Vegetable Disease Control

for the Organic Farmer/Gardener

Steve Bost
Extension Plant Pathologist
Soil, Plant & Pest Center
Nashville, TN

UT Extension

Foreword

A widespread misconception!

OMRI (Organic Materials Review Institute) does NOT determine which products are allowed for use in organic production. Only the NOP (National Organics Program) makes that determination, and a certifying agency can further refine the list.

OMRI is a private, non-profit organization that reviews products only for companies that request the review and pay the review fee.

NOP is a USDA agency charged with establishing the standards to be used in certified organic production.

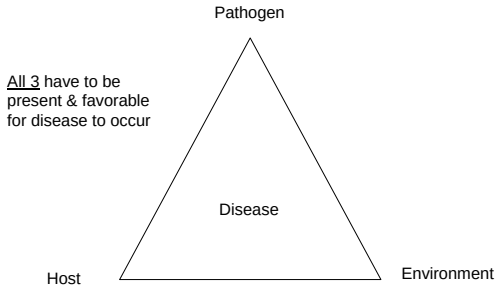
Your organic certifying agency reserves the right to disallow products allowed by NOP. Submit to your certifying agency the list of products you plan to use, and get their approval prior to use.

What is a disease?

How does it differ from other plant problems?

- Disease – caused by a pathogen, such as a fungus, bacterium, virus, or nematode.
- Disorder – caused by cultural or environmental factors, a.k.a. "abiotic problems."
- Pest damage – caused by insects or other animals that feed on or otherwise damage plants.

THE DISEASE TRIANGLE



Disease Control for the Organic Producer

- Plan ahead
- Must be integrated
  - with general production practices
- Must have an ecological basis
  - Manage soil
    - Encourage diversity of beneficial microorganisms
  - Crop diversity

Disease Control for the Organic Producer

- Good crop husbandry
- Site selection
  - Good water drainage
  - Good air drainage
  - No history of problems
- Exclusion
  - Seed treatments
  - Certified seed
  - Disease-free transplants
    - Avoid chain-store plants
  - Infested soil on tractor equipment
- Protection materials
  - Copper
  - Sulfur
  - Biologicals
  - Bicarbonates
  - Bacteriophages
  - Oils (mineral, essential)
- Cultural practices

Good crop husbandry

Happy plants resist disease better

Plants more susceptible to disease if:

- improper pH
- crowded
- weed competition
- seeded in cool soil
- inadequate fertilization
- excessive fertilization (poor drying conditions)

Site selection for disease control

Good water drainage

Surface drainage prevents standing water

Phytophthora capsici on pepper

Good internal drainage very important

Fusarium crown of pumpkin on Dickson silt loam soil

Air drainage

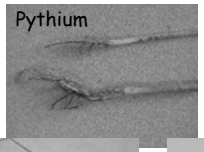
Wet rot (whisker rot, Choanephora)

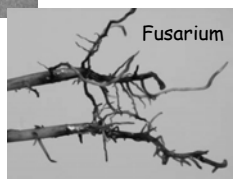
Controllable with site selection & planting density. Avoid tree-lined fields.

Field disease history

Keep records

Some soil-borne pathogens are in all soils and are unavoidable

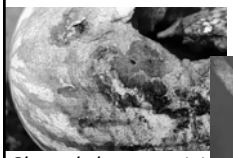




Field disease history

Keep records

Some pathogens are limited in occurrence and clean fields should be available



Phytophthora capsici

Southern blight

Fusarium wilt

Exclusion

Keeping the pathogen out

- Seed disinfestation
- Certified seed
- Disease-free transplants
  - Avoid chain-store plants
- Cleaning infested soil from tractor equipment
- Sanitizing transplant production tools

Seed treatment

- Seed disinfestation -- Hot water
- Seed protection -- Kodiak, T-22, Actinovate

Crop	Temp (F)	Minutes
Brussels sprouts, cabbage, eggplant, spinach, tomato	122	25
Broccoli, cauliflower, cucumber, carrot, collard, kale, kohlrabi, rutabaga, turnip	122	20
Mustard, cress, radish	122	15
Pepper	125	30
Lettuce, celery	118	30

Must be adhered to, exactly. Hot water treatment has many drawbacks. See discussion in *Commercial Vegetable Disease Control Guide*, http://www.utextension.utk.edu/publications/wfiles/W141.pdf

Clean equipment between fields

After working infested field, before working non-infested field

Clean tractor tires, plows, other implements if a difficult-to-control disease is present in some, but not all, fields.

