

PLANT ANATOMY Lecture 3 - Roots

- I. **Root function**
 - A. **Absorption** - uptake of water and nutrients (primarily root tips and hairs)
 - B. **Anchorage** - holds plant in place and keeps it stuck in the soil (older roots)
 - C. **Storage** - food reserves (especially dicots; monocots have little capacity for storage)
 - D. **Transport** - enable movement of substances up through the plant
 - E. **Propagation** - development of a new plant from roots through growth and differentiation into a new plant
 - F. **Growth regulation** - roots are believed to be the primary source of the gibberellins and cytokinins
- II. **Root study techniques**
 - A. **Trench** - excavating a trench perpendicular to the plant or row of plants
 - B. **Framed monolith and pinboard** - follows the trench; pull and map roots with a pinboard
 - C. **Soil moisture and depletion** - moisture (measured by weighing or a neutron probe) as an indication of root growth
 - D. **Core sampling** - estimate of entire root profile through representative sample
 - E. **Minirhizotron** - observation pit in soil with a glass front
 - F. **Radioactive isotope method** - place isotopes (^{32}P) in soil and count uptake
 - G. **Allometry** - use shoot growth as an estimate of root growth
- III. **Root development and structure**
 - A. **Root cap** - protects the tip of the root
 - B. **Apical meristem** - gives rise to meristematic tissue
 - 1. **Quiescent center** - frequency of mitoses is low
 - 2. **Proximal meristem** (the area closest to or of meristematic cells)
 - a) **Protoderm** - produces epidermis
 - b) **Ground meristem** - produces ground tissue (cortex and endodermis)
 - c) **Procambium** - produces vascular tissue (vascular cylinder referred to as the stele)
 - C. **Developmental zones of the root**
 - 1. **Zone of cell division (meristematic zone)** - tip of root
 - a) **Apical meristem & primary meristematic tissues**
 - 2. **Zone of cell elongation** (above division zone)
 - a) **Cells grow in length & diameter** - little division or differentiation
 - 3. **Zone of cell differentiation** (uppermost - kinda where root hairs are visible)
 - a) **Secondary wall formation**
 - b) **Formation of root hairs and endodermis**
 - D. **Primary root cross-section**
 - 1. **Dicot**
 - a) **Epidermis** - outermost layer - no cuticle - produces hairs
 - b) **Cortex** - middle tissue between epidermis and vascular cylinder - undifferentiated parenchyma cells - major region of nutrient absorption
 - c) **Endodermis** - encases the vascular cylinder (stele) - seals off stele from cortex
 - 1) **Casparian strip** - waxy thickening in cell walls of endodermal cells - contains suberin and waxes - keeps water in
 - d) **Stele**
 - 1) **Everything inside endodermis**
 - 2) **Xylem occurs in radiating arms in center** (diarch, triarch, etc.)
 - 3) **Phloem occurs between xylem arms**
 - 4) **Pericycle forms a layer of parenchyma cells just to the inside of the endodermis**
 - 2. **Monocot** - similar to dicot root, but with pith in center of the stele
 - a) **Monocot stele is different because it doesn't really have "arms" and because its vascular tissue is in a polyarch arrangement**
 - E. **Secondary tissue of roots** - laid down similarly to that of shoots
 - 1. **Vascular**: Secondary xylem to the inside; secondary phloem to the outside
 - 2. **Cork**: Phellem to the outside and phelloderm to the inside (root bark consists of phellem and phelloderm)