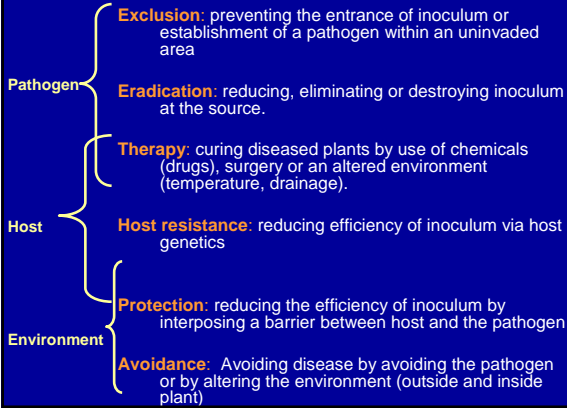


Principles of Disease Control



Chemical Control

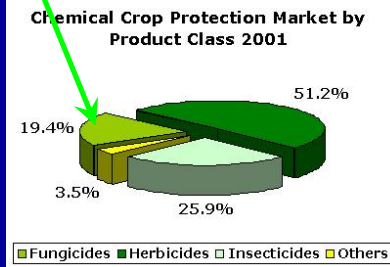
- Effective, flexible technology! 😊
- Cost can be a factor 😐
- Users require special knowledge and training 😐
- Repeat treatments may be necessary 😐
- Pathogen-resistance to fungicides 😞
- Health and environment concerns 😞
- Chemistry continues to evolve 😊

Fungicide market:

90-100 million pounds of copper and sulfur applied to fruit crops

40 million pounds of synthetic, organic chemicals applied to:

- apples
- potato
- peanuts
- citrus
- grapes
- other veges, fruits
- cereals in high yield situations
- ornamentals and turf



Dominant uses of fungicides:

Field crops – Seeds, foliage in some high yield environments.

Nursery – Foliage and soil, pot drenches, root dips, seeds, stored products.

Fruits and nuts - Foliage, Fruit pre- and post-harvest. Essential tools in most crops: apples, bananas, grapes.

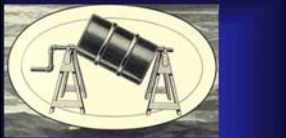
Mushrooms – Routine treatment of spawn beds.

Vegetables - Seeds, Foliage Essential for some crops (e.g., potato)

Turf – Essential for maintenance of very high value playing surfaces

Methods of Fungicide Application

Seed treatment



Rotary duster (1930's) made from a 30 gallon steel oil drum. A baffle board was placed inside to help mix the seed. Construction cost was \$1.25

Small-farm technology



Seed warehouse or farm service provider

Methods of Fungicide Application



Ground or 'boom' sprayer for field and vegetable crops

Air blast (or air assisted) sprayer for orchards and vineyards

Methods of Fungicide Application

Chemigation – applying fungicide via irrigation equipment



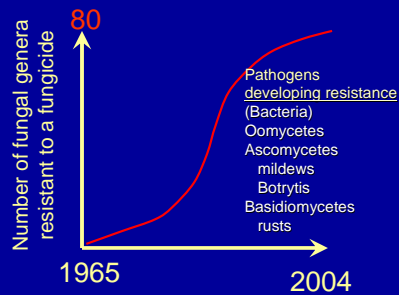
Airplane application less common because fungicides require higher volumes of water than other pesticides

Classification of Fungicides

- **Protectant** - house paint analogy – a chemical barrier protects plants from infection
- **MOST** fungicides are in this category, they prevent infection, **but do not kill** spores
- **Eradicant** - kill the target organism (like insecticides) the chemical reduces inoculum – uncommon for foliar fungicides
- **Chemotherapeutant** cure infections (drug therapy) generally restricted to indexing programs e.g. injections to target a pathogen inside plant

Fungicide resistance

After repeated, prolonged use of fungicides, pathogens 'resistant' to their toxic effects are selected for.

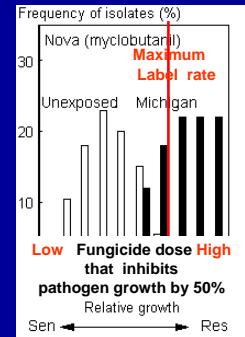
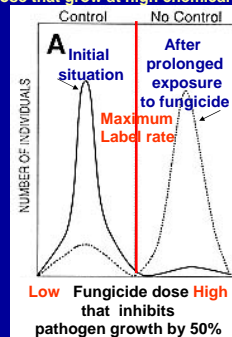


Every family of fungicides discovered in the last 35 years has developed a problem with pathogens becoming resistant to their effects

Fungicide resistance example

Initially, pathogen individuals are sensitive to low doses of the chemical. Exposure to the fungicide selects for those that grow at high chemical doses.

Example: apple scab pathogen collected from unexposed, natural area compared to Michigan orchards.



Strategies for managing resistance in pathogens to chemicals

- **Mixtures of fungicides** (common industry recommendation)
typical 'pre-packaged' strategy: mix locally-systemic, single site (at risk) mode-of-action fungicide with a contact material that has a multi-site mode-of-action
- **Rotate chemicals** (extension service recommendation)
Alternate fungicide family with each application
- **Limit usage** (crop management consultant recommendation)
comprehensive, disease management program including use of disease warning models

Resources for knowing *when* to spray fungicides

- Regional spray guides are published for just about every economically important plant species *in the flavor* of your choice: industrial, homeowner, conventional, organic

Example: Phenology-based spray guide for backyard fruit production in Minnesota:

<http://www.extension.umn.edu/distribution/horticulture/DG0675.html>

- Disease warning models have been developed for many foliar diseases where fungicides are required for control. These models use weather data to provide information on the likelihood that conditions for infection have been fulfilled.

Example: California PestCast, Disease Model Database

<http://www.ipm.ucdavis.edu/DISEASE/DATABASE/diseasemodeldatabase.html#ABOUTPLANT>