Introduction to the Colloquium: Mechanisms of Root–Shoot Communication

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Additional index words. competition, drought, nutrients, phenotypic plasticity, PGRs, succulents

Presentations in this Colloquium come from a diverse group of researchers looking to understand the impacts of roots on plants at a variety of levels of plant organization. The following four articles focus on how water, carbon, mineral nutrients, and other plant growth regulators (PGRs) affect root–shoot communication, growth and quality of individual plants and their populations. Examples of root–shoot communication include tree fruits, crop plants, succulents, native plants, and the model plant *Arabidopsis*. Differences in drought tolerance, root distribution, shoot growth, and leaf physiology often correspond closely with water uptake characteristics. For example, hydraulic conductivity of the peach tree root system can control tree size and cropping. Roots express an array of adaptive

traits that help plants cope with stresses, but such traits can require significant metabolic costs and tradeoffs for competing for limited resources. Succulents are important horticultural species that can exhibit longitudinal root contraction and radial swelling of older roots that help maintain root-to-soil contact and increase hydraulic conductance in xeriscapes. Environmental stresses such as drought, high temperature, and nutrient deficiency influence photosynthetic efficiency and assimilate partitioning that can give rise to management practices that increase production efficiency. P availability regulates root form and function to optimize P acquisition from soil. In addition, root competition can affect the ability of shoots to compete for aboveground resources and hence, influence

plant quality. Plant–herbivore and plant–insect interactions can fundamentally alter plant diversity and how plants modify growth or efficiency through phenotypic plasticity. PGRs originate in roots or shoots and play a role in internal signaling that regulates morphology and physiological responses in distal plant parts. Changes in the presence, balance, and distribution of PGRs communicate developmental, stress-related, or environmental cues that alter plant productivity or quality. This group of articles demonstrates that root interactions are complex and that roots cannot function alone or as an isolated part of the plant. Root–shoot communications are causally linked to many plant characteristics that are of importance in horticulture.