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Introduction

BURLEY tobacco production is an important source of income for many farmers in southwestern West Virginia. Production is centered around the Huntington tobacco market. Although the acreage has declined during recent years, burley tobacco is still the most important cash crop in the area.

Tobacco experiments were initiated in 1913* when eight varieties were compared at Milton. Fertilizer tests,* started in 1914, showed yield increases from applications of manure and from nitrogen, phosphorus, and potash fertilizers. The experimental work reported here was started in 1940 to study the effect of various rates and ratios of fertilizers on the yield and quality of tobacco.

Experimental Methods

The tests were conducted at the Lakin Experimental Substation on Wheeling loam soil of moderate fertility. A three-year rotation of tobacco, wheat, and clover and timothy was used with each crop being grown each year in triplicate for each treatment. The varieties used were Kentucky 16 burley tobacco, Thorne wheat, and commercial red clover and timothy. The tobacco plants were grown in a tobacco plant bed and transplanted in the normal manner. The rows were spaced 15 inches apart with plants 15 inches apart in rows. Each plot consisted of 7 rows with 12 plants plants per row. Only the central 50 plants were harvested for yield. The tobacco was cured, graded, and sold on the Huntington market; results for tobacco are available, therefore, for yield in pounds per acre and for value in dollars per acre.

The nitrogen was applied in the form of urea, the phosphate as 15 per cent superphosphate, and the potash as a mixture in which 20 pounds of the potash were obtained from muriate of potash (KCl) and the balance from sulfate of potash (K_2SO_4) except in the lowest (25-pound) rate where one-half of the potash was from each source. These

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fertilizers were applied to the tobacco crop in narrow bands on each side of the row. Manure, where used, was applied broadcast and plowed under. Magnesium sulfate, sodium borate (borax), manganese sulfate and calcium sulfate were applied to the soil surface after plowing.

Experimental Results, 1940-46

In the initial tests (1940-46), three rates of nitrogen, three rates of phosphate, and three rates of potash were applied in all possible combinations. The results are given in Tables 1 and 2. Increased rates of nitrogen, up to 50 pounds per acre, produced significant increases in yield and value of the crop. Phosphate fertilizer had no effect on yield but did show a tendency to increase value, although this was below significance at the 5 per cent level. Potash fertilizer increased yield and value of tobacco, with highest results being secured at the highest rates

Table 1. Summary of the Effect of Fertilizer on Yield and Value of Tobacco 1940-46

Fertilizer Treatment	Yield Pounds Per Acre	Value Dollars Per Acre	Calculated Price Cents Per Pound
12.5 lbs. N	1397	506	36.2
25 lbs. N	1475	536	36.3
50 lbs. N	1550	564	36.4
25 lbs. P_2O_5	1460	527	36.1
50 lbs. P_2O_5	1482	537	36.2
100 lbs. P_2O_5	1479	542	36.6
25 lbs. K_2O	1422	510	35.8
50 lbs. K_2O	1474	538	36.5
100 lbs. K_2O	1525	558	36.6
L.S.D. 5%	68	16	

Table 2. Summary of the Residual Effect of Fertilizer on Yields of Wheat and Hay

Fertilizer Treatment	Wheat (1941-47) Bu. Per. Acre	Hay (1942-48) Tons Per Acre
12.5 lbs. N	20.9	1.73
25 lbs. N	21.2	1.75
50 lbs. N	21.6	1.74
25 lbs. P_2O_5	20.4	1.68
50 lbs. P_2O_5	21.5	1.73
100 lbs. P_2O_5	21.8	1.81
25 lbs. K_2O	20.9	1.74
50 lbs. K_2O	21.5	1.71
100 lbs. K_2O	21.4	1.77
L.S.D. 5%	0.4	0.08

of application. The quality of the tobacco, as measured by price per pound, appeared to increase slightly as the amounts of nitrogen, phosphorus, and potassium were increased. All three ingredients—nitrogen, phosphorus and potassium—had some residual effect on wheat yields but only phosphorus influenced the yield of hay.

A separate experiment consisting of nine treatments in triplicate was conducted to determine the effect of (1) omitting all fertilizer, (2) omitting one of the ingredients of mixed fertilizer, and (3) adding certain other nutrient elements.

