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TOLERANCE TO LOW PHOSPHORUS IN AN ANTHOCYANINLESS TOMATO VARIETY (*LYCOPERSICON ESCULENTUM*)

Key words: anthocyaninless tomato, phosphorus stress.

Introduction

Runoff from fertilized fields is one of the major causes of polluted water supplies in Northwest Ohio, USA. Due to this environmental problem and for obvious economic reasons, attempts to produce a tomato variety that can grow under low phosphorus (P) concentrations are in progress. Breeding programs have produced several varieties of "green stem" tomatoes that lack anthocyanin. One of the characteristics of tomatoes grown under low P is the appearance of a dark purple color on the stems and on the under side of the leaves. This characteristic is not present in the anthocyaninless variety so the possibility that these plants would be able to grow productively in low P soils is being pursued.

Materials and Methods

Seeds of two determinate processing varieties, 80883, and 80957, an anthocyaninless variety, were germinated in vermiculite moistened with distilled water. Eighteen days after germination the seedlings were weighed and placed in hydroponic culture media. The media contained necessary microelements (H_3PO_4, $MnCl_2$, $ZnCl_2$, $CuCl_2$, and MoO_3) and macroelements (2 mM KNO_3, 3 mM $Ca(No_3)_2$, 2 mM Mg SO_4, and 1 mM EDTA). KH_2PO_4, the source of P in the media, was varied from 2 mM to 0.03 mM. As KH_2PO_4 was decreased KCl was used to replace the lost K. Plants, in one liter black plastic containers, were grown in growth chambers with sixteen hour photoperiod. The day temperature was 30 °C and the night temperature was 18 °C. The LICOR 6200 Photosynthetic System was used to measure net photosynthesis, conductance, and respiration on leaves at nodes 6 and 10 as counted from the base of each plant. For mineral analysis dried plant material was assayed for nitrogen, phosphorus, and potassium content.

Results and Discussion

The lack of typical P stress characteristics, purpling and decreased foliage, which were observed in variety 80883, were not displayed or were greatly reduced throughout this experiment in 80957. These observations are supported by the increased growth and accumulation of dry matter as seen from the dry and fresh weight data (Fig. 1). Variety 80957 constantly displayed increased growth over variety 80883 in all of the P concentrations in both fresh weight and dry mass. Mineral analysis of the dried

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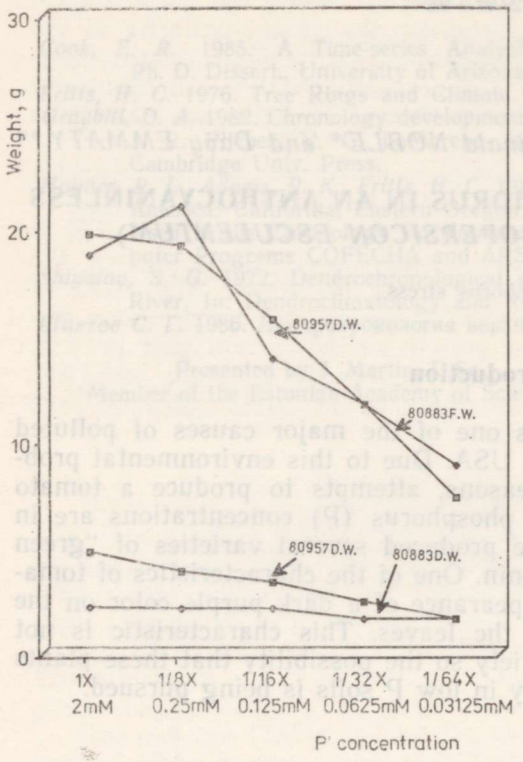

Fig. 1. Comparison of fresh and dry weights.

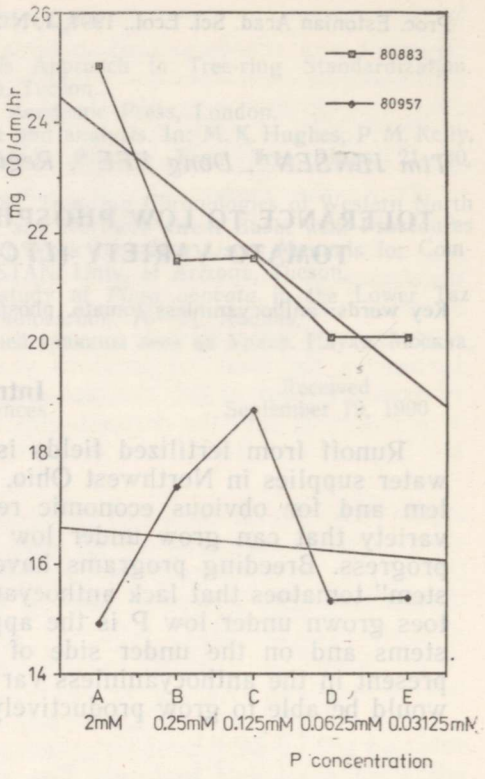

Fig. 2. Photosynthesis rates vs. P concentration.

plant material showed variety 80957 with a lower concentration of P in its tissues than did variety 80883. This leads us to believe that variety 80957 does not require as much P for its physiological processes as does variety 80883 and that variety 80957 does not simply have a better uptake mechanism.

Photosynthesis rates (Fig. 2) for variety 80957 are lower than those for 80883 except at the lowest concentration of P (00.03 mM). As seen in Fig. 2 the rate of decline of photosynthesis for variety 80883 is much steeper than that of variety 80957. This suggests that variety 80957 may not achieve the high level of photosynthesis seen in variety 80883, but that 80957 is able to deal with the stress better as the amount of P decreases. The fact that plants of variety 80957 showed a higher photosynthesis rate at the lowest P level proves that this anthocyaninless variety is able to function under low P conditions better than its counterpart. These data demonstrate variety 80957 to be more tolerant to P stress than variety 80883 under the growth conditions described above. Further work to determine tolerance to P stress in soil and under more natural growth conditions is needed; which if successful, will provide an incentive for breeders to move this characteristic into agricultural varieties.

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