Causes of Very Poor Growth of Crops on a Formerly Productive Soil

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In July 1946, it was noted that potatoes were growing very poorly on a large field in central Connecticut. On a few spots in that field and on other fields of the farm, potatoes appeared quite normal. The owner stated that potatoes had been grown on the unproductive field for 13 consecutive years and had received annually a ton or more per acre of 5-8-7 or 5-10-10 fertilizer, but very little, if any, lime. It had produced very large yields in the late 1930's, but growth had been unsatisfactory for 2 or 3 years before 1946. Since 1946, other fields on the farm had developed the same trouble.

The problem soil was formed from glacial outwash, red triassic shale, and sandstone. It had a pH of 5.0, contained 2.7% organic matter, 10% clay, and 45% total sand. Quick tests (Morgan method) showed the soil was very high in Al and Mn, high in P and K, low in Mg and Fe, and very low in Ca.

Barley, lettuce, millet, potatoes, rye, soybeans, and tomatoes have not grown normally in pots of the untreated, unproductive soil. Potatoes were very small and spindly, with branches rising at acute angles, and appeared similar to those suffering from a severe deficiency of P (Fig. 1). Barley and millet had light green to yellow foliage; rye leaves were reddish in color; soybeans were much stunted with lower leaves yellowish green; tomatoes had a type of growth similar to potatoes but in addition, had purplish colored leaves. In all cases, the roots were short and stubby and had few branches (Fig. 2).

Definite proof of the causes of the trouble has not been obtained, and therefore the evidence pertaining to several hypotheses will be mentioned.

Physical Condition of Unproductive Soil

It was suggested that poor physical condition of the soil was responsible for the poor growth of plants. Strong negative evidence is furnished by the facts that mixing the soil with 50% sand or pumping air continually through the soil did not improve the growth of potatoes in pots, while adding Na$_2$CO$_3$ was very beneficial to tomatoes in pots and somewhat favorable to potatoes on plots (Table 1 and Fig. 3).

Chemical Conditions in the Unproductive Soil

The evidence accumulated on the inorganic conditions is condensed under two headings: (1) deficient plant nutrients; (2) toxic elements.

Deficient Plant Nutrients

Calcium.—A deficiency of Ca as the cause of the trouble was ruled out because gypsum at from 1,000 to 4,000 pounds per acre did not affect the growth of several crops and also Na$_2$CO$_3$ was practically as beneficial to tomatoes as an equivalent amount of CaCO$_3$. It should be recalled, however, that Fried and Pech (4) found that several crops did not obtain their Ca requirements.