Average yields and values for all years are given in Table 3. Variability was so great that differences were not significant during most years. However, the unfertilized plot always produced the lowest yield and value; as an average of all years, it was significantly lower in yield and value than any of the fertilized plots. When either nitrogen or potash were omitted there were significantly lower yields and values. Omission of phosphate resulted in lower value of tobacco than was secured with a complete fertilizer. Magnesium sulfate, borax, manganese sulfate or calcium sulfate had no effect on yield or value.

The residual effect of the miscellaneous treatments on wheat and hay yields are given in Table 4. These showed no significant effect in any one year but the average effect is significant. The lowest yields were secured from the unfertilized plots or from those without phosphorus.

Experimental Results, 1947-52

The results of these experiments indicated that higher rates of fertilization might have given higher yields and greater gross returns

Table 3. The Yield, Value, and Price Per Pound of Tobacco as Influenced by Fertilizers

Miscellaneous treatments

Treatment			Yield Pounds Per Acre	Value Dollars Per Acre	Average Price Per Pound
N	P_2O_5	K_2O			
0	0	0	1204	402	33.5
25	50	0	1377	485	35.2
25	0	50	1444	487	33.7
0	50	50	1356	486	35.8
25	50	50 + $MgSO_4$	1463	505	34.5
25	50	50 + Borax	1495	427	35.3
25	50	50 + $MnSO_4$	1446	501	34.6
25	50	50 + $CaSO_4$	1521	558	36.7
25	50	50	1510	555	36.8
L.S.D. 5%			126	53	

$MgSO_4$—50 pounds per acre; Borax—10 pounds per acre; $MnSO_4$—50 pounds per acre; $CaSO_4$—100 pounds per acre.

Table 4. Summary of Residual Effect of Fertilizers on Yield of Wheat and Hay

Treatment, Lbs. Per Acre N	P_2O_5	K_2O	Wheat (Bu. Per Acre) 1941-47	Hay (Tons Per Acre) 1942-48
0	0	0	19.5	1.36
25	50	0	22.1	1.53
25	0	50	19.7	1.48
0	50	50	21.3	1.74
25	50	50 + $MgSO_4$	20.8	1.66
25	50	50 + Borax	21.7	1.64
25	50	50 + $MnSO_4$	20.4	1.54
25	50	50 + $CaSO_4$	22.3	1.75
25	50	50	22.7	1.72
L.S.D. 5%			1.5	.23

$MgSO_4$—50 pounds per acre; Borax—10 pounds per acre; $MnSO_4$—50 pounds per acre; $CaSO_4$—100 pounds per acre.

per acre. Furthermore, it is common practice among farmers in the area to apply manure to the land before planting tobacco. In order to secure information on manuring and heavier rates of fertilization, the experiment was revised following the 1946 tobacco harvest. The rates of nitrogen were increased to 40, 80, and 120 pounds per acre and the rates of potash were increased to 80, 160, and 240 pounds per acre. All plots were treated with 200 pounds of P_2O_5 per acre (445 pounds of 45 per cent superphosphate), and the plots previously used to measure response to phosphate were treated with 0, 10, or 20 tons of manure per acre. The manure was broadcast before plowing and plowed under. The general procedure was the same as previously used in all other respects.

Yield of Tobacco

The effect of the various rates of manure, nitrogen, and potash on yields of tobacco is given by years in Table A (Appendix). Results for 1950 are not included because some of the crop was lost on certain plots during a wet period in the growing season and the stand remaining on certain other plots was too poor to provide reliable yield information.

Analysis of variance of the data showed significant effect of treatment for each year and for the five-year average. The highest yields were always obtained on the plots which received at least 10 tons of manure, 80 pounds of nitrogen, and in four of the five years, from the plots receiving at least 160 pounds of K_2O. As an average of all years, the highest yield was obtained from the plot which received 10 tons of manure, 120 pounds of nitrogen, and 160 pounds of potash per acre.

The average results showing the effect of the three rates of nitrogen, potash, and manure are given in Table 5. From this table it may be

Table 5. The Effect of Fertilizer and Manure on Tobacco Yield and Value 1947-1952

Fertilizer Treatment	Yield Pounds Per Acre	Value Dollars Per Acre	Calculated Price Cents Per Pound
40 lbs. N	2233	1023	45.8
80 lbs. N	2426	1104	45.4
120 lbs. N	2501	1105	44.3
No Manure	2221	990	44.5
10 Tons Manure	2448	1105	45.1
20 Tons Manure	2492	1138	45.7
80 lbs. K_2O	2340	1057	45.1
160 lbs. K_2O	2405	1090	45.3
240 lbs. K_2O	2416	1087	45.0
L.S.D. 5%	63	33	

seen that increasing the rate of nitrogen from 40 to 80 pounds per acre raised the yield of tobacco by 193 pounds. The next 40 pounds (80 to 120 pounds N) gave a further increase of 75 pounds of tobacco per acre. Both of these increases are significant at the 5 per cent level. The lower effect of the 120-pound rate of application of nitrogen indicates that this rate is approaching the maximum for yield of tobacco under the conditions of this experiment.

