Radioactive Calcium in the Study of Additive and Native Supplies in the Soil

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In conventional lysimeter studies on liming materials it has been necessary to attribute enhancement in calcium outgo as coming from the additive materials (*1, 2, 3*). Through the use of radiocalcium[2] it now seemed feasible to determine the relative contributions of the native calcium and the added calcium to leachate calcium from limed soils and to the plant calcium from crops grown thereon.

The labeled $CaCO_3$ used in these experiments was prepared by adding $Ca^{45}Cl_2$ to a water solution of C.P.$CaCl_2$ and then precipitating the calcium as carbonate by making the solution alkaline with NH_3 and then bubbling CO_2 into the solution, under pressure, until precipitation was virtually complete. The precipitate was water-washed, dried, pulverized, and its radioactivity determined. Thus prepared to contain a suitable amount of activity per rate of input, the material was incorporated in the soils given in Table 1 at rates of 0, 1, 2, 3, 4, and 5 thousand lbs/ac.

TABLE 1

PROPERTIES OF SOILS USED

Determinations*	Hartsells very fine sandy loam	Claiborne silt loam
Exchange capacity at pH 7	12.2 me	11.4 me
Exchangeable Ca	1.2 me	4.5 me
Exchangeable Mg	0.3 me	1.1 me
Exchangeable H	10.7 me	5.8 me
Base saturation, %	12.3	49.1
pH values in H_2O	4.5	5.7

* Exchangeable Ca and Mg by ammonium acetate extraction and leaching, exchangeable H by replacement with 0.5 *M* neutral Ca-acetate and titration of the engendered acidity, and exchange capacity by summation of the Ca, Mg, and H.

Lysimeter and greenhouse experiments were conducted on each soil in the manner described (*3, 4*). A lysimeter of 1/20,000 acre was used for each of the 5 liming rates on both soils, and crops were not grown. The drainage waters were collected at successive periods, and samples were evaporated. The resultant residues were taken up with dilute HCl, and total calcium

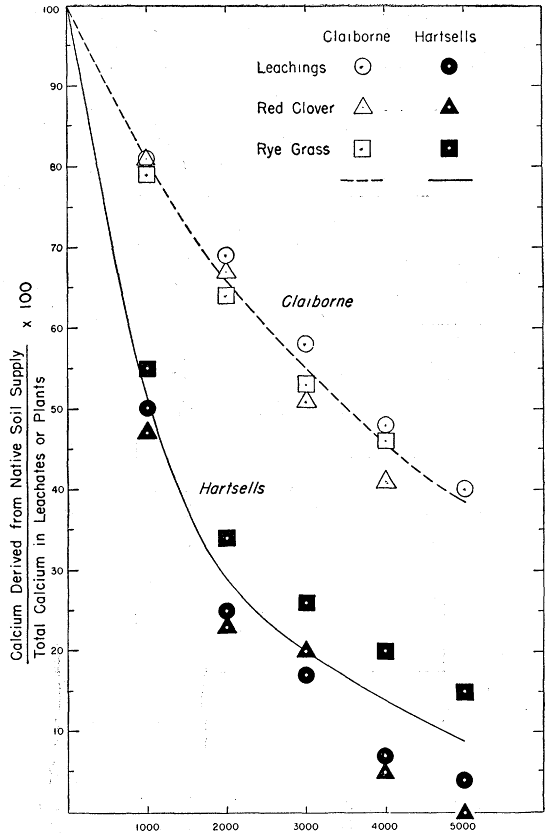

FIG. 1. Percentage of the total calcium content of leachings or in crops that was derived from the native soil calcium as a function of the amount of $CaCO_3$ incorporated.

was determined in aliquots of the HCl solutions through precipitation as the oxalate and permanganate titration. Aliquots of the acid solutions were evaporated in 50-mm Petri dish bottoms for radioactivity measurements by means of a thin-window Geiger counter. The usual corrections for self-absorption and decay were made.

The greenhouse pot cultures were in triplicate. The crops were sampled successively and harvested at approximately the maximum vegetative stage that had developed before flowering. The plant material was ashed; the ash was taken up with dilute HCl, and total and radioactive calcium were determined as described above. The parallel lysimeter and pot culture experiments were started on November 2, 1949.

The analytical values for the periodic samplings of the drainage waters and of the crops are so similar that totals only are reported. To facilitate comparison, the lysimeter results and the plant uptakes are given in the same figures.

The incorporations of calcium increased the crop yields on the more acidic Hartsells soil, but had little effect on Claiborne. The heavier rates of liming increased the total calcium in the drainage and in the crops. However, the increase in calcium content was not so pronounced for the crops grown on the Clai-

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[2] The Ca^{45} was obtained from the Oak Ridge National Laboratory through allocation from the U. S. Atomic Energy Commission.

