.22	.21	.36	.27	.47	.38	.43	3.92	1.56	2.86
4	NP	2 989	1 263	4 252	1.25	1.85	1.43	.31	.38	.33	.47	.40	.46	4.23	1.64	3.12
5	NK	4 042	2 658	6 700	1.00	1.78	1.31	.25	.37	.30	.49	.40	.45	4.00	1.63	3.05
6	CaSO <sub>4</sub>	2 864	1 371	4 235	.92	1.71	1.17	.27	.35	.30	.42	.38	.41	3.66	1.53	2.98
16	M	4 497	3 100	7 597	.85	1.73	1.21	.29	.39	.33	.54	.41	.49	4.07	1.68	3.10
19	Tobacco stems	4 864	3 496	8 360	1.10	1.86	1.42	.34	.38	.31	.64	.39	.54	3.95	1.69	3.00

<sup>a</sup> Data of M. A. Scovell and A. M. Peter.

<sup>b</sup> N = 31 pounds of nitrogen per acre applied in ammonium sulfate; P = 19.2 pounds of phosphorus per acre applied in superphosphate; K = 44 pounds of potassium per acre applied in sulfate of potash; CaSO<sub>4</sub> = 1000 pounds of gypsum per acre; M = barnyard manure in liberal amount; Tobacco stems = tobacco stems at the rate of about 4,000 pounds per acre and containing about 90 pounds of nitrogen, 17.6 pounds of phosphorus and 200 pounds of potassium per acre.

**Table 2.—Composition of corn crops grown on the Experiment Station farm at Lexington in 1889<sup>a</sup>**  
(Stated as percent, moisture-free.)

Plot	Treatment <sup>b</sup>	Yield			Nitrogen			Phosphorus			Potassium		
		Stover	Grain	Whole crop	Stover	Grain	Whole crop	Stover	Grain	Whole crop	Stover	Grain	Whole crop
2	None	2 670	1 400	4 070	.73	1.73	1.06	.14	.330	.208	.34	.37	.36
13	NPK	5 148	4 972	10 120	.58	1.26	.90	.13	.238	.182	.43	.27	.36
14	PK	6 098	4 872	10 970	.56	1.14	.82	.18	.242	.208	.42	.27	.40
15	NP	3 453	1 977	5 430	.81	1.77	1.16	.16	.325	.221	.32	.38	.34
16	NK	5 260	5 360	10 620	.59	1.16	.86	.19	.216	.200	.46	.24	.33
17	None	2 790	1 400	4 190	.65	1.83	1.05	.16	.277	.204	.32	.38	.34

<sup>a</sup> Data of M. A. Scovell and A. M. Peter.

<sup>b</sup> N = 25.6 pounds of nitrogen per acre applied in nitrate of soda; P = 25 pounds of phosphorus per acre, applied in acid black; K = 67 pounds of potassium per acre applied in muriate of potash. Acid black is superphosphate made from spent boneblack.

**Composition.**— Nitrogen fertilization in the 1888 test increased the nitrogen content of the whole crop on plots 4 and 19 only (Table 1). This enrichment in nitrogen on plot 4 was probably due to the fact that the nitrogen and phosphorus application caused only a slight increase in yield on that plot over the check plot. Both yield and nitrogen content of the crop of plot 19, on the other hand, were increased greatly by the application of tobacco stems containing almost three times as much nitrogen and over four times as much potassium as was applied to other plots. On plot 3, where the yield was high because of phosphorus and potassium fertilization, the crop was lower in nitrogen than that from the untreated plot. Nitrogen fertilization probably prevented a depression of the nitrogen content of the stover from high-yielding plots that would have occurred otherwise, and increased the nitrogen content of the stover from plot 4 which produced only slightly higher yield than the untreated plot. On the other hand, it seems probable that nitrogen fertilization had little effect on the nitrogen content of the grain.

Phosphorus fertilization in the 1888 test in general had a very slight effect on the phosphorus content of the grain, the stover, and the whole crop.

Potassium fertilization in 1888 had no effect upon the percentage of potassium in the grain, and little if any effect upon the percentage in the whole crop or in the stover except on plot 19, which had received over four times as much potassium in tobacco stems as other plots had received in mineral fertilizer. On that plot the potassium content of both the whole crop and the stover was substantially higher than on other plots.

In the 1889 test (Table 2) nitrogen fertilizers increased the nitrogen content of stover and of the whole crop only where total fertilization increased yield little or none. Where fertilizers increased the yield, both stover and grain contained less nitrogen than the stover and grain produced on untreated plots. Where nitrogen fertilizer was used along with potassium or phosphorus or both, the nitrogen content of both grain and stover was higher than where only phosphorus and potassium fertilizers were used.

Phosphorus fertilizers in 1889 increased the phosphorus percentage of the whole crop only on plot 15, where the total fertilizer treatment produced no large increase in total yield. On plots 13, 14, and 16, where fertilizer treatments increased the yields over the untreated checks, the phosphorus component of the fertilizer caused no increase in the phosphorus percentage of the total crop or of the grain. On

the contrary, phosphorus fertilization accompanied by potassium fertilization where yields also were increased greatly, produced grain of lower phosphorus content than was produced on the untreated plots. Phosphorus fertilization had little consistent effect on the phosphorus content of stover.

Potassium fertilization in the 1889 tests had little if any effect upon the potassium content of the whole crop. It increased the potassium content of stover and was accompanied by a distinct decrease in the potassium content of the grain.

It will be noted that crops produced on similarly treated plots in 1888 and 1889 differed in composition. The 1889 crop was lower in nitrogen, phosphorus, and potassium than the 1888 crop. Less fertilizer nitrogen was used per acre in the 1889 test but more phosphorus and potassium were used (Tables 1 and 2). Rainfall was somewhat higher in 1889 than in 1888, and this may have accounted for the better yield obtained without fertilization in 1889 than in 1888.

In general this 1888-89 study shows the effect on yield and composition of supplying a nutrient (potassium, in this instance) that had become limiting because of heavy cropping and poor soil drainage. The data support the old idea that fertilizing with a plant food element that has become a limiting nutrient does not increase the proportion of that nutrient in the crops grown until some other element becomes limiting and holds down further yield increases.

### 1928-1930 Experiments

The Agronomy Department collected a number of samples of corn grain from the Fariston, Greenville, and Princeton soil experiment fields in 1928, and of corn-stover samples from these fields and from the Campbellville, Lexington, and Mayfield soil experiment fields in 1929 and 1930. These samples were analyzed by the Chemistry Department of the Experiment Station.<sup>1</sup>

A few conclusions may be drawn from results of the analyses obtained in this study and presented in Tables 3 and 4: (1) Soil treatments that improved yields also usually increased the nitrogen content of the grain and either did not affect or decreased the calcium content of the grain; (2) phosphate fertilization increased the phosphorus content of the grain; (3) superphosphate fertilizer was slightly more effective than rock phosphate in increasing the phosphorus content of

<sup>1</sup> Analyses by J. S. McHargue and S. D. Averitt. The results are presented in this bulletin with the approval of the leaders of the project at the time, George Roberts and J. S. McHargue.

Table 3.—Analyses<sup>a</sup> of corn grain produced on the Kentucky Soil Experiment Fields, 1928 crops

(Stated as percent, moisture-free.)

Plot	Treatment <sup>b</sup>	Yield lbs per acre	Calcium	Potassium	Phosphorus	Nitrogen
<b>Princeton</b>						
801	M	2 400	.011	.277	.221	1.16
802	ML	3 080	.011	.280	.252	1.40
803	MSp	2 310	.011	.322	.287	1.14
806	MLSp	3 770	.011	.292	.281	1.45
808	MLSpK	3 940	.009	.302	.261	1.60
830	MLRpK	3 270	.009	.275	.230	1.25
<b>Fariston</b>						
	ML		.013	.349	.241	1.15
	MLSp		.013	.277	.246	1.22
<b>Greenville</b>						
Checks	M	1 900	.016	.305	.224	1.15
402	ML	2 030	.011	.289	.206	1.12
404	MSp	2 800	.008	.319	.284	1.24
405	MRp	2 800	.009	.328	.284	1.09
407	MLSp	4 180	.008	.318	.274	1.39
408	MLRp	3 980	.013	.273	.248	1.27
411	MLSpK	4 460	.008	.326	.287	1.38
413	MLRpK	4 880	.007	.295	.290	1.42

<sup>a</sup> Analyses by Department of Chemistry, Ky. Agr. Exp. Sta.

<sup>b</sup> M = manure; L = limestone; Sp = superphosphate; Rp = rock phosphate; K = muriate of potash.

the grain where both were applied with limestone; (4) potassium fertilization increased the potassium content of the grain slightly.

The effect of soil treatment upon the composition of the stover was generally quite variable. However, it appears that phosphorus fertilization always increased the phosphorus content of the stover. The very high phosphorus content of the stover from the Lexington soil field, as compared with that in the stover from the other soil fields, would appear significant were it not for the fact that the stover of Scovell and Peter's experiments (Tables 1 and 2, page 6) varied greatly with the season.

Many years' fertilization with phosphorus, which was the first limiting element for corn production in the soils of these tests except at Lexington, had added considerable amounts of phosphorus to the treated plots from which samples were obtained and had built up fertility to a high level. Consequently it may be assumed that phosphorus was no longer a limiting element in samples from these plots. The corn crop was enriched appreciably in the element by phosphorus fertilization.

Except at Lexington, nitrogen was the second limiting element in the soils on which these samples were grown. Phosphorus fertilization, along with liming, was indirectly equivalent to nitrogen fertilization because the larger crops of legumes thereby produced in the

Table 4.—Analyses<sup>a</sup> of corn stover produced on the Kentucky Soil Experiment Fields  
(Stated as percent, moisture-free.)

Plot	Treatment <sup>b</sup>	Yield, pounds per acre	Ash	Silica	Iron	Calcium	Magne- sium	Potas- sium	Manga- nese	Phos- phorus	Nitrogen	Sulfur	Fat	Fiber
1929 Crops														
Princeton	None	—	6.81	1.83	.027	.61	.28	1.26	.013	.071	.81	.20	1.09	37.2
	MLSpK	—	5.37	1.17	.031	.50	.29	.72	.010	.087	.74	.16	1.04	38.2
Farlston	M	1 600	5.43	1.22	.035	.33	.31	1.33	.015	.082	.74	.16	1.12	38.3
	MLSpK	1 300	6.12	1.15	.029	.57	.16	1.48	.007	.165	.75	.18	1.35	36.8
Mayfield	M	—	6.13	1.49	.019	.33	.33	1.08	.011	.088	.71	.19	1.08	37.3
	MLSpK	—	5.54	1.33	.016	.39	.28	1.17	.008	.121	.79	.18	1.07	38.3
Campbellsville	M	1 750	5.26	1.09	.029	.41	.26	1.37	.002	.055	.67	.12	1.11	39.4
	MLSpK	2 090	4.56	.81	.021	.49	.24	.90	.009	.064	.58	.12	.99	41.1
Greenville	M	2 700	6.15	1.53	.019	.36	.40	.82	.011	.054	.71	.19	1.00	37.1
	MLSpK	2 330	6.02	1.52	.016	.34	.32	1.12	.010	.057	.58	.21	1.01	38.8
1930 Crops														
Lexington	None	—	5.59	.67	.023	.63	.34	1.36	.004	.310	1.27	.16	2.10	25.4
Mayfield	None	520	4.66	1.64	.025	.304	.477	.759	.027	.153	1.30	.055	—	—
	ML	2 100	4.67	1.74	.020	.338	.507	.692	.011	.145	1.07	.045	—	—
	M	1 230	4.87	1.88	.019	.268	.417	.925	.017	.141	1.15	.139	—	—
	MLRP	2 510	4.99	1.64	.015	.384	.505	.845	.012	.162	1.18	.144	—	—
	MLSp	2 610	4.80	1.54	.020	.462	.505	.781	.013	.168	1.11	.018	—	—

<sup>a</sup> Analyses by Department of Chemistry, Ky. Agr. Exp. Sta.

<sup>b</sup> M = manure; L = limestone; Sp = superphosphate; Rp = rock phosphate; K = muriate of potash.

rotations (5) added nitrogen to the soil in sufficient amounts to remove it, in considerable degree, as the second limiting element, particularly after early summer. Consequently, crops produced on phosphated plots tended to be somewhat enriched in nitrogen.

Potassium is abundant in all soils from which the samples of this test were obtained and the yields obtained from potassium fertilization have been improved little if any where barnyard manure was used regularly. Consequently, potassium may be considered as not a limiting element in corn production on the plots from which these samples were obtained and potassium fertilization had no evident effect on the composition of the corn crops reported in Tables 3 and 4.

### 1935 Experiments

In 1935 a number of samples of corn grain were taken from fields in 10 counties in the central and western parts of the state. These samples were collected by the Agronomy Department and analyzed by the Department of Feed Control.<sup>1</sup>

Data on composition of the corn grain (Table 5) indicate no marked relation between soil productivity and content of any constituent determined in the grain except phosphorus. The grain from fields that were "very high" in productivity averaged 0.339 percent phosphorus and those from fields "high" in productivity averaged .310 percent. The average percent of phosphorus in the 7 samples in these two categories was 0.322 percent phosphorus and in the 7 samples from fields of "medium" productivity, 0.279 percent. It appears that variability in content was related to the amount of available phosphorus in the soil. All samples, with the possible exception of No. 1422 from Shelby county, were produced on soil naturally too low in phosphorus for good crop production. Since yields obtained on phosphorus-deficient soils in Kentucky are improved substantially only by applications of phosphate or phosphate and limestone, it may be assumed that at least the easily soluble phosphorus in the highly productive soils was higher than in the soils classed as "medium" in productivity. If this assumption be true, the data in Table 5 support the conclusion that applying the limiting element to the soil in sufficient amounts to remove it as a factor limiting yields causes an enrichment of the crop in that element. It is likely that yields of corn on the soils classed

<sup>1</sup> This work was part of a joint project of the Departments of Agronomy and of Feed Control. The purpose was to determine the variability of feeds produced in the state, some of which are used in the manufacture of commercial feeds. Howell D. Spears was the leader of this project from the Feed Control Department, and the junior author of this bulletin the leader from the Agronomy Department.

**Table 5.—Analyses<sup>a</sup> of corn grain produced in certain counties of Kentucky in 1935**  
(Stated as percent, moisture-free.)

Sample	County <sup>b</sup>	Ash	Silica	Calcium	Potassium	Phosphorus	Nitrogen	Fat	Fiber	Color
<b>Medium productivity</b>										
1416	Todd	1.23	.021	.055	.34	.274	1.82	5.26	2.01	white
1420	Todd	1.26	.039	.032	.36	.275	1.59	5.00	2.24	white
1424	Todd	1.26	.015	.044	.36	.280	1.91	5.02	2.21	yellow
1417	Warren	1.29	.011	.044	.37	.275	1.73	5.67	2.12	white
1421	Crittenden	1.35	.005	.022	.36	.292	1.59	4.89	2.05	white
1426	Hart	1.32	0	.032	.39	.281	1.77	5.27	2.04	white
1427	Marion	1.32	0	.043	.38	.279	1.37	5.10	2.09	mixed
<b>High productivity</b>										
1419	Breckinridge	1.53	.026	.032	.39	.348	1.74	4.68	2.01	white
1423	Davless	1.37	.016	.043	.37	.299	1.61	4.95	2.12	yellow
1425	Hart	1.28	0	.032	.37	.294	1.89	4.89	2.19	white
1430	Caldwell	1.28	.007	.032	.36	.299	1.79	5.28	1.75	white
<b>Very high productivity</b>										
1418	Hancock	1.48	.015	.032	.36	.343	1.70	5.19	2.12	white
1428	Hancock	1.42	0	.032	.38	.324	1.42	4.78	2.08	yellow
1422	Shelby	1.59	.013	.044	.44	.349	1.85	4.67	2.35	white
Average, 7 medium		1.29	.013	.039	.37	.279	1.67	5.17	2.08	-----
Average, 7 high and very high		1.42	.011	.035	.38	.322	1.72	4.92	2.09	-----

<sup>a</sup> Analyses by H. D. Spears and W. G. Terrell of the Department of Feed Control, Ky. Agr. Expt. Sta.

<sup>b</sup> Soil productivity was estimated by the farmer in terms of bushels of corn per acre that the land would produce in an average season. These productivity ratings were then converted by the authors into the relative terms used in the table. Medium productivity designates soil that produces 30 to 40 bushels per acre; high, soil that produces about 50 bushels; very high, soil that produces 60 to 70 bushels.

as "high" in productivity would be determined usually by amount of seasonal rainfall rather than soil nutrients and that the higher yields certainly would be limited by rainfall. The calcium content was quite variable, ranging from 0.022 to 0.055 percent. These percentages are consistently larger than those obtained in later experiments from analysis of grains from the experiment fields (Table 9, page 22).

### PLAN OF PRESENT EXPERIMENTS

The samples of corn used in the next study were grown on the variously treated plots of the Campbellsville and Berea soil experiment fields, in the regular rotations used to determine the soil treatments needed for effective field crop production in the respective soil areas. The rotation on the Berea field is corn, rye, and a mixture of legumes and grasses for two years. On the Campbellsville field it is corn, wheat, and clover. At the latter field where there is more than one experiment, corn was obtained from both the general fertilizer test and the phosphate fertilizer test.

Work was started with the 1937 crop on the Campbellsville field and was continued through 1941, when it was discontinued because of the war. Sampling of the corn plots at the Berea field began in 1938 and continued through 1941. Details of the field-plot experiments from which the samples used in this study were obtained have been reported from time to time in bulletins of the Kentucky Agricultural Experiment Station, the most recent being Bulletin 397.

All samples were collected at harvest time, 14 to 18 stalks being taken from each plot at regular intervals on a line diagonally from one end of the plot to the other, tied into bundles, wrapped loosely in burlap to prevent loss of leaves, and dried thoroughly in a well-ventilated room. Usually about 2 months were allowed for drying.

All plots were divided crosswise in 1937, 1938, and 1939, and a hybrid variety was grown on one end and an open-pollinated variety on the other. The 14 to 18 stalks from each plot during those years were divided according to variety and were treated as two separate samples.