Application of 10 tons of manure per acre increased tobacco production by 227 pounds per acre. Manure at 20 tons per acre gave an increase of only 44 pounds of tobacco over the 10-ton rate. This is less than the 63 pounds required to be significant at the 5 per cent level.

The effect of potash was not as great as that of nitrogen or manure. However, the increase of 65 pounds of tobacco for the 160-pound application over the 80-pound application is significant. The increase of 11 pounds for the next rate is so small that it is probably the result of plot variation.

Value of Tobacco

The influence of treatment on value of tobacco by years is given in Table B (Appendix). Highest values per acre were produced each year on the plots receiving 10 to 20 tons of manure, with 80 to 120 pounds of nitrogen, and 80 to 160 pounds of potash per acre. For the five-year period the highest value was obtained with the treatment of 20 tons of manure, and 80 pounds of nitrogen and 160 pounds of potash per acre.

The average effect of the various rates of application of manure, nitrogen, and potash are summarized in Table 5. These data show that increasing the nitrogen application from 40 to 80 pounds per acre in-

creased the value per acre by $81.00. Further increase in nitrogen application had little effect on value. As may be noted in the table the increase in yield was offset by a decrease in quality as indicated by the lower average price per pound. This decrease was the result of a larger proportion of low quality tobacco, particularly tips, which brought a low price per pound.

The application of 10 tons of manure increased the acre value by $115.00. This was the result of both increased yield and better quality as indicated by the increase in average price per pound. The next increment of manure increased value by $33.00 per acre. This was the result of a small increase in both yield and quality. Inasmuch as the increased value is exactly the same as the L.S.D. at the 5 per cent level it appears that 20 tons of manure are about the maximum which should be used under conditions similar to those encountered in this experiment.

The data in Table 5 which show average results do not give a complete picture of the effect of nitrogen and manure. Analysis of the data showed that there was an interaction between nitrogen and manure. The effect of manure on the response from nitrogen is shown in Figure 1. Increased rates of nitrogen increased both yield and value when no manure was applied. When 10 tons of manure were applied per acre the application of 80 pounds of nitrogen also increased both yield and value. The 120-pound application increased yield but had little effect on value because of lowered quality. When 20 tons of manure were applied, more than 80 pounds of nitrogen caused a decrease in both yield and value per acre. Quality, as measured by price per pound, was highest with the 20-ton application of manure with 40 pounds of nitrogen.

The inter-relationship between manure and nitrogen suggested that a considerable part of the effect of manure might be the result of the nitrogen which it furnished. In order to test this, yield and value curves were calculated from the unmanured plots to cover the range of available nitrogen which might be furnished by the manure and the nitrogen fertilizer applied. These curves are shown in Figure 2, in which the points for the 40, 80, and 120 pounds of nitrogen applied as urea are shown by a dot and the line is extended according to the yield equation calculated from these points. The amount of nitrogen furnished by 10 and 20 tons of manure was then determined from the yield curve by calculating from the yield values the amounts of nitrogen which would

[2]Curves were calculated and drawn using the yield equation Log (A-y) = Log A − c(x + b) in which A = the maximum yield, y = the actual yield, x = the quantity of nitrogen applied, b = the amount of available nitrogen furnished by the soil and c = an effectiveness factor. Y values were taken from yields for plots without manure but with 40, 80, and 120 pounds of nitrogen. Maximum yield was calculated as 2,823 pounds and maximum value $1,465.

