

Introduction to Plant Pathogens: Prevention and Management
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General Hygiene for Prevention of Spreading Disease

When removing a dead or dying plant growing in the ground, be sure to eliminate all traces of leaf and flower litter around the environment as well. Many plant pathogens survive in fallen leaves and flower petals on the ground and act as a reservoir of inoculum. The next year as new growth is emerging from the shoots or flowers are forming, fungal spores or bacteria can splash or land on these new susceptible tissues via rain, irrigation water or wind. This is true even if the plant isn't dying, many floral blights show up year after year from leaving infected flowers on the ground, a good example of this is Camellia flower blight caused by *Ciborinia camellia*, a common fungal plant pathogen in California and elsewhere. Viruses in dried tissue are mainly an issue if you touch the material and then with unwashed hands touch your other plants. If a plant died from a wilt syndrome especially, remove as many of the roots as possible along with a 4-6 inch area of soil surrounding the hole and be sure to not plant the same species in its place to try and avoid infecting the new plant. This is no guarantee of course, but planting the same species ensures the same susceptibility to whatever pathogen is in the soil.

For potted plants, do not reuse potting soil from plants that have died or seedlings that collapsed. The fungi that are most likely responsible for the death will still be there in many cases, just waiting for another host to show up. Wash pots as discussed below before refilling with new potting mix. It is not a good idea to compost plant material and old soil from obviously infected plants. Even ideal composting temperatures of 140° F do not kill all plant pathogens and most plant pathologists believe the risk is too high to warrant reusing it.

Overwatering accelerates the majority of root rot problems. Many of the fungi that are responsible for attacking roots thrive in moist, always damp soils that are poorly drained. If you notice a plant starting to wilt and the soil obviously has enough moisture in it-do not add more water! If the plant has water available it is not wilting because it is dry; it is wilting because the fungus has either "eaten" all the roots or blocked the water conducting tissues (= xylem) so that water cannot be taken up by the roots and transported to the upper portions of the plant. Sometimes if you can catch this early enough and allow the soil to dry out before rewatering, you can reduce the effects of some water loving fungi and the plant may recover. Unfortunately, once wilting becomes apparent it is usually too late.

When selecting plants pick those that look vigorous and hardy, fully green with no spots or yellowing leaves. When purchasing a "6 pack" make sure all plants look similar in size and quality-ones that are stunted or sickly may have already contaminated the others in the group but they haven't started to show symptoms yet. For vegetable crops in particular, select plants or seeds that are rated for "VFN" disease resistance (for *Verticillium*, *Fusarium* and Nematodes) and other diseases such as some viruses or *Alternaria* fungi where they are a problem to let the plant naturally fight off these infections. Rotate crops in the garden to different areas each year to prevent build up of pathogens that attack similar hosts.

Avoiding and managing plant diseases is a multifaceted strategy. Start with good plant stocks, optimize watering and fertilization, and above all else use good hygiene in the growing areas to prevent encouragement of diseases and their build up if they do occur.

Tool Clean-up

As I mentioned in class, the only totally fool proof method of decontaminating tools is to remove physical debris and then soak for 2-5 min in 10% or 20% household bleach (1 part bleach to either 9 parts water (10%) or 4 parts water (20%)). Pots should be soaked for 5-10 minutes, avoid using bleach with terra cotta pots. This is for people like me who work with many infected materials and need absolute certainty of no cross contamination between experiments or large scale propagators who have hundreds of thousands of plants at stake. Since bleach is so caustic to tools, not to mention human skin and eyes, a different recommendation for the home gardener might be in order. Since most of your plants are probably quite healthy you don't have to generally go to such drastic measures on a routine basis. Save the hard core decontamination for when you see an obviously infected plant and you use tools to remove it. For less critical times you can simply make up a small bucket or other container of warm soapy water and using a small brush, briefly scrub the clippers, etc., in the solution, then rinse with clean water (use a hose with a 'gun sprayer' or another bucket of clean water, but change the water when visible soap is in the rinse water). This should suffice for all but the worst pathogens, and even at that will knock down the chance of contamination about 90%. If you are trimming an obviously sick plant for removal or to try and save it as long as possible, then use an older set of trimmers or one set you will designate as 'bleach trimmers' and do the bleach treatment when done with that plant. Be sure to rinse the tools well after the bleach treatment either before using on another plant or before ending for the day. Before storage at the end of the day, coat all metal surfaces that came in contact with the bleach with a light coating of machine oil (like 3 in 1, WD-40 or similar) to prevent rusting. You will still notice gradual degradation of the metal surfaces over time, but if you reserve one set of tools for this purpose and treat them as recommended, they will still last for years, they just won't be as pretty as the untreated ones.

