# 9 Plant biology

## 9.1 Transport in the xylem of plants

### Modeling water transport

- porous pots can be used to model evaporation from leaves, as water is drawn into pot cohesion causes water molecules to be drawn up the glass tube
- capillary tubes dipped into water and mercury; no adhesion of mercury to glass or each other

### Adaptations for water conservation

- xerophytes: plants adapted to growing in deserts and other dry habitats
- strategies for survival: increasing rate of water uptake, reducing water loss by transpiration
- some xerophytes are ephemeral with very short life cycle which is completed in brief period of water availability, then remain dormant until next rains
- other plants are perennial and rely on storage of water in specialized leaves, stems, roots
- most cacti are xerophytes with leaves reduced to spines, stems contain water storage tissue, epidermis has thick waxy cuticle, stomata are more widely spaced and usually only open at night (transpiration occurs slower), carbon dioxide is absorbed at night and stored in four-carbon compound (malic acid)
- carbon dioxide is released fro malic acid during day allowing photosynthesis with stomata closed: Crassulacean acid metabolism (CAM plants)
- Marram Grass (adapted for dry conditions) has rolled leaf: creates localized environment of water vapor, stomata set in small pits, folded leaves have hairs on inside to slow air movement
- saline soils contain high concentrations of salts; plants living in saline souls are halophytes: adaptations are reduced leaves, leaves are shed when water is scarce and stem becomes green (does photosynthesis), water storage structures, thick cuticle, multiple layered epidermis, sunken stomata, long roots, structures for removing salt build-up

## 9.2 Transport in the phloem of plants

### Phloem sieve tubes

- functions of phloem: loading of carbohydrates, transport of carbohydrates, unloading of carbohydrates at sinks
- phloem is composed of sieve tubes; sieve tube elements are living but have reduced quantities of cytoplasm and no nucleus
- reason they need to be living is that they depend on membrane to help maintain sucrose and organic molecule concentration that has been established by active transport
- sieve tubes are closely associated with companion cells (share same parent cell): companion cell perform many genetic and metabolic functions of sieve tube cell
- abundant mitochondria in companion cell support active transport of sucrose
- infolding of plasma membrane increases phloem loading capacity using apoplectic route
- larger plasmodesmata between companion cell and sieve tube cells to accommodate movement of oligosaccharides and genetic elements between the two cells
- rigid cell walls of sieve tube cell allow establishment of pressure necessary to achieve flow of phloem in sieve tube cell
- individual sieve tube cells are separated by perforated walls called sieve plates: remnants of cell walls that separated the cells; in combination with reduced cytoplasms, resistance to flow of phloem sap will be lower

## 9.3 Growth in plants

### Micropropagation of plants

- micropropagation: in vitro procedure for large numbers of identical plants; depends on totipotency of plant tissues
- tissues from stock plant are sterilized and cut into pieces (explants), least differentiated tissue serves as source (e.g. meristem)
- explant placed into sterilized growth media with plant hormones (auxin, cytokinin)

- equal proportion of hormones leads to formation of undifferentiated cell mass (callus), if growth media contains more than auxin to cytokinin (10:1) it is a rooting media and roots form, if growth media contains less than (10:1) it is a shoot media and shoots develop
- once shoots and roots are developed, cloned plant can be transferred to soil

### Micropropagation is used for rapid bulking up

- micropropagation can be used to produce virus-free strains of plants; viruses are transported through vascular tissue and via plasmodesmata, apical meristem is often free of viruses
- can be used for production of many identical copies of plants with desirable characteristics
- process is faster and takes up less space than traditional methods of production
- used for preservation of species such as orchids: bulk of production allows wild replanting and commercial production; seeds of orchids are difficult to germinate (asexual more successful)
- cryopreservation: micropropagated plantlets can be stored in liquid nitrogen
- stock of endangered species is maintained

## 9.4 Reproduction in plants

### Inducing plants to flower out of season

- flower forcing is procedure to get flowers to bloom out of season or at a specific time
- additional light is provided in the middle of night which leads to flowering