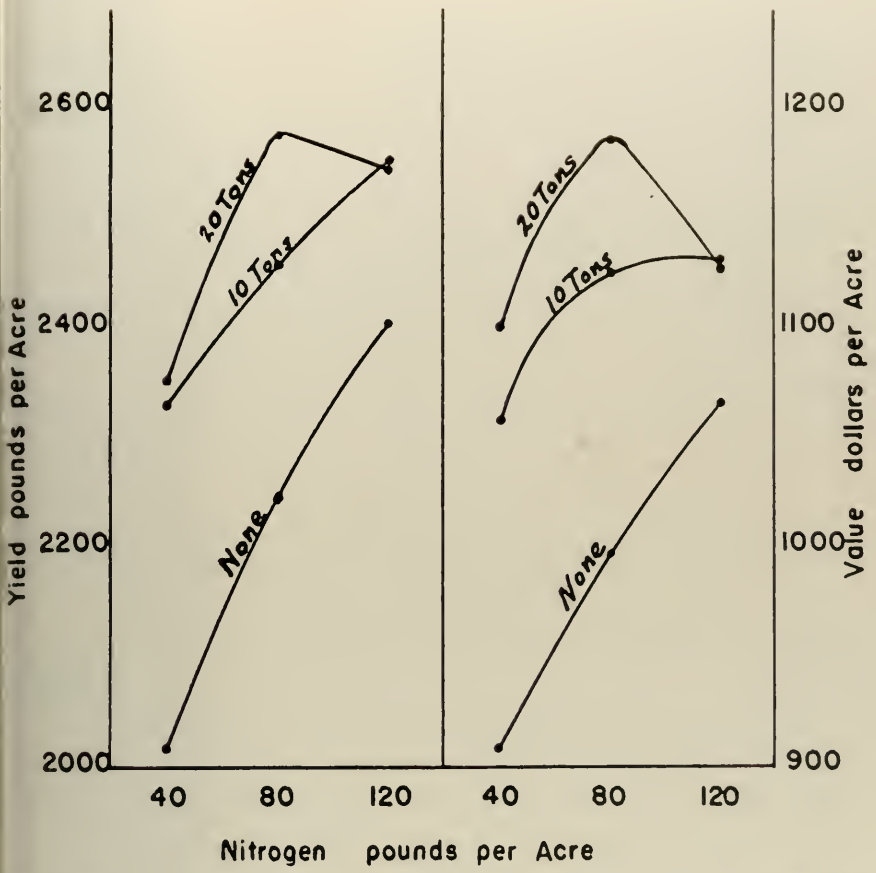

FIGURE 1. The effect of manure at 0, 10, and 20 tons per acre on response of tobacco to nitrogen fertilizers.

best fit the curve. These points are indicated by X and O for the 10- and 20-ton rates of manure respectively. In making this calculation the yield at the 20-ton rate of manure and 120-pound application of nitrogen was not included because these applications caused a decrease in yield which was considered to be beyond the scope of the calculated curve. The closest fit was secured when the nitrogen in manure was evaluated at 4.5 pounds per ton (45 and 90 pounds of nitrogen for the 10- and 20-ton rates).

This is within the range of the nitrogen content usually attributed to manure. With only one point within the range of nitrogen from which the curve was calculated this fit seems remarkably good for an extrapolated curve.

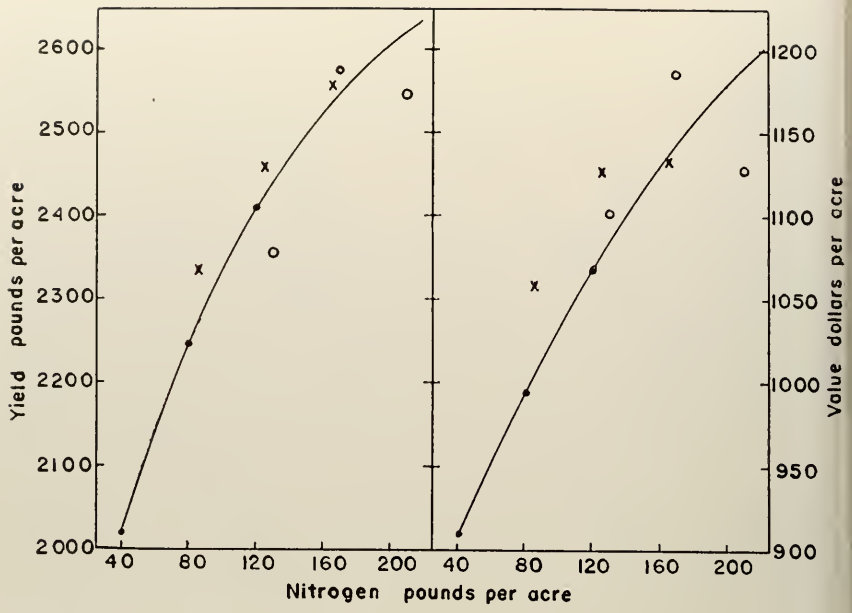

FIGURE 2. Extended curves showing relationship of nitrogen to yield and value of tobacco with manure calculated as furnishing 4½ pounds of nitrogen per ton.

