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W. J. Peevy
Iowa Agricultural Experiment Station

F. B. Smith
Iowa Agricultural Experiment Station

P. E. Brown
Iowa Agricultural Experiment Station

THE EFFECT OF VARIOUS TREATMENTS ON THE RATE OF DECOMPOSITION OF ORGANIC MATTER IN SOILS UNDER CONTINUOUS CORN

W. J. Peevy, F. B. Smith and P. E. Brown

A study of the content and rate of decomposition of organic matter in soils is of considerable practical importance. The benefits derived from a supply of rapidly decaying organic matter in the soil include increased microbial activity, greater availability of nitrogen and other plant food constituents and the maintenance of good tilth in the soil and hence better crop yields. Under continuous cropping, as with corn, the rate of decomposition is fairly rapid and the content of organic matter drops to a low level unless regular additions are made. Under such a system some organic matter is added each year in the form of crop residues but the amount is not sufficient to balance the loss by decomposition. In general the amount of organic matter added in crop residues has been found to vary widely with the crop, the yields and any treatments which the soil may have received. It has been shown by numerous investigators (1, 2, 3, 4, 6, 7, 8) that the organic matter content of the soil bears a close relationship to the crop yields, that there is a greater loss of organic matter from the soil in intertilled crops, such as corn, than from those in noncultivated crops, such as wheat, and that it is not possible to maintain the organic matter content of the soil under continuous cropping unless heavy applications of manure are made.

The rate of loss of organic matter from the soil has been found to be influenced by any treatment which affects microbiological action in the soil. Liming acid soils stimulates microbiological action and the soil may be lower in organic matter content after a number of years than without the addition of lime. The rate of decomposition is also usually greater in soils high in organic matter than in soils low in this constituent, and the rate of decomposition is rapid at first and becomes slower as the amount of organic matter present decreases.

The purpose of this work was to determine the effect of lime and manure on the rate of decomposition of organic matter under continuous cropping to corn.

EXPERIMENTAL

The continuous corn plots in the fertility experiments at the Agronomy Farm of the Iowa Agricultural Experiment Station were selected for this study. The soil treatments made in this experiment were as follows:

PLOT NO.	TREATMENT
906	None
907	8 Tons per acre of manure once in 4 years
908	8 Tons per acre of manure once in 4 years + lime in the amount necessary to neutralize the acidity of the soil.
909	Lime in the amount necessary to neutralize the acidity of the soil.
910	None

The first applications of lime and manure were made in 1914, and every four years thereafter manure applications were made but lime was added only when the soil showed acidity. Samples of soil for analysis were taken from each of these plots in 1917 and again in 1936. Total carbon was determined by the dry combustion method and the inorganic carbon by the Schollenberger method (5). The organic carbon was obtained by difference and the organic matter by the use of the conventional factor 1.724. The pH was determined by the quinhydrone electrode. The results obtained are presented in Tables I and II.

Table I — Average Percentage of Organic Matter in Soils

DATE OF SAMPLE	TREATMENTS				
	CHECK (906)	MANURE (907)	MANURE + LIME (908)	LIME (909)	CHECK (910)
1917	4.7959	4.2866	4.0169	2.8468	2.5011
1936	3.8912	4.0187	3.0866	2.8815	2.1375

Table II — Average pH of Soils

DATE OF SAMPLE	TREATMENTS				
	CHECK (906)	MANURE (907)	MANURE + LIME (908)	LIME (909)	CHECK (910)
1917	5.99	6.01	5.90	6.14	6.14
1936	5.92	6.21	7.40	7.04	6.01

RESULTS

The soil in plots 906 and 908 showed the largest reduction in percentage of organic matter for the period. The soil in plot 906 received no addition of organic matter, except that in the crop residues, whereas the soil in plot 908 received 48 tons of manure per acre during the 19 years. Since the soil in plot 906 contained considerably more organic matter in 1917 than did that in plot

908 and the soil in plot 908 received 48 tons of manure per acre, it would be expected that the soil in plot 906 would show the greater loss. However, the pH of the soil in plot 906 was 5.9 and that of 908 was 7.4. This higher pH and the larger number of microorganisms introduced into the soil with the manure undoubtedly account for the increased decomposition in the soil of plot 908.

The soil in plot 907 showed only a small loss of organic matter. Forty-eight tons of manure per acre were added to this plot, yields were increased and the amount of crop residues were also increased. The relatively small loss of organic matter in this soil is attributed to the fact that the soil was acid and biological action was slower than if the acidity had been neutralized. Therefore, the manure and crop residues added were almost equal to the amount of organic matter decomposed. The loss would have been larger, no doubt, if there had been no manure added to this soil.

The soil in plot 909 showed a small increase in organic matter. Since this soil was treated with lime, it would be assumed that there would have been a considerable loss of organic matter on account of the higher pH and increased bacterial action. However, the content of organic matter was rather low in the beginning and the decomposition would not be as rapid as it would have been if the organic matter content had been higher. The inference drawn is that the line stimulated decomposition but this was offset by the fact that the organic matter was apparently in an advanced stage of decomposition and hence the action was very slow.

The soil in plot 910 showed a loss of 0.36 per cent of organic matter. The loss of organic matter in this soil was not as great as in the soil of plot 906. The soil in plot 910 was low in organic matter in the beginning and the amount added in the crop residues was small, therefore, the loss of organic matter in this soil would not be expected to be as great as in the other check soil. The organic matter in this soil is also in an advanced stage of decomposition.

The amount of organic matter added as crop residues was estimated from crop yields and a balance sheet or inventory of the organic matter, Table III, was calculated from the analyses.

The data in the table show considerable decomposition of organic matter in all soils and a decrease in the supply due to losses from all soils, except in the soil of plot 909 where the amount of loss was about the same as the amount added. The apparent effect

Table III — Organic Matter Balance in Soils Under Continuous Corn (Pounds Per Acre)

Plot No.	Organic Matter Content of Soil in 1917	Organic Matter Added in Crop Residues	Organic Matter Added in Manure	Total Organic Matter After Additions	Organic Matter Content of Soil in 1936	Amount of Organic Matter Decomposed
906	95,918	44,798	——	140,716	77,824	62,892
907	85,732	53,195	24,000	162,927	80,374	82,553
908	80,338	57,057	24,000	161,395	61,732	99,663
909	56,936	47,685	——	104,622	57,630	46,992
910	50,022	36.145	——	86,167	42,750	43,417

of lime on this soil was to conserve the organic matter, whereas in the soil of plot 908, the effect of lime was to speed up the rate of decomposition. The explanation of this apparent difference in effect of lime in the two soils is undoubtedly related to the amount and kind of organic matter in the two soils.

Summary

The soils of the continuous corn plots at the Iowa Agricultural Experiment Station were sampled in 1917 and again in 1936 under treatment of manure and lime. The organic matter content and pH of the soils were determined and a balance sheet or inventory made of the organic matter losses and gains. The results obtained show that the organic matter content of the soil cannot be maintained under continuous corn even with relatively large additions of manure.

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Soils Subsection,
Iowa Agricultural Experiment Station,
Ames, Iowa.