

CHEMICAL ESTIMATION OF THE FERTILITY OF SOILS IN FULTON COUNTY, INDIANA.

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During recent years there has been an effort on the part of many States to invoice their soils as to plant food content in addition to making the usual survey in order to classify them into types and series. This invoice is useful first to the farmer in pointing out any deficiencies or excesses in the soil's food supply, and second to the State in estimating the wealth, since this usually resides in the fertility of the soils. Usually only the plant food elements are determined which seem to be the most important or have the greatest influence in modifying crop yield. They are the following: total organic carbon, total nitrogen, total phosphorus, total potassium, total calcium, total inorganic carbon. The test for the last is made for the presence of limestone, the absence of which often indicates soil acidity. There are many factors other than plant food concerned in producing a crop on any piece of land, as rainfall, tillage, drainage, etc., but deficiencies in these can be determined often by observation. But a deficiency in the main chemical elements is not so easily estimated and is a matter of life or death to the plant.

AVAILABILITY OF PLANT FOOD.

Much discussion has arisen over the availability of these plant foods even when analysis has shown plenty to be present. It is conceded, however, that it is possible to make two per cent of total nitrogen, one per cent of phosphorus and one-fourth of one per cent of potassium available in one year by approved agriculture methods. If this were true, or somewhere near true, it would make a big difference in the crop yield to be expected whether there were 500 or 5,000 lbs. of phosphorus or nitrogen, etc., present per acre to a depth of six and two-thirds inches.

PLANT FOODS PRESENT IN A GOOD SOIL.

It is difficult to set a definite standard of plant food content, but if we choose samples of our productive loam soils frequently producing

75 bushels of corn per acre, we find a plant food content about as follows:

POUNDS OF PLANT FOOD PER 2,000,000 POUNDS OF SURFACE SOIL.

Nitrogen 4,500 lbs., 2 per cent possible available in 1 year.....	90 lbs.
Phosphorus 1,500 lbs. (too low), 1 per cent.....	15 lbs.
Potassium 32,000 lbs., one-fourth of one per cent.....	80 lbs.
Organic matter, 160,500 lbs.	
Limestone present, 350 lbs.	

A 50-bushel corn crop would need about 74 lbs. of nitrogen, 11.5 lbs. of phosphorus and 35.5 lbs. of potassium in addition to the other essential elements usually present, and this amount of plant food could more than be supplied in a soil like the above.

PLAN OF INVOICING FULTON COUNTY SOILS.

The soil samples chosen numbered 128 and they were collected from the eight townships. Most of the soil samples were taken from surface soil (7 ins. deep), but 38 were from subsoils (6 to 20 ins.). Twenty of the samples were from virgin soil and represent more or less the original fertility of the soil unchanged by cropping. Many items were noted while the samples were being collected (August, 1916) or information was secured from the people living on the farms as to the prevalent weeds, stand of clover, kinds of timber, grain yield per acre, use of fertilizers and manures, etc. The following determinations were made on the soil samples: first, total organic matter; second, total nitrogen; third, total phosphorus; fourth, presence of carbonates and acidity to litmus. An attempt was made to correlate this data with the yield of corn per acre. It was thought this could be done best by means of graphs. Since the presence or absence of organic matter is so vitally related to crop yield, the soils were grouped into eight series depending on the amount of organic matter present in the soil. The samples are numbered as follows:

Richland Twp., 1-10 and 108-111, inclusive.

Aubbeenaubbee, 11-19 and 106-107.

Henry, 20-24 and 124-128.

Newcastle, 25-27 and 112-123.

Rochester, 28-31 and 45-60 also 66.

Liberty, 61-65 and 67-75.

Wayne, 76-87 and 91-93.

Union, 80-90 and 94-105.

The tables and graphs which follow will give a partial composition of the soil in per cents and pounds per acre and express this in terms of bushels of corn per yield.

TABLE I.

The N. P. and Organic Matter, from 0.5 to 1% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre	% P.	Pounds per Acre.
1	9 Subsoil	.5143	10,286	.014	280	.0243	486
2	116 Subsoil	.6664	13,328	.017	340	.0462	924
3	87 Subsoil	.6789	13,578	.015	300	.0725	1,450
4	103 Subsoil	.7945	15,890	.0042	84	.0576	1,152
5	16 Subsoil	.8014	16,028	.014	280	.0674	1,348
6	*68 Subsoil	.8046	16,092	.027	540	.0364	728
7	2 Subsoil	.8614	17,228	.0084	168	.0553	1,106
8	79 Subsoil	.9824	19,648	.021	420	.0580	1,160

*Acid.