When the bundles were thoroughly dry, grain and stover were separated (cobs included with the stover) and the whole sample of each was ground in a small hammer mill to pass an 0.8-mm screen. After thorough mixing, a 1-pint lot of each sample was stored in a waxed-paper container until analyzed. In the beginning the methods used by the American Association of Agricultural Chemists were

used. The system of analysis finally adopted has been outlined briefly in two previous papers (12, 13) and will not be described here. When changes were made, the results by the new method were compared with those by the official methods on a sufficient number of samples to make certain that the two were comparable. This is true in all cases except for silica, as will be explained later. All analyses are the average of duplicate determinations and are expressed on a moisture-free basis. Crop yields also have been calculated on a moisture-free basis.

To interpret adequately the effects of various soil treatments on the composition of corn it is necessary to consider not only the treatments and the chemical analyses themselves, but also to a certain extent the cumulative effect of crop yields, legume growth, and amount of manure returned on the availability of the different nutrients. Likewise it is necessary to separate, so far as possible, the effects of weather and variety upon composition of the crop. Data on yields and on effects of weather (seasonal variation) and variety on both yield and composition therefore were included.

## ENVIRONMENTAL CONDITIONS

### Soil

The soils of both the Berea and Campbellsville fields are representative of considerable acreages of farm land in the respective areas. The Berea field is located in the Knobs belt, a hilly area surrounding the Outer Bluegrass region. It lies on a flat, poorly drained terrace derived from sandstones and shales. The soil would probably be classified as Tyler silt loam.<sup>1</sup> The field was tile-drained in 1917, and since that time its productivity has increased. Some idea of the natural fertility of this soil and its mechanical composition can be gained from data in Table 6.

The Campbellsville field is located in the Eastern Pennyroyal soil area just outside the Knobs. The soil is derived from a shale containing a considerable admixture of calcareous material and will probably be classified as Pearman silt loam. This soil has better internal drainage, is less acid, and as indicated in Table 6 is naturally somewhat more fertile than the soil of the Berea field. The Berea field was established in 1913 and the Campbellsville field in 1919.

<sup>1</sup> Private communication from W. S. Ligon.

**Table 6.—Composition of air-dry surface soil from manure check plots of the Berea and Campbellsville soil fields**

	Berea	Campbellsville
pH of surface soil .....	4.8	5.5
Cation exchange capacity m.e./100 g .....	8.4	6.8
Replaceable calcium m.e./100 g .....	2.19	2.8
Replaceable magnesium m.e./100 g .....	0.82	1.05
Replaceable potassium m.e./100 g .....	0.13	0.28
Total nitrogen, lb/acre .....	2 000	2 385
Total potassium, lb/acre .....	13 850	17 600
Total phosphorus, lb/acre .....	600	684
Acid-soluble phosphorus, lb/acre <sup>a</sup> .....	20	12
Clay < .002 mm, percent .....	14.0	18.7

<sup>a</sup> Soluble in 0.05 N H<sub>2</sub>SO<sub>4</sub>.

### Soil Treatment

The soil treatments and fertilizers used on these fields have been fully described in Bulletin 397 of this Station and therefore are only summarized here. Manure was used on all plots except plot 1 at Berea and plot 2 in the general fertilizer tests at Campbellsville, in amounts, by weight, equal to the crops removed excepting wheat grain. Varying treatments of limestone and fertilizer have been used on certain of these plots once in each rotation, as described in footnote to Table 13, page 30. Since the fields were established, the limed plots of the Berea field have received 5 tons, and those of the Campbellsville field 4 tons of ground limestone per acre, mostly in the first two rounds of the rotation.

### Weather

No weather data are taken on either of the experiment fields; therefore those recorded at the United States Weather Bureau station nearest each field are used. The Berea field is 2 miles west of the weather station at Berea, while the nearest to Campbellsville is the Greensburg station about 10 miles south. Doubtless temperatures recorded at each station are quite similar to those existing at the respective fields at any given time, but the rainfall data certainly indicate only the probable precipitation on the field over periods of considerable length. Weather data obtained at the two stations are presented in Table 7.

In general, weather conditions at the two stations were about the same. At Greensburg, the year 1937 was almost normal in temperature and in total rainfall, although during the growing season rainfall was somewhat low. Temperatures during the growing season were near normal and rainfall was about 3.1 inches, or almost 20 percent less than normal. In 1938 at both stations the temperature was some-

Table 7.— Normal temperature and rainfall, and departures from normal, at Berea and Greensburg, 1937-1941

Month	Normal monthly temperature, degrees F.	Departures in temperature, degrees F.					Normal monthly rainfall, inches	Departure in rainfall, inches					
		1937	1938	1939	1940	1941		1937	1938	1939	1940	1941	
<b>Berea</b>													
January	37.2	-----	+0.2	+3.2	-14.8	-0.8	4.85	-----	-1.61	+0.80	-3.41	-	1.96
February	38.8	-----	+7.6	+4.8 <sup>a</sup>	-2.1	-5.4	3.19	-----	-0.59	+3.99	+0.82	-	2.60
March	46.6	-----	+7.2	+2.0	-2.2	-5.8	4.93	-----	-0.26	+0.65	+0.29	-	3.31
April	55.8	-----	+5.0	-2.9	-2.4	+3.8	3.64	-----	-1.42	+2.91	-0.32	-	0.87
May	64.9	-----	+0.7 <sup>a</sup>	+1.3	-3.1	+1.7	4.02	-----	+0.51 <sup>a</sup>	-2.34	+0.22	-	3.16
June	73.2	-----	-2.5	+2.9	+0.3	+1.1	4.50	-----	+1.23	+1.03	-1.04	+	0.34
July	76.3	-----	+0.3	-0.5 <sup>a</sup>	-1.0	+1.1	4.84	-----	+1.53	+1.61 <sup>a</sup>	-2.98	+	1.81
August	74.5	-----	+2.6 <sup>a</sup>	+0.5	+1.0	+0.7	4.21	-----	+0.26 <sup>a</sup>	-2.71	+1.28	-	2.32
September	69.9	-----	-1.1	+4.3	-5.1	+3.5	2.94	-----	-0.04	-1.31	+0.71	-	0.54
October	58.6	-----	+1.2	+2.6	+1.4	+5.6	3.08	-----	-2.77	+0.98	-2.54	-	0.68
November	47.5	-----	+1.1	-4.0	-0.9	-1.4	3.34	-----	+0.03	-2.25	+0.23	-	0.57
December	38.0	-----	0.0	+1.2	+5.8	+4.5	4.26	-----	-2.00	-2.43	-1.13	-	1.22
Annual	56.8	-----	+1.9	+1.3	-1.9	+0.7	47.86	-----	-5.13	+0.93	-7.67	-	15.08
<b>Greensburg</b>													
January	35.5	+9.6	+1.3	+4.2	-14.9	+1.4	5.25	+12.81	-1.18	+1.90	-3.97	-	2.73
February	36.3	+2.9	+10.1	+5.6	0.0	-2.9	3.61	-1.66	-1.90	+4.36	+1.73	-	2.95
March	46.1	-3.5	+8.0	+3.5	-2.5	-5.4	5.07	-3.42	+0.17	-0.95	+0.57	-	2.98
April	55.5	+0.6	+3.1	-2.3	-1.3	+3.1	3.89	-1.15	-1.16	+2.30	-1.19	+	1.52
May	64.5	+0.4	+1.0	+0.9	-4.2	+1.3	4.38	-1.30	+0.72	-2.47	-0.83	+	3.37
June	73.2	+1.4	-1.8	+1.4	-0.4	-0.3	4.43	+0.29	+0.67	+1.20	-2.41	+	3.72
July	76.6	-1.0	+0.5	-0.2	-1.7	+0.4	3.84	-1.18	+1.74	-0.40	-1.54	+	3.88
August	75.2	+3.4	+2.4	+0.1	-0.8	-0.3	4.18	-0.94	+0.87	-1.56	-2.15	+	0.51
September	69.8	-3.0	-0.6	+3.5	-4.2	+2.2	3.29	-1.21	+0.72	-3.13	-1.57	-	2.60
October	57.1	-2.6	+0.8	+2.7	-0.1	+5.8	3.39	+0.66	-3.05	-1.29	-2.47	+	1.52
November	45.7	-3.4	+1.3	-4.1	-1.1	-0.6	3.56	-1.65	+0.87	-2.65	+1.67	+	0.35
December	37.3	-1.3	+0.1	+0.7	+5.9	+6.3	4.52	-2.08	+2.37	-2.05	-0.01	-	1.92
Annual	56.1	+0.3	+2.2	+1.3	-2.1	+0.9	49.40	-0.83	-3.90	-2.84	-12.17	-	6.07

<sup>a</sup> Average at the Richmond Weather Bureau Station, about 14 miles north of the Berea soil field. No data were available at the Berea Station for these periods.

what above normal and rainfall slightly below normal. During the growing season temperature was about normal and rainfall above normal. The average temperature at each station during 1939 was somewhat above normal and the rainfall nearly normal. Departures for the growing season were similar to those for the year. In 1940, temperature averaged slightly below normal and rainfall was 16 percent and 24 percent below normal at Berea and Greensburg, respectively. The year 1941 was essentially normal in temperature at both stations but rainfall was 31 percent below normal at Berea and 12 percent below normal at Greensburg. During the growing season the average temperatures at both stations were somewhat above normal. Rainfall was slightly below normal at the Berea station and somewhat above normal at the Greensburg station.

### VARIETAL DIFFERENCES IN YIELD

As previously noted, during the 1938 and 1939 seasons at Berea and the 1937, 1938, and 1939 seasons at Campbellsville two varieties of corn were grown on each plot; one an open-pollinated variety, the other, one of the better Kentucky hybrids. In 1940 and 1941 only the hybrid varieties were grown. At the Berea field the varieties used were Reid Yellow Dent and Kentucky yellow hybrid Y-101; at Campbellsville they were Pride of Saline and the Kentucky white hybrid D-69. Average yields of each variety at both fields are shown in Table 8. Data for several similarly treated plots at each field were averaged as follows: all no-treatment plots; all manure check plots; all manure and superphosphate; all manure and rock phosphate; all manure, limestone, and superphosphate; all manure, limestone, and rock phosphate; and all potash plots with manure, limestone, phosphate, or nitrate. There were no plots with potash only, or potash and manure only. Plots treated with nitrogen fertilizers are not grouped separately but are averaged in with the phosphate or potash group to which they belong.

At Berea the hybrid variety averaged over 20 percent more ear corn than Reid Yellow Dent, and about 10 percent less stover (Table 8). At Campbellsville the two varieties produced similar average yields of ear corn, but the hybrid produced about 8 percent less stover.

Table 8.—Acre-yield of ear corn and stover on similarly treated plots<sup>a</sup> at Berea and Campbellsville  
(Stated as pounds per acre, oven-dry.)

Year and kind <sup>b</sup>	No treatment		M		MSP		MRp		MLSp		MLRp		K with others <sup>c</sup>		Average, all treatments	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
<b>Berea</b>																
1938																
Hybrid	860	517	1 190	638	1 770	858	1 565	773	1 825	905	1 972	1 029	1 920	985	1 640	833
O.P.	350	435	754	481	1 280	739	1 260	858	1 480	948	1 665	1 203	1 635	1 095	1 307	880
1939																
Hybrid	308	315	598	441	1 050	635	1 290	880	1 370	908	1 625	1 058	1 467	978	1 205	797
O.P.	334	333	322	454	908	890	1 210	1 095	1 195	945	1 350	1 219	1 266	1 100	1 042	914
1940, hybrid	365	495	1 150	745	2 550	1 195	3 335	2 040	3,270	1 833	3 870	2 308	4 800	2 118	2 910	1 715
1941, hybrid	305	458	944	867	2 185	1 766	3 095	2 339	3 064	2 311	3 473	2 427	2 968	2 177	2 590	1 970
Average of hybrid	459	446	970	672	1 883	1 113	2 321	1 568	2 382	1 514	2 735	1 705	2 739	1 565	2 066	1 329
<b>Campbellsville</b>																
1937																
Hybrid	—	—	1 972	1 401	3 040	2 209	3 313	2 012	2 903	1 845	3 300	2 385	3 220	2 273	2 735	1 870
O.P.	—	—	1 571	1 454	2 717	2 223	2 980	2 538	2 614	2 073	2 850	2 182	3 279	2 637	2 430	2 011
1938																
Hybrid	1 650	890	2 561	1 409	3 480	1 908	3 378	2 037	3 567	1 903	3 813	2 123	3 760	2 010	3 170	1 760
O.P.	1 120	670	3 097	1 482	4 070	2 210	4,260	2 300	4 313	2 293	4 657	2 300	4 182	2 550	3 770	1 990
1939																
Hybrid	950	880	2 693	1 786	4 066	2 877	4 343	2 800	4 073	2 757	4 567	2 837	4 305	3 010	3 600	2 407
O.P.	630	850	2 871	1 930	4 000	2 927	3 997	2 993	3 953	2 880	4 117	2 900	4 265	3 375	3 510	2 540
1940, hybrid	630	820	1 859	1 157	2 910	1 680	3 137	1 927	2 733	1 780	3 107	1 993	3 032	1 985	2 360	1 580
1941, hybrid	1 627	1 381	2 499	1 743	3 846	2 482	3,627	2 623	4 034	2 386	4 309	2 695	4 189	2 619	3 392	2 230
Average of hybrid	1 214	933	2 317	1 499	3 468	2 231	3 560	2 280	3 462	2 134	3 819	2 407	3 701	2 379	3 051	1 969

<sup>a</sup> M = manure; Sp = 16 percent superphosphate; Rp = rock phosphate; L = limestone; K = 50 percent muriate of potash; N = nitrate of soda. All plots receiving potash were treated also with other materials. Plots on which phosphate applications were discontinued in 1936 are included in plot groups according to the phosphates they received prior to that year.

<sup>b</sup> At Berea, hybrid Ky.Y-101; at Campbellsville, hybrid Ky.D-89. O.P. = open pollinated; at Berea, Reid Yellow Dent; at Campbellsville, Pride of Saline.

<sup>c</sup> At Berea, average from MLPK and MLRPK plots. At Campbellsville, average from MSPKN, MBsKN, MLSpKN, and MLBsKN plots.

## SEASONAL VARIATION IN YIELD

Great differences occurred in average yield of corn on the two fields during the time this study was in progress (Table 8). Average yield of ear corn from the hybrid variety at the Berea field ranged from a low of 1,205 pounds per acre in 1939 to a high of 2,910 pounds in 1940. At the Campbellsville field the lowest yield, 2,360 pounds of ear corn per acre, was produced in 1940 and the highest, 3,600 pounds, in 1939. Both total annual and seasonal rainfall probably were much the same at both fields during those two years and temperatures quite similar (Table 7). However, the soil of the Berea field has poor internal drainage, whereas that of the Campbellsville field has relatively good internal drainage. The former was therefore wet during the first half of 1939, whereas the latter had a more favorable moisture content. In 1940, while the soil of the Berea field was not too wet during the spring and summer, the soil of the Campbellsville field was deficient in moisture, especially from April through August.

At the Berea field during the 1938 and 1941 seasons intermediate ear corn yields of 1,640 pounds and 2,590, respectively, of the hybrid variety were obtained. This may be explained by the fact that soil moisture conditions were rather unfavorable from May through August in 1938, and more or less satisfactory throughout the early growing season in 1941.

At the Campbellsville field during 1937, 1938, and 1941 ear yields of the hybrid variety were 2,735, 3,170 and 3,392 pounds per acre respectively. In 1937, rainfall in January was excessive but thereafter it was below normal throughout the growing season. The 1938 season was more favorable though rainfall was probably somewhat deficient at planting time. In 1941 when ear yields almost equaled those of 1939, rainfall was slightly below normal at planting time but greater than normal during June and July, and then an almost normal amount during August made a very good growing season.

## EFFECT OF SOIL AND SOIL TREATMENT ON YIELD

Hybrid corn Ky. Y-101 produced an average yield of 459 pounds of ear corn and 446 pounds of stover per acre on the untreated plot of the Berea soil in the period 1938-1941 (Table 8). On the untreated plot of the Campbellsville field during the same period, the hybrid Ky. D-69 produced an average yield of 1,214 pounds of ear corn and 993 pounds of stover. These differences in yield were caused primarily

by difference in natural productivity of the two soils. Probably the Campbellsville soil is more productive because of better internal drainage and its greater native base content (Table 6).

Yields of corn are greatly improved on both soils by the use of manure, limestone, and fertilizers, as shown by yield data in Tables 8 and 13. Manure used in amounts equivalent to weight of crops removed per rotation, wheat grain excepted, produced twice the ear yields and 50 percent larger stover yields than the untreated soil. The use of phosphate fertilizers, either superphosphate or rock phosphate, caused another increase of 100 percent in the yield of grain at the Berea field and about 50 percent at the Campbellsville field. Rock phosphate has been more effective in this respect than superphosphate. However, rock phosphate was used at twice the rate of superphosphate (this amounted to equal money value at the time the fields were started), and therefore about four times as much total phosphorus has been applied to the rock phosphate-treated as to the superphosphate-treated plots. Attention should also be called to the apparently very slight advantage of the higher rates of phosphate applications on the Campbellsville field in comparison with lower rates (Table 13), and it should be further noted that no phosphate was applied to plots 5, 6, 11, and 12 after 1929; consequently the comparative yields of these plots measure in part the residual effect of phosphate applications before 1930. On both fields the residual effect of rock phosphate treatment before 1930 has been substantially larger than that of superphosphate (Table 13). Liming the soil along with phosphate treatment has caused a substantial further increase in yield at Berea over manure plus phosphate treatment, and at Campbellsville it has increased corn yield slightly.

Potassium fertilizers have caused no increase in yield of corn at either of the fields and nitrogen fertilizers used at Campbellsville have not affected yield. It is difficult to determine from the Campbellsville field data presented in these tables whether potassium and nitrogen fertilizers had any effect on corn yield, but complete data of this field presented by Roberts *et al* (5) indicate they have had very little effect.<sup>1</sup>

<sup>1</sup> During the relatively long periods of experimentation on the soil experiment fields of Kentucky total and chemically available calcium and phosphorus have been built up to a very considerable extent by regular application of limestone and phosphate fertilizer (11). In many cases the reserves of these elements built up in the soil are sufficient to maintain yields for a number of years without further additions. Crop growth and yield data indicate that growing legumes and returning manure have helped maintain the available nitrogen and potassium contents at fairly satisfactory levels at least for corn. On the other hand, in the soil of most of the manured and fertilized plots at the soil experiment fields, the amount of potassium available is decreasing rapidly.

