General Guidelines for Managing Vegetable Diseases Organically

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Additional information posted at: http://www.longislandhort.cornell.edu/vegpath/organic.html

1. Know what diseases to expect and potential impact on yield.

State recommendations for conventional crop production cover diseases occurring in the region. Cornell's is available on-line at: www.nysaes.cornell.edu/recommends/. It includes symptom descriptions and information about management practices appropriate for organic production, such as rotational periods, plus organic and conventional fungicides.

Some diseases directly affect the harvestable part of the plant. Those only occurring on leaves, such as cucurbit powdery mildew, also can have a great impact on fruit quality because fruit ripen prematurely before maximum sugar accumulation is reached, which results in poor flavor in melon and also poor storability in winter squash.

Obtain current information about diseases. New pathogens and new pathogen strains have appeared in the northeastern USA over the past decade affecting occurrence and management of several diseases, including late blight, cucurbit mildews, and basil downy mildew.

2. Become familiar with the symptoms of these diseases.

Many images posted on the web can be found using Google Image search. Photographs of diseases occurring in the northeastern US are at
http://www.longislandhort.cornell.edu/vegpath/photos/index.htm

3. Learn about the life cycle of pathogens that could occur.

Knowing the potential sources for a pathogen, how it spreads, and conditions favoring disease development is the basis of cultural management practices. Pathogens vary greatly in these characteristics, as well as survival mechanisms and host range. Information is available on the internet.

4. Select resistant varieties when possible.

Unfortunately there are not many vegetable varieties with genetic resistance that are currently available as organic or untreated seed. Tables are on line at
http://vegetablemdonline.ppath.cornell.edu/Tables/TableList.htm

5. Practice good sanitation.

For example, use new or clean, disinfected planting materials (eg trays for growing transplants and tomato stakes). Clean greenhouses before seeding transplants. Hose–off farm equipment between fields or management units. Also clean shoes. Disinfect tools. The NOP national list allows chlorine materials (calcium and sodium hypochlorite, chlorine dioxide), hydrogen peroxide, and peracetic acid.

6. Obtain seed with low probability of harboring seed-borne pathogens when possible.

Some seed companies have the resources and produce the quantity needed to test seed for pathogens. Companies lacking these resources should be able to provide information on where the seed was produced and what diseases if any were present.

7. Consider hot-water treating seed when seed-borne pathogens are a concern.

Treating seed with hot-water needs to be done carefully as there is a small margin between the temperature and length of exposure needed to kill pathogens and the treatment conditions that will kill seeds. Note that the highest temperature seed can tolerate varies among crops and some crops cannot tolerate the temperature needed to kill pathogens. It is better to treat seed just before planting. Check that seed was not already treated as twice can be damaging.

See http://vegetablemdonline.ppath.cornell.edu/NewsArticles/All_BactSeed.htm

8. Plant healthy seedlings.

Routinely inspect all seedlings with a thorough inspection before planting. Discard whole trays containing plants with disease symptoms as the pathogen may have spread throughout.

9. Rotate land away from susceptible crops for soil-borne pathogens.

Note that rotation is not effective for all soil-borne pathogens, including those able to infect a wide range of plants (white mold fungus), those able to survive saprophytically (Pythium, *Rhizoctonia*), and those with means to be easily re-introduced into a field (cucurbit powdery mildew fungus). Rotation is most effective for pathogens that survive without hosts short periods (3 years at most). Rotating among crop families is not always sufficient as some pathogens are able to infect crops from different families. For example, *Phytophthora capsici* causes Phytophthora blight in cucurbits, pepper, eggplant, tomato, snap bean, lima bean but not potato. Thus effective use of rotation necessitates knowledge of pathogen biology. Additionally, the unit of land being rotated (preferably an entire field) needs to be maintained separate from others. Cultivators and other farm equipment used within a unit need to be cleaned before working in another unit, and water should not flow between units following a heavy rainstorm.

10. Separate susceptible crops with later plantings located up-wind of earlier plantings.

Effective distance depends on the mode of pathogen dispersal. Greater distances will be needed when the pathogen is dispersed by wind than splashing water.

11. Use practices that promote soil health.

Amending soil with compost, reducing tillage, growing cover crops, and other practices that improve soil health may promote beneficial microorganisms that control pathogens. Also, a crop with a healthy, large root system will be better able to resist and tolerate root rot pathogens.

12. Maintain healthy plants.

Plants that are healthy but not too luxuriant are thought to be able to resist disease.

13. Avoid conditions that favor disease development.

Plant when conditions are favorable for plant growth to minimize losses to damping-off. Most fungal and bacterial pathogens causing foliar diseases need a period of free moisture on their host in order to complete the infection process. High humidity is sufficient for some. Wetness periods can be minimized by planting rows parallel to the prevailing wind direction, avoiding dense plant populations, managing weeds to maintain good air movement, trellising plants when possible, and using drip irrigation or overhead irrigation when plants are dry and a good drying period will follow. Managing moisture and humidity is especially important in high tunnels and greenhouses due to greater ability to effectively manipulate than in the field.

Wet soils are favorable for some soil-borne fungal pathogens, notably *Pythium* and *Phytophthora* species. Select fields with soil that drains well and use raised beds when growing susceptible crops.