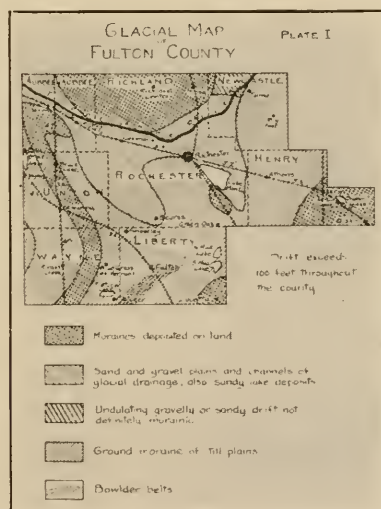


TABLE II.

The N. P. and Organic Matter, from 1 to 2% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre.	% P.	Pounds per Acre.
1	12 Subsoil	1.141	22,820	.925	500	.0320	640
2	98 Subsoil	1.158	23,160	.915	300	.0539	1,078
3	5 Subsoil	1.171	23,420	.918	360	.0381	762
4	*33 Subsoil	1.233	24,460	.911	220	.0324	648
5	*96 Subsoil	1.318	26,360	.943	860	.0677	1,354
6	*55 Subsoil	1.376	27,520	.946	920	.1072	2,144
7	70 Subsoil	1.389	27,780	.917	340	.0755	1,510
8	89 Surface	1.396	27,920	.918	360	.0239	478
9	*110 Surface	1.397	27,940	.929	580	.0694	1,388
10	77 Subsoil	1.404	28,080	.927	540	.0674	1,318
11	*104 Virgin	1.472	29,440	.934	680	.0485	970
12	*61 Surface	1.576	31,520	.929	580	.0398	796
13	57 Subsoil	1.646	32,920	.914	280	.0516	1,032
14	*11 Surface	1.711	34,330	.959	1,180	.0526	1,052
15	67 Surface	1.744	34,880	.941	820	.0644	1,288
16	48 Surface	1.811	36,280	.966	1,320	.0768	1,536
17	*47 Surface	1.844	36,880	.963	1,260	.0256	512
18	*50 Virgin	1.902	38,040	.953	1,060	.0310	620
19	*102 Surface	1.992	39,840	.950	1,000	.0465	930
20	*86 Surface	1.997	39,940	.950	1,000	.0613	1,226

*Acid.

12.2% of Surface Soils in this organic group.

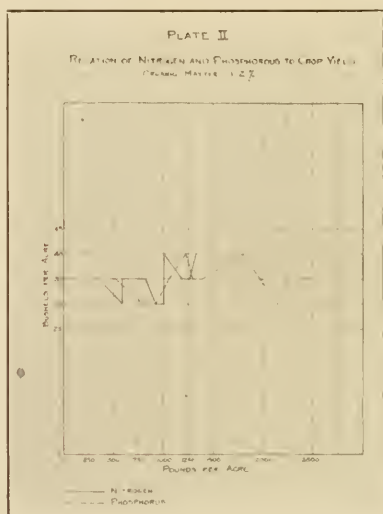


TABLE III.

