Plant Interactions
**Plant Interactions**

By the end of this lecture, you should be able to –

- define two positive and three negative plant interactions
- be familiar with characteristics of three major parasitic weeds including
  - names and their hosts
  - where the weed is a problem
- understand why chemical control of parasitic weeds is difficult
- explain two strategies for management of parasitic weeds.
Plant Interactions

- Plants live in mixtures of species so interaction is inevitable.

- Interactions are often categorized by the effects on the plants involved.

- Competition - main form of interaction.

- Obligate - essential to at least one species.

- Facultative - not essential for either species.
Positive Plant Interactions

- Also known as Ecological Facilitation
  - Mutualism: both plants benefit, it may be obligate (+ +)
  - Commensalism: one plant benefits, while the other plant is unaffected (+ 0)
Commensalism

- Epiphytic plants benefit from living on other plants but they take no nutrients from host.

- Epiphytic plants gain access to:
  - more direct sunlight
  - a greater number of canopy animal pollinators
  - the possibility of dispersing their seeds via wind

- Hosts are not affected even in cases when they are supporting what appears to be a large population of epiphytes.
  - bromeliads, orchids, and some ferns are epiphytes
  - lichens, mosses, and liverworts
Negative Plant Interactions

- Competition – an interaction between plants that is mutually detrimental (- -).

- Amensalism – an interaction that involves one plant impeding or restricting the other without being affected (- 0).

- Parasitism – an interaction in which one plant uses the nutrients and water of another plant, the host, to the detriment of the host (+ -).
Competition

- Competition occurs when
  - two plants seek the same resource
  - the supply of that resource is below the combined demand of the plants.

- Competition occurs for light, nutrients, and water.
Amensalism - Allelopathy

- Allelopathy is the deleterious effect that one plant has on another by the release of a chemical inhibitor.

- May have a net benefit to the allelopathic plant by removing competition, and allowing it greater access to resources.
Parasitic Plants
Parasitism in Plants

- There are over 4,000 parasitic species that represent 15 plant families.

- In some parts of the world, more crop yield is lost due to parasitism rather than to competition.
Parasitism in Plants

- A parasite connects to the vascular system (xylem & phloem) of the host plant.

- Nutrients and water are transported to the parasite via a physiological bridge called a haustorium.

- The parasite may lack the ability to photosynthesize.

- Parasitic plants may cause complete yield loss, but do not usually kill their hosts
  - WHY????
Parasitic Weeds and Some Common Hosts

- Dodder – alfalfa, clover, sugarbeets, tomato, safflower, and cranberry
- Broomrape – clover, sunflower, lentil, lettuce
- Witchweed – corn, sorghum
- Mistletoe – oak
Parasitic Weeds – Dodder

- *Cuscuta* spp. – Convolvulaceae family

- Over 170 species of obligate parasite plants

- Occur everywhere crops are cultivated and in some non-crop areas

- Invade algae, ferns, gymno- and angiosperms

- The plant long, thin, rootless, leafless, and with a yellow-orange stem
Dodder (*Cuscuta* spp.)

Photos courtesy of Dr. T. Ombrello, Union County College Biology Department, New Jersey.
Parasitic Weeds – Dodder

- Seed are small (0.5 to 1.0 mm) and contain minimal reserves.
- The seedling must attach to the host plant within a few days.
- Dodder attaches to aboveground shoots only.
- Dodder does not attach to members of the Poaceae family.
How Does Dodder Find its Host?

- Studies indicate that dodder can perceive volatile signals from the host (tomato and impatiens).

- Dodder placed near tomatoes, a host, and artificial plants – dodder grew towards host 77% of the time.

- Several compounds and their interaction may be involved.
Parasitic Weeds – Broomrape

- Orobanche spp. – Orobanchaceae family
- Obligate parasite
- Contains no chlorophyll
- Mostly in the Mediterranean and warm temperate areas of Europe
  - Found in clover fields in 1998 in Oregon
- Broomrape attaches to the roots of broadleaved hosts
- Poaceae not hosts
Small Broomrape Life Cycle

1. **Emergence** (Late May to Early June)
2. **Flowering**
3. **Capsules** (Early July)
4. **Seeds**
5. **Host plant**
6. **Stimulant**
7. **Germination & Attachment** (March)
8. **haustoria**

**Above ground**

**Below ground**
Parasitic Weeds – Witchweed

- Striga spp. – Scrophulariaceae family
- Witchweed - corn, sorghum, grasses
- Over 50 species
- Can cause total crop loss
- Major problem in Africa
  - Infests about 40% of arable land in the semi-arid tropics of the sub-Saharan
  - Some farmers abandon their infested land
- Found also in North and South Carolina
Parasitic Weeds – Witchweed

- A highly prolific obligate parasite
  - One plant produces thousands of tiny, dust-like seeds that can remain dormant for 15-20 years.

- Attaches to roots
  - Approximately ½ of the life cycle is underground

- Enzyme and hormone changes that ultimately alter the host plant’s ability to utilize water and carbon
Parasitic Weeds

- Broomrape and witchweed have chemotropic growth towards the root of the host plant.

- Host plant root produces exudates that trigger the parasitic plant to germinate and attach.

- Major germination stimulant
  - (+)-strigol
Management of Parasitic Weeds

- Most existing weed control measures are not effective, economical, or practical.

- The biology of these weeds is not well understood.

- Due to attachment between the host and the parasite, only a highly selective herbicide can control the weed without damage to the host.
Management of Parasitic Weeds

- Other herbicide complications:
  - Some crops (corn) metabolize the herbicide before it can be translocated to the underground tissue of the parasite.
  - Chemical technology is not available.

- Two promising and culturally accepted methods:
  - Trap crops
  - Resistant cultivars
Management of Parasitic Weeds

- Trap crops induce germination of the parasite, but the crops are not infested, and parasite seedlings die.

- Also known as False Hosts
  - Cowpea, cotton, soybean, and peanut for witchweed
  - Grass and cereal crops, flax for broomrape
  - Grown in rotation or intercropped
Management of Parasitic Weeds

- Breeding for resistance in the host plant is also being investigated.

- Challenges –
  - Resistance is a complex genetic trait & many genes are involved.
  - New races of the parasites develop quickly.
  - Limited adoption of resistant cultivars.
Management of Parasitic Weeds

- Plant non-hosts that do not stimulate germination.

- Fumigation to kill seed with treatments such as methyl bromide.

- Herbicide seed treatments
  - Soak crop seeds in a herbicide solution
  - The herbicide is present in the crop seedling to inhibit growth of the parasite.