Species Interactions

- Competition (exploitation competition)
  - Exploitation of a resource faster than another competing organism
- Antagonism (interference competition / combat)
  - Antibiotic production / parasitism
- Commensalism (mutualism)
  - Two species coexisting, benefit to one or both species

Role of Antibiotics in Fungal Interactions

- Antibiotic: A diffusible secondary metabolite of one organism that inhibits another organism at a concentration of 100 μg/mL\(^1\)
  - Penicillins, cephalosporins and griseofulvin
- Some fungi are able to gain survival advantage by production of certain antibiotics
  - Can out-compete bacteria and other fungi by antibiotic production

Fungal Antibiotics in Nature

- Disease-suppressive soil
  - Soil that contains high amounts of fungal antibiotics that inhibit infection of desirable crops by other microbes
- Disease-conductive soil
  - Soil that allows infection of desirable crops by other microbes, through the lack of fungal-produced antibiotics

Trichoderma Antibiotics and Disease Control

- *Trichoderma* are antagonists of many other fungi
  - Produce antibiotics in soil
    - 6-pentyl-α-pyrene, trichodermin, suzukacillin, alamethicine, viridin, viridiol, gliovirin, heptelidic acid, gliotoxin
    - Used as biological agents to control plant pathogens

- *Trichoderma* Antibiotics and Disease Control
  - Not only does the species *Trichoderma* use antibiotics to antagonize other pathogens, it is an extremely fast growing fungus
    - Some strains are able to grow up to 25 mm hr\(^-1\)
    - Outcompetes other organisms by growing faster and exploiting resources at a faster rate
Commercial Products from *Trichoderma*

- **Trichodex™**
  - Controls gray mould, *Botrytis cinerea* on grapes
- **Trichodowels™**
  - Used as plugs for holes bored in trees, controls infection of the tree from *Chondrostereum pupureum*
- **Bio-Trek 22G™**
  - Strain of *Trichoderma* used to control pathogens of golf courses

Hyphal Interference by *Basidiomycota*

- Inactivation of competitor fungi hyphae, allowing the victorious fungi hyphae to exploit the resource of competition
- Does not require that hyphae are in contact with one another
  - Possible to have interference between hypae separated by up to 50 µm

Environmental Impact of Hyphal Interference

- Aids in the control of pine root rot
- Pine root rot causing fungus *Heterobasidion annosum* is antagonized by *Phlebiopsis gigantea*
  - *Phlebiopsis gigantea* is applied to the stumps left behind from deforestation of pine trees
  - *Phlebiopsis gigantea* application prohibits the proliferation of *Heterobasidion annosum*, thus controlling pine root rot

Mycoparasites

- Fungi that parasitize other fungi are termed mycoparasites
- Necrotrophic mycoparasites
  - Invasion and destruction of other fungi cells by parasitic fungi that feed on the cellular contents
- Biotrophic mycoparasites
  - Specialized feeding relationship, haustoria penetrates and absorbs nutrients from living fungal hyphae

Biotrophic Mycoparasites

- Haustorial biotrophs
  - Group of fungi that penetrate living hyphae of host fungus, penetration leads to formation of a haustorium inside host and allows for exploitation of host nutrients
  - Causes little damage to host fungi
  - Several *Zygomycota* are haustorial biotrophs

Control of Potato Black Scurf

- *Verticillium biguttatum*, a biotrophic mycoparasite used as a biocontrol agent for the disease causing *Rhizoctonia solani*, the causative agent of potato black scurf
  - Inhibition of parasitic fungi on potato plant tubers
Necrotrophic Mycoparasites

- Fungi that use inhibitory toxins, or other metabolites for the control of competing fungi
- Generally destroy the fungi in which competition is against

Antagonism from *Talaromyces flavus*

- *Talaromyces flavus* can antagonize *Rhizoctonia solani*
- *Talaromyces flavus* produces four antibiotics, one of which being talaron, a highly antifungal compound
- Glucose oxidase produced by *Talaromyces flavus*, produces $\text{H}_2\text{O}_2$, parasitizing it’s competitor

Commensalism and Mutualism

- Interaction of *Thermomyces lanuginosus* with the cellulose degrading fungus *Chaetomium thermophile*
  - *Thermomyces lanuginosus* is unable to degrade cellulose, therefore cannot grow on cellulose without the presence of *Chaetomium thermophile*
  - Illustrates a mutualistic relationship between two different fungal species