## VARIETAL DIFFERENCES IN COMPOSITION

Hybrid and open-pollinated varieties at both fields differed little in average percentages of calcium and potassium (Tables 9 and 10). It seems doubtful, therefore, that one of these varieties when grown widely would be richer than the others in either element. Neither is there any evidence that one variety contains appreciably more of either element than the other varieties when grown with specific fertilizer treatments. There are insufficient data, however, to permit of a critical analysis of the relative amounts of these elements in the varieties studied.

Average phosphorus and nitrogen contents of the grain of the Campbellsville field were a little larger in open-pollinated varieties than in hybrid varieties (Tables 11 and 12). The content of phosphorus was also slightly larger, on the average, in the stover of the open-pollinated variety grown on the Berea field than in the stover of the hybrid variety, but the stover of the hybrid variety produced at Campbellsville was slightly higher in phosphorus than that of the open-pollinated variety. Nitrogen percentages were quite similar in the stover of the two varieties. It may be concluded that these data indicate no substantial superiority of either variety in its percentages of any of the common nutrient elements.

## SEASONAL VARIATION IN COMPOSITION

The average calcium content of the grain of both varieties varied considerably from year to year at each field (Table 9). Grain of the hybrid variety produced on all plots of the Berea field contained 0.0134 percent calcium in 1938, 0.0089 percent in 1939, and 0.0083 percent in 1941. On the Campbellsville field in 1937, 1938, 1939, and 1941 the average percentages were 0.0113, 0.0122, 0.0056, and 0.0068, respectively. The difference between the lowest and highest average calcium content was 61 percent in the Berea crops and 117 percent in the Campbellsville crops.

Stover from the two fields varied less from year to year in average calcium content than the grain. The stover of the 1938, 1939, and 1941 crops contained averages of 0.500, 0.598, and 0.504 percent of calcium at Berea; and 0.348, 0.486, and 0.472 percent at Campbellsville, respectively. Extreme differences between the percentages in the Berea and Campbellsville crops for those years were 19 and 39 percent, respectively.

Other considerations being equal, the soil treatment that produces the most uniform chemical composition along with satisfactory yield

Table 9.— Calcium content of grain and stover from similarly treated plots<sup>a</sup> at Berea and Campbellsville  
(Stated as percent, oven-dry.)

Year and kind <sup>b</sup>	No treatment		M		MSP		MRp		MLSp		MLRp		K with others <sup>c</sup>		Average all treatments	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
<b>Berea</b>																
1938																
Hybrid	.0140	.400	.0124	.457	.0119	.515	.0121	.497	.0147	.521	.0136	.521	.0134	.459	.0134	.500
O.P.	.0135	.300	.0128	.390	.0109	.461	.0120	.596	.0149	.546	.0138	.528	.0149	.361	.0133	.498
1939																
Hybrid	.0124	.473	.0103	.493	.0089	.490	.0090	.653	.0092	.642	.0070	.671	.0085	.588	.0089	.598
O.P.	.0137	.526	.0106	.458	.0091	.490	.0089	.829	.0091	.655	.0083	.611	.0083	.606	.0094	.582
1940, hybrid		.410		.415				.606		.483		.642		.483		
1941, hybrid	.0115	.420	.0087	.392	.0072	.390	.0081	.499	.0085	.585	.0078	.561	.0078	.546	.0083	.504
Average of hybrid	.0126	.427	.0105	.439	.0093	.465	.0097	.539	.0108	.558	.0095	.599	.0099	.519	.0102	.534
<b>Campbellsville</b>																
1937																
Hybrid			.0109	.335	.0101	.380	.0103	.521	.0127	.487	.0107	.453	.0128	.492	.0113	.445
O.P.			.0116	.328	.0137	.419	.0105	.489	.0153	.423	.0107	.604	.0180	.427	.0133	.448
1938																
Hybrid	.0120	.235	.0113	.287	.0121	.348	.0132	.370	.0160	.339	.0114	.403	.0092	.338	.0122	.348
O.P.	.0125	.238	.0123	.279	.0115	.331	.0139	.350	.0125	.371	.0118	.364	.0096	.326	.0119	.337
1939																
Hybrid	.0066	.466	.0055	.425	.0050	.447	.0051	.454	.0056	.539	.0063	.530	.0059	.518	.0056	.486
O.P.	.0049	.452	.0056	.384	.0047	.358	.0050	.538	.0053	.522	.0056	.602	.0061	.472	.0054	.479
1940, hybrid		.444		.488		.564		.637		.624		.632		.575		.587
1941, hybrid	.0083	.425	.0071	.429	.0066	.408	.0065	.452	.0070	.517	.0071	.494	.0083	.529	.0068	.472
Average of hybrid	.0090	.392	.0087	.393	.0085	.429	.0088	.487	.0103	.501	.0088	.502	.0086	.490	.0090	.467

<sup>a</sup> M = manure; Sp = 16 percent superphosphate; Rp = rock phosphate; L = limestone; K = 50 percent muriate of potash; N = nitrate of soda. All plots receiving potash were treated also with other materials. Plots on which phosphate applications were discontinued in 1930 are included in plot groups according to the phosphates they received prior to that year.

<sup>b</sup> At Berea, hybrid Ky.Y-101; at Campbellsville, hybrid Ky.D-69. O.P. = open pollinated; at Berea, Reid Yellow Dent; at Campbellsville, Pride of Saline.

<sup>c</sup> At Berea, average from MLPK and MLRPK plots. At Campbellsville, average from MSPKN, MBsKN, MLSpKN, and MLBsKN plots.

Table 10.—Potassium content of grain and stover from similarly treated plots<sup>a</sup> at Berea and Campbellsville  
(Stated as percent, oven-dry.)

Year and kind <sup>b</sup>	No treatment		M		MSp		MRp		MLSp		MLRp		K with others <sup>c</sup>		Average all treatments	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
<b>Berea</b>																
<b>1938</b>																
Hybrid	.355	.77	.381	1.34	.373	1.02	.398	—	.365	—	.388	.80	.393	1.23	.378	.97
O.P.	.352	1.15	.354	.98	.374	1.01	.379	—	.376	—	.363	.82	.378	1.11	.368	.94
<b>1939</b>																
Hybrid	.380	1.19	.350	.98	.367	.98	.392	.90	.373	.98	.383	1.19	.372	1.25	.375	1.04
O.P.	.349	.83	.341	.93	.371	.90	.386	.89	.378	.98	.391	.98	.374	1.19	.374	.94
1940, hybrid	—	.68	—	1.22	—	—	—	.98	—	—	—	.71	—	—	1.08	—
1941, hybrid	.324	.95	.375	1.28	.399	1.24	.422	1.04	.339	.98	.378	.89	.336	1.13	.378	1.04
Average of hybrid	.353	.90	.369	1.20	.380	1.08	.404	.97	.359	.98	.383	.90	.367	1.17	.377	1.01
<b>Campbellsville</b>																
<b>1937</b>																
Hybrid	—	—	.320	1.70	.336	1.25	.367	1.12	.298	1.39	.364	1.26	.282	1.41	.333	1.41
O.P.	—	—	.290	1.60	.338	1.36	.372	1.18	.262	1.20	.340	1.41	.287	1.41	.314	1.40
<b>1938</b>																
Hybrid	.360	1.41	.397	1.27	.364	1.17	.436	1.14	.381	1.07	.302	1.12	.366	1.25	.379	1.19
O.P.	.349	1.36	.364	1.29	.317	1.31	.414	1.10	.350	1.30	.335	1.14	.352	1.21	.354	1.24
<b>1939</b>																
Hybrid	.350	1.48	.327	1.61	.359	1.27	.365	1.14	.363	1.18	.376	1.16	.359	1.29	.351	1.35
O.P.	.283	1.15	.321	1.40	.360	1.10	.334	.96	.321	1.03	.295	.89	.351	1.08	.323	1.14
1940, hybrid	—	1.27	—	1.41	—	1.22	—	1.03	—	1.02	—	1.14	—	—	1.14	1.22
1941, hybrid	.370	1.38	.367	1.81	.367	1.28	.375	1.34	.351	1.67	.355	1.68	.369	1.45	.349	1.60
Average of hybrid	.360	1.38	.353	1.56	.357	1.24	.386	1.15	.348	1.26	.349	1.27	.344	1.31	.353	1.35

<sup>a</sup> M = manure; Sp = 16 percent superphosphate; Rp = rock phosphate; L = limestone; K = 50 percent muriate of potash; N = nitrate of soda. All plots receiving potash were treated also with other materials. Plots on which phosphate applications were discontinued in 1930 are included in plot groups according to the phosphates they received prior to that year.

<sup>b</sup> At Berea, hybrid Ky.Y-101; at Campbellsville, hybrid Ky.D-69. O.P. = open pollinated; at Berea, Reid Yellow Dent; at Campbellsville, Pride of Saline.

<sup>c</sup> At Berea, average from MLPK and MLRPK plots. At Campbellsville, average from MSpKN, MBsKN, MLSpKN, and MLBsKN plots.

**Table 11.—Phosphorus content of grain and stover from similarly treated plots<sup>a</sup> at Berea and Campbellsville**  
(Stated as percent, oven-dry.)

Year and kind <sup>b</sup>	No treatment		M		M <sup>c</sup> Sp		MR <sup>c</sup> p		ML <sup>c</sup> Sp		MLR <sup>c</sup> p		K with others <sup>c</sup>		Average, all treatments	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
<b>Berea</b>																
1938																
Hybrid	.258	.063	.218	.069	.269	.084	.316	.137	.266	.074	.321	.087	.276	.077	.281	.086
O.P.	.234	.095	.230	.079	.293	.103	.330	.162	.294	.058	.283	.109	.287	.093	.283	.097
1939																
Hybrid	.186	.072	.214	.063	.244	.077	.257	.129	.257	.064	.240	.092	.241	.071	.240	.082
O.P.	.180	.071	.198	.089	.260	.079	.265	.162	.245	.084	.283	.135	.247	.096	.242	.104
1940, hybrid	.180	.063		.077				.144		.053				.053		
1941, hybrid	.202	.093	.188	.052	.274	.076	.309	.118	.207	.059	.273	.100	.208	.078	.244	.081
Average of hybrid	.206	.073	.206	.065	.262	.079	.294	.132	.243	.063	.278	.093	.242	.070	.255	.083
<b>Campbellsville</b>																
1937																
Hybrid			.201	.076	.275	.078	.330	.121	.236	.091	.243	.083	.276	.098	.245	.087
O.P.			.234	.064	.311	.101	.320	.098	.275	.077	.260	.082	.305	.079	.270	.080
1938																
Hybrid	.255	.070	.259	.078	.302	.127	.336	.169	.294	.106	.247	.143	.238	.095	.280	.113
O.P.	.239	.076	.266	.076	.303	.114	.365	.152	.290	.095	.289	.096	.297	.108	.299	.099
1939																
Hybrid	.182	.062	.198	.069	.284	.078	.283	.084	.247	.067	.312	.099	.266	.069	.247	.076
O.P.	.185	.084	.231	.056	.298	.063	.294	.100	.248	.074	.251	.117	.292	.069	.254	.077
1940, hybrid	.155	.062		.058		.065		.095		.063		.083		.063		.069
1941, hybrid	.202	.045	.197	.057	.264	.067	.276	.109	.215	.061	.260	.065	.245	.073	.231	.068
Average of hybrid	.198	.060	.214	.067	.281	.083	.306	.116	.248	.078	.266	.095	.256	.079	.251	.083

<sup>a</sup> M = manure; Sp = 16 percent superphosphate; Rp = rock phosphate; L = limestone; K = 50 percent muriate of potash; N = nitrate of soda. All plots receiving potash were treated also with other materials. Plots on which phosphate applications were discontinued in 1930 are included in plot groups according to the phosphates they received prior to that year.

<sup>b</sup> At Berea, hybrid Ky.Y-101; at Campbellsville, hybrid Ky.D-69. O.P. = open pollinated; at Berea, Reid Yellow Dent; at Campbellsville, Pride of Salline.

<sup>c</sup> At Berea, average from MLPK and MLRPK plots. At Campbellsville, average from MSpKN, MBsKN, MLSpKN, and MLBsKN plots.

Table 12.— Nitrogen content of corn grain and stover from similarly treated plots<sup>a</sup> at Berea and Campbellsville  
(Stated as percent, oven-dry.)

Year and kind <sup>b</sup>	No treatment		M		MSp		MRp		MLSp		MLRp		K with others <sup>c</sup>		Average, all treatments	
	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
<b>Berea</b>																
1938																
Hybrid	1.62	0.99	1.42	1.09	1.42	0.96	1.24	0.68	1.47	0.89	1.48	0.95	1.49	0.91	1.44	0.92
O.P.	1.83	1.30	1.56	1.12	1.44	0.88	1.43	0.86	1.54	0.74	1.53	1.03	1.56	1.02	1.53	0.94
1939																
Hybrid	1.74	1.15	1.57	0.90	1.38	0.67	1.37	0.72	1.44	0.83	1.63	0.87	1.56	0.90	1.51	0.82
O.P.	1.71	1.19	1.40	0.76	1.44	0.69	1.39	0.65	1.51	0.85	1.41	0.76	1.44	0.81	1.46	0.79
1940, hybrid		1.28		1.12				0.86		0.58				0.58		
1941, hybrid	1.47	0.90	1.31	0.88	1.21	0.57	1.23	0.65	1.39	0.72	1.58	0.67	1.31	0.69	1.38	0.68
Average of hybrid	1.61	1.08	1.40	0.94	1.34	0.73	1.28	0.73	1.43	0.75	1.56	0.83	1.45	0.77	1.44	0.81
<b>Campbellsville</b>																
1937																
Hybrid			1.35	1.04	1.33	0.83	1.40	0.90	1.38	0.96	1.37	0.90	1.41	1.07	1.36	0.95
O.P.			1.52	0.84	1.45	0.92	1.53	0.77	1.63	0.81	1.62	1.04	1.58	0.85	1.55	0.87
1938																
Hybrid	1.28	0.98	1.32	0.85	1.41	0.86	1.37	0.78	1.58	1.04	1.58	1.08	1.53	1.00	1.42	0.91
O.P.	1.72	1.07	1.50	0.87	1.61	0.87	1.52	0.81	1.73	1.06	1.74	1.01	1.79	1.08	1.60	0.92
1939																
Hybrid	1.77	1.20	1.61	1.05	1.60	0.92	1.58	0.88	1.54	0.98	1.61	0.95	1.62	0.95	1.62	0.99
O.P.	1.66	1.17	1.62	0.96	1.65	0.79	1.72	0.90	1.68	0.96	1.65	1.06	1.68	0.94	1.66	0.95
1940, hybrid	1.55	1.16		1.10		1.05		0.95		1.01		1.08		1.00		1.06
1941, hybrid	1.36	0.63	1.49	0.74	1.48	0.72	1.48	0.81	1.55	0.88	1.56	0.92	1.62	0.87	1.50	0.79
Average of hybrid	1.49	0.89	1.44	0.96	1.46	0.87	1.46	0.86	1.51	0.97	1.53	0.99	1.55	0.98	1.48	0.94

<sup>a</sup> M = manure; Sp = 16 percent superphosphate; Rp = rock phosphate; L = limestone; K = 50 percent muriate of potash; N = nitrate of soda. All plots receiving potash were treated also with other materials. Plots on which phosphate applications were discontinued in 1930 are included in plot groups according to the phosphates they received prior to that year.

<sup>b</sup> At Berea, hybrid Ky.Y-101; at Campbellsville, hybrid Ky.D-69. O.P. = open pollinated; at Berea, Reid Yellow Dent; at Campbellsville, Pride of Saline.

<sup>c</sup> At Berea, average from MLPK and MLRPK plots. At Campbellsville, average from MSpKN, MBsKN, MLSpKN, and MLBsKN plots.

from year to year is to be preferred to treatments that are accompanied by wide annual fluctuation in composition. It therefore is desirable to study briefly the variations with respect to treatment. Hybrid grain produced on Berea field plots treated with manure and rock phosphate contained 49 percent more calcium in 1938 than in 1941, years of highest and lowest content during this study (Table 9). Plots receiving other fertilization produced extreme variations in calcium content of 65 to 73 percent. Hybrid grain from plots of the Campbellsville field treated with manure, limestone, and rock phosphate varied 81 percent from its lowest average content of calcium in 1941 to its highest in 1938. Grain from the untreated plot had a similar variation and from plots treated with manure only a variation of 102 percent. Variations of 141 to 185 percent occurred with other fertilizer treatments.

Stover from all groups of fertilized plots of the Berea field showed about the same seasonal variation in average calcium content, the range being 22 to 33 percent, the least being in crops fertilized with potassium. Annual variation in calcium content of stover from the groups of plots of the Campbellsville field was 62 to 113 percent, the least variation being in crops fertilized with manure and superphosphate. Liming in addition to phosphate fertilization caused an increase in the annual variation in average calcium content of the stover.

The average potassium content of all the grain of the hybrid variety grown on the Berea field during these studies, was essentially the same each year (Table 10), but a variation of about 13 percent occurred on the Campbellsville field. The content of this element in the stover from the Berea field was approximately the same each year, but that in the stover from the Campbellsville field varied 34 percent.

Potassium content of the grain of the hybrid variety from plots of the Berea field treated with manure, rock phosphate and limestone varied only 2 percent during the period of this study, whereas grain from other groups of treated plots varied from 7 to 17 percent. A variation of 9 percent occurred in the grain of the Campbellsville field from plots treated with manure and superphosphate. Grain of other groups of treated plots varied 14 to 31 percent, the largest variation being in grain produced on plots receiving potassium fertilizers.

The annual variation in potassium in hybrid stover from potassium-treated plots on the Berea field was 18 percent; in other groups of treated plots from 26 to 67 percent. Stover from the Campbellsville plots fertilized with manure and superphosphate, varied 9 percent. A range of 67 percent occurred in stover from plots treated with lime-

stone, manure and superphosphate. Potassium fertilizers on the Campbellsville field produced stover that varied a maximum of 27 percent in potassium content.

As shown in Table 11, the average phosphorus content of the grain of the hybrid variety produced on the Berea field ranged from a high of 0.281 percent in 1938 to a low of 0.240 percent in 1939, a difference of 17 percent. At the Campbellsville field the range was from 0.280 percent also in 1938 to 0.231 percent in 1941, a difference of 21 percent. The average seasonal variation in phosphorus content of the open-pollinated varieties was much the same as for the hybrid varieties.