When these same values for manure (45 and 90 pounds per acre for the 10- and 20-ton rates) are applied to the curve for value of tobacco the fit is not as good. The placement of four of the points well above the curve and another just below indicates that manure may also add a factor affecting quality which is not a function of its nitrogen content. This is in agreement with the increased price per pound noted for the manured plots.

The highest value was obtained with the 160-pound per acre rate of potash. This was just significantly higher than for the 80-pound rate at the 5 per cent level. Further addition of potash resulted in a slight decrease in value of the tobacco crop. There was no apparent effect of potash on the price per pound received for tobacco.

Wheat and Hay

The residual effect of manure and fertilizer on wheat is given in detail in Table C (Appendix) and summarized in Table 6. The effect of nitrogen is within the limits of error of the experiment. Manure, especially the initial 10-ton application, had a pronounced effect, increasing the wheat yield by 4.0 bushels per acre. Potash showed no residual effect on wheat.

The residual effect of manure and fertilizer on hay yields is given in Table D (Appendix) and summarized in Table 6. Neither nitrogen or potash had any appreciable effect, but manure application did show a residual effect, increasing yields by 0.17 tons at the 10-ton rate and an additional 0.08 tons for the 20-ton rate.

Table 6. Summary of the Residual Effect of Fertilizer and Manure on Yields of Wheat and Hay

Treatment	Wheat (1948-52) Bu. Per Acre	Hay (1949-52) Tons Per Acre
0 lbs. N	22.9	2.24
0 lbs. N	22.8	2.27
20 lbs. N	23.6	2.24
No Manure	20.0	2.11
0 Tons Manure	24.0	2.28
0 Tons Manure	25.1	2.36
0 lbs. K_2O	23.2	2.19
60 lbs. K_2O	23.1	2.27
40 lbs. K_2O	22.9	2.29
L.S.D. 5%	1.2	.14

Summary

Fertilizer experiments on a three-year rotation of tobacco, wheat, clover, and timothy were initiated in 1940. In the original tests yield and value of tobacco increased with increasing rates of nitrogen, phosphorus, and potassium up to the maximum rates used (50 pounds of nitrogen, 100 pounds of P_2O_5, and 100 pounds of K_2O per acre). Wheat yields also were increased by increasing the rate of fertilizer application to tobacco, but the yield of hay was not affected. The addition of magnesium sulfate, borax, manganese sulfate, or calcium sulfate had no effect on any of the crops in the rotation.

The rates of application of nitrogen and potassium were increased during the latter part of the experiment and a manure variable was substituted for the phosphate variable originally used.

The application of 80 pounds of nitrogen produced a highly significant increase in yield and value of tobacco over the application of 40 pounds of nitrogen. The next increment of 40 pounds of nitrogen caused an additional significant increase in yield but no significant increase in value of tobacco. The decrease in quality is indicated by the lower price per pound.

The application of 10 tons of manure gave a highly significant increase in both yield and value of tobacco. The increase in value for

20 tons of manure over 10 tons was just barely significant but the increas in yield was not significant. Manure increased the quality as show by the price per pound received for tobacco, the highest price bein on the plots receiving 20 tons of manure.

One of the principal effects of manure, as indicated by its inte action with nitrogen, was in supplying nitrogen to the crop. On the bas of yield, it was calculated that manure furnished about 4½ pounds c nitrogen per ton. However, its effect on quality and value indicate that it had other effects as well.

The increase in potash application from 80 pounds to 160 pounc per acre produced a significant increase in both yield and value c tobacco. An additional 80 pounds potash had little effect on eithe yield or value. The price per pound was increased by the use of 16 pounds over 80 pounds but was decreased by additional potash.

The application of 10 tons manure to tobacco resulted in a highl significant increase in the yield of wheat and a significant increase i the yield of hay following wheat.

Increased rates of the nitrogen or potash fertilizer applied to t bacco did not have any significant effect on the yield of wheat followin tobacco or on the hay crop following the wheat.

