CESIUM UPTAKE FROM DILUTE SOLUTIONS
BY YOUNG WHEAT SEEDLINGS AS AFFECTED
BY SELECTED CATIONS *

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INTRODUCTION

In short term experiments with small volumes of soil Tensho* et al. 24 have shown that addition of K to soils containing carrier-free Cs137 resulted in appreciable reductions in uptake of Cs137 by rice seedlings. On the other hand, applications of NH4 and Rb increased Cs137-uptake while, Na, Ca, and Mg had much smaller effects. Equilibration experiments and radioautographs of soil columns revealed large differences in the capacities of the added salts to displace previously applied Cs137 from the soil, the displacing ability following the order Ca = Mg < Na < K < NH4 < Rb. Similar observations in our laboratories have been made with some North Carolina soils†. In contrast to their effects on uptake of Cs137 from soil systems, NH4, K, and Rb all are inhibitors of Cs137-uptake by excised barley roots in solution 10. Approximately 0.01 me K or Rb per liter and 0.03 me NH4 per liter were required for 50 per cent inhibition of carrier-free Cs137-uptake. Many plants take up K in preference to Cs, especially at low K-concentrations 6 7 17. This preference usually is expressed to a greater extent in the above

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† Jackson, W. A., Craig, Doris and Lugo, H. M. Effects of various cations on cesium uptake from soils and clay suspensions. Manuscript in preparation.
ground portions than in roots \(^6\) \(^7\) \(^16\) \(^17\). An understanding of the influences of inorganic ions added to soils on the Cs found in shoots of plants requires a knowledge of the effects these ions have on maintenance of Cs in the soil solution, the influence of the ions on uptake by root systems, and their influence on subsequent transport of Cs to the shoots.

It has been noted occasionally that the proportion of an incoming ion found in the shoots may be enhanced when root accumulation processes are restricted. For example, Russell and Martin \(^20\) observed as the concentration of P supplied was increased that there was an increase in the proportion of the total P absorbed found in the shoots. Pretreatments with P increased relative upward movement of the P subsequently applied in dilute solutions, and selected concentrations of the metabolic inhibitors NaN\(_3\), 2,4-dinitrophenol and diethyldithiocarbamate increased the proportion of total P absorbed transported to shoots \(^21\). The results were interpreted \(^19\) \(^21\) as indicating metabolic retention of P in the root with consequent decrease of P available for transport. This was especially evident at low solution concentrations of P or low initial plant P-status. Competition between uptake by root cells and transport to tops has also been indicated for Rb \(^11\) \(^12\) \(^19\). Broyer \(^5\) has shown that Br transported to barley shoots came mainly from the external solution; Br previously accumulated by roots did not move rapidly to the shoots.

The experiments reported here were designed to examine (a) the uptake of Cs by young wheat seedlings in very dilute, slowly stirred solutions containing Cs and other selected monovalent cations and (b) the relative distribution of Cs between roots and shoots as a consequence of treatments designed to alter the processes involved in uptake of Cs by the root cells. The data indicate appreciable reduction in Cs-uptake by roots and transport to shoots when NH\(_4\), K, and Rb were added to the solution. Moreover, these experiments show that relative Cs-transport to shoots was reduced under some conditions which tended to maximize retention in roots, suggesting that transfer of Cs into the vascular stele was not dependent upon previous Cs-uptake by root cells.