DIFFERENCES IN ROOT AND SHOOT DEVELOPMENT OF TOMATO (*LYCOPERSICON ESCULENTUM* L.) VARIETIES ACROSS CONTRASTING SOIL ENVIRONMENTS

by SHERRY L. GULMON* and NEIL C. TURNER**

SUMMARY

The root and shoot growth of three tomato (*Lycopersicon esculentum* L.) varieties, VF-10, VF-1908 and Paste 56 were compared in either a river-washed sand or an alluvial silty loam, with or without added nutrients, to determine factors influencing root growth and development. VF-10 had consistently higher shoot weights than the other two varieties, particularly by 45 days from germination. Although the root-to-shoot ratio varied with soil treatment, no significant differences in this ratio occurred among varieties. The roots were characterised by a taproot, thickened in the uppermost 3 to 5 cm, with 86 to 190 secondary roots when harvested 30 days after germination. Although the root-to-shoot ratio varied with soil treatment, no significant differences in this ratio occurred among varieties. The variety VF-1908 had a higher proportion of fine roots than the other two varieties over all treatments. On the basis of root weight and length, VF-1908 was also more stable across the imposed environmental gradient than the varieties VF-10 or Paste 56. This arose from less variability across soil treatments in secondary branching in VF-1908; over the four soil treatments the number of secondary roots varied from 104 to 131 in VF-1908 compared to 86 to 139 in VF-10 and 95 to 190 in Paste 56. VF-1908 and Paste 56 also had less variation in tertiary branching than VF-10, which had a consistently greater number of major tertiary roots than the other two varieties over all soil treatments. With the exception of Paste 56 in the fertilized silt, shoot growth was correlated with root length.

INTRODUCTION

Varietal differences in nutrient uptake and water use are well established13. However, the gross patterns of root growth, which

* CSIRO Division of Plant Industry, P.O. Box 1600, Canberra City, A.C.T., 2601, Australia. Present address: Department of Biological Sciences, Stanford University, Stanford, California, 94305, U.S.A.

** CSIRO Division of Plant Industry, P.O. Box 1600, Canberra City, A.C.T., 2601, Australia
might be expected to influence these basic aspects of plant performance, have only infrequently been compared among closely related varieties. Differences in phosphorus uptake among maize varieties have been shown to be related to differences in the ratio of secondary roots to primary roots and differences in competitive ability between two barley varieties have been attributed to the production of a dense mat of roots directly beneath the crown. Hurd in a study of the root growth of seven wheat varieties attributed the higher yields of some varieties under low moisture conditions to the deeper penetration and greater distribution of roots in these varieties.

Species are distinguishable by their characteristic root morphology. Also differences among varieties in the total number and disposition of their roots have been reported in soybean and pole beans, suggesting that varieties may also be characterised by consistent differences in root growth patterns. However, root growth varies greatly with environmental conditions, and the ability of a root character to remain unchanged across different soil environments may vary with variety.

Recently, Zobel reported differences among root systems of several tomato varieties and indicated that in some of the varieties root growth and distribution was more constant in a range of soil environments than it was in other varieties. Since Zobel's assessments were based simply on visual observations of field grown plants in which a spadeful of roots were dug up and washed, the present study in which the degree of branching and root length, diameter and weight of three tomato varieties were measured, was initiated to determine whether the visual observation in the field represented measurable differences under controlled environmental conditions. To determine the degree of stability in root growth and development under a range of edaphic conditions, the three varieties were grown in four extreme soil environments created by the use of two soils of contrasting textures and two nutrient regimes.

MATERIAL AND METHODS

Three tomato (Lycopersicon esculentum L.) varieties, VF-10, VF-1908 and Paste 56, were grown in either a river-washed sand or an alluvial silt loam; hereafter referred to simply as sand or silt, respectively. Some characteristics