14. Use disease forecasting systems to determine when diseases are likely to occur.

There are 2 basic types of systems. The forecasting system for cucurbit downy mildew (pathogen survives only on living host tissue) in the eastern USA uses information on regional disease occurrence, favorability of conditions for spore production, release, and movement by wind from where the disease is occurring, plus favorability of conditions for disease development where the spores are predicted to land. This system is free to use.
http://cdm.ipmpipe.org

Other systems assume the pathogen is present and use field data on daily temperature and moisture (RH, leaf wetness, and/or rainfall) to predict the favorability of these conditions for disease development and to recommend when fungicide applications are needed. A free forecasting system for late blight in tomato and potato in the northeast is at http://uspest.org/risk/tom_pot_map. FAST and TOM-CAST developed for early blight in tomato have proved useful for other diseases (e.g. leaf blights in carrot). WISDOM considers crop maturity when forecasting early blight in potato. BLITECAST is for late blight. Sensors, data loggers, and software needed to collect on-farm data and run forecasting systems can be purchased from companies such as Spectrum Technologies (www.specmeters.com/). Regional forecasting programs have been run by extension in some states. Another option is to subscribe to services that provide weather and disease as well as other pest predictions at the farm scale (www.skybit.com).

15. Manage weeds and insects that can carry pathogens.

Weeds can be alternate hosts for some pathogens as well as contributing to favorable conditions for disease development by increasing humidity. Insects that vector pathogens include aphids (viruses), thrips (TSWV), leafhoppers (aster yellows), and cucumber beetles (bacterial wilt). Controlling these insects is often the only way to control the pathogen.

16. Destroy volunteer crop plants.

They can harbor pathogens. Practice is especially important with potatoes due to late blight.

17. Avoid moving pathogens during farming operations.

Bacteria and splash-dispersed fungal spores are often present on foliage when plants are wet and can be easily moved when plants are handled by farm workers or when a high-pressure sprayer is used. Workers pruning tomatoes should routinely clean hands.

18. Examine plants weekly for disease symptoms and for insect vectors.

Thorough examination is needed to detect diseases near the onset of development, when starting to apply fungicides is more likely to result in successfully slowing disease development. Begin at emergence in the field or greenhouse.

19. Minimize the opportunity for soil-borne pathogens to be splash-dispersed to crops.

Covering soil with an organic or plastic mulch provides a barrier between pathogens in soil and the crop. Hairy vetch mulch has also been shown to stimulate plant defenses in tomato. Trellising tomatoes greatly reduces number of fruit in contact with soil.

20. Accurately diagnose disease problems.

If the first symptoms observed are not sufficient to make a definitive diagnosis, examine other plant parts for symptoms and other plants to determine distribution. Submit samples via overnight mail to state diagnostic laboratory if still in doubt.

21. Apply approved fungicides when cultural practices are not expected to provide adequate control and disease is at an early stage in development.

Fungicides can be an important tool when yield or crop quality is likely to be affected to an unacceptable level without this intervention. An example of such a disease is cucurbit downy mildew, which cannot be avoided because the pathogen produces spores capable of long-distance dispersal (it progresses up the east coast from FL to New England) and can no longer be managed with resistant varieties (an important cultural practice) since the pathogen evolved to overcome the genetic resistance in these varieties (first evident in 2004).

Another reason to manage diseases effectively is to minimize the impact of an outbreak on future crops in the field, due to the pathogen population increasing, or on crops in other fields or farms, such as with a very contagious and destructive disease like late blight of tomato and potato. More information on managing this unique disease are in a separate write-up.

There are many products suitable for organic production now on the market. Before obtaining a fungicide, make sure it is registered in the state, approved for organic production, and acceptable with your certifier. It is important to understand that any material used specifically for disease control on a commercial farm (i.e. where treated produce will be sold) in the USA is required by law to be registered as a fungicide for this use with the Environmental Protection Agency (the EPA Reg. No. will be on the product label) unless the product contains an active ingredient that is general recognized as safe (GRAS), which applies to several botanical oils. In some states products that are exempt from EPA registration because of their ingredients do not need to be registered in the state (this is the case in NY). Note that documented efficacy is not a requirement for labeling a use in the USA as it is in some other countries. Read the precautionary statement on the product label to learn about any potential adverse impacts on humans or other non-target organisms.

Fungicides can be effective when started very early in disease development. There are no products, not even conventional fungicides, which can cure a sick plant, in contrast with human medicines. Accurate diagnosis is critical because fungicides are not effective for all diseases. A preventive schedule is best, especially with products that act by affecting plants' natural defense mechanisms.

22. Maintain records of disease occurrence, impact, and efficacy of management practices.

These records will be invaluable in the future. A camera is a great tool for recording symptoms and disease severity.

23. Rogue and destroy diseased plants.

Removing affected plants is a worthwhile management step with diseases that start on individual plants (e.g. viral diseases) and those caused by pathogens that can survive long-term in soil (e.g. white mold). It is essential for plants with unmanageable late blight.

24. Incorporate diseased crop debris immediately after harvest.

Crop debris is broken down faster by microbes when in soil than left on the surface, thus reducing the survival time of pathogens that can only survive in crop debris. Plus in the process of incorporating the debris (such as by disking) it will be broken up which will also hasten break down.

25. Grow mustard or other biofumigant cover crops to manage soil-borne pathogens.

Select varieties developed for this and follow guidelines to maximize benefit.