APPENDIX

TABLE A. YIELD OF TOBACCO AS INFLUENCED BY MANURE AND FERTILIZER* (1947-52)

TREATMENTS			YIELD IN POUNDS PER ACRE BY YEARS					
ANURE /ACRE	N LB/ACRE	K_2O LB/ACRE	1947	1948	1949	1951	1952	AVERAGE
0	40	80	1602	1340	2029	1872	2456	1858
0	40	160	1854	1464	2153	1933	2707	2010
0	40	240	1682	1772	2244	2202	3052	2188
10	40	80	1686	1889	2561	2271	3020	2274
10	40	160	1921	1843	2591	2500	2997	2370
10	40	240	1785	1729	2437	2480	3311	2348
20	40	80	1971	1879	2645	2371	2977	2369
20	40	160	1391	1878	2709	2552	3117	2329
20	40	240	1963	1815	2696	2403	2943	2364
0	80	80	1826	1765	2334	2101	2938	2193
0	80	160	1873	1693	2394	2439	3027	2285
0	80	240	1802	1917	2352	2314	2878	2253
0	80	80	1884	1831	2628	2505	2785	2327
0	80	160	1734	2016	2731	2413	3032	2385
0	80	240	2132	2300	2948	2556	3379	2663
20	80	80	1807	2170	2626	2707	3451	2552
20	80	160	2166	2326	2993	2632	3176	2659
20	80	240	1667	2280	2849	2661	3115	2514
0	120	80	1037	2093	2677	2326	2895	2405
0	120	160	1989	1989	2611	2351	2811	2351
0	120	240	1892	2038	2444	2331	3492	2439
0	120	80	2101	2049	2847	2733	2908	2528
0	120	160	2083	2143	2952	2846	3394	2681
0	120	240	1526	2317	2714	2705	3003	2453
0	120	80	1848	1709	2949	2692	3568	2553
0	120	160	1573	2369	2678	2823	3402	2569
0	120	240	1663	2233	2745	2586	3377	2521
S.D. 5%			252	456	245	134	593	187

*700 pounds per acre P_2O_5 applied to all plots.

TABLE B. VALUE OF TOBACCO AS INFLUENCED BY MANURE AND FERTILIZER (1947-52)

TREATMENTS			VALUE IN DOLLARS PER ACRE BY YEARS					
MANURE T/ACRE	N LB/ACRE	K_2O LB/ACRE	1947	1948	1949	1951	1952	AVERAGE
0	40	80	574	604	992	958	1055	837
0	40	160	679	710	1059	1004	1145	919
0	40	240	599	795	1097	1172	1215	976
10	40	80	580	856	1305	1234	1206	1035
10	40	160	690	869	1299	1351	1160	1074
10	40	240	651	806	1248	1353	1264	1064
20	40	80	720	958	1356	1308	1214	1111
20	40	160	187	881	1410	1409	1275	1092
20	40	240	746	899	1372	1328	1215	1112
0	80	80	662	783	1179	1194	1161	996
0	80	160	672	763	1187	1288	1153	1013
0	80	240	664	902	1168	1225	1010	994
10	80	80	700	895	1338	1360	1109	1080
10	80	160	637	981	1396	1320	1108	1088
10	80	240	789	1149	1503	1388	1212	1208
20	80	80	626	1061	1318	1505	1287	1159
20	80	160	779	1135	1539	1461	1234	1230
20	80	240	607	1117	1488	1501	1137	1170
0	120	80	712	936	1304	1165	1009	1025
0	120	160	716	920	1300	1251	1132	1064
0	120	240	693	941	1223	1257	1291	1081
10	120	80	757	994	1440	1474	902	1113
10	120	160	763	1015	1505	1559	1201	1209
10	120	240	591	1074	1396	1480	838	1075
20	120	80	716	800	1523	1482	1259	1156
20	120	160	568	1140	1353	1574	986	1124
20	120	240	585	1080	1397	1415	1019	1099
L.S.D. 5%			NS	198	137	166	238	98

*200 pounds per acre P_2O_5 applied to all plots.

