Top Facts To Know About Managing Vegetable Diseases

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1. Accurate diagnosis is essential to know what management practices are appropriate for a particular disease. Pathogens vary in how they survive and spread as well as the conditions that favor their development. Additionally, genetic resistance bred into plants is disease specific.

2. Cultural management practices vary among diseases and are based on knowledge about the pathogen's biology. Implementing all appropriate cultural practices is the foundation of a good plant disease management program.

Manage all potential sources of a pathogen. For diseases caused by pathogens that can be inside or on the surface of seed (seed-borne), it is important to try to obtain seed that was produced where these pathogens do not occur (preferably) or are well managed, and that was tested for these pathogens. Hot water is an effective treatment for some types of seed (see website listed above). Several pathogens can survive in soil, thus changing the location where crops are grown (crop rotation) is a commonly recommended management practice. Length of time depends on how the pathogen is surviving. For pathogens that survive in crop debris until it is completely decomposed, mowing debris after harvest and then promptly incorporating it into the soil can hasten decomposition and thus shorten the length of time the pathogen can survive. Some pathogens produce specialized resting structures (ex. white mold pathogen produces sclerotia) that enable them to survive in soil for several years. Removing affected plant debris sometimes is worth the effort, such as with white mold in high tunnels. Some root rot pathogens can infect weeds or exist as soil inhabitants (saprophytes). Controlling weeds is also important because some foliar pathogens can persist between crops by surviving on weeds. Controlling insects is important when they play a role in spreading pathogens. Note there are pathogens that produce small spores able to be dispersed long distance by wind (ex. powdery mildew, downy mildew).

Make environment less favorable for disease development. Most fungal and bacterial pathogens need leaves to be wet for several hours to infect. Use drip irrigation. When overhead irrigation is the only option, start when leaves are not wet from dew and end when they will be able to dry before night. Trellising plants like tomatoes, with rows parallel to the prevailing wind direction, promotes drying. Wet soil is favorable for *Pythium* and *Phytophthora*.

Minimize opportunity for pathogen dispersal. Some pathogens can be moved by splashing water including irrigation, insects, workers handling plants, or farm equipment that touches foliage or moves soil (ex. cultivators).

3. Resistant varieties vary substantially in degree of suppression provided. Resistance to powdery mildew in cucurbit crops is a good example. Degree of resistance in cucumber is essentially immunity, thus it is possible to not realize cucumber is susceptible to this common foliar disease until an heirloom variety lacking resistance is grown. In contrast, resistant varieties of squash and pumpkin can become severely affected potentially impacting yield or fruit quality when not treated with fungicides.

4. Resistant varieties vary substantially in the durability of their resistance. Some pathogens have proven adept at evolving such that they can infect a resistant variety without being detected, thus rendering it susceptible. Typically, the new pathogen is called a race and given a sequential number. The plant is described as having "race-specific" resistance. The races that a variety has resistance to will be listed in a catalogue. An example is spinach downy mildew. 19 races have

been designated so far. The resistance is extremely effective, but when only the targeted pathogen races are present, thus it clearly is not durable. This typically single major gene resistance is easier to breed for than multi-gene resistance that is more durable but not as effective.

5. Organic fungicides have protectant rather than curative activity. Since they act on the pathogen before infection, it is important to start applications before symptoms are seen or when first seen. Not only will fungicides not cure established infections, but the pathogen will also continue to be active and multiplying. Ensure application timing is good by checking crops routinely (weekly) for symptoms and being familiar with the symptoms of diseases that could occur.

6. Organic fungicides have contact activity. Many pathogens are more likely to infect through the lower surface (underside) of leaves because there typically are more stomates (important for those fungal and bacterial pathogens that enter leaves this way) and conditions typically are more favorable for infection and pathogen development (protected from uv radiation and more humid). Consequently, it is important to obtain thorough spray coverage. Use water sensitive paper to assess coverage, especially on lower leaf surfaces. Additionally, because these fungicides remain on the plant surface, rather than enter plant tissue as many conventional fungicides do, residue will be removed by rain, especially with an intense storm. Using an adjuvant can be beneficial. Some fungicides are described as inducing resistance; the degree to which this occurs with plants and diseases appears to vary. Note that EPA focuses on product safety during registration review, not product efficacy for labeled uses.

7. Applying fungicide before rain is more important than after. This is because most pathogen infect while leaves are wet, and fungicides act on pathogens before infection.

8. Organic fungicides can have environmental and health risks. Before purchasing and using, check the label to determine if it can be toxic to bees, there are any other environmental concerns, and what personal protective equipment (PPE) is required when applying and when a treated planting needs to be entered during the re-entry interval (REI). Labels are available on the web. Note that several copper fungicides have a 48-hour REI and harvesting is not a permitted activity during the REI. Also note that pesticide labels are legal documents which means the product must be used as stated on its label.

9. Many foliar pathogens have a latent period and life cycle of about 7 days. Latent period is the time from infection to visible symptom. Thus there may be a lot more infections in a crop then are visible; latent infections won't be stopped by a fungicide application. Life cycle is the time from infection to when the pathogen begins producing new propagules (fungal spores, bacterial cells). This time is so short because many of these pathogens are producing asexually.

10. Pathogens vary a lot in host range. The cucurbit downy mildew pathogen exists as cucurbit host specialized groups called clades; the one that can infect cucumber and cantaloupe does not infect squash. In contrast, the white mold pathogen infects over 400 plant species.

11. Pathogens evolve and diseases change. Changes in disease occurrence can be partly due to appearance of new pathogen strains; for example increased occurrences of cucurbit downy mildew starting in 2004 and tomato late blight in 2009, and also new races overcoming resistant varieties. Beans are a relatively new host for the Phytophthora blight pathogen. Changes also occur with environment and climate change. Gray mold, powdery mildew and leaf mold are much more common on tomato grown in high tunnels than open field. Gray leaf spot (*Stemphylium*) is a new fungal disease of tomato in the northeastern US that has been especially problematic in high tunnels reflecting the fact it favors high temperatures; it is common in the southeast. New diseases in an area can be due to sowing contaminated seed. Examples are Septoria leaf spot of lettuce and Stemphylium leaf spot of spinach.