Another commercially available disinfectant you may want to look at is Physan 20, which may be available at some nurseries and is recommended for most plant pathogen disinfection and in some applications can be directly used on the plants themselves (see "www.physan.com" for complete information, quaternary ammonium based). I also looked into the disinfecting 'wipes' that are available at the grocery store. These may be a decent alternative to the bleach treatment, especially after doing the soapy water wash. I looked at the active ingredients and they all basically use the same chemical, but the 'Lysol' brand had twice the amount of active ingredient in them than any other brand I looked at. The trick is to make sure the thing you are sterilizing stays wet for at least 2-5 minutes. Nolvasan (used by many veterinarians, not specifically noted for plant pathogens, but kills many bacteria, fungi and viruses, chlorhexidine based) could also be used and might be easier to find for the average person (vet supply stores) and I know some people that use Lysol spray. Always rinse tools after any chemical treatment to avoid toxicity to the plant. Be sure to carefully read the instructions for use and safety when using any of these chemicals and use proper gloves and eye protection.

I clean and oil treat all my tools at the end of the day even without bleach treatment just to preserve them. At my home I really don't worry about cleaning tools between trees since they are healthy for the most part, and I don't have any 'specimen' plants that I couldn't stand to lose. Use your best judgment with your own gardens.

Information for Further Learning and Reference

Below are several websites and books that I recommend for continuing education and reference. Don't forget that even though you may not have a computer or be too savvy with one, your local public library has terminals available and the personnel will be happy to get you started looking for information. You just type in these addresses and press 'Enter' and it will take you right to the sites. Have no fear!

Internet:

<http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html> (very good site covering tons of plants)

<http://www.ipm.ucdavis.edu/PMG/selectnewpest.floriculture.html> (good subset of above for flowers)
see available book on IPM)

<http://www.ipm.ucdavis.edu/PMG/menu.homegarden.html> (covers many plant topics)

<http://plantclinic.cornell.edu/Default.htm> (lots of diseases, see Master Gardener section)

<http://ucanr.org/sites/gardenweb/> (home gardening)

<http://vegetablemdonline.ppath.cornell.edu/cropindex.htm> (vegetables)

<http://cals.ncsu.edu/plantpath/extension/> (lots of plant pathology)

<http://plantpath.osu.edu/extension/> (tons of plant pathology info)

<http://www.chasehorticulturalresearch.com/> (in depth articles about specific diseases, sells books and symptom diagnosis flashcards with color pictures-see 'products' on left side of page)

<http://www.apsnet.org/> (plant pathology society page, advanced topics, order books from APS press, call 1.800.328.7560 to order a catalog for mail order)

<http://www.agls.uidaho.edu/ebi/vdie/> (for advanced virus study)

Books

Essential Plant Pathology, Second Edition by G.L. Schumann and C.J. D'Arcy, 2010. ISBN 978-0-89054-381-8 \$79.95

Any of the APS (see apsnet site above) 'Diagnostic Compendia', including citrus, tomatoes, roses, melons, lettuce etc. These are excellent guides with pictures of diseases, also include advanced info about the pathogens and control. Average cost: \$55-60, but go on sale occasionally 10% off.