E.g., Phytophthora blight, fusarium wilt, bacterial diseases

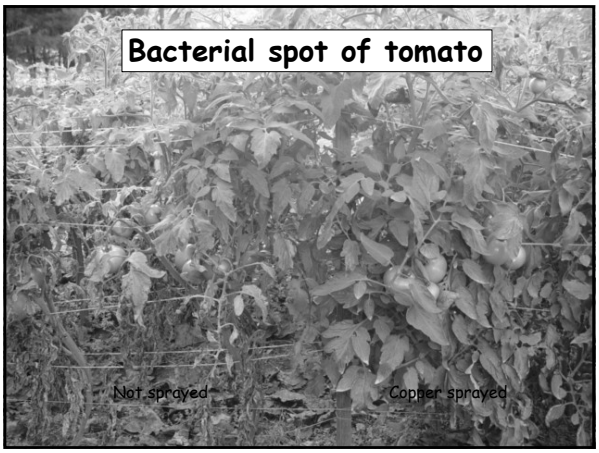
Prevent pathogen introduction into transplant production system

- Clean and disinfest any re-used trays, pots, tools, or surfaces, using 10% bleach (NOP approved) or a hydrogen peroxide (NOP and OMRI approved) product.
- Do not allow soil particles to contact potting mix.
  - Do not store or mix potting media on ground
  - Wash hands before working
  - Especially if you smoke! (viruses)

Protection materials I

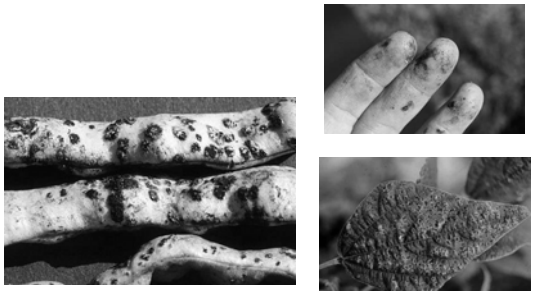
- Copper – Good control of bacterial diseases; fair to moderate control of some fungal diseases. Note: There are some restrictions on how copper is used, but most copper products are NOP approved.
- Sulfur – Excellent control of powdery mildews; good control of peach scab; slight rust control.
- Biologicals (biocontrols) – Can provide fair control, but high pathogen population overwhelms them. Mostly for soil-borne diseases.

cont'd



Bean rust control

Resistant varieties and sulfur sprays



Protection materials II

- Bicarbonates – Slight control of powdery mildews and a few other fungal diseases.
- Bacteriophages – Viruses that attack bacteria. Specific for bacterial spot and speck of tomato and bacterial spot of pepper.
- Oils
  - Mineral oils – Moderate control of powdery mildews and some control of viruses vectored by aphids.
  - Essential oils (plant extracts) – Convincing evidence of disease-control activity is lacking.