The average phosphorus content of the stover of both varieties produced on the Berea field was nearly the same in all years, ranging in the hybrid variety from 0.081 percent to 0.086 percent and in the open-pollinated variety from 0.097 percent to 0.104 percent. At the Campbellsville field, stover of both varieties varied greatly in phosphorus content, ranging in the hybrid variety from 0.068 to 0.113 percent and in the open-pollinated variety from 0.080 to 0.099 percent, differences of 66 percent and 23 percent respectively.

The phosphorus content of the grain of the hybrid variety varied less at both fields on the plots receiving manure and superphosphate than on plots with other treatment. The range for the former was 12 percent at Berea and 14 percent at Campbellsville. Ranges for the other treatments were 16 to 47 percent at Berea and 16 to 65 percent at Campbellsville.

In the stover at Berea, the least variation in phosphorus content, amounting to 11 percent, again was on the plots treated with manure and superphosphate. Variations of 22 to 48 percent occurred where other treatments were used. The phosphorus content of stover from all fertilizer treatments at Campbellsville varied widely, the range being from 51 to 120 percent—least in crops from plots treated with potash in addition to other elements.

The average nitrogen percentages in the hybrid grain produced on the Berea field as shown in Table 12, ranged from 1.38 percent in 1941 to 1.51 percent in 1939, a difference of 9 percent. In the hybrid grain from the Campbellsville field the range was from 1.50 percent to 1.62 percent, a difference of 8 percent. Extreme variation in the average nitrogen content of stover from the Berea and Campbellsville fields were 34 percent and 35 percent, respectively.

A seasonal variation of 6 percent in average nitrogen content occurred in grain from plots at the Berea field treated with manure, limestone, and superphosphate; that from other fertilizer treatments

was from 10 to 19 percent. The manure, limestone and superphosphate treatment was also effective in producing grain of uniform nitrogen content at the Campbellsville field. Grain from this group of plots varied only 14 percent; that from other treatments varied 15 to 20 percent.

Nitrogen in the stover from Berea plots fertilized with manure and rock phosphate varied 32 percent during the years of these studies, and the crop from other treatments and the untreated plot varied 42 to 68 percent. Stover from the fertilized plots of the Campbellsville field ranged in nitrogen content from 18 percent in the crop from the plot treated with manure, limestone and superphosphate to 46 percent in that from the plot treated with manure and superphosphate.

Thus, at both fields the average potassium and nitrogen contents of the grain varied much less than the phosphorus content which, in turn, varied less than the calcium content. The range in each of these elements in grain from the Campbellsville field was greater than in grain from the Berea field. The variation in composition of the stover from the Berea field from year to year was much less than in the grain. Potassium varied somewhat less than calcium and phosphorus, which in turn varied substantially less than nitrogen. Nitrogen variations in the stover from the Campbellsville field on the other hand, were lower from year to year than any of the other elements but potassium variations were only slightly greater. Phosphorus and calcium contents varied much more than nitrogen and potassium. On the whole stover from the Berea field varied less from year to year in these four elements than that from the Campbellsville field.

The data are insufficient to indicate definitely whether any treatment is more effective than others in producing grain and stover from year to year similar in content of nitrogen, phosphorus, potassium, and calcium; nor do they show definitely the effect of weather upon composition. They do suggest, however, that superphosphate is superior to rock phosphate treatment in causing uniform phosphorus and nitrogen contents in both grain and stover. Such relative effect appears reasonable because the superphosphate applied to the plots carried but  $\frac{1}{4}$  of the amount of phosphorus applied in rock phosphate. Therefore in these tests rock phosphate treatment should provide more often than superphosphate treatments an amount of phosphorus in excess of the needs of corn. This tentative conclusion is supported by the larger average phosphorus contents of both grain and stover from the rock-phosphate treated plots of both fields (Table 11).

## EFFECT OF SOIL AND SOIL TREATMENT ON COMPOSITION

The primary purpose of these experiments as previously noted, was to obtain information concerning the effect of soil and soil treatment on the chemical composition of crops. While the data obtained to date may be insufficient to reveal the exact degree to which the chemical composition of corn grown on two soils is influenced by specific liming and fertilizing treatments, they do suggest certain general relationships, which are here considered briefly.

### Ash

Data presented in Table 13 show that grain from the untreated plots of the Berea and Campbellsville fields contained averages of 1.14 and 1.13 percent of ash respectively. The manured check plots of the two fields produced grain containing averages of 1.10 and 1.22 percent respectively. Grain produced on the plots of the Berea field treated with manure and superphosphate and with manure and rock phosphate contained an average of 6 to 17 percent and 28 to 32 percent more ash, respectively, than grain from manured check plots. Liming in addition to the phosphate treatment caused a further increase of 3 to 17 percent, while potash added to limestone and phosphate fertilization resulted in a small decrease in ash content. Grain produced on plots of the Campbellsville field treated with manure and superphosphate and with manure and rock phosphate varied from about 4 percent less to 8 percent more, and from 6 to 24 percent more, respectively, in ash content than grain from the manured check plots. Limestone in addition to manure and a phosphate fertilizer had little if any effect on the average content of ash in the grain.

Average ash percentage in the stover grown on the Campbellsville field, in contrast to the percentage in the grain, was highest in crops grown on the manured checks and untreated plots and lowest in those from plots fertilized with rock phosphate, the latter containing from 82 to 94 percent as much as the former. Stover produced on the Berea field was somewhat higher in ash content than that produced on the Campbellsville field and the content varied less from plot to plot. At this field, variation in ash content of the stover appeared to be unrelated to soil treatment.

### Silica

The insoluble residue from the ash determinations was used for silica in the analysis of the crops of 1937 and 1938. In subsequent crops, the residue left from the wet combustion of the samples with perchloric and nitric acids was used. By either method, duplicate

**Table 13.—Average yield and composition of corn grown on the Berea and Campbellsville field plots during the period of this study**  
(Yield stated as pounds per acre and composition as percent, oven-dry.)

Plot <sup>a</sup>	Treatment <sup>b</sup>	Yield		Ash		Calcium		Magnesium		Potassium		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
<b>Berea (1938-1941)</b>															
1	None	399	438	1.14	5.42	.0127	.420	.113	.237	.347	.90	.210	.075	1.64	1.13
2E	ML (SP)	2 144	1 348	1.22	5.58	.0102	.534	.105	.170	.371	1.14	.237	.077	1.45	.88
2W	ML (fine Rp)	2 029	1 386	1.20	5.78	.0102	.517	.104	.200	.357	1.04	.231	.069	1.47	.86
3	M	782	600	1.12	5.65	.0107	.444	.102	.204	.351	1.12	.195	.069	1.42	.98
4	MSp (400 lb)	1 952	1 229	1.30	5.06	.0092	.457	.107	.146	.366	1.03	.255	.074	1.31	.67
4a	MSp (400 lb)	1 720	1 032	1.18	6.48	.0092	.455	.115	.155	.395	1.10	.282	.090	1.37	.77
5	MRp (800 lb)	2 249	1 588	1.42	5.15	.0096	.527	.120	.155	.411	.98	.303	.149	1.34	.71
5a	MRp (800 lb)	2 298	1 584	1.46	4.98	.0097	.569	.113	.165	.388	.96	.292	.130	1.29	.77
6	MLSp (400 lb)	2 535	1 653	1.34	5.34	.0108	.665	.112	.202	.362	.86	.260	.072	1.48	.84
6a	MLSp (400 lb)	2 231	1 510	1.39	5.55	.0112	.627	.105	.205	.341	1.11	.237	.068	1.49	.81
7	MLRp (800 lb)	2 754	1 816	1.48	5.40	.0097	.608	.120	.166	.395	.86	.321	.108	1.48	.81
7a	MLRp (800 lb)	2 688	1 747	1.57	5.72	.0098	.582	.117	.186	.403	.96	.287	.120	1.41	.80
8	M	981	709	1.09	5.30	.0104	.408	.110	.182	.374	1.19	.216	.066	1.36	.89
9	MLSpK (400 lb)	2 452	1 608	1.24	5.61	.0104	.535	.107	.149	.365	1.10	.243	.075	1.40	.79
9a	MLSpK (400 lb)	2 050	1 325	1.34	5.67	.0108	.499	.111	.149	.379	1.13	.244	.058	1.46	.81
10	MLRSpK (800 lb)	2 661	1 782	1.49	5.15	.0098	.543	.115	.157	.374	1.20	.261	.094	1.45	.82
10a	MLRpK (800 lb)	2 549	1 678	1.19	5.35	.0095	.553	.117	.150	.342	1.31	.213	.096	1.47	.86
<b>Campbellsville (1937-1941)</b>															
g 2	None	1 108	987	1.13	5.67	.0088	.400	.112	.244	.347	1.34	.211	.063	1.53	1.00
g 9	MSpKN (600 lb)	3 952	2 813	1.20	5.21	.0086	.420	.119	.217	.350	1.40	.295	.085	1.56	.97
g10	M	2 528	1 719	1.13	5.68	.0100	.414	.117	.240	.338	1.41	.236	.069	1.48	.94
g11	MBSKN	3 543	2 390	1.17	5.03	.0088	.444	.128	.231	.337	1.34	.252	.072	1.62	.94
g17	MLSpKN (600 lb)	3 816	2 430	1.37	5.28	.0104	.509	.120	.243	.343	1.21	.278	.084	1.60	.93
g18	MLBSKN	3 670	2 391	1.20	5.15	.0095	.546	.129	.250	.339	1.19	.257	.075	1.65	1.00
1	M	2 012	1 330	1.29	5.38	.0090	.371	.124	.228	.370	1.53	.228	.063	1.49	.91
2	MSp (300 lb)	3 223	1 958	1.23	4.91	.0084	.398	.117	.246	.351	1.26	.256	.071	1.46	.81
3	MRp (600 lb)	3 570	2 275	1.36	4.73	.0094	.462	.127	.262	.365	1.06	.293	.103	1.49	.81
4	M	2 345	1 465	1.25	5.43	.0094	.381	.119	.250	.339	1.40	.228	.063	1.50	.91
5	MSp (900 lb)	3 290	2 029	1.39	4.61	.0094	.450	.127	.257	.353	1.08	.287	.091	1.49	.83
6	MRp (1800 lb)	3 404	2 438	1.59	4.43	.0089	.484	.136	.257	.410	1.06	.326	.118	1.52	.82
7	M	2 358	1 512	1.30	5.20	.0089	.388	.115	.234	.348	1.52	.219	.066	1.44	.89
8	MLSp (300 lb)	3 321	2 070	1.24	4.86	.0101	.479	.130	.246	.331	1.35	.223	.069	1.59	.95
9	MLRp (600 lb)	3 820	2 374	1.42	4.77	.0093	.497	.133	.269	.342	1.32	.252	.092	1.59	1.02
10	M	2 224	1 472	1.22	5.39	.0086	.384	.141	.254	.350	1.59	.230	.062	1.55	1.00
11	MLSp (900 lb)	3 350	2 120	1.15	4.89	.0102	.500	.125	.255	.338	1.22	.249	.076	1.56	1.01
12	MLRp (1800 lb)	3 803	2 447	1.40	4.82	.0089	.534	.124	.271	.357	1.23	.272	.096	1.58	.97
13	M	2 430	1 561	1.17	5.38	.0084	.411	.120	.245	.344	1.61	.223	.066	1.45	.94
14	MRp (1200 lb)	3 765	2 422	1.42	5.03	.0084	.524	.138	.277	.364	1.30	.312	.113	1.53	.94
15	MLRp (1200 lb)	3 818	2 440	1.37	4.74	.0083	.532	.141	.281	.359	1.23	.273	.100	1.58	1.01
16	M	2 549	1 621	1.15	5.18	.0084	.372	.117	.245	.323	1.65	.202	.067	1.50	.93

<sup>a</sup> "E" and "W" halves of plot 2 have received 400 pounds per acre per rotation of 16 percent superphosphate and 300-mesh rock phosphate respectively since 1930. The "a" halves of plots have received no phosphate since 1930. At Campbellsville the first 8 plots (2 to 16) are the general fertilizer experiment; the others (1 to 16) are from the phosphate experiment.

<sup>b</sup> Figures in parenthesis mean pounds per acre of 16-percent superphosphate and of phosphate applied per rotation when fields were started. At Berea these rates were reduced  $\frac{1}{2}$  after two rounds of the rotation. At Campbellsville since 1930 no phosphate has been applied on plots 5, 6, 11 and 12 of the phosphate experiment, and the rate on plots 14 and 15 has been reduced one-half. Basic slag was used in amounts equivalent to 800 pounds of 16-percent superphosphate.

analyses of stover gave essentially the same results, but those of grain varied so much that the results could not be considered accurate. Consequently only the silica content of the stover is reported in Tables 14 to 27. There appeared to be no relation between soil treatment and content of silica in the stover produced at either field.

### Calcium

Data in Table 13 show that grain produced on the untreated soil of the Berea field contained an average of 0.0126 percent of calcium, which is 20 to 38 percent more than in grain from the treated plots despite the acid reaction (pH 4.9) of the untreated soil. The lowest average percentage of calcium, as shown in Table 9, was in grain grown on plots treated with manure and superphosphate, and the highest in grain from plots treated with manure, superphosphate, and limestone. The effect of liming in this instance was to increase the calcium content of the grain by about 16 percent. Plots treated with manure, rock phosphate and limestone, on the other hand, produced grain no higher in average calcium content than unlimed plots. Grain from plots of this field treated with manure and rock phosphate, with manure and superphosphate, and with manure, limestone, and rock phosphate had similar average contents of calcium which are from 11 to 17 percent less than the average calcium content of grain from plots treated with manure, limestone, and superphosphate.

Grain from the Campbellsville field averaged 13 percent lower in calcium than that grown on the Berea field. The highest average content at this field, 0.0103 percent, was in grain grown on plots treated with limestone, manure, and superphosphate. Other treatments produced grain containing averages of 14 to 20 percent less calcium.

Stover produced on the Berea field contained an average of 0.534 percent of calcium, as shown by Table 9, and that from the Campbellsville field 0.467 percent, or 12.4 percent less than the Berea stover. Variation in the average percentage of this element in stover from groups of differently treated plots of both fields was greater than in the grain.

In contrast to grain, stover from the untreated plot of the Berea field was lower in average calcium content than that produced by any group of treated plots, and that from plots treated with manure, limestone, and rock phosphate was higher in calcium content than that from any other group of plots. The increase in average content from this treatment was about 30 percent. Manure, limestone, and superphosphate treatment produced an increase of about 28 per-

cent in calcium content of the stover above that in stover from the untreated plot. Other fertilizer treatments caused increases of 8 to 25 percent. Potassium fertilization increased the calcium content of the stover 25 percent above that from the untreated plot, and treatment with manure alone gave no appreciable increase.

As on the Berea field, stover grown on the untreated and manured check plots of the Campbellsville field was lower in calcium than stover from the fertilized plots, and the highest average content of this element was in stover from plots treated with manure, limestone, and superphosphate or rock phosphate. The respective averages were 0.393 percent and 0.503 percent, a difference of 28 percent. Stover from the latter plots contained an average of about 9 percent more calcium than that from the comparable unfertilized plots. Potash fertilization on the Campbellsville field produced stover containing about 23 percent less calcium than stover from the comparable plots receiving no potash fertilization.

A few conclusions appear to be warranted by the results presented in Table 9. Limestone and superphosphate treatment on both fields provided conditions that favored a greater concentration of calcium within the grain than other fertilizer treatments. Limestone and rock phosphate treatments which added even larger amounts of calcium to the soil also provided favorable conditions for calcium enrichment of the crop but in this instance the calcium remained in the stover. This suggests that more calcium is taken into the plant in the earlier stages of growth from the former than from the latter plots. The content of the crop from the untreated plot of the Berea field may be taken to indicate somewhat of a luxury consumption for the small growth produced on the plot.

### Magnesium

Calculations made from the data in Table 13 show that grain produced on soil-treatment plots of the Campbellsville field was 14 to 17 percent higher in average percentage of magnesium than grain from the more or less comparable plots of the Berea field, and stover 18 to 48 percent higher. Variation of magnesium in grain from the Berea field was about 17 percent, and from the Campbellsville field, about 25 percent. Stover from the Berea field varied about 60 percent in average magnesium content and that of the Campbellsville field about 29 percent. Neither in the grain nor in the stover, however, do the variations appear to be related to plot treatments.

### Potassium

Grain produced on the Berea field contained an average of 0.377 percent of potassium (Table 10), or about 7 percent more than grain grown on the Campbellsville field in the same years. The range in plot averages of potassium in grain from the Berea field was from .341 to .411 percent (Table 13), a difference of 20 percent. Unlimed phosphated plots produced grain containing an average of almost 6 percent more potassium than the comparable limed plots. The Campbellsville field produced grain ranging in potassium content from .323 to .410 percent (plot averages), a difference of about 25 percent. Grain from the unlimed rock phosphate plots contained an average of about 8 percent more potassium than grain from corresponding superphosphated plots but grain from plots treated with these two phosphates on limed land had the same content of potassium. Unlimed phosphated plots produced grain containing an average of 6.6 percent more potassium than comparable limed plots. Potassium fertilization appears to have had no effect on the potassium content of the grain of the Campbellsville field.

Stover produced on the Berea field was about 34 percent lower in average content of potassium than stover from the Campbellsville field during the years 1938-1941. Potash in addition to superphosphate and rock phosphate on the Berea field, as computed from data in Table 13, increased the average percentage of potassium in the stover 14 and 37 percent, respectively. The average potassium content of stover from the manured check plots was about the same as that of the stover from the potash-treated plots.

On the Campbellsville field, the manured check plots produced stover containing averages of 29 to 35 percent more potassium than the fertilized plots and 13 percent more than the untreated plot. Potassium fertilization had little if any effect on the potassium content of the stover.

At least two conclusions appear evident from the data summarized in Table 10. First, liming in addition to fertilization of the soil of both fields produced grain generally lower in potassium content than corresponding unlimed soil. Second, rock phosphate produced grain of higher average potassium content than superphosphate on unlimed soil at both fields and on limed soil at Berea. Finally, since the average contents of potassium do not vary greatly with treatment, it appears that the available potassium content of the soil was but little in excess of the needs of the crop. Had potash fertilizers been applied at much heavier rates than they were it is possible that the corn crop would have been enriched in potassium by the treatment.

## Phosphorus

Grain from the Berea and Campbellsville fields in 1938-1941 averaged .255 and .251 percent, respectively, in phosphorus content (Table 11). Grain from the phosphated plots averaged 18 to 43 percent higher in this element than grain from the untreated plot and the manured check plots both of which averaged 0.206 percent at the Berea field, and 25 to 55 percent higher than grain from the untreated plot (0.198 percent) at the Campbellsville field. Grain from the manured check plots at the Campbellsville field contained 8 percent more phosphorus than grain from the untreated plot. Manure and rock phosphate at both fields was the most effective treatment in increasing average phosphorus content of grain, the increases being 43 at Berea and 55 percent at Campbellsville.

Grain from all the plots, except two of the Berea field (4a and 9a) on which phosphorus fertilization was discontinued in 1930 as shown in Table 13, contained an average of 3.6 percent to 18.4 percent less phosphorus than that from comparable plots on which phosphorus fertilization was continued. Grain from plot 4a, one of the exceptions, contained an average of 9.5 percent more phosphorus, and 9a, the other exception, contained the same amount as the comparable plot. Both these were superphosphate-treated plots. Discontinuance of phosphate treatments in 1930 resulted in an increase in the phosphorus content of the grain of 0.2 percent for the superphosphate plots, and a decrease of 10.9 percent for the rock phosphate plots, as compared with comparable plots where the treatments were continued. Plots 5, 6, 11, and 12 in the phosphate experiments on the Campbellsville field, on which phosphate applications were discontinued in 1930, may not be compared critically with plots 2, 3, 8, and 9, on which phosphate applications were continued, because of different rates of application; but it may be noted from Table 13 that the averages for phosphorus in grain from plots where phosphorus treatments had been discontinued were the higher.

Stover produced on both fields had an average phosphorus content of 0.083 percent. Extreme variation in average content with individual plot treatment (Table 13) was 120 percent in the Berea crops and 77 percent in the Campbellsville crops. Stover from the manured check plots of the Berea field had an average phosphorus content of 0.065 percent (Table 11)—lower than that of any other group of plots except those where limestone and superphosphate were used. Stover from the manured checks of the Campbellsville field averaged 0.067 percent phosphorus, or 0.007 percent more than stover from the untreated

plot, which was lower in this element than any other plots listed in Table 11. On both fields plots treated with manure and rock phosphate produced stover highest in average phosphorus content. Stover from these plots at both the Berea and Campbellsville fields contained on the average 102 percent and 73 percent more phosphorus, respectively, than that from the manured checks. Stover from plots on both fields treated with limestone and superphosphate had average phosphorus contents about 25 percent and 6 percent lower, respectively, than that from comparable unlimed plots.

It is apparent from these phosphorus data that on both fields treatments with superphosphate and rock phosphate almost always increased the average phosphorus content of the grain above that from unfertilized plots, and they usually increased the phosphorus content of the stover. Both phosphates were more effective in increasing phosphorus content of grain when used on unlimed than on limed land. At the rates used, rock phosphate was more effective than superphosphate in increasing the phosphorus content of both grain and stover when both were used under the same conditions. Finally, the phosphorus content remained high in the crops from plots on which phosphate applications were discontinued. Doubling the rate of phosphate fertilizer treatments increased the phosphorus content of both grain and stover (Table 13).

### Nitrogen

The average nitrogen content of the grain produced on the Berea and Campbellsville fields in 1938, 1939, and 1941 was 1.44 and 1.48 percent respectively (Table 12). Average nitrogen content of the grain of different plots of the Berea field ranged from 1.29 percent to 1.64 percent (Table 13), a difference of about 27 percent. The highest amount was in the grain from the untreated plot. Grain from the different plots of the Campbellsville field ranged from 1.44 percent to 1.65 percent, a difference of about 14 percent.

The nitrogen content of grain from the Berea plots treated with limestone and superphosphate and limestone and rock phosphate averaged about 7 percent and 22 percent more, respectively, than that of grain from comparable unlimed plots. Grain from the limed and phosphated plots of the Campbellsville field averaged about 4 percent more nitrogen than that from the comparable unlimed plots.

Percentage of nitrogen in the stover from the Berea field ranged from .67 to 1.13 percent (plot averages) and in the stover from the Campbellsville field from .82 to 1.02 percent. The untreated plots of both fields produced stover with the highest or nearly highest con-

tent of the element. Stover from the limed and phosphated plots on both fields contained slightly more nitrogen, on the average, than that from comparable unlimed plots.

The higher average nitrogen content of the corn crop produced on limed and phosphated plots of both fields as compared with phosphated plots is probably a measure of the increased nitrogen fixation induced by liming. Certainly the legume crops of the rotation were larger on the limed plots (5) and probably nonsymbiotic fixation was also more active. Nitrogen applications made on the Campbellsville soil cannot be evaluated in respect to their effect on the nitrogen content of the corn crop, but since the content was but little higher than in the crops receiving no potassium or nitrogen fertilization it is obvious that nitrogen fertilization had little effect on content of nitrogen.

### **Iron and Manganese**

Percentages of iron and manganese, insofar as they were determined, are shown in Tables 14 to 27. The content of these constituents in the grain was very low, except in a few instances—and in those there probably was some contamination of the samples, with iron particularly, in their preparation. This was especially likely in the first two years. There was no relation between composition and plot treatments within the limits of accuracy in analysis. Percentage of iron was somewhat higher in grain from the check plots than in grain from the plots receiving limestone and phosphorus. Percentage of iron in the stover was considerably higher than in the grain, and it was quite variable. The data obtained in these studies indicate no soil treatment that will enrich corn in iron when the corn is grown on land producing high yields.

### **Sulfur and Chlorine**

Sulfur and chlorine percentages were quite variable, and were not definitely related to either plot treatment or crop yield (Tables 14 to 27).

### **Fat and Fiber**

Ether extract and crude fiber were determined in grain and stover crops for the first two years (Tables 14 to 27). There appears to have been some relation between plot treatments and ether extract, the percentage of this constituent being generally somewhat higher in both grain and stover from fertilized plots of both fields than from plots treated with manure alone. Crude fiber content varied greatly, and was apparently unrelated to plot treatment.

Table 14.—Yield and composition of hybrid corn (Ky.D-69) grown on Campbellsville Soil Experiment Field, 1937  
(Yield stated as pounds per acre and composition as percent, oven-dry.)\*

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium		Magnesium		Potassium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
309	MSPKN	3 890	3 384	1.51	6.08	—	2.24	.0018	—	.0120	.410	.130	.232	.342	1.44
310	M	2 560	1 808	1.03	5.80	—	1.96	.0020	—	.0150	.348	.110	.244	.270	1.75
311	MBsKN	2 930	2 034	1.07	5.86	—	1.95	.0022	—	.0130	.437	.122	.263	.258	1.48
317	MLSPKN	3 050	1 692	1.17	6.51	—	1.81	.0010	—	.0150	.572	.107	.302	.258	1.33
318	MLBsKN	3 010	1 980	1.19	6.22	—	2.03	.0015	—	.0150	.550	.117	.282	.270	1.40
901	M	1 635	1 053	1.44	6.10	.02	1.59	.0025	—	.0121	.318	.121	.247	.329	1.90
902	MSP (300 lb)	2 330	1 400	1.13	4.57	.01	1.05	.0034	—	.0125	.340	.119	.263	.329	1.35
903	MRp (600 lb)	3 080	1 689	1.48	4.09	.05	0.72	.0275	—	.0137	.432	.111	.233	.404	1.09
904	M	1 675	1 000	1.27	5.84	.01	1.66	.0065	—	.0115	.410	.122	.289	.346	1.60
905	MSP (900 lb)	2 900	1 845	1.19	3.66	.04	.73	.0032	—	.0102	.390	.107	.227	.336	.98
906	MRp (1800 lb)	3 320	2 277	1.32	4.40	.02	.90	.0028	—	.0095	.578	.124	.278	.351	1.00
907	M	1 760	1 224	1.11	4.39	.01	.76	.0026	—	.0102	.300	.124	.219	.345	1.52
908	MLSp (300 lb)	2 770	1 957	1.14	4.27	.09	.74	.0028	—	.0126	.384	—	.248	.303	1.45
909	MLRp (600 lb)	3 150	2 268	1.60	3.82	.09	.81	.0039	—	.0176	.360	—	.252	.328	1.28
910	M	1 610	1 512	1.03	5.02	.01	1.48	.0045	—	.0070	.333	—	.270	.312	1.61
911	MLSp (900 lb)	2 890	1 890	1.14	5.18	.03	1.30	.0040	—	.0102	.504	.138	.306	.332	1.39
912	MLRp (1800 lb)	3 290	2 376	1.28	3.92	.03	.68	.0028	—	.0104	.414	.145	.262	.366	1.09
913	M	2 005	1 399	1.07	5.96	.03	1.79	.0080	—	.0095	.387	.145	.282	.329	1.85
914	MRp (1200 lb)	3 540	2 070	1.34	5.10	—	1.36	.0029	—	.0083	.554	.151	.340	.340	1.28
915	MLRp (1200 lb)	3 460	2 511	1.59	5.36	—	1.32	.0043	—	.0100	.568	.168	.317	.398	1.42
916	M	2 560	1 710	1.06	4.72	.01	1.21	.0090	—	.0115	.250	.121	.269	.310	1.57

  

Plot	Treatment	Manganese		Phosphorus		Nitrogen		Sulfur		Chlorine		Crude fat		Crude fiber	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
309	MSPKN	.0028	—	.352	.107	1.47	1.10	.098	.150	.075	.336	5.86	1.56	1.53	30.52
310	M	.0012	—	.188	.083	1.29	1.11	.091	.132	.048	.271	3.98	1.77	1.70	31.01
311	MBsKN	.0047	—	.226	.080	1.38	0.97	.097	.154	.053	.267	4.39	1.62	1.90	30.76
317	MLSPKN	.0035	—	.275	.114	1.34	1.11	.090	.135	.062	.376	4.51	1.60	1.79	30.09
318	MLBsKN	.0019	—	.252	.089	1.43	1.11	.090	.160	.063	.283	4.76	1.64	1.76	29.47
901	M	—	—	.191	.084	1.30	1.09	.092	.141	.052	.226	3.35	1.26	2.53	32.28
902	MSP (300 lb)	.0005	—	.211	.085	1.29	0.79	.089	.080	.038	.170	4.34	1.29	1.68	34.21
903	MRp (600 lb)	.0005	—	.320	.095	1.46	0.72	.087	.071	.032	.189	4.25	1.16	2.17	32.66
904	M	.0005	—	.238	.096	1.49	1.27	.089	.137	.053	.219	3.96	2.12	1.80	28.19
905	MSP (900 lb)	.0006	—	.262	.063	1.23	0.59	.080	.066	.040	.240	4.66	1.25	1.94	37.66
906	MRp (1800 lb)	.0005	—	.352	.138	1.32	0.86	.076	.092	.024	.227	5.42	1.34	2.67	30.45
907	M	.0006	—	.203	.057	1.40	0.83	.099	.097	.054	.210	4.24	1.14	2.55	33.59
908	MLSp (300 lb)	—	—	.199	.061	1.47	0.78	.090	.120	.065	.346	4.44	1.42	2.31	34.69
909	MLRp (600 lb)	—	—	.270	.081	1.35	0.72	.094	.115	.056	.284	4.38	1.43	2.26	33.35
910	M	—	—	.226	.064	1.37	0.97	.078	.079	.066	.268	4.50	1.39	1.94	32.00
911	MLSp (900 lb)	—	—	.235	.099	1.32	0.99	.069	.125	.059	.314	4.48	2.11	2.38	31.48
912	MLRp (1800 lb)	—	—	.278	.088	1.42	0.85	.076	.094	.051	.247	4.34	1.25	2.01	32.57
913	M	.0004	—	.178	.086	1.27	1.16	.089	.114	.061	.310	4.43	1.72	2.02	31.29
914	MRp (1200 lb)	.0005	—	.319	.130	1.42	1.13	.081	.111	.046	.267	4.38	1.79	2.44	30.98
915	MLRp (1200 lb)	.0011	—	.182	.100	1.34	1.13	.069	.113	.059	.254	5.56	1.77	1.79	30.45
916	M	.0002	—	.179	.059	1.30	0.87	.081	.116	.060	.228	4.41	1.40	1.75	32.86

\*Missing values in columns indicate that samples were lost or results were unacceptable.

Table 15.—Yield and composition of open-pollinated corn (Pride of Saline) grown on Campbellsville Soil Experiment Field, 1937  
(Yield stated as pounds per acre and composition as percent, oven-dry).<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium		Magnesium		Potassium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
309	MSPK	3 540	3 132	1.12	5.75	—	1.95	.0060	—	.0190	.428	.156	.271	.370	1.45
310	M	2 380	1 980	1.18	5.57	—	2.09	.0025	—	.0120	.354	.093	.248	.262	1.38
311	MBSK	3 130	2 502	1.21	4.92	—	1.01	.0015	—	.0150	.357	.127	.236	.250	1.62
317	MLSPK	3 180	2 412	1.34	4.64	—	1.22	.0010	—	.0210	.127	.127	.195	.275	1.27
318	MLBSK	3 265	2 502	1.18	4.95	—	1.11	.0030	—	.0170	.495	.128	.275	.250	1.29
901	M	1 112	1 072	1.60	4.90	.03	1.04	.0042	—	.0122	.254	.124	.197	.324	1.80
902	MSP (300 lb)	2 130	1 557	1.05	4.59	.01	.94	.0024	—	.0119	.321	.119	.208	.310	1.49
903	MRP (600 lb)	2 720	2 124	1.35	4.03	.02	.82	.0040	—	.0105	.468	.158	.209	.324	1.07
904	M	1 320	1 222	1.11	4.68	.05	.91	.0051	—	.0118	.328	.126	.202	.285	1.60
905	MSP (900 lb)	2 480	1 980	1.24	4.88	.01	1.35	.0058	—	.0111	.507	.130	.226	.334	1.15
906	MRP (1800 lb)	2 870	2 810	2.32	3.60	.05	.41	.0086	—	.0126	.408	.207	.208	.470	1.04
907	M	1 495	1 347	1.22	4.43	.05	.72	.0026	—	.0117	.304	—	.224	.325	1.50
908	MLSP (300 lb)	2 160	1 768	1.08	4.20	.07	.58	.0068	—	.0137	.440	—	.232	.273	1.30
909	MLRP (600 lb)	2 770	1 854	1.60	4.42	—	1.08	.0143	—	.0118	.556	—	.298	.363	1.42
910	M	1 370	1 347	1.04	4.91	.02	.98	.0037	—	.0117	.338	.214	.266	.266	1.78
911	MLSP (900 lb)	2 502	2 038	1.20	4.43	.03	.71	.0036	—	.0119	.403	.152	.252	.298	1.04
912	MLRP (1800 lb)	2 750	2 232	1.40	5.17	.02	1.05	.0047	—	.0105	.596	.120	.258	.355	1.39
913	M	1 618	1 431	1.14	4.18	—	.95	.0056	—	.0104	.305	.140	.208	.275	1.48
914	MRP (1200 lb)	3 250	2 880	1.38	5.00	—	1.20	.0029	—	.0087	.590	.166	.288	.322	1.43
915	MLRP (1200 lb)	3 030	2 461	1.21	5.91	—	1.60	.0031	—	.0094	.660	.163	.324	.301	1.42
916	M	1 795	1 783	1.10	5.47	.01	1.54	.0053	—	.0106	.414	.133	.252	.296	1.67

  

Plot	Treatment	Manganese		Phosphorus		Nitrogen		Sulfur		Chlorine		Crude fat		Crude fiber	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
309	MSPK	.0008	—	.393	.119	1.57	1.02	.094	.140	.073	.297	6.85	1.64	1.84	32.57
310	M	.0008	—	.264	.063	1.47	0.67	.102	.110	.056	.264	4.53	1.23	1.72	34.51
311	MBSK	.0035	—	.238	.065	1.46	0.82	.092	.102	.054	.276	4.72	1.22	1.70	33.34
317	MLSPK	.0015	—	.317	.071	1.67	0.78	.092	.107	.070	.265	5.37	1.24	1.89	32.85
318	MLBSK	.0010	—	.270	.063	1.60	0.78	.101	.131	.068	.251	5.45	1.31	2.24	33.56
901	M	—	—	.220	.054	1.50	0.88	.099	.095	.060	.184	4.49	1.15	1.83	31.87
902	MSP (300 lb)	—	—	.232	.054	1.27	0.65	.078	.078	.041	.190	4.91	1.53	1.75	31.24
903	MRP (600 lb)	.0010	—	.388	.080	1.40	0.69	.096	.099	.043	.193	5.22	1.26	2.24	33.77
904	M	.0009	—	.217	.046	1.52	0.72	.087	.109	.070	.253	4.65	1.07	1.82	37.34
905	MSP (900 lb)	.0006	—	.308	.129	1.50	1.09	.084	.125	.056	.196	5.22	1.33	2.07	29.05
906	MRP (1800 lb)	.0011	—	.379	.089	1.55	0.67	.081	.067	.056	.240	6.87	1.46	2.62	37.18
907	M	—	—	.240	.088	1.60	0.87	.093	.091	.059	.224	4.45	1.11	3.17	33.55
908	MLSP (300 lb)	—	—	.235	.063	1.62	0.71	.092	.093	.066	.294	4.65	1.49	2.25	40.25
909	MLRP (600 lb)	.0010	—	.223	.057	1.54	1.03	.091	.125	.062	.249	6.37	1.61	1.75	31.53
910	M	.0006	—	.241	.067	1.63	0.97	.084	.110	.077	.266	4.82	1.88	2.26	31.95
911	MLSP (900 lb)	.0004	—	.274	.098	1.59	0.93	.084	.092	.056	.376	5.10	1.36	2.50	31.89
912	MLRP (1800 lb)	.0003	—	.285	.098	1.60	1.05	.092	.129	.060	.288	5.43	1.69	2.64	31.98
913	M	.0008	—	.278	.052	1.46	0.75	.092	.095	.062	.261	4.55	1.09	2.44	33.66
914	MRP (1200 lb)	.0012	—	.294	.125	1.65	0.96	.114	.129	.058	.278	5.45	1.73	2.31	31.24
915	MLRP (1200 lb)	.0010	—	.273	.090	1.72	1.04	.087	.112	.062	.248	5.03	1.72	2.45	31.32
916	M	.0008	—	.176	.080	1.46	1.01	.095	.113	.078	.208	4.50	1.64	2.37	32.18

<sup>a</sup> Missing values in columns indicate that samples were lost or results were unacceptable.

