

Advanced Master Gardener Training

Diagnosing Plant Problems,

A systemic approach to diagnosing plant damage.

This handout is designed to accompany the Diagnosing Plant Problems slide presentation. The presentation is a modification of a slide set developed by James L. Green and Joe Capizzi of Oregon State University and Otis Maloy of Washington State University.

The systemic approach to diagnosing a plant problem consists of five basic steps.

1. Determine if a problem exists.
2. Look for patterns.
3. Determine the time of development.
4. Ask questions.
5. Synthesize the information.

Step 1: Determine that a real problem exists.

Normal vs. Abnormal Appearance.
Symptoms vs. Signs.

Examples Normal vs. Abnormal Appearance.

- *Acer griseum*, the paper bark maple, has NORMAL exfoliating bark as seen here
- Scattered loss of older needles on evergreens is NORMAL as seen here on this Mugo pine.
- Scattered loss of all ages of needles is ABNORