Manganese as a Factor in the Fertility of Southern Illinois Soils

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Manganese is among the thirty-five elements that have been detected in the analysis of plants, according to Miller[1], and it is an element which is considered essential by at least a majority of green plants. The amount of manganese required by plants is relatively small as compared to the amounts of some of the other commonly recognized essential elements.

Generally speaking, concerning what is known of the action of manganese in soils, it may be said that small amounts are beneficial to most crops, but larger proportions may act as plant poisons and cause considerable harm to the growing plant. Manganese has a peculiarity which distinguishes it from some of the other more common elements in the soil. A deficiency is harmful to plants, an optimum amount is unquestionably beneficial, and an excess available in soils may prove harmful to some plants. The amount of available (soluble and replaceable) manganese in cultivated soils is not a constant value throughout the year or season. This may be illustrated by some determinations of available manganese in cultivated soils on the Oblong experiment field in Crawford county. On this field the amount of available manganese found in the soil about the middle of July was 400 pounds an acre and by late September the amount had dropped to 120 pounds an acre. Changes similar to this have been observed in cultivated soils throughout Illinois, and such changes are important considerations in the study of manganese and its relation to soil fertility.

TABLE I—COMPOSITION OF THE SOIL FROM LIMED AND UNLIMED PLOTS, JUNE 17, 1937

Experiment field	Soil treatment	pH	Mn, lbs.	N, lbs.	P, lbs.	K, lbs.
Sparta	No lime	4.4	240	1,120	14	75
	Lime	6.3	60	1,340	32	70
Ewing	No lime	4.2	340	1,230	18	60
	Lime	6.1	80	2,120	26	75

A study of the influence of soil treatment indicates that a rise in pH of the soil causes a corresponding drop in amount of available manganese. Soils from the Sparta experiment field having a pH 4.4 had an available manganese content of 240 pounds an acre (June 17, 1937), and where the soil reaction was raised to pH 6.3 the manganese content dropped to 60 pounds an acre. Almost identical results were obtained on the Ewing field as indicated in Table I. This change in the amount of available manganese in the soil is reflected in the amount of total manganese in the young corn plants, June 17, 1937. The results given in Tables I and II indicate that the corn plant is very sensitive to the amount of available manganese in the soil.

The rise in the pH of the soil due to liming on the Sparta and Ewing fields increased decidedly the available phosphorus content of the soil (Table I), and this also is reflected in the higher phosphorus content of the corn plants (Table II). The total nitrogen content of the soil was increased by liming mainly due to the increased vegetative growth and the growing of legumes. The liming had a tendency to decrease the

amount of available potassium in the soil, and accordingly decreased the amount of total potassium in the corn plant. The lower potassium content of the corn plants on limed soils may be due to the increased calcium content of the plant which may represent the much discussed potassium-calcium antagonism in plants.

TABLE II.—COMPOSITION OF CORN PLANTS FROM LIMED AND UNLIMED PLOTS, JUNE 17, AND THE CORN GRAIN YIELDS, NOVEMBER, 1937

Experiment field	Soil treatment	Mn, %	N, %	P, %	K, %	Ca, %	Mg, %	Corn grain, bushels per acre
Sparta	No lime	.220	3.40	.26	2.36	.65	.55	15.0
	Lime	.015	3.54	.32	1.82	1.15	.80	28.2
[illegible]	No lime	.220	3.58	.14	3.09	.70	.53	13.4
	Lime	.022	3.54	.30	1.14	1.10	1.00	30.2

The addition of lime increased the corn yield, increased the available phosphorus in the soil and the phosphorus content of the corn plant, also increased greatly the calcium and magnesium content of the corn plant, but had the opposite effect on both manganese and potassium. These are very important factors in the fertility of southern Illinois soils.

[5] Miller, E. C. Plant physiology. McGraw-Hill Book Company, New York, pp. 232-239. 1931.