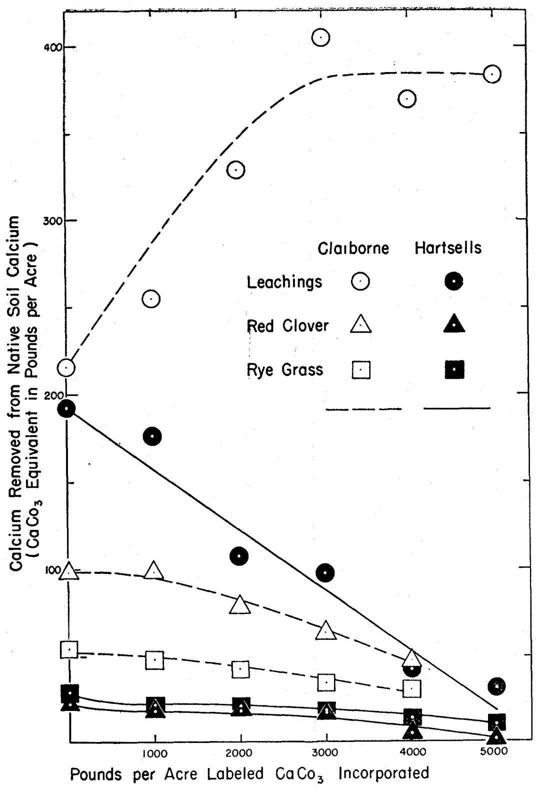

FIG. 2. Total amount of native soil calcium, as $CaCO_3$ equivalent in lb/ac., in leachings or crops as a function of the amount of $CaCO_3$ incorporated.

borne soil, which is naturally fairly well supplied with this element.

Increases in the total input of calcium were reflected by increases in the amounts of additive calcium in the drainage waters and in the crops.

The percentage of added calcium recovered in the drainage was relatively constant at about 16% for the Hartsells soil, but increased continuously from 6 to 11.5% for the Claiborne soil as the incorporation rate increased. On Hartsells soil the percentage of the added calcium recovered through the plants is related to increased growth, with decrease in the recovery after the point of maximal yield. On Claiborne soil, crop growth was affected only slightly by the incorporated calcium, and there was a progressive decrease in percentage recovery. Recoveries of calcium via crops fell between 0.9 and 3.0% of the incorporated calcium.

In the drainage, and in the crops, the percentage of calcium that was derived from the supplies native to the soils (Fig. 1) decreased with increases in the incorporation of calcium carbonate. The soils functioned differently, however, since the highest rate of calcium input on the Hartsells decreased the percentage of native calcium to practically nil, whereas that input of $CaCO_3$ on the Claiborne decreased the value to approximately 40%.

The quantity of native calcium in the drainage from the Hartsells soil (Fig. 2) decreased progressively with increases in additive calcium. On the contrary, the quantity of native calcium in the drainage of the Claiborne soil increased through the 3,000-lb incorporation but showed little further change at the higher rates. The amount of native calcium in the crops decreased with increases in rates of incorporation (Fig. 2).

In general, the results from the lysimeter and greenhouse experiments are of similar import. The two soils behaved very differently, as would be expected from their properties. It was noteworthy that additive calcium increased the removal of native calcium in the drainage of the Claiborne soil, but decreased it progressively in the drainage of the Hartsells. More detailed explanations will be given in a later publication.

References

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Titanium tetrafluoride, hoolamite, aluminum trimethyl, bromosilane, bromogermane, pyrene-1,2-quinone, sodium cetyl sulfonate, β-sulfopropionic acid, dinaphthyl methane, di-o-tolyl amine, heptadecyl alcohol, *o*-iodosobenzoic acid, methyl-α-benzyl acrylate, 1-phenyl indane, fluorene-9-carboxylic acid, α,α′-dinaphthyl, 1,1-dimethylethylene oxide, decamethylene dicarboxylic acid, dicarbazyl, and trans-α-decalone are among the chemicals wanted by the **Registry of Rare Chemicals,** 35 West 33rd St., Chicago 16, Ill.

Milton C. Whitaker, 80-year-old pioneer in the fields of chemical engineering education, industrial research, and plant organization and development, has received Columbia University's Chandler Medal for 1950 in recognition of his outstanding achievements in the chemical industry. Mr. Whitaker founded Columbia's Department of Chemical Engineering and was at one time its head. Named for the distinguished chemist who was one of the founders of Columbia's School of Mines, the awards have been given to 22 scientists in the past 40 years.

George Urdang, of the University of Wisconsin School of Pharmacy, was chosen to receive the Lascoff award for 1950 for his contributions to American professional pharmacy. The award is presented annually by the American College of Apothecaries. The presentation will be made at the annual meeting of the group next summer in Buffalo, N. Y.

W. Alan Wright, of East Orange, N. J., has joined Chas. Pfizer & Co. as director of Medical Service, Antibiotics Division. Dr. Wright came to Pfizer from the Schering Corp., Bloomfield, N. J., where he was associate director of clinical research.