Colloquium Papers and Authors

Presiding: Daniel I. Leskovar

Seedling Morphological and Physiological Adaptation to Abiotic Stress: Introduction to the Colloquium

Daniel I. Leskovar

Vegetable Seedling Root Systems: Morphology, Development, and Importance

Daniel I. Leskovar and Peter J. Stoffella

How Maize Seeds and Seedlings Cope with Oxygen Deficit

B. Greg Cobb, Malcolm C. Drew, David L. Andrews, James Johnson, David M. MacAlpine, Tricia Danielson, Meredith A. Turnbough, and Ronald Davis

Adaptations of Beans (*Phaseolus vulgaris* L.) to Low-phosphorus Availability

Jonathan P. Lynch and Stephen E. Beebe

Plant Photomorphogenesis in Canopies, Crop Growth, and Yield

Carlos L. Ballaré, Ana L. Scopel, and Rodolfo Sanchez

The Dual Role of Mannitol as Osmoprotectant and Photoassimilate in Celery

D.M. Pharr, J.M.H. Stoop, J.D. Williamson, M.E. Studer Feusi, M.O. Massel, and M.A. Conkling

Genetic and Environmental Aspects of Roots and Seedling Stress

R.W. Zobel

Seedling Morphological and Physiological Adaptation to Abiotic Stress: Introduction to the Colloquium

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The seedling environment is seldom optimum for uninterrupted growth. Seedlings commonly experience temporary periods of abiotic stresses, resulting in necessary root and shoot metabolic and structural adjustments to withstand stress conditions. Abiotic stresses not only have an impact on the subsequent growth and productivity of cultivated plants, but also constitute a significant barrier for introducing crop plants into areas not used in agriculture.

Adverse conditions in the root environment include mechanical impedance, deficient or excess water or salts, deficit or imbalance of nutrients, and insufficient O₂ and CO₂. The canopy environment may also limit photosynthesis and assimilate translocation. In the past decade, considerable progress has been made in identifying and understanding seedling growth physiological, morphological, and physical adaptation mechanisms to drought, O₂, salt, nutrient, and light stresses. This new knowledge has enhanced our understanding of vegetable seedling growth responses during establishment. However, considerable scientific investigation remains to be accomplished. Abiotic stresses generally do not occur separately—rather, interaction of stresses are the norm in natural environments (e.g., drought and high

temperature). I hope that this colloquium will stimulate interdisciplinary interaction among ecologists, plant physiologists, breeders, and other scientists from related disciplines to pursue investigations on these complex and interactive processes. Information generated from this colloquium will be useful for genetic improvements in rooting patterns, nutrient acquisition, photomorphogenic behavior, and enzyme systems involved in anaerobic, salt, and drought stress tolerance.

The authors discuss changes in root morphological components in various vegetable species and their impact on shoot growth during early stages of plant establishment. Seedling adaptation to O₂ stresses will be emphasized by analysis of changes in enzymatic activity associated with anaerobic respiration. The physiological basis for genetic differences in crop adaptation to low-P soils is presented for beans (*Phaseolus vulgaris* L.). Seedling responses to light signals, photomorphogenesis, and photophysiology will be discussed to explore plant adaptations to competition and population density. The subsequent paper will focus on mannitol, a translocated photosynthetic product active in plant growth, drought and salt stress, and the novel enzyme mannitol dehydrogenase, located in nonphotosynthetic "sink" tissue (particularly roots), necessary for biosynthetic events in growing tissues. Finally, seedling root growth responses to soil stresses and techniques used to detect and select for genetic tolerance based on individual developmental root type are addressed.

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