Organic Approaches to Pathogen Control

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• **Abiotic: environmental**
  Lighting, Hail, Temperature, Nutrient excess, Nutrient deficiency, Ozone, etc.

• **Biotic or living:**
  A living organism causes a disease on a susceptible host plant.

  For Example: A fungus infecting a plant and causing a rot. The fungus is feeding on the plant.
Corky spots from hail damage

Fruit

Stem

• **Abiotic: (environmental)**
  
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**Biotic (living) causes of diseases**

**Animal Kingdom**
- Nematodes (microscopic worms)

**Plant Kingdom**
- Parasitic vines (*Dodder*)
- Mistletoe (e.g. *Viscum*)
- Witchweed (*Striga*)
- Algae (*Cephaleuros*)

**Biotic causes of diseases:**

**Fungal Pathogens**
- Pathogens feed on the plant and cause a disease

**Bacterial Pathogens**
**Viral Pathogens**
Marasmiellus

Botrytis or Gray Mold
Disease Cycle: cool weather (68 F)

1. Moisture
2. Spot expands
3. Spreads by wind and splash
4. Only one spore is needed to begin a spot
5. To a healthy petal
Phyllosticta on Orchids

Yellow spots are common symptoms; Fungal thread inside the yellow spot. Phyllosticta yellow spot can be spread by water. Fungal spores can spread disease. The fungal fruiting body can be found on the leaf surface.
Fungal thread growing on leaf surface and penetrating through the stomata

Fungal spore germinating

Zooospore that has been attracted to an open stomata

Zooospore, germinated, and thread penetrating the stomata.
Spore distributes the fungus leaf
Spores form
Disease forms
Healthy Plant

Spore lands on the leaf
Spore germinates
Fungus penetrates the host

Understanding the Disease cycle will help you to control the disease

Break the disease cycle
Healthy Plant

Spore distributes the fungus

Spores form

Disease forms

Spore lands on the leaf

Spore germinates

Fungus penetrates the host

No water

Spore fails to germinate

Break the disease cycle
DISCARD DISEASED PLANTS or PLANT PARTS

REDUCE WATER

Disease Control for Organic growers:

Sanitation:
Discard diseased plants; Avoid spore production; BREAK the disease cycle.

Reduce water:
Without water the fungal pathogen:
Spores will not germinate
Host plant will not be infected
Pathogen produces few spores
Spores cannot splash to healthy plants
Exclusion: Prevent new diseases from coming into Hawaii or your nursery; Quarantine Laws;

Example: Soy Bean Rust

- The U.S. grew 2.0 billion bushels of soybean in 2001. 52% was used to feed poultry and 23% for swine feed.
- Soybean Rust, a highly destructive disease, causes crop losses of 40 to 90% in countries where it occurs.

Soybean rust was not present in the U.S. in 2001

It would devastate the soybean industry in the U.S.

Compendium of Soybean Diseases. Sinclair and Backman. APS Press
In 1994, Soybean rust caused by *Phakopsora pachyrhizi* was reported from Mililani where 100% of the field was infected; the crop was not salvageable. It was also found in other parts of Oahu, Kauai, and Hilo.

Today:

Soybean rust has spread to the U.S. Southern States are infected.

Close monitoring is made. Spore traps.

As soon as the rust is found, the farmers applies fungicides to reduce infection.

A weed has been found to be a good host.
Potentially devastating to the ohia forests with heavy defoliation and tip death.
Cultural Practices:
Reduce water; Sanitation; Exclusion; Pathogen free stock

Field crops:
1. Crop rotation
2. Adding compost to the field
3. Fallow the field
4. Fallow with a cover crop or green manure
5. Host resistance

Marasmiellus
Pathogen free stock

- Heliconia diseased by fungal pathogen
- Clean the diseased plants
- Trim of diseased areas; surface disinfest
- Plant and prepare clean stocks
- New plants from clean stock

Diseased Heliconia with root and rhizome rots
Cultural Practices:
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Field crops:
1. Crop rotation
2. Adding compost to the field
3. Fallow the field
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5. Host resistance

Crop rotation: alternate your crops
E.G. Corn, peanut, corn, peanut
Pathogens that attack corn cannot feed on peanut; Peanut pathogens cannot feed on corn; No host; pathogens starve.

Fallow the field: keep the field clean.
The pathogens that survive in the soil will starve without the host to feed on.
Fallow with a legume crop

E. G. Plant your crop, harvest, remove the crop, and plant Sunn Hemp. After 6 weeks, cut the Sunn Hemp and till it into the soil.

As the Sunn Hemp decomposes, the microorganisms that feed on the Sunn Hemp increase tremendously. Many of these are known as beneficial microbes that increase the health of the soil.

Sunn Hemp fixes nitrogen and will increase the level of nitrogen in the field.
When a crop is attacked by *Pythium*, a common root rotting pathogen, the *Pythium* forms billions of spores. The spores survive in the dead host tissue (protected). After the host tissue decomposes, the *Pythium* spores can survive in soil until a susceptible host is planted again.

As the Sunn Hemp decomposes, the number of *bacteria* are so high that some of them *encounter the Pythium spores*. They *feed on the spores*, killing the spores and over time the pathogen population *declines*.

Other microorganisms also feed on the Sunn Hemp and increase in numbers.
Mycoparasitism

Fungi that feed on the Pythium spore.

Biological control in potting mixes

*Pythium ultimum* that cause root rot of potted ornamental plants can be controlled by organisms in the potting mix.

Pine bark composting
Mechanized composting

Dr. Harry Hoitink

*Plant Disease*, vol. 75 No. 9
Example of disease suppression with compost

A = Old decomposed sphagnum
B = Less decomposed sphagnum
C = Blend using pine bark compost

All pots were inoculated with the same amount of *Pythium ultimum*, the pathogen.

Biological control:

Using a living organism to control the pathogen population.

Many are bacterial such as *Bacillus* or fungal such as *Trichoderma*. 
Future:

Invite Dr. Hoitink to Hawaii for a seminar or workshop on the use of compost to control diseases

Screen organically approved chemicals (biocontrols) to control powdery mildew