THE DISTRIBUTION OF POTASSIUM, CALCIUM AND MAGNESIUM IN YOUNG TOMATO PLANTS GROWN IN WATER CULTURE

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ABSTRACT

Tomato seedlings, cv. Moneymaker were grown in water culture at a low [half] level of K, Ca of Mg as well as in a control in which the three nutrient elements were present at a higher [full] concentration. At weekly intervals, plants were harvested and partitioned. The dry weight and the K, Ca and Mg concentrations of each part were determined. In all treatments characteristic concentration gradients of each element were apparent within the plant, and in the case of K, leaf concentration changed with age. The possibility of internal re-distribution of nutrients seemed greatest in the case of K.

Comparison of nutrient concentration in equivalent leaves from high and low treatments suggests that choice of leaf is not critical in assessing Ca and Mg status, but that the lower leaves during their sixth and seventh weeks of development are most sensitive to K supply.

INTRODUCTION

Recent research in mineral nutrition has sought to establish critical levels of nutrient content at different stages of the plant’s development. The problem is complicated by the possibility of internal redistribution of the more mobile ions.

In the present investigation, tomatoes were grown in water culture at two levels of K, Ca and Mg. The aim was, by partitioning the plants, to monitor the pattern of distribution of the three elements during the first weeks of the plant’s development. By comparison between such patterns in plants supplied with a particular nutrient at a near optimal level, and those in plants supplied at a sub-optimal level, it was hoped that possible sampling recommendations for determining the mineral status of tomatoes might emerge.
Tomatoes, *Lycopersicum esculentum* Mill. cv. Moneymaker were germinated in sand [21.6.74] and transferred to water culture in plastic troughs [5.7.74]. The troughs had a capacity of 10 liters and were fitted with perforated polystyrene lids.

The plants were subjected to four nutrient treatments based on the Long Ashton solution formula using nitrate as a nitrogen source. In the control, K was supplied at 2 meq.1\(^{-1}\), Ca at 4 meq.1\(^{-1}\) and Mg at 1.5 meq.1\(^{-1}\). Low K, low Ca and low Mg treatments were obtained by halving the concentration of the appropriate element. The low K and Ca solutions were kept isotonic with the control solution by substituting equivalent amounts of NaNO\(_3\), and the low Mg solution, by an equivalent amount of Na\(_2\)SO\(_4\).

Three troughs of 17 seedlings were allocated to each treatment and randomised in adjacent bays of a greenhouse. Minimum night temperature during the investigation was, on average, 13.6° C, and maximum day temperature, 26.9° C. Ventilation was given when the temperature reached 20° C, and generally occurred between 10 a.m. and 5 p.m. The solutions were constantly aerated. The oxygen concentration of the solutions, determined by an oxygen electrode, varied between 9.6 and 10.1 ppm. Water loss due to evaporation was rectified periodically. The pH of the fresh solution was 4.5–4.7 but gradually rose to 7.2 as plant nutrient uptake occurred. The solution was renewed four times at regular intervals.

At weekly intervals the heights of four plants selected at random from each treatment were measured from the insertion of the cotyledons. The plants were then partitioned into as many parts as were present at the time of sampling. The parts distinguished were: – root, stem, leaf, 1, 2, 3, ... 13, inflorescence 1, inflorescence 2 and shoot apex. The leaf samples included the petiole, and the shoot apex was defined as all growing material above the last sampled leaf. Each part was dried separately to constant weight in a hot air oven at 95° C. Dry weights were determined and used to estimate total dry weights for each plant. Samples [0.1 g] of the ground, dried, tissue were ashed in a furnace at 450° C overnight. The ash was taken up in 5 cm\(^3\) of 0.5 N HCl and diluted to 20 cm\(^3\) with distilled water. K and Ca were estimated by flame photometry and Mg by atomic absorption spectrometry. From these estimations, the mean concentrations of K, Ca and Mg as percentages of the dry weight, and their mean absolute contents were calculated.

The weekly samples were taken from 22.7.74, when the plants had been in water culture for 17 days, until 9.9.74 when the plants were 12 weeks old and had been in water culture for 66 days. The sampling dates were numbered 1, 2, ... 8.