The N. P. and Organic Matter, from 2 to 3% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre.	% P.	Pounds per Acre.
1	*60 Subsoil	2.023	40,460	.018	960	.0745	1,490
2	*97 Surface	2.063	41,260	.069	1,380	.0559	1,118
3	*64 Subsoil	2.065	42,300	.021	420	.1543	3,086
4	*76 Surface	2.073	41,460	.056	1,120	.1180	2,360
5	*1 Surface	2.114	42,280	.063	1,260	.0273	546
6	*115 Surface	2.197	43,940	.083	1,660	.0182	364
7	*63 Surface	2.198	43,960	.053	1,060	.0411	822
8	*107 Surface	2.245	44,900	.067	1,340	.0816	1,632
9	†13 Virgin	2.307	46,140	.063	1,260	.0654	1,308
10	*21 Subsoil	2.394	47,880	.032	640	.0762	1,524
11	†29 Subsoil	2.403	8,060	.022	440	.0162	324
12	*56 Surface	2.422	48,440	.077	1,540	.0634	1,268
13	*31 Surface	2.442	48,840	.032	1,240	.0580	1,160
14	*75 Surface	2.475	49,500	.038	760	.1031	2,062
15	*99 Virgin	2.526	50,520	.070	1,400	.1031	2,062
16	*90 Subsoil	2.564	51,280	.055	1,100	.0738	1,476
17	* Surface	2.567	51,340	.070	1,400	.0849	1,698
18	*32 Surface	2.579	51,580	.064	1,280	.0479	958
19	51 Surface	2.585	51,700	.076	1,520	.0499	998
20	*4 Surface	2.620	52,400	.081	1,620	.0580	1,160
21	19 Subsoil	2.679	53,580	.036	720	.0394	788
22	65 Virgin	2.722	54,440	.059	1,180	.0600	1,200
23	†58 Virgin	2.798	55,960	.039	780	.0620	1,240
24	*105 Surface	2.841	56,820	.011	220	.0229	458
25	*111 Virgin	2.886	57,720	.076	1,520	.1092	2,184
26	95 Surface	2.935	58,700	.125	2,500	.0644	1,288
27	*6 Virgin	2.994	59,880	.076	1,520	.0519	1,038

*Acid. †Very acid.

23.3% of Surface Soils in this organic group.

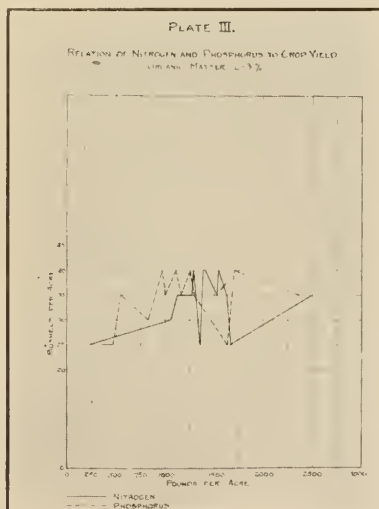


TABLE IV.

The N. P. and Organic Matter, from 3 to 4% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre.	% P.	Pounds per Acre.
1	*69 Surface	3.000	60,000	.085	1,700	.0576	1,152
2	34 Virgin	3.006	60,120	.085	1,700	.0843	1,686
3	118 Subsoil	3.101	62,020	.080	1,600	.0708	1,416
4	*43 Surface	3.131	62,620	.083	1,660	.0718	1,436
5	9 Subsoil	3.164	62,280	.082	640	.0414	828
6	*28 Surface	3.170	63,400	.070	1,400	.0634	1,268
7	52 Subsoil	3.176	63,520	.028	560	.0209	418
8	37 Surface	3.202	64,040	.090	1,800	.0516	1,032
9	122 Surface	3.228	65,160	.118	2,360	.0738	1,476
10	*62 Surface	3.258	65,360	.102	2,040	.0839	1,678
11	*10 Virgin	3.291	65,820	.074	1,480	.0401	802
12	92 Subsoil	3.338	66,760	.062	1,240	.0445	890
13	*42 Surface	3.405	68,100	.111	2,220	.0704	1,408
11	123 Subsoil	3.433	68,660	.078	1,560	.0623	1,246
15	74 Surface	3.489	69,780	.105	2,100	.0462	924
16	*8 Surface	3.589	71,790	.101	2,020	.0516	1,032
17	*14 Surface	3.837	76,740	.111	2,220	.0630	1,260
18	*7 Surface	3.861	77,220	.106	2,120	.0741	1,482
19	*38 Surface	3.905	78,100	.104	2,080	.0775	1,550
20	46 Subsoil	3.912	78,240	.062	1,240	.1132	2,264
21	*15 Surface	3.913	78,260	.143	2,860	.0593	1,186

*Acid.

16.6% of Surface Soils in this organic group.

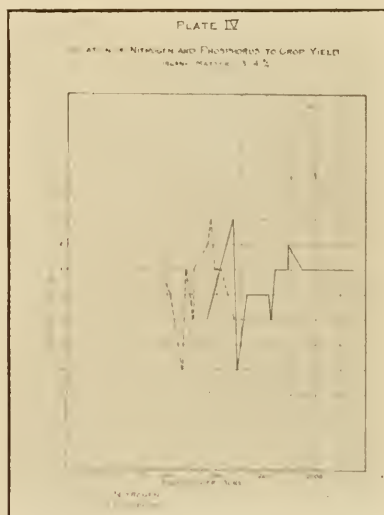


TABLE V.