Table 16.—Yield and composition of hybrid corn (Ky.101) grown on Berea Soil Experiment Field, 1938  
(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium		Magnesium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
101	None	860	517	1.11	6.69	—	3.21	.0036	—	.0140	.400	.140	.228
102E	ML	1 380	680	1.19	5.85	.0441	3.00	.0029	—	.0122	.427	.136	.141
102W	ML	1 400	700	1.22	6.40	.0300	3.53	.0031	—	.0132	.490	.135	.198
103	M	1 020	540	1.15	7.33	.0260	4.16	.0029	—	.0105	.518	.129	.172
104	MSp	1 880	940	1.23	6.10	.0171	3.22	.0028	—	.0120	.507	.144	.164
104a	MSp	1 660	775	1.30	5.59	.0177	2.88	.0031	—	.0118	.523	.133	.131
105	MRp	1 410	680	1.35	5.17	.0166	2.69	.0028	—	.0125	.463	.136	.085
105a	MRp	1 720	865	1.39	4.81	.0144	2.29	.0048	—	.0116	.530	.138	.115
106	MLSp	1 920	960	1.24	5.82	.0293	3.18	.0052	—	.0161	.575	.136	.163
106a	MLSp	1 900	940	1.16	5.34	.0144	2.36	.0034	—	.0143	.616	.133	.184
107	MLRp	1 580	820	1.54	5.50	.0808	3.08	.0033	—	.0150	.505	.143	.141
107a	MLRp	2 110	1 075	1.33	5.78	.0216	3.29	.0056	—	.0137	.466	.131	.184
108	M	1 360	735	—	6.15	—	3.52	—	—	.0143	.396	.144	.158
109	MLSpK	1 660	860	—	5.75	—	3.45	—	—	.0156	.497	.153	.098
109a	MLSpK	1 820	860	—	6.21	—	4.07	—	—	.0126	.396	.125	.085
110	MLRpK	2 040	1 170	—	5.40	—	2.79	—	—	.0125	.454	.146	.126
110a	MLRpK	2 160	1 050	—	5.73	—	2.94	—	—	.0130	.490	.131	.099

  

Plot	Treatment	Potassium		Manganese		Phosphorus		Nitrogen		Crude fat		Crude fiber	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
101	None	.355	.77	.0010	—	.258	.063	1.62	0.89	4.25	0.98	2.76	34.00
102E	ML	.405	1.23	.0008	—	.203	.075	1.47	0.88	4.37	0.94	2.73	33.52
102W	ML	.361	1.17	.0007	—	.276	.083	1.60	1.03	4.36	0.97	2.43	31.86
103	M	.372	1.34	.0005	—	.214	.069	1.35	1.15	3.86	1.15	2.42	32.36
104	MSp	.354	1.11	.0006	—	.268	.066	1.37	0.88	5.77	1.03	2.32	34.30
104a	MSp	.391	.93	.0007	—	.271	.101	1.47	1.04	4.59	1.09	2.82	29.56
105	MRp	.406	—	.0005	—	.308	.151	1.16	0.66	5.00	1.32	2.66	35.30
105a	MRp	.390	—	.0005	—	.323	.123	1.32	0.69	4.57	1.23	2.80	34.53
106	MLSp	.318	—	.0005	—	.268	.090	1.42	0.82	4.65	1.08	2.34	32.96
106a	MLSp	.354	—	.0008	—	.227	.061	1.55	0.93	4.23	0.86	2.65	34.32
107	MLRp	.403	.72	.0004	—	.308	.086	1.48	0.84	4.72	0.99	2.48	33.97
107a	MLRp	.366	.88	.0004	—	.238	.100	1.41	1.10	4.60	0.97	2.72	29.48
108	M	.390	1.33	.0005	—	.221	.068	1.49	1.03	4.45	1.00	2.76	30.61
109	MLSpK	.415	1.00	.0006	—	.308	.083	1.35	0.84	4.92	0.94	2.76	30.68
109a	MLSpK	.373	1.16	.0004	—	.260	.063	1.51	0.95	4.70	1.06	2.83	33.14
110	MLRpK	.412	1.30	.0003	—	.276	.090	1.58	0.97	4.90	1.33	2.72	31.85
110a	MLRpK	.370	1.48	.0003	—	.260	.073	1.44	0.87	4.56	1.00	2.66	34.86

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 17.—Yield and composition of open-pollinated corn (Reid Yellow Dent) grown on Berea Soil Experiment Field, 1938  
(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium		Magnesium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
101	None	350	435	1.29	5.32	.0602	2.56	.0070	—	.0135	.300	.138	.171
102E	ML	1 270	890	1.13	4.62	—	1.80	.0035	—	.0143	.448	.131	.156
102W	ML	1 430	865	1.16	5.16	.0250	2.16	.0055	—	.0116	.491	.122	.149
103	M	552	412	1.13	4.68	.0441	2.20	.0046	—	.0119	.374	.138	.155
104	MSp	1 220	657	1.31	4.92	.0232	2.36	.0031	—	.0118	.465	.136	.120
104a	MSp	1 340	820	1.28	5.37	.0144	2.39	.0031	—	.0099	.457	.134	.120
105	MRp	1 230	795	1.59	4.88	—	2.21	.0050	—	.0128	.554	.156	.121
105a	MRp	1 290	920	1.36	4.79	.0160	2.09	.0039	—	.0112	.637	.152	.151
106	MLSp	1 510	1 010	1.50	5.18	.0205	2.41	.0040	—	.0134	.550	.168	.081
106a	MLSp	1 450	980	1.13	5.39	.0226	2.56	.0036	—	.0168	.687	.128	.209
107	MLRp	1 500	1 130	1.61	5.65	.0210	3.01	.0034	—	.0117	.536	.149	.080
107a	MLRp	1 580	1 100	1.29	6.20	.0257	3.75	.0058	—	.0148	.543	.136	.154
108	M	955	550	—	5.39	—	2.95	—	—	.0133	.406	.116	.136
109	MLSpK	1 520	980	—	5.47	—	3.24	—	—	.0145	.402	.139	.096
109a	MLSpK	1 440	820	—	—	—	—	—	—	.0163	—	.151	—
110	MLRpK	1 800	1 200	—	4.98	—	2.28	—	—	.0146	.545	.159	.107
110a	MLRpK	1 780	1 380	—	5.16	—	2.22	—	—	.0140	.488	.182	.105

  

Plot	Treatment	Potassium		Manganese		Phosphorus		Nitrogen		Crude fat		Crude fiber	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
101	None	.352	1.15	.0010	—	.234	.095	1.83	1.30	3.56	1.18	2.66	25.80
102E	ML	.328	1.00	.0006	—	.245	.079	1.55	1.13	4.81	1.08	2.66	31.79
102W	ML	.380	1.25	.0005	—	.250	.068	1.41	0.83	5.00	0.98	2.63	24.48
103	M	.335	.88	.0008	—	.240	.087	1.62	1.16	8.34	1.03	3.19	35.44
104	MSp	.403	.90	.0009	—	.292	.092	1.43	0.82	3.91	1.31	2.63	33.52
104a	MSp	.344	1.12	.0007	—	.294	.113	1.45	0.93	4.58	1.19	2.35	33.20
105	MRp	.415	—	.0007	—	.354	.182	1.45	0.87	3.40	1.21	3.14	32.52
105a	MRp	.342	—	.0008	—	.305	.141	1.41	0.84	4.38	1.28	3.10	31.92
106	MLSp	.402	—	.0009	—	.349	.076	1.63	0.97	4.49	1.16	2.66	33.42
106a	MLSp	.329	—	.0005	—	.254	.074	1.49	1.06	2.85	0.94	2.67	31.75
107	MLRp	.373	.97	.0005	—	.313	.135	1.55	0.95	4.46	1.15	2.66	30.80
107a	MLRp	.340	.69	.0006	—	.242	.106	1.36	1.03	4.69	1.10	2.77	28.90
108	M	.372	1.08	.0007	—	.219	.071	1.49	1.07	3.69	0.92	3.10	29.25
109	MLSpK	.386	1.09	.0006	—	.286	.083	1.43	0.93	4.93	1.26	2.74	26.60
109a	MLSpK	.386	1.06	.0005	—	.286	—	1.60	—	3.91	—	2.75	—
110	MLRpK	.370	1.19	.0006	—	.305	.097	1.59	1.05	4.80	1.48	2.90	31.34
110a	MLRpK	.370	—	.0005	—	.271	.099	1.61	1.07	4.54	1.34	2.73	30.78

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 18.—Yield and composition of hybrid corn (Ky.D-69) grown on Campbellville Soil Experiment Field, 1938

(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium		Magnesium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
102	None	1 650	890	1.33	6.43	.033	4.15	.0081	—	.0120	.235	.139	.086
109	MSPKN	3 940	2 000	1.08	6.13	.031	4.07	.0056	—	.0111	.235	.135	.080
110	M	2 560	1 240	0.71	6.08	.030	4.07	.0032	—	.0097	.180	.144	.099
111	MBSKN	3 780	2 040	1.20	5.95	.021	3.43	.0038	—	.0090	.432	.178	.074
117	MLSpKN	3 640	2 000	—	5.03	.061	2.41	.0035	—	.0085	.256	.170	.178
118	MLBSKN	3 680	2 000	—	5.60	.036	3.14	.0024	—	.0073	.430	.133	.119
701	M	2 400	1 430	1.39	6.32	.033	3.90	.0030	—	.0118	.314	.166	.152
702	MSp (300 lb)	3 420	1 855	1.23	6.21	.014	3.85	.0024	—	.0108	.418	.147	.198
703	MRp (600 lb)	3 120	2 010	1.39	6.22	.060	3.72	.0032	—	.0137	.327	.149	.170
704	M	2 240	1 410	1.49	6.71	.047	3.24	.0035	—	.0115	.247	.171	.149
705	MSp (900 lb)	3 080	1 870	1.76	5.89	.024	2.87	.0036	—	.0143	.392	.199	.167
706	MRp (1800 lb)	3 655	2 120	1.38	6.27	.029	3.53	.0035	—	.0131	.397	.152	.171
707	M	2 660	1 480	1.20	5.82	.011	3.33	.0041	—	.0104	.252	.278	.110
708	MLSp (300 lb)	3 420	1 760	1.39	5.54	.026	2.72	.0054	—	.0131	.367	.366	.157
709	MLRp (600 lb)	3 840	2 230	1.58	5.60	.013	2.56	.0040	—	.0121	.455	.195	.178
710	M	2 760	1 430	1.33	5.76	.011	3.07	.0036	—	.0122	.330	.187	.194
711	MLSp (900 lb)	3 640	1 950	1.32	5.43	—	2.64	.0048	—	.0254	.394	.163	.142
712	MLRp (1800 lb)	3 840	2 100	1.38	5.82	.039	2.51	.0036	—	.0112	.350	.153	.122
713	M	2 510	1 430	1.20	5.79	.007	3.16	.0038	—	.0126	.465	.149	.152
714	MRp (1200 lb)	3 360	1 980	1.40	5.68	.022	2.98	.0037	—	.0129	.385	.182	.138
715	MLRp (1200 lb)	3 960	2 040	1.58	4.90	.026	2.23	.0040	—	.0109	.404	.162	.153
716	M	2 800	1 430	1.33	5.60	.045	3.41	.0032	—	.0110	.220	.173	.109

  

Plot	Treatment	Potassium		Manganese		Phosphorus		Nitrogen		Crude fat		Crude fiber	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
102	None	.360	1.41	.0008	—	.255	.070	1.28	0.98	3.40	1.16	2.43	33.30
109	MSPKN	.390	1.27	.0007	—	.276	.086	1.46	0.99	3.85	1.24	2.58	33.02
110	M	.365	1.28	.0007	—	.276	.076	1.29	0.88	5.48	1.22	3.32	32.86
111	MBSKN	.404	1.38	.0008	—	.203	.083	1.58	1.00	5.92	1.15	2.94	33.90
117	MLSpKN	.358	1.16	.0002	—	.240	.121	1.59	0.96	3.20	1.10	2.84	34.44
118	MLBSKN	.310	1.19	.0006	—	.234	.090	1.49	1.03	3.28	1.06	1.92	33.30
701	M	.420	1.30	.0008	—	.276	.089	1.38	0.79	5.20	1.10	2.68	34.80
702	MSp (300 lb)	.375	1.07	.0006	—	.260	.113	1.35	0.83	3.80	1.48	2.16	35.00
703	MRp (600 lb)	.424	1.04	.0006	—	.313	.160	1.30	0.76	4.30	0.96	2.05	36.49
704	M	.412	1.30	.0003	—	.281	.068	1.26	0.75	4.50	1.05	2.57	34.45
705	MSp (900 lb)	.327	1.16	.0003	—	.370	.182	1.43	0.75	5.40	1.05	2.30	33.00
706	MRp (1800 lb)	.462	1.22	.0006	—	.359	.169	1.40	0.73	5.50	0.84	2.88	37.22
707	M	.395	1.18	.0004	—	.313	.071	1.26	0.81	4.80	1.10	2.67	34.12
708	MLSp (300 lb)	.383	1.07	.0006	—	.266	.104	1.59	1.13	4.05	1.03	2.30	32.50
709	MLRp (600 lb)	.462	1.06	.0009	—	.219	.156	1.68	1.19	5.48	1.10	2.50	32.88
710	M	.388	1.29	.0008	—	.176	.079	1.48	0.97	4.00	1.20	2.69	32.34
711	MLSp (900 lb)	.402	0.97	.0011	—	.375	.094	1.57	1.07	4.45	1.30	2.72	32.05
712	MLRp (1800 lb)	.346	1.13	.0005	—	.224	.141	1.50	1.04	3.80	1.30	2.00	34.36
713	M	.407	1.19	.0006	—	.234	.087	1.21	0.81	5.25	1.24	2.34	31.88
714	MRp (1200 lb)	.422	1.16	.0002	—	.336	.177	1.40	0.85	3.85	1.04	2.45	34.65
715	MLRp (1200 lb)	.397	1.17	.0003	—	.297	.132	1.43	1.02	3.52	1.00	2.32	35.35
716	M	.391	1.37	.0010	—	.260	.078	1.38	0.83	4.70	1.14	2.15	34.10

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 19.— Yield and composition of open-pollinated corn (Pride of Saline) grown on Campbellsville Soil Experiment Field, 1938

(Yield stated as pounds per acre and composition as percent, oven-dry.)\*

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium		Magnesium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
102	None	1 120	870	1.19	6.26	.040	3.75	.0040	—	.0125	.238	.160	.120
109	MSPKCN	4 250	2 610	0.86	5.43	.034	3.10	.0028	—	.0081	.247	.149	.097
110	M	2 450	1 470	1.25	5.91	.020	3.82	.0035	—	.0134	.213	.198	.117
111	MBsKN	4 050	2 460	1.16	5.29	.020	3.14	.0039	—	.0110	.275	.180	.079
117	MLSpKN	4 230	2 680	1.55	5.86	.036	3.13	.0041	—	.0109	.375	.221	.136
118	MLBsKN	4 200	2 450	1.06	5.01	.032	2.29	.0033	—	.0092	.406	.197	.107
701	M	2 195	1 175	1.22	5.19	.022	2.23	.0034	—	.0126	.326	.163	.181
702	MSP (300 lb)	3 770	1 820	1.26	5.77	.024	2.73	.0038	—	.0132	.377	.155	.132
703	MRp (600 lb)	4 120	2 285	1.61	5.85	.054	3.13	.0037	—	.0154	.343	.163	.135
704	M	3 620	1 600	1.55	5.81	.028	3.51	.0035	—	.0137	.327	.176	.167
705	MSP (900 lb)	4 190	2 200	1.49	6.04	.037	3.61	.0039	—	.0132	.370	.180	.177
706	MRp (1800 lb)	4 560	2 485	1.55	5.09	.024	3.13	.0035	—	.0142	.376	.185	.176
707	M	3 180	1 490	1.29	5.78	.024	2.97	.0035	—	.0128	.260	.168	.141
708	MLSp (300 lb)	4 170	1 960	1.40	5.55	.025	2.36	.0052	—	.0146	.366	.200	.182
709	MLRp (600 lb)	4 830	2 400	1.21	5.15	.016	2.41	.0036	—	.0106	.327	.269	.115
710	M	3 330	1 490	1.19	5.58	.014	2.73	.0040	—	.0125	.222	.156	.116
711	MLSp (900 lb)	4 540	2 240	1.19	5.49	.014	2.32	.0040	—	.0119	.372	.153	.164
712	MLRp (1800 lb)	4 540	2 400	1.56	5.55	.029	2.53	.0041	—	.0129	.422	.154	.150
713	M	3 300	1 510	1.29	5.77	.011	2.46	.0035	—	.0109	.328	.156	.160
714	MRp (1200 lb)	4 100	2 130	1.47	5.40	.014	3.23	.0043	—	.0122	.332	.176	.100
715	MLRp (1200 lb)	4 600	2 400	1.21	4.96	.017	2.88	.0061	—	.0120	.343	.185	.107
716	M	3 600	1 640	1.19	6.32	.010	3.72	.0037	—	.0104	.280	.161	.100

  

Plot	Treatment	Potassium		Manganese		Phosphorus		Nitrogen		Crude fat		Crude fiber	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
102	None	.349	1.36	.0004	—	.239	.076	1.72	1.07	2.80	1.00	2.76	33.22
109	MSPKN	.275	1.28	.0008	—	.268	.107	1.76	0.93	3.42	1.72	2.13	31.60
110	M	.412	1.11	.0010	—	.339	.072	1.43	0.90	4.96	1.72	3.00	33.68
111	MBsKN	.370	1.14	.0008	—	.337	.108	1.69	1.05	5.18	1.20	2.71	32.92
117	MLSpKN	.394	1.34	.0004	—	.349	.109	1.87	1.10	5.00	1.29	2.24	32.48
118	MLBsKN	.367	1.09	.0007	—	.234	.110	1.88	1.25	4.05	1.05	2.52	31.14
701	M	.365	1.30	.0007	—	.276	.068	1.43	0.85	4.52	1.13	2.69	34.29
702	MSP (300 lb)	.320	1.44	.0010	—	.297	.095	1.48	0.79	3.45	1.12	2.51	34.05
703	MRp (600 lb)	.413	1.06	.0006	—	.380	.151	1.46	0.73	4.60	0.97	2.55	36.00
704	M	.368	1.23	.0007	—	.313	.092	1.57	0.91	3.92	1.18	2.79	32.00
705	MSP (900 lb)	.357	1.21	.0006	—	.344	.141	1.59	0.90	3.88	1.28	2.58	34.46
706	MRp (1800 lb)	.440	1.14	.0006	—	.386	.169	1.52	0.83	6.00	1.15	2.70	34.06
707	M	.390	1.28	.0007	—	.221	.065	1.43	0.83	4.81	0.94	2.44	34.43
708	MLSp (300 lb)	.359	1.42	.0010	—	.229	.085	1.72	0.98	4.68	0.98	2.50	33.75
709	MLRp (600 lb)	.246	1.25	.0008	—	.276	.104	1.79	1.08	3.25	1.20	1.75	32.36
710	M	.341	1.48	.0006	—	.323	.060	1.54	0.84	4.10	1.16	2.60	33.41
711	MLSp (900 lb)	.298	1.14	.0007	—	.219	.092	1.65	1.10	4.00	1.04	2.28	32.52
712	MLRp (1800 lb)	.376	1.22	.0007	—	.279	.079	1.66	0.90	4.00	0.98	2.41	35.49
713	M	.340	1.22	.0005	—	.239	.078	1.52	0.83	4.00	1.16	2.69	33.41
714	MRp (1200 lb)	.390	1.10	.0004	—	.328	.135	1.57	0.86	4.62	1.06	2.80	34.78
715	MLRp (1200 lb)	.382	0.95	.0011	—	.313	.104	1.77	1.04	4.92	1.34	2.37	32.66
716	M	.332	1.47	.0010	—	.288	.085	1.59	0.91	6.00	1.26	2.73	34.56

\* Missing values in tables indicate that samples were lost or results were unacceptable.

