The Relation of Nitrogen, Phosphorus and Organic Matter to Corn Yield in Elkhart County, Indiana.

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The fertility of the soil is so closely related to the progress of a community that any considerable increase in the productiveness of the soil from any cause is reflected in greater community prosperity. It is therefore important to study the soil and its needs.

Invoice of the Soil.

Just as an invoice of the stock of goods in a store aids the merchant in estimating his resources, so an invoice of the plant food in the soil enables the farmer to get a rating of his possible crop yield and enables him to plan intelligently for future soil improvement. A supply of plant food does not necessarily insure a good crop yield, as there are present sometimes counteracting conditions. Examples of such are found in Samples 1, 10 and 51. But these are usually evident, and the data to be presented shows that crops are generally produced where there is present sufficient plant food.

Release of the Soil's Food Supply.

The soil is composed of small fragments of rock particles mixed with more or less organic matter in various stages of decay. Only a small part of the plant food in the rock particles is available at any time. It is thought that the food elements contained in these rock particles alone, are not liberated fast enough from year to year to produce a paying crop. This is not so, however, with that stored in organic matter, especially the fresh organic matter, which not only releases its plant food rather rapidly, through bacterial action, but also aids materially in freeing that tied up in the rock particles of the soil. In view of this important part played by soil organic matter, it was thought best to classify all soils collected according to the amount of organic matter they contained.

Plan of Invoicing.

The samples of soil (total 57) from eleven soil types were collected late in September, 1917, in order to estimate more accurately the pos-

sible corn yield of that year. Much data was obtained relative to fertilizer treatment, kinds of weeds prevalent, the use of limestone, and especially the approximate crop yield as estimated by the man in charge of the farm. The following determinations were made on soil samples: First, total organic matter; second, total nitrogen; third, total phosphorus; fourth, presence of carbonates and acidity to litmus paper. The tables which follow will give a partial composition in per cent and pounds per acre (6.66 ins. 2,000,000 lbs.), together with the yield of corn per acre where the samples were secured:

TABLE I.

Content of Nitrogen, Phosphorus and Acre Yield. 0 to 2% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
32	18	1.75	35,000	.095	1,910	.062	1,242
33	0	1.32	26,400	.070	1,400	.079	1,580
34	0	.99	19,800	.039	785	.073	1,460
35	10	1.47	29,400	.030	612	.116	2,322
	14		27,650		1,177		1,651 ave.

TABLE II.

Content of Nitrogen, Phosphorus and Acre Yield. 2 to 4% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
2x	30	2.53	50,600	.105	2,100	.210	4,212
13x	40	3.12	62,400	.113	2,267	.098	1,960
14	25	3.36	67,200	.110	2,204	.135	2,700
16x	25	3.25	65,000	.101	2,030	.078	1,566
15x	35	3.62	72,400	.140	2,800	.089	1,782
18	40	3.48	69,600	.105	2,100	.108	2,160
26x	35	3.30	66,000	.091	1,820	.012	2,056
27xs	.....	2.58	51,600	.073	1,466	.124	2,480
35v	.....	2.51	50,200	.066	1,330	.135	2,700
39x	40	3.67	73,400	.105	2,100	.129	2,592
56	15	2.23	44,600	.087	1,750	.480	2,970
5vs	.....	3.79	75,800	.157	3,150	.132	2,656
	32.5		62,400		2,093		2,486 ave.

x—Soil acid.
v—Virgin soil.
s—Subsoil.

Reproduction of Soil Map made by U. S. Bureau of Soils of Elkhart County, showing areas of different type and places where samples were taken.

TABLE III.

Content of Nitrogen, Phosphorus and Acre Yield. 4 to 5% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
3	40	4.63	92,600	.140	2,800	.135	2,700
9s	.....	4.03	80,600	.077	1,540	.095	1,906
12	20	4.73	94,600	.108	2,160	.113	2,268
25x	35	4.53	90,600	.152	3,050	.116	2,322
40x	40	4.46	89,200	.140	2,800	.243	4,860
45x	30	4.08	81,600	.098	1,860	.078	1,586
46x	50	4.89	97,800	.124	2,485	.113	2,278
47x	30	4 70	94,000	.150	3,000	.086	1,728
53	.....	4.53	90,600	.098	1,960	.107	2,140
54	40	4.10	82,000	.097	1,942	.103	2,060
	35.5		89,360		2,359		2,385 ave.

x—Acid soil.
s—Subsoil.

TABLE IV.