The N. P. and Organic Matter, from 4 to 6% Organic Matter.

	Sample No.	% O. M	Pounds per Acre.	% N.	Pounds per Acre.	% P.	Pounds per Acre.
1	80 Virgin	4.010	80,200	.109	2,180	.0812	1,624
2	†20 Surface	4.057	81,140	.113	2,260	.0593	1,186
3	*17 Virgin	4.119	82,380	.118	2,360	.0937	1,874
4	128 Virgin	4.233	84,660	.099	1,980	.1014	2,028
5	*66 Surface	4.299	85,980	.146	2,920	.1078	2,156
6	109 Surface	4.473	89,460	.133	2,660	.0317	634
7	*83 Surface	4.547	90,940	.120	2,400	.0600	1,200
8	91 Surface	4.833	96,660	.140	2,800	.0846	1,692
9	126 Surface	4.892	97,840	.112	2,240	.1001	2,002
10	*85 Surface	4.901	98,020	.164	3,280	.1099	2,198
11	100 Surface	5.130	102,600	.157	3,140	.0620	1,240
12	27 Subsoil	5.334	106,680	.0084	168	.0101	202
13	*59 Surface	5.335	106,700	.176	3,520	.0752	1,504
14	*93 Virgin	5.451	109,020	.175	3,500	.0866	1,732
15	127 Subsoil	5.504	110,080	.077	1,540	.2123	4,246
16	78 Surface	5.579	111,580	.090	1,800	.0647	1,294
17	119 Virgin	5.703	114,060	.220	4,400	.1479	2,958
18	125 Subsoil	5.833	116,660	.108	2,160	.0696	1,392
19	*30 Virgin	5.996	119,920	.169	3,380	.0910	1,820

*Acid. †Very acid.

17.7% of Surface Soils in this organic group.

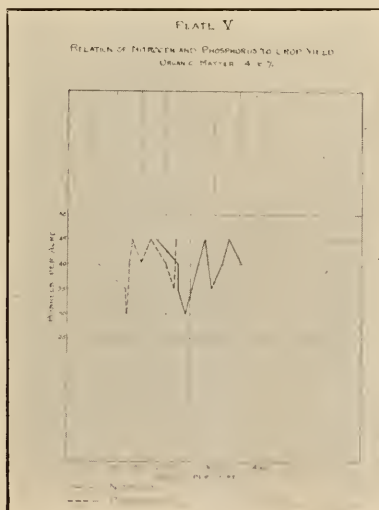


TABLE VI.
The N. P. and Organic Matter, from 6 to 10% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre.	% P.	Pounds per Acre.
1	117 Surface	6.278	125,560	.195	3,900	.0667	1,334
2	113 Subsoil	6.462	129,240	.192	3,840	.0654	1,308
3	73 Virgin	6.737	134,740	.190	3,800	.0382	2,764
4	72 Subsoil	7.215	144,300	.167	3,340	.0317	634
5	114 Virgin	7.427	148,740	.258	5,160	.1533	3,066
6	108 Surface	7.603	152,060	.020	400	.1412	2,824
7	112 Surface	8.645	172,900	.307	6,140	.1587	3,174
8	18 Surface	8.695	173,900	.245	4,900	.0108	216
9	94 Surface	9.312	186,240	.076	1,520	.0559	1,118
10	23 Subsoil	9.377	187,540	.227	4,540	.1031	2,062
11	26 Surface	9.634	192,680	.274	5,480	.1122	2,244
12	45 Surface	9.836	196,720	.295	5,900	.1692	3,384

10% of Surface Soils in this organic group.

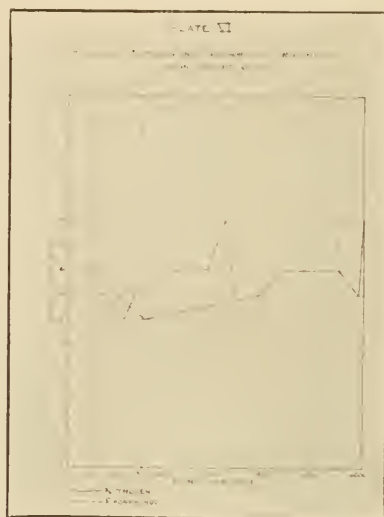


TABLE VII.

The N. P. and Organic Matter, from 10 to 40% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre.	% P.	Pounds per Acre.
1	25 Surface	11.205	224,100	.409	8,180	.1361	2,722
2	24 Virgin	11.891	237,820	.403	8,060	.1227	2,454
3	121 Surface	12.009	240,190	.399	7,980	.0341	688
4	82 Surface	12.025	240,500	.000	0.000	.1301	2,602
5	*71 Surface	13.146	262,920	.391	7,820	.0839	1,678
6	22 Surface	13.228	264,560	.428	8,560	.0816	1,632
7	84 Surface	16.318	326,360	.610	12,200	.1752	3,504
8	81 Surface	20.026	400,520	.626	12,520	.2763	5,526
9	39 Surface	28.239	564,780	.994	19,880	.1995	3,990
10	101 Surface	33.230	664,600	1.205	24,100	.3936	7,872

*Acid.

11.1% of Surface Soils in this organic group.

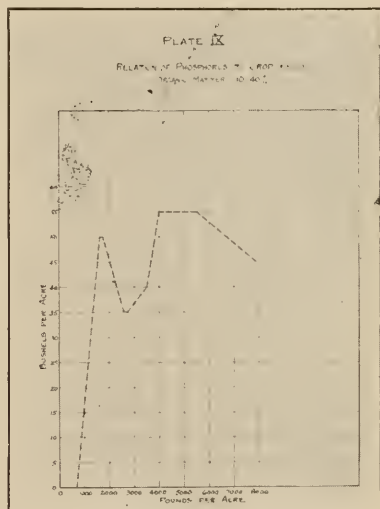
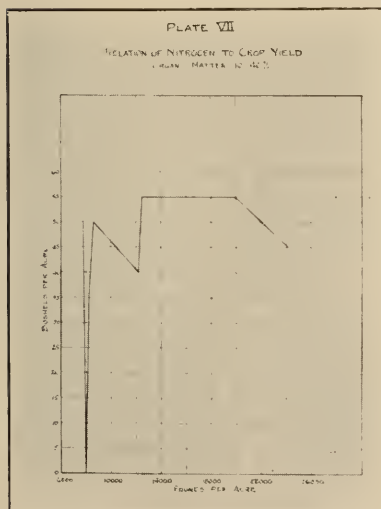


TABLE VIII.

The N. P. and Organic Matter, from 40 to 85% Organic Matter.

	Sample No.	% O. M.	Pounds per Acre.	% N.	Pounds per Acre.	% P	Pounds per Acre.
1	*120 Surface	41.666	416,660	1.491	14,910	.0903	902
2	41 Virgin	51.778	517,780	1.529	15,290	.2258	2,258
3	*36 Subsoil	56.469	564,690	1.876	18,760	.2642	2,642
4	144 Surface	64.652	646,520	2.138	21,380	.2116	2,116
5	124 Surface	66.196	661,960	2.124	21,240	.2035	2,035
6	135 Surface	68.514	685,140	2.254	22,540	.3060	3,060
7	106 Surface	72.343	723,430	2.656	26,560	.3923	3,923
8	53 Surface	76.913	769,130	3.276	32,760	.3572	3,572
9	54 Subsoil	80.661	806,610	3.157	31,570	.3478	3,478
10	40 Subsoil	81.260	812,600	1.928	19,280	.3977	3,977
11	88 Surface	84.698	846,980	2.496	24,960	.2912	2,912

*Acid. †Very acid. *1,000,000 pounds per acre 6-2-3 in. = weight of muck soil.

S 8% of the Surface Soils in this organic group.

SUMMARY.

Analysis shows that a large per cent of the soils of Fulton County are deficient in organic matter. About half of them are below 4 per cent.

The soils are not very acid to litmus. Only six samples were found to be unusually acid while fifty-two others were slightly acid to the same indicator. Most of the acid samples were among the soils containing a low amount of organic matter.

A considerable number of the soils contained less than 1,500 pounds of phosphorus and nitrogen per acre (6 2/3 in.). These amounts are deficient and such soils would undoubtedly respond profitably if fertilized with these elements.

The tables show a considerable decrease in content of plant food in cultivated soil compared with corresponding virgin soils.

The accompanying graphs indicate that there is a close relationship between the yield of corn and the nitrogen and phosphorus content of the soil. As the nitrogen and phosphorus content increases, the yield increases.