Growth and Nutrient Uptake of Ladino Clover Grown on Red and Yellow and Grey-Brown Podzolic Soils Containing Varying Ratios of Cations

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THE type of soil clay minerals and the relative proportions of the cations in the exchange complex of soil significantly affect uptake of ions by plants. Allaway (1), Chu and Turk (4), Marshall (7), Mehlich (10), and others have shown that the release of cations, especially Ca, is greater from the 1:1 lattice-type clays than from the 2:1 types. Soils of the southeastern United States generally contain kaolinitic clay minerals, and those of the northeast the illitic types.

The purpose of this study was to determine whether these differences in the clay minerals would affect the mineral composition of Ladino clover when extreme variations in Ca, Mg, and K ratios were established in the exchange complex of soils from these areas.

Experimental

Annandale loam and Sassafras sandy loam soils from New Jersey and two similar soils formed from the same type of parent material in Georgia, the Cecil loam and Tifton sandy loam, were chosen for study. Annandale and Cecil soils are formed from granites, gneisses, and schists, and Sassafras and Tifton soils from unconsolidated Coastal Plain materials. Separation of the clay fractions and identification by X-ray spectrometer method showed that the clays of the Annandale and Sassafras soils contained 50 and 30% of illite, respectively, the remainder being largely kaolin. The Cecil and Tifton clays were mainly kaolin. The organic matter contents of the soils were as follows: Annandale, 4.35%; Cecil, 3.58%; Sassafras, 1.85%; and the Tifton, 1.75%.

A1 horizon samples of virgin soils were collected, air-dried, sieved, and made to the same cation exchange capacity (1.88 m.e. per 100 grams) by dilution with acid washed quartz sand. Since the field soils were largely H-saturated, no attempt was made to remove the basic cations already present, but their contents were considered in calculating the quantities of CaCO3, KHCO3, and MgO to add to each soil to give the desired cation ratios. The preparation of the soil by this procedure was chosen because preliminary studies (5) had shown that little difference exists in the availability of cations from soils prepared by the addition of carbonates (or bicarbonates for K), by titration with hydroxides, or by mixing homoionically saturated soils. Seven soil treatments were used (Table 1), the last representing the “ideal soil” as proposed by Bear and Toth (2). Sulfur and phosphorus were added uniformly to all cultures, as dilute acids, at the rate of 85 pounds of S or P2O5 per acre. Trace elements were applied in solution and the plants were grown from seed on July 18. Moisture was maintained at the optimal tilled water. The first cutting was made on August 8, and the second on September 9, 1949, both at the preharvest moisture. All potting materials were harvested after the second cutting. All pots were dried at 80°C in a draft oven, replicated yields were composited, and the material was ground in a Wiley mill. The plant was analyzed by the method of Toth, et al. (13), determined by the A.O.A.C. procedure.

Cation release from the potted soils was estimated by giving the exchangeable cations in the soil water extracted. Results were corrected for the Ca, Mg, and K ratios of the soil water. The first and second cutting yields were composited, and the data were analyzed by the analysis of variance (12). The mean soil dry weight with the root and mean dry weight of the root only were calculated. The latter was determined by multiplying the mean dry weight of the plant by the mean percent of the plant roots and green material of the plant weight.

![Table 1](image)

* m.e. per pot.