Table 20.—Yield and composition of hybrid corn (Ky.Y-101) produced on the Berea Soil Experiment Field, 1939  
(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
201	None	308	315	1.08	5.30	.0110	1.78	.0022	.0114	.0124	.473
202E	ML	1 220	720	1.22	5.88	.0083	2.52	.0023	.0107	.0092	.616
202W	ML	1 110	740	1.30	5.70	.0155	2.02	.0023	.0079	.0094	.645
203	M	465	342	1.04	4.56	.0089	1.75	.0023	.0087	.0113	.520
204	MSp	1 090	700	1.32	4.68	.0094	2.08	.0018	.0064	.0081	.542
204a	MSp	1 010	570	1.30	4.80	.0121	1.85	.0023	.0085	.0097	.438
205	MRp	1 130	840	1.41	5.86	.0128	2.66	.0018	.0064	.0098	.643
205a	MRp	1 450	920	1.36	4.65	.0139	2.27	.0020	.0089	.0082	.662
206	MLSp	1 140	780	1.15	4.52	.0094	2.12	.0021	.0079	.0079	.790
206a	MLSp	1 530	1 000	1.40	5.99	.0072	2.70	.0021	.0094	.0094	.690
207	MLRp	1 760	1 760	1.36	5.75	.0139	1.86	.0021	.0052	.0084	.755
207a	MLRp	1 680	1 120	1.52	6.60	.0117	3.25	.0021	.0070	.0073	.665
208	M	730	640	1.17	6.04	.0094	3.23	.0023	.0127	.0093	.465
209	MLSpK	1 550	1 050	1.26	6.47	.0067	2.84	.0018	.0100	.0101	.495
209a	MLSpK	1 260	800	1.37	6.25	.0133	2.56	.0020	.0071	.0094	.592
210	MLRpK	1 550	940	1.36	5.68	.0161	2.60	.0018	.0129	.0070	.655
210a	MLRpK	1 510	1 120	1.32	5.00	.0133	1.29	.0019	.0104	.0074	.610

  

Plot	Treatment	Magnesium		Potassium		Manganese		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
201	None	.103	.284	.380	1.19	.0004	.0117	.186	.072	1.74	1.15
202E	ML	.085	.189	.350	1.11	.0004	.0088	.232	.081	1.56	1.12
202W	ML	.088	.188	.365	1.14	.0004	.0086	.248	.068	1.51	1.13
203	M	.058	.212	.325	0.92	.0004	.0146	.180	.056	1.77	.99
204	MSp	.082	.127	.357	1.05	.0005	.0177	.237	.068	1.33	.64
204a	MSp	.086	.138	.377	0.90	.0004	.0171	.250	.085	1.42	.70
205	MRp	.108	.181	.404	0.98	.0005	.0131	.228	.158	1.42	.77
205a	MRp	.091	.139	.379	0.81	.0005	.0108	.285	.099	1.32	.66
206	MLSp	.090	.228	.352	0.79	.0004	.0088	.237	.052	1.33	.74
206a	MLSp	.106	.251	.396	1.17	.0004	.0076	.298	.070	1.60	.88
207	MLRp	.092	.212	.360	1.06	.0005	.0092	.263	.076	1.60	.74
207a	MLRp	.117	.217	.394	1.31	.0004	.0093	.228	.141	1.51	.71
208	M	.084	.213	.375	1.03	.0004	.0098	.247	.070	1.37	.81
209	MLSpK	.087	.173	.344	1.21	.0004	.0088	.257	.075	1.40	.75
209a	MLSpK	.091	.179	.398	1.30	.0004	.0065	.235	.060	1.44	.94
210	MLRpK	.093	.196	.355	1.25	.0005	.0078	.220	.080	1.61	.97
210a	MLRpK	.095	.188	.392	1.24	.0005	.0058	.250	.070	1.80	1.05

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 21.—Yield and composition of open-pollinated corn (Reid Yellow Dent) grown on the Berea Soil Experiment Field, 1939  
(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
201	None	334	333	1.04	5.08	.0222	2.05	.0025	.0101	.0137	.526
202E	ML	1 190	865	1.35	4.98	.0111	1.81	.0020	.0090	.0090	.645
202W	ML	1 130	840	1.21	5.35	.0078	1.91	.0023	.0099	.0072	.644
203	M	273	388	1.21	5.02	.0216	2.19	.0024	.0094	.0119	.485
204	MSp	915	940	1.38	4.36	.0145	1.92	.0024	.0118	.0094	.446
204a	MSp	900	840	1.24	5.11	.0078	1.87	.0019	.0091	.0087	.533
205	MRp	1 280	1 120	1.47	4.86	.0150	1.79	.0018	.0091	.0070	.580
205a	MRp	1 140	1 070	1.33	4.77	.0072	2.04	.0017	.0073	.0108	.677
206	MLSp	1 300	1 040	1.51	6.26	.0122	2.38	.0023	.0086	.0116	.805
206a	MLSp	1 050	840	1.39	4.51	.0094	2.08	.0021	.0077	.0090	.583
207	MLRp	1 430	1 250	1.43	5.28	.0122	1.62	.0022	.0074	.0068	.623
207a	MLRp	1 340	1 100	1.41	5.38	.0078	2.12	.0022	.0064	.0087	.650
208	M	370	520	1.09	5.03	.0100	2.16	.0022	.0075	.0092	.430
209	MLSpK	1 470	1 100	1.33	6.08	.0128	2.50	.0016	.0099	.0078	.735
209a	MLSpK	960	800	1.30	5.24	.0122	1.90	.0018	.0079	.0079	.515
210	MLRpK	1 190	1 170	1.41	5.70	.0133	2.40	.0018	.0106	.0083	.558
210a	MLRpK	1 440	1 330	1.43	6.34	.0178	2.76	.0016	.0133	.0093	.614
Plot	Treatment	Magnesium		Potassium		Manganese		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
201	None	.083	.236	.349	0.83	.0005	.0126	.180	.071	1.71	1.19
202E	ML	.098	.155	.393	0.92	.0004	.0100	.256	.086	1.64	1.05
202W	ML	.090	.225	.338	0.94	.0003	.0077	.228	.061	1.60	1.01
203	M	.087	.176	.364	0.86	.0007	.0200	.202	.066	1.40	.75
204	MSp	.087	.101	.395	0.79	.0006	.0144	.285	.083	1.39	.62
204a	MSp	.088	.131	.347	1.00	.0006	.0149	.235	.074	1.49	.77
205	MRp	.101	.185	.372	1.09	.0008	.0108	.262	.190	1.39	.67
205a	MRp	.084	.188	.399	0.68	.0005	.0152	.268	.134	1.39	.83
206	MLSp	.098	.250	.390	0.93	.0005	.0097	.270	.104	1.56	1.01
206a	MLSp	.105	.192	.383	1.03	.0004	.0065	.273	.083	1.53	.68
207	MLRp	.097	.216	.403	1.03	.0004	.0081	.408	.152	1.43	.70
207a	MLRp	.093	.218	.401	0.92	.0005	.0065	.285	.150	1.37	.81
208	M	.087	.213	.318	1.00	.0004	.0068	.193	.071	1.39	.76
209	MLSpK	.090	.245	.397	0.68	.0005	.0076	.223	.077	1.45	.96
209a	MLSpK	.083	.219	.342	1.12	.0004	.0081	.208	.070	1.49	.75
210	MLRpK	.101	.189	.360	1.32	.0005	.0073	.282	.110	1.44	.73
210a	MLRpK	.095	.179	.398	1.33	.0006	.0084	.176	.128	1.39	.79

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 22.—Yield and composition of hybrid corn (Ky.D-69) produced on the Campbellsville Soil Experiment Field, 1939

(Yield stated as pounds per acre and composition as percent, oven-dry.)\*

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
202	None	950	880	1.23	5.40	—	2.03	.0015	.0113	.0068	.468
209	MSpKN	4 370	3 330	1.36	4.48	—	2.16	.0015	—	.0055	.397
210	M	2 970	2 100	1.29	5.23	—	3.14	.0025	.0187	.0069	.506
211	MBsKN	4 080	2 880	1.21	4.55	—	1.69	.0023	.0079	.0061	.500
217	MLSpKN	4 520	2 950	1.42	5.21	—	1.77	.0021	.0103	.0055	.538
218	MLBsKN	4 250	2 880	1.32	4.98	—	2.02	.0024	.0123	.0064	.635
801	M	2 550	1 570	1.11	5.48	—	2.15	.0019	.0110	.0045	.368
802	MSp (300 lb)	3 780	2 560	1.19	5.25	—	2.18	.0023	.0118	.0038	.490
803	MRp (600 lb)	3 840	2 790	1.17	4.50	—	1.23	.0024	.0061	.0040	.425
804	M	3 310	2 140	1.22	6.06	—	2.42	.0024	.0122	.0055	.418
805	MSp (900 lb)	4 050	2 740	1.39	4.45	—	1.56	.0021	.0080	.0054	.454
806	MRp (1800 lb)	4 630	2 630	1.52	4.10	—	1.30	.0021	.0077	.0055	.426
807	M	2 710	1 760	1.14	5.95	—	1.84	.0018	.0115	.0048	.395
808	MLSp (300 lb)	3 860	2 580	1.21	5.34	—	2.07	.0022	.0124	.0059	.533
809	MLRp (600 lb)	4 620	2 790	1.49	4.70	—	1.45	.0017	.0069	.0067	.580
810	M	2 580	1 730	1.08	5.85	—	2.15	.0016	.0166	.0067	.421
811	MLSp (900 lb)	3 840	2 740	1.19	4.94	—	1.69	.0020	.0077	.0055	.548
812	MLRp (1800 lb)	4 480	2 860	1.32	4.40	—	1.33	.0024	.0084	.0055	.495
813	M	2 430	1 640	1.09	6.50	—	2.96	.0016	.0210	.0053	.488
814	MRp (1200 lb)	4 560	2 980	1.35	4.60	—	1.55	.0023	.0129	.0059	.510
815	MLRp (1200 lb)	4 600	2 860	1.58	4.90	—	1.52	.0021	.0153	.0067	.518
816	M	2 300	1 560	1.06	5.30	—	1.88	.0015	.0132	.0049	.380

  

Plot	Treatment	Magnesium		Potassium		Manganese		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
202	None	.085	.250	.350	1.48	.0002	.0081	.182	.062	1.77	1.20
209	MSpKN	.078	.256	.320	1.44	.0002	.0081	.240	.072	1.56	0.88
210	M	.092	.281	.372	1.36	.0005	.0095	.227	.074	1.58	1.08
211	MBsKN	.105	.227	.332	1.34	.0004	.0054	.264	.065	1.65	0.94
217	MLSpKN	.098	.273	.387	1.22	.0004	.0054	.279	.067	1.55	0.90
218	MLBsKN	.102	.300	.395	1.17	.0004	.0068	.279	.074	1.72	1.07
801	M	.077	.272	.379	1.70	.0004	.0105	.207	.068	1.62	0.88
802	MSp (300 lb)	.090	.300	.372	1.33	.0005	.0130	.256	.075	1.62	0.89
803	MRp (600 lb)	.090	.334	.347	1.28	.0004	.0068	.263	.069	1.64	0.78
804	M	.072	.246	.310	1.77	.0003	.0086	.190	.073	1.54	1.05
805	MSp (900 lb)	.093	.298	.388	1.04	.0003	.0095	.258	.088	1.62	0.99
806	MRp (1800 lb)	.092	.321	.384	1.05	.0003	.0073	.277	.088	1.52	0.85
807	M	.069	.275	.319	1.59	.0002	.0092	.176	.064	1.54	1.11
808	MLSp (300 lb)	.079	.280	.340	1.31	.0002	.0081	.213	.070	1.63	1.08
809	MLRp (600 lb)	.108	.282	.372	1.19	.0003	.0086	.292	.082	1.62	0.93
810	M	.084	.240	.309	1.50	.0004	.0100	.210	.062	1.62	1.10
811	MLSp (900 lb)	.095	.308	.362	1.01	.0004	.0086	.250	.066	1.45	0.95
812	MLRp (1800 lb)	.091	.317	.356	1.18	.0004	.0075	.292	.094	1.56	0.75
813	M	.078	.278	.321	1.67	.0004	.0127	.198	.073	1.67	1.18
814	MRp (1200 lb)	.106	.362	.364	1.10	.0006	.0066	.310	.093	1.57	1.00
815	MLRp (1200 lb)	.121	.304	.400	1.11	.0008	.0073	.370	.121	1.64	1.17
816	M	.070	.266	.280	1.72	.0003	.0094	.175	.048	1.70	0.93

\* Missing values in tables indicate that samples were lost or results were unacceptable.

Table 23.—Yield and composition of open-pollinated corn (Pride of Saline) produced on the Campbellville Soil Experiment Field, 1939

(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
202	None	630	850	1.08	5.19	.....	2.20	.0019	.0132	.0049	.452
209	MSPKN	4 440	3 680	1.40	4.50	.....	1.81	.0016	.0081	.0049	.392
210	M	2 920	2 220	1.45	5.23	.....	2.10	.0026	.0084	.0074	.414
211	MBsKN	4 170	3 320	1.18	4.55	.....	1.73	.0020	.0088	.0055	.410
217	MLSpKN	4 350	3 350	1.29	5.21	.....	1.75	.....	.0101	.0059	.520
218	MLBsKN	4 100	3 150	1.45	.....	.....	2.24	.0022	.....	.0081	.566
801	M	2 710	1 770	1.28	4.98	.....	1.42	.0019	.0105	.0045	.275
802	MSp (300 lb)	3 660	2 680	1.15	3.32	.....	0.90	.0022	.0050	.0037	.256
803	MRp (600 lb)	4 150	2 970	1.31	5.25	.....	2.00	.0024	.0081	.0044	.553
804	M	3 000	1 880	0.99	5.76	.....	2.24	.0016	.0110	.0050	.415
805	MSp (900 lb)	3 900	2 440	1.44	4.56	.....	1.53	.0020	.0107	.0054	.425
806	MRp (1800 lb)	4 180	3 260	1.63	4.55	.....	1.20	.0018	.0075	.0039	.438
807	M	3 080	2 040	1.09	4.92	.....	1.55	.0017	.0090	.0048	.354
808	MLSp (300 lb)	3 770	2 590	1.18	4.24	.....	1.46	.0020	.0079	.0048	.473
809	MLRp (600 lb)	4 250	2 900	1.28	5.10	.....	2.07	.0017	.0125	.0055	.600
810	M	2 620	1 730	1.07	5.00	.....	2.25	.0015	.0157	.0061	.398
811	MLSp (900 lb)	3 740	2 640	1.15	4.63	.....	1.83	.0018	.0092	.0053	.574
812	MLRp (1800 lb)	4 200	3 030	1.19	4.47	.....	1.50	.0017	.0098	.0049	.545
813	M	2 970	2 040	1.13	4.94	.....	2.10	.0018	.0098	.0059	.452
814	MRp (1200 lb)	3 660	2 730	1.32	4.81	.....	1.93	.0030	.0086	.0067	.622
815	MLRp (1200 lb)	3 900	2 770	1.10	4.75	.....	1.55	.0025	.0099	.0064	.662
816	M	2 800	1 820	1.06	5.56	.....	1.90	.0015	.0108	.0055	.378

  

Plot	Treatment	Magnesium		Potassium		Manganese		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
202	None	.082	.278	.263	1.15	.0004	.0086	.185	.084	1.66	1.17
209	MSPKN	.121	.191	.362	1.20	.0004	.0079	.316	.066	1.55	0.81
210	M	.115	.262	.364	1.28	.0008	.0090	.249	.056	1.65	0.91
211	MBsKN	.100	.258	.321	0.99	.0006	.0077	.275	.066	1.77	0.90
217	MLSpKN	.107	.275	.342	1.14	.0005	.0043	.269	.070	1.64	0.90
218	MLBsKN	.124	.314	.380	1.00	.0006	.0063	3.09	.076	1.75	1.15
801	M	.095	.207	.372	1.54	.0005	.0077	.230	.041	1.53	0.84
802	MSp (300 lb)	.105	.183	.346	1.04	.0007	.0068	.282	.044	1.71	0.63
803	MRp (600 lb)	.115	.283	.344	1.13	.0006	.0152	.306	.100	1.70	0.98
804	M	.075	.258	.265	1.56	.0004	.0122	.188	.058	1.60	1.11
805	MSp (900 lb)	.113	.273	.371	1.06	.0005	.0090	.297	.079	1.70	0.93
806	MRp (1800 lb)	.099	.287	.370	0.95	.0006	.0112	.263	.086	1.75	0.86
807	M	.077	.252	.320	1.28	.0002	.0090	.191	.049	1.60	0.87
808	MLSp (300 lb)	.088	.279	.317	1.03	.0003	.0059	.210	.073	1.59	0.99
809	MLRp (600 lb)	.110	.300	.317	0.91	.0003	.0105	.275	.095	1.64	1.08
810	M	.078	.271	.314	1.21	.0005	.0098	.204	.068	1.65	1.00
811	MLSp (900 lb)	.105	.238	.305	0.93	.0005	.0086	.265	.080	1.80	0.99
812	MLRp (1800 lb)	.088	.316	.266	0.90	.0004	.0090	.228	.131	1.76	1.08
813	M	.090	.300	.351	1.35	.0006	.0115	.243	.064	1.64	0.94
814	MRp (1200 lb)	.110	.316	.288	0.80	.0005	.0126	.312	.114	1.71	.087
815	MLRp (1200 lb)	.095	.319	.302	0.87	.0005	.0081	.250	.126	1.56	1.01
816	M	.081	.284	.260	1.60	.0005	.0081	.188	.064	1.66	1.08

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 24.—Yield and composition of hybrid corn (Ky.Y-101) grown on the Berea Soil Experiment Field, 1940

(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield <sup>a</sup>		Silica, stover	Calcium, stover	Magnesium, stover	Potassium, stover	Manganese, stover	Phosphorus		Nitrogen, stover
		Grain	Stover						Grain	Stover	
301	None	365	495	2.93	.410	.283	0.68	.0176	.180	.063	1.28
302E	ML	3 420	1 700	---	---	---	---	---	---	---	---
302W	ML	3 010	1 950	2.41	.375	.278	0.82	.0063	.190	.054	0.82
303	M	1 050	700	2.64	.423	.283	1.13	.0358	.152	.080	1.14
304	MSp	2 780	1 290	---	---	---	---	---	---	---	---
304a	MSp	2 320	1 100	---	---	---	---	---	---	---	---
305	MRp	3 280	2 150	1.94	.544	.160	0.72	.0135	.313	.140	0.74
305a	MRp	3 390	1 930	2.08	.462	.169	1.24	.0125	.278	.155	0.97
306	MLSp	3 600	2 140	---	---	---	---	---	---	---	---
306a	MLSp	2 900	1 790	---	---	---	---	---	---	---	---
307	MLRp	3 840	2 350	2.18	.642	.242	0.71	.0054	.296	.117	---
307a	MLRp	3 820	2 210	---	---	---	---	---	---	---	---
308	M	1 250	790	2.28	.405	.222	1.31	.0266	.202	.078	1.10
309	MLSpK	3 480	2 010	---	---	---	---	---	---	---	---
309a	MLSpK	3 100	1 790	1.39	.483	.172	1.06	.0054	.200	.054	0.84
310	MLRpK	4 070	2 480	---	---	---	---	---	---	---	---
310a	MLRpK	3 750	2 210	---	---	---	---	---	---	---	---

<sup>a</sup> Many of the samples of this group were damaged and lost in storage before analyses were completed.