Cultural Practices for Disease Control

- Crop rotation
- Sanitation
  - Plow under residue
  - Roguing
- Irrigation practices
- Improve drainage
  - Raised beds
  - Incorporate organic matter
- Control other pests
- Soil solarization
- Manipulate environment
  - Greenhouse practices
  - Avoid crowded plantings
- Resistant varieties
- Biofumigation
  - Green manure
  - Seed meal

Crop rotation is family rotation

Plant a member of a different plant family on a plot of ground each year

Family*	Example members
Cucurbitaceae	Cucumber, cantaloupe, watermelon, pumpkin, squash, gourds
Cruciferae	Broccoli, cabbage, Brussels sprouts, collard, mustard, kale, turnip, rutabaga
Gramineae	Corn, grasses
Leguminosae	Beans, peas
Solanaceae	Tomato, potato, pepper, eggplant

* There are several other families represented by 1 or 2 vegetable crops

Crop Rotation

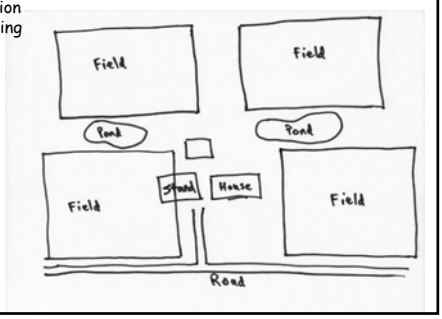
Works best against pathogens that:

- Are soilborne (so they can't escape)
- Have narrow host range (so they can't find something else to eat)
- Are short-lived (so they can't wait you out)

Crop rotation can be affected by the farm plan

Factors affecting field site selection:
- good production potential
- close to irrigation
- type of marketing

A four-yr rotation plan



Cucurbit downy mildew

A disease that crop rotation will not control

Tomato spotted wilt virus

Most viruses are insect-borne and not controllable by crop rotation.

Sanitation

The destruction or removal of diseased plants.
1.Plow under crop residue
2.Roguing

May also include **Exclusion** practices such as cleaning and disinfecting tools.

Sanitation

- Plow under crop residue ASAP after harvest. Speeds decomposition of debris.
- Turning plow best, but can cause erosion problem.
- Disk plow is adequate, unless southern blight (*Sclerotium*) is a problem.

Roguing

The removal of diseased plants

Should be done immediately upon first detection of a disease.

Don't scatter the pathogen during the removal process!

Southern blight, *Sclerotium rolfsii*

Sclerotia and white mycelium

Removal of diseased plant parts, where practical

(gardens, greenhouses, high tunnels)

Target spot (*Corynespora*) of cucumber. Too late for removal of infected plant parts.

Low tunnels and row covers

They're great, but they can interfere with drying conditions and spraying. Remove any diseased plants prior to row cover application.

Cull piles

Don't dump in production fields

Good idea to scoop it up, carry it away and bury it, especially if you had late blight.

Late blight

Clean Trellising Stakes

- Wash soil and debris from stakes
- Disinfect with a 10% bleach solution (NOP-approved)

Improve drainage

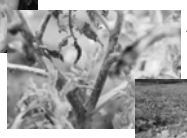
- Incorporate organic matter (cover crop, compost, etc.)
- Use raised beds (plastic mulches are NOP-approved).

Control other pests

- Some pathogens are spread by insects.
- Weeds reduce drying conditions, and can host certain pathogens.

Insect-transmitted diseases and their vectors

Mosaic virus -- aphids



Tomato spotted wilt virus -- thrips

Cucurbit yellow vine disease -- squash bugs

Cucurbit bacterial wilt -- cucumber beetles

Manipulate the environment

I.e., keep the leaves dry and humidity low

Field and greenhouse

- Watch plant density (sun and air)
- Trellising (sun and air)
- Avoid overhead irrigation

Greenhouse

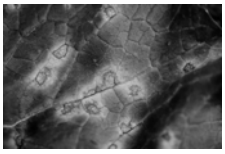
- Ventilate warm, moist air out at the end of each day

Plant density

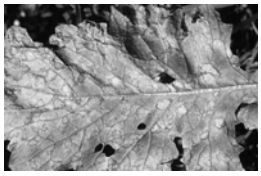
Crowding = poor drying conditions

Use recommended row spacing for tall-growing plants.

Avoid broadcasting turnips…
Leaf spot a major threat…
Seed in rows at rec. spacing.