TABLE C. YIELD OF WHEAT AS INFLUENCED BY RESIDUAL EFFECT OF MANURE AND FERTILIZER* (1948-52)

TREATMENTS			YIELD IN BUSHELS PER ACRE BY YEARS					
MANURE T ACRE	N LB/ACRE	K_2O LB/ACRE	1948	1949	1950	1951	1952	AVERAGE
0	40	80	25.0	26.2	11.0	16.2	24.1	19.3
0	40	160	27.4	18.4	12.3	17.3	27.3	20.5
0	40	240	25.3	22.1	9.8	18.3	27.7	20.6
10	40	80	27.2	25.1	13.0	24.2	28.1	23.5
10	40	160	26.9	27.6	12.2	16.2	32.7	23.1
10	40	240	26.2	29.9	13.4	18.4	31.0	23.8
20	40	80	29.8	25.4	12.4	25.2	30.4	24.6
20	40	160	25.3	27.6	15.2	20.9	34.5	24.7
20	40	240	27.1	29.4	12.9	26.7	33.1	25.8
0	80	80	25.0	13.4	12.2	21.0	22.8	18.9
0	80	160	25.7	26.6	11.7	18.7	28.1	22.2
0	80	240	25.3	18.1	11.5	15.0	23.0	18.6
10	80	80	27.7	30.2	14.4	21.8	31.8	25.2
10	80	160	20.1	27.5	15.9	20.2	30.4	22.8
10	80	240	20.5	27.0	15.4	15.9	31.3	22.0
20	80	80	24.6	30.4	13.0	24.3	33.4	25.1
20	80	160	25.4	27.6	14.9	21.1	30.3	23.9
20	80	240	28.2	28.1	15.7	23.5	35.3	26.2
0	120	80	29.0	21.3	9.7	21.5	28.4	22.0
0	120	160	22.4	17.0	12.2	18.2	23.7	18.7
0	120	240	22.0	18.7	12.5	22.1	23.1	19.7
10	120	80	28.3	30.5	13.1	21.2	31.2	24.9
10	80	160	31.1	27.1	14.1	25.2	31.2	25.7
10	120	240	26.9	29.0	13.4	25.1	31.3	25.1
20	120	80	28.1	24.3	16.2	26.3	30.8	25.2
20	120	160	31.6	32.2	14.3	23.5	34.4	27.2
20	120	240	26.0	26.2	15.2	18.5	33.8	23.9
L.S.D. 5%			3.9	6.3	3.8	5.5	6.4	2.4

*200 pounds per acre P_2O_5 applied before tobacco on all plots.

TABLE D. YIELD OF HAY AS INFLUENCED BY RESIDUAL EFFECT OF MANURE AND FERTILIZER* (1949-52)

TREATMENTS			YIELD IN TONS PER ACRE BY YEARS				
MANURE T/ACRE	N LB./ACRE	K_2O LB./ACRE	1949	1950	1951	1952	AVERAGE
0	40	80	2.22	1.40	3.18	1.76	2.14
0	40	160	2.57	1.61	2.97	1.51	2.17
0	40	240	1.97	2.00	2.44	1.62	2.01
10	40	80	2.18	2.05	2.89	1.91	2.26
10	40	160	1.99	2.12	2.96	1.60	2.17
10	40	240	2.22	2.22	2.88	2.08	2.35
20	40	80	2.24	1.97	2.71	2.26	2.30
20	40	160	2.04	2.28	2.93	2.27	2.38
20	40	240	2.37	2.16	3.10	1.99	2.41
0	80	80	1.93	1.42	3.68	1.49	2.13
0	80	160	2.39	1.79	3.26	1.91	2.34
0	80	240	1.79	1.80	2.78	1.87	2.06
10	80	80	2.24	2.19	2.52	1.87	2.21
10	80	160	1.99	2.05	3.34	2.10	2.37
10	80	240	2.35	2.02	3.20	1.89	2.37
20	80	80	2.21	1.82	2.74	1.89	2.17
20	80	160	2.28	2.01	2.99	1.88	2.29
20	80	240	2.27	2.43	2.99	2.29	2.50
0	120	80	2.08	1.23	2.95	1.57	1.96
0	120	160	2.05	1.73	2.89	1.49	2.04
0	120	240	2.75	1.51	2.61	1.55	2.11
10	120	80	1.97	2.02	2.51	2.08	2.15
10	120	160	2.10	2.00	3.34	2.06	2.38
10	120	240	2.30	2.06	3.01	1.89	2.32
20	120	80	2.13	1.87	2.64	2.85	2.37
20	120	160	2.16	2.21	2.91	2.09	2.34
20	120	240	1.99	2.22	2.93	2.89	2.51
L.S.D. 5%			0.59	0.52	0.87	0.75	0.42

*200 pounds per acre P_2O_5 applied before tobacco on all plots.