Table 25.—Yield and composition of hybrid corn (Ky.D-69) grown on the Campbellsville Soil Experiment Field, 1940

(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield		Silica, stover	Calcium, stover	Magnesium, stover	Potassium, stover	Manganese, stover	Phosphorus		Nitrogen	
		Grain	Stover						Grain	Stover	Grain	Stover
302	None	630	820	2.77	.444	.322	1.27	.0113	.155	.062	1.55	1.16
309	MSpKN	3 430	2 210	2.41	.567	.293	1.43	.0131	.095	.078	1.46	1.16
310	M	2 380	1 420	2.62	.570	.274	1.33	.0158	.090	.062	1.39	1.15
311	MBsKN	2 820	1 810	2.20	.564	.307	1.15	.0113	.126	.059	1.45	1.05
317	MLSpKN	3 020	1 960	1.32	.600	.281	0.99	.0090	---	.087	---	0.90
318	MLBsKN	2 860	1 960	1.21	.568	.302	1.00	.0050	.200	.054	1.61	0.88
901	M	1 720	1 000	1.77	.379	.258	1.51	.0121	.181	.068	1.43	1.19
902	MSp (300 lb)	2 720	1 430	1.91	.499	.286	1.25	.0126	.213	.062	1.60	1.10
903	MRp (600 lb)	3 160	1 860	1.43	.640	.314	1.10	.0117	.189	.095	1.53	0.95
904	M	1 750	1 000	1.75	.456	.306	1.26	.0167	.173	.052	1.56	0.99
905	MSp (900 lb)	2 580	1 400	1.69	.623	.283	0.99	.0194	.164	.060	1.41	0.91
906	MRp (1800 lb)	2 990	1 890	1.48	.668	.298	0.90	.0180	.296	---	1.57	0.90
907	M	1 780	1 200	1.83	.597	.295	1.44	.0153	.140	---	1.53	1.06
908	MLSp (300 lb)	2 730	1 780	2.01	.642	.292	1.00	.0126	.260	.063	1.77	0.99
909	MLRp (600 lb)	3 140	1 960	1.92	.355	.349	1.29	.0126	.145	.092	1.53	1.14
910	M	1 480	1 060	2.07	.467	.313	1.41	.0167	.183	.056	1.71	1.21
911	MLSp (900 lb)	2 450	1 600	2.38	.622	.321	1.08	.0121	.144	.065	1.54	1.14
912	MLRp (1800 lb)	3 180	1 940	1.47	.692	.358	0.98	.0121	.215	.080	1.53	1.08
913	M	2 090	1 230	1.89	.427	.307	1.50	.0144	.178	.056	1.56	0.99
914	MRp (1200 lb)	3 260	2 030	1.54	.602	.349	1.10	.0117	.169	.098	1.46	1.00
915	MLRp (1200 lb)	3 000	2 080	1.51	.650	.366	1.06	.0100	.160	.082	1.56	1.02
916	M	1 810	1 180	2.40	.615	.338	1.44	.0153	.154	.061	1.56	1.14

<sup>a</sup> Many of the samples of this crop were damaged and lost in storage before analyses were completed.

Table 26.—Yield and composition of hybrid corn (Ky.Y-101) grown on the Berea Soil Experiment Field, 1941  
(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre		Ash		Silica		Iron		Calcium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
401	None	305	458	1.16	5.58	.0422	2.61	.0031	.0129	.0115	.420
402E	ML	2 624	2 024	1.22	6.09	.0170	2.70	.0022	.0075	.0083	.535
402W	ML	2 570	2 024	1.15	6.04	.0204	2.52	.0023	.0080	.0098	.555
403	M	922	862	1.11	6.15	.0202	2.80	.0023	.0106	.0092	.405
404	MSp	2 480	2 006	1.29	5.14	.0200	2.25	.0038	.0080	.0069	.392
404a	MSp	1 850	1 526	0.99	6.00	.0216	2.50	.0026	.0075	.0075	.388
405	MRp	3 190	2 482	1.36	5.05	.0170	1.93	.0020	.0082	.0078	.443
405a	MRp	3 000	2 196	1.64	5.45	.0210	2.16	.0023	.0071	.0083	.655
406	MLSp	3 606	2 578	1.33	5.40	.0167	2.27	.0022	.0080	.0079	.635
406a	MLSp	3 060	2 368	1.65	6.02	.0200	2.86	.0026	.0083	.0095	.602
407	MLRp	4 040	2 788	1.46	5.10	.0210	1.86	.0028	.0064	.0091	.562
407a	MLRp	3 568	2 578	1.94	5.18	.0216	2.09	.0026	.0063	.0072	.583
408	M	966	871	1.05	4.60	.0162	1.81	.0024	.0060	.0081	.378
409	MLSpK	3 229	2 425	1.18	4.94	.0140	2.19	.0022	.0088	.0072	.540
409a	MLSpK	2 369	1 871	1.34	5.06	.0146	2.04	.0023	.0064	.0092	.563
410	MLRpK	3 285	2 349	1.58	4.56	.0170	1.56	.0022	.0054	.0082	.522
410a	MLRpK	3 000	2 063	1.00	4.94	.0160	2.01	.0016	.0095	.0067	.557

  

Plot	Treatment	Magnesium		Potassium		Manganese		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
401	None	.106	.254	.324	.95	.0009	—	.202	.093	1.47	.90
402E	ML	.088	.191	.374	1.28	.0006	—	.244	.071	1.24	.53
402W	ML	.094	.218	.344	1.08	.0005	—	.181	.044	1.31	.61
403	M	.087	.254	.355	1.34	.0005	—	.167	.058	1.20	.73
404	MSp	.095	.188	.343	1.15	.0006	—	.226	.068	1.23	.54
404a	MSp	.124	.203	.465	1.33	.0005	—	.321	.084	1.18	.59
405	MRp	.108	.180	.435	1.18	.0006	—	.332	.118	1.30	.59
405a	MRp	.105	.197	.408	.90	.0006	—	.286	.118	1.16	.71
406	MLSp	.090	.242	.357	.85	.0005	—	.217	.060	1.45	.76
406a	MLSp	.077	.195	.292	1.11	.0006	—	.183	.059	1.37	.66
407	MLRp	.120	.174	.420	.81	.0006	—	.317	.093	1.41	.81
407a	MLRp	.112	.170	.458	.97	.0006	—	.374	.110	1.38	.57
408	M	.114	.188	.394	1.21	.0006	—	.209	.046	1.21	.63
409	MLSpK	.085	.141	.323	1.14	—	—	.192	.066	1.39	.61
409a	MLSpK	.109	.162	.386	1.14	.0003	—	.236	.050	1.35	.68
410	MLRpK	.096	.172	.373	1.08	.0003	—	.242	.092	1.24	.61
410a	MLRpK	.110	.163	.260	1.17	.0002	—	.160	.104	1.27	.68

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

Table 27.—Yield and composition of hybrid corn (Ky.D-69) grown on the Cambridgeville Soil Experiment Field, 1941  
(Yield stated as pounds per acre and composition as percent, oven-dry.)<sup>a</sup>

Plot	Treatment	Yield per acre <sup>c</sup>		Ash		Silica		Iron		Calcium	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
102	None	1 627	1 381	0.96	5.35	.0211	2.06	.0031	.0072	.0083	.425
109	MSpKN	4 115	2 788	1.17	4.64	.0200	1.49	.0029	.0097	.0059	.475
110	M	2 340	1 718	1.05	5.79	.0246	2.30	.0029	.0133	.0078	.498
111	MBsKN	3 828	2 525	1.14	4.57	.0184	1.39	.0027	.0082	.0055	.450
117	MLSpKN	4 576	2 649	1.30	4.86	.0206	1.63	.0029	.0097	.0075	.600
118	MLBsKN	4 237	2 516	1.16	4.76	.0187	1.48	.0023	.0126	.0062	.593
701	M	2 036	1 615	1.08	5.02	.0200	1.76	.0032	.0098	.0071	.498
702	MSp (300 lb)	3 852	2 450	1.41	4.77	.0206	1.72	.0029	.0098	.0061	.392
703	MRp (600 lb)	4 176	2 579	1.29	4.00	.0173	1.37	.0025	.0076	.0066	.395
704	M	2 391	1 700	1.16	4.29	.0189	1.70	.0027	.0083	.0082	.376
705	MSp (900 lb)	3 570	2 207	1.29	3.68	.0184	1.15	.0029	.0087	.0077	.356
706	MRp (1800 lb)	4 173	2 598	1.46	3.70	.0189	1.15	.0029	.0066	.0065	.442
707	M	2 568	1 690	1.64	5.13	.0189	1.84	.0024	.0075	.0080	.410
708	MLSp (300 lb)	3 800	2 260	1.20	4.68	.0151	1.46	.0028	.0080	.0081	.470
709	MLRp (600 lb)	4 228	2 689	1.28	4.68	.0135	1.42	.0019	.0073	.0078	.490
710	M	2 506	1 658	1.50	6.60	.0210	2.06	.0026	.0078	.0061	.431
711	MLSp (900 lb)	3 727	2 249	1.00	4.48	.0110	1.35	.0018	.0062	.0055	.482
712	MLRp (1800 lb)	4 385	2 798	1.53	4.60	.0195	1.41	.0029	.0076	.0071	.566
713	M	2 645	1 848	1.20	4.95	.0195	1.56	.0025	.0069	.0065	.416
714	MRp (1200 lb)	4 333	2 693	1.57	4.61	.0210	1.47	.0028	.0084	.0063	.520
715	MLRp (1200 lb)	4 315	2 598	1.30	3.67	.0169	1.00	.0029	.0072	.0057	.426
716	M	3 007	1 975	1.21	4.14	.0173	1.34	.0025	.0076	.0060	.383

  

Plot	Treatment	Magnesium		Potassium		Manganese		Phosphorus		Nitrogen	
		Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover	Grain	Stover
102	None	.102	.288	.370	1.38	.0005	.0032	.202	.045	1.36	.63
109	MSpKN	.096	.230	.368	1.51	.0004	.0022	.256	.071	1.56	.90
110	M	.090	.299	.329	1.66	.0003		.170	.072	1.56	.78
111	MBsKN	.105	.278	.378	1.60	.0004	.0065	.235	.070	1.70	.82
117	MLSpKN	.113	.254	.363	1.33	.0004	.0054	.247	.079	1.55	.87
118	MLBsKN	.116	.252	.370	1.37	.0004	.0054	.240	.071	1.65	.90
701	M	.121	.254	.366	1.38	.0004	.0075	.208	.047	1.58	.68
702	MSp (300 lb)	.100	.301	.377	1.20	.0005	.0097	.254	.073	1.47	.68
703	MRp (600 lb)	.115	.308	.330	.84	.0005	.0086	.236	.093	1.46	.77
704	M	.103	.290	.362	1.20	.0005	.0097	.196	.049	1.49	.67
705	MSp (900 lb)	.096	.315	.355	1.13	.0005	.0060	.229	.057	1.42	.61
706	MRp (1800 lb)	.112	.275	.401	1.20	.0005	.0100	.295	.103	1.55	.80
707	M	.095	.263	.344	2.02	.0005	.0107	.200	.057	1.36	.72
708	MLSp (300 lb)	.105	.247	.338	1.93	.0005	.0092	.214	.054	1.54	.90
709	MLRp (600 lb)	.096	.284	.324	1.67	.0005	.0081	.230	.090	1.54	1.01
710	M	.097	.277	.432	2.11	.0006	.0119	.227	.052	1.55	.86
711	MLSp (900 lb)	.092	.254	.351	1.76	.0004	.0060	.184	.049	1.57	.88
712	MLRp (1800 lb)	.119	.282	.398	1.78	.0006	.0076	.295	.086	1.55	.92
713	M	.101	.230	.362	2.16	.0005	.0097	.206	.052	1.45	.61
714	MRp (1200 lb)	.107	.273	.394	1.98	.0004	.0107	.298	.130	1.45	.87
715	MLRp (1200 lb)	.117	.277	.344	1.60	.0005	.0054	.256	.084	1.60	.82
716	M	.096	.248	.356	2.11	.0005	.0097	.172	.066	1.44	.70

<sup>a</sup> Missing values in tables indicate that samples were lost or results were unacceptable.

## SUMMARY

From the results of four studies made at different times, on the chemical composition of corn crops grown on Kentucky soils, it was evident that composition is influenced by environment and is fully as variable as yield. The factors found to have greatest effect on composition as well as on yield were seasonal or weather conditions, soil, soil management, fertilizer practice, and to a lesser extent varietal differences. Each factor had its own peculiar effect on composition, but because so many were involved, it is difficult to determine the exact part played by each in the net result. For this reason definite explanation of many of the chemical relationships involved must wait until a more exact measure of each factor can be obtained.

In two early studies, samples of corn grain and stover were collected and analyzed from treated and untreated plots on the Experiment Station farm at Lexington and certain of the soil experiment fields in different parts of the state. In the third study, a number of samples of grain were collected from farmers' fields in ten counties in central and western Kentucky. Results from these studies showed particularly that composition of corn crops from widely scattered areas of the state varied because of soil fertility and fertilizer treatment. Phosphorus, calcium, and nitrogen particularly were affected in the crops represented and potassium to a lesser extent. In the latest and most comprehensive study, yield data were taken and grain and stover samples collected and analyzed each year from all plots at the Berea soil experiment field from 1938 to 1941, and from all plots of the phosphate tests and six plots of the general fertilizer test at the Campbellsville field from 1937 to 1941. Until 1940, two varieties of corn were grown on each field, both of which were sampled and analyzed separately. Analyses were made for total ash, silica, iron, calcium, magnesium, potassium, manganese, phosphorus, nitrogen, sulfur, chlorine, crude fat, and crude fiber.

Yield and composition were markedly different at the two fields, indicating that soil conditions and weather effects were quite different. From year to year there was appreciable variation that bore no close relationship either to weather or to variations in yield, and that was largely independent of soil treatment.

The effects of liming, fertilizer treatments, and other soil-management practices on yield and composition of the crop were approximately the same at the two fields. The effect of these things on composition with respect to all the major nutrients was usually one of enrichment. The amount of a given nutrient absorbed was influenced

by the amount available in the soil, whether it was added in fertilizers or its availability was affected indirectly by some fertilizer or soil management practice. Addition of limestone usually caused an increase in the calcium content of the crop, the increase being greater in stover than in grain. Potassium and phosphorus content of the crop tended to be lower on limed plots than on the corresponding unlimed plots, though differences were not very great. Nitrogen content was higher in crops from limed plots, but content of magnesium, iron, or manganese was not consistently influenced by liming.

Of all soil treatments, phosphate fertilization had greatest effect on crop growth and composition. Yield and phosphorus content were increased by phosphate applications almost in proportion to the amount used.

Applications of potash and nitrogen fertilizers had little effect on corn yields and slight effect on composition. Potassium tended to be slightly higher in stover from plots where yields were comparatively low and the drain on potassium was not great. Manure was effective, along with the rotation used, in maintaining nitrogen at a satisfactory level, and so far as corn was concerned it was sufficient to maintain fairly adequate supplies of potassium in the soil.

Other nutrient elements in the crop were not consistently affected by any of the factors studied.

As to the bearing of the findings of these studies on practical fertilizer practices in Kentucky, it would seem that regular application of substantial amounts of phosphate fertilizers to crops grown in rotation on phosphate-deficient soil in Kentucky will remove phosphorus as a limiting factor in corn production. If the soil protected from erosion is limed when necessary, and if the potassium removed in the crops is replaced, and if livestock manures and crop residues are returned, the fertility of the soil will constantly be improved and the composition of the crop, particularly in calcium, phosphorus, nitrogen, and potassium, will be maintained at a high level. This is the conclusion indicated by these data, though full and definite proof of it must await further data that will be accumulated in the continuation of these studies.

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