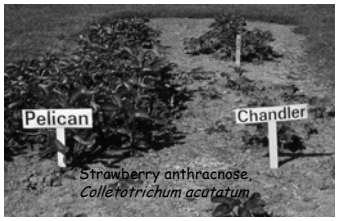


Cercospora leaf spot of turnip



Resistant varieties make life a lot easier.

But do your customers want that variety?



Strawberry anthracnose, *Colletotrichum acutatum*

Diseases for which resistant varieties are the primary means of control

Some diseases will be difficult to control IF the pathogen is present and IF conditions are favorable.

Ex.: Most virus diseases, black rot of cabbage, verticillium and fusarium wilts of tomato (there are more).

WHAT DISEASES DO I NEED RESISTANCE TO?

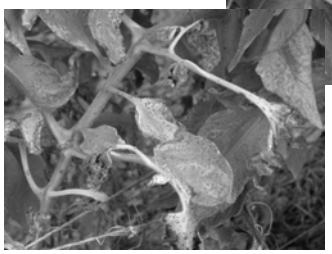
Use history as your guide – What diseases has the field or farm had problems with?

Be skeptical of certain claims

- "Disease resistant" – A cop out. Specific diseases need to be named.
- "Resistant to powdery mildew" – Fine, but how resistant is it? Resistance levels can range from low to high.
- "Tolerant" – Find out for yourself how useful this is on your farm.

Bacterial spot

"Mountain Fresh" has valuable "field tolerance"



Biofumigation

Certain members of the mustard family provide soil fumigation naturally

Caliente mustard, *Brassica juncea*, is commonly used for this purpose.

Two methods:
1.As a green manure
2.Using seed meal

Biofumigation with mustard I

As a green manure

Cover crop is cut down and quickly plowed in. It produces a gas in the soil.

Biofumigation with mustard II

Using seed meal

Mustard seed meal may be applied to the row and tilled in.

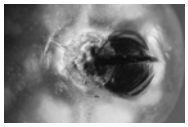
Plastic mulch may be applied to the row to slow the escape of the gas.

Organic growers: Beware early blight

Control options very limited

1. Crop rotation
2. Staking
3. Mulching

Overwinters in plant debris in soil.
Can also enter field on air currents.



Transplant production: Don't start out behind the 8-ball

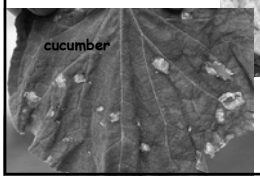
Prevent the splashing of soil particles onto leaves.
Cover the soil or place trays onto benches.

Organic growers: Beware anthracnose

Control options limited; explosive in rainy weather

However: beans, cucurbits, strawberries, and blackberries each has its own anthracnose fungus (will not cross over)

1. Crop rotation
2. Resistant varieties – bush snap beans, cucumbers, watermelons, strawberries
3. No overhead irrigation if present



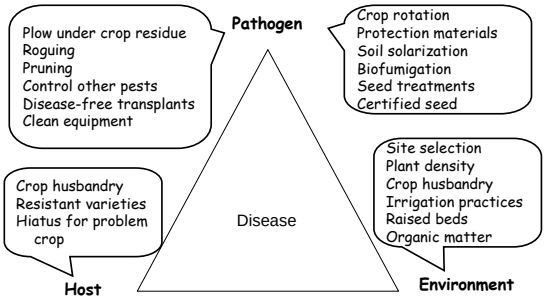
Organic vs. Conventional

How disease control is different for the organic grower

- Have fewer weapons for control, so exclusion of pathogens all the more important (Have to be more careful about borrowing equipment).
- Rely more heavily on a biologically diverse soil to suppress diseases, so proper amendments are important.
- Rely more heavily on resistant varieties. Thus, accurate ID of diseases is important so appropriate varieties can be used.
- Heirloom varieties and the saving of seeds play a bigger role, so on-farm seed disinfestation is more important.

THE DISEASE TRIANGLE

Exploit it for control!



Questions?

Steve Bost
scbost@utk.edu
(615) 835-4573