Content of Nitrogen, Phosphorus and Acre Yield. 5 to 6% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
4	35	5.20	104,000	.161	3,220	.221	4,428
5x	35	5.45	109,000	.100	2,000	.099	2,000
17v	.....	5.08	101,600	.186	3,720	.108	2,160
24	40	5.94	118,800	.141	2,834	.121	2,430
36x	0	5.71	114,200	.098	1,960	.129	2,592
41x	50	5.75	115,000	.122	2,450	.162	3,240
49	60	5.85	117,000	.175	3,450	.189	3,780
50	30	5.75	115,000	.129	2,580	.421	4,212
52	.....	5.01	100,200	.119	2,380	.087	1,755
55	45	5.90	118,000	.144	2,880	.119	2,380
	42.14		111,280		2,748		2,898 ave.

x—Acid soil.
v—Virgin soil.

TABLE V.

Content of Nitrogen, Phosphorus and Acre Yield. 6 to 8% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
6	50	7.20	144,000	.210	4,200	.145	2,916
7	75	7.05	141,000	.252	5,040	.272	5,454
8	35	7.10	142,000	.171	3,420	.094	1,890
10x	15	6.60	132,000	.157	3,140	.105	2,106
22x	40	6.87	137,400	.157	3,150	.183	3,672
29x	15	6.13	122,600	.098	1,969	.094	1,880
30v	.....	7.02	140,400	.119	2,380	.113	2,278
37x	45	6.10	122,000	.132	2,650	.188	3,760
38	30	6.12	122,400	.165	3,305	.097	1,944
42	55	7.39	147,800	.192	3,840	.154	2,916
1x	0	7.46	149,200	.260	5,200	.270	5,400
31x	35	7.06	141,200	.140	2,800	.143	2,862
48	40	7.11	142,200	.210	4,200	.124	2,482
	40.45		137,200		3,484		3,043 ave.

x—Acid soil.
v—Virgin soil.

TABLE VI.

Content of Nitrogen, Phosphorus and Acre Yield. 8 to 10% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
11x	65	8.52	170,400	.218	5,260	.116	2,322
21	80	8.37	167,400	.252	5,040	.216	4,320
23	55	8.35	167,000	.226	4,524	.197	3,942
	66.6		168,233		4,941		3,528 ave.

x—Acid soil.

TABLE VII.

Content of Nitrogen, Phosphorus and Acre Yield. 10 to 15% Organic Matter.

Sample No.	Bushels of Corn	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit.	Lbs. per Acre	Per Cent. Phos.	Lbs. per Acre
43	60	10.04	200,800	.297	5,950	.189	3,780
44	65	13.00	260,000	.267	5,346	.240	4,800
51x	0	12.54	250,800	.434	8,680	.259	5,184
	62.5		237,200		6,659		4,588 ave.

x—Acid soil.

TABLE VIII.

Content of Nitrogen, Phosphorus and Acre Yield. 15 to 85% Organic Matter.

Sample No.	Bushels of Onions	Per Cent. Organic Matter	Lbs. per Acre	Per Cent. Nit	Lbs. per Acre	Per Cent. Phos	Lbs. per Acre
19x	Onions	78.16	781,600*	2.800	28,000	.398	3,980
20x	Onions	81 18	811,800	3.010	30,100	.426	4,260
			796,700		29,050		4,120 ave.

*—Wt. muck soil, 1,000,000 lbs. per acre 6 2/3 ms.
x—Acid soil.

Discussion of Results.

About 50% of the soils of Elkhart County are of the Miami loam and Miami sandy loam types, and about 27% are of the Plainfield sandy loam type. These soils are rather low in organic matter and 51% are acid. The crop yield as given by the man in charge of the farm and corroborated as to the possible yield when the samples were secured bears a close relation to the organic matter present, and this in turn is closely associated with the amounts of nitrogen and phosphorus present. There were only three samples—1, 10 and 51—which were exceptions to the general rule that high plant food content equals good corn yield. Sample 1 is a greenish ferrous iron soil turning brown when exposed to air on plowing. Sample 10 is a sandy soil, low in potassium. There may be other causes also for the corn on this soil turning yellow when it is about two or three feet high. The reason for the poor yield of Sample 51 has not been investigated. *Summarizing* the data in Tables 1–6, relating to plant food content and corn yield, it is noted that the difference in yield between the 0–2% and the 8–10% organic matter averages 25.6 bushels. Using this figure as a standard for organic matter increase, it is shown that on average field conditions for every increase of 2,672 pounds of organic matter, 71.6 pounds of nitrogen and 35.7 pounds of phosphorus per acre (2,000,000 pounds) there is an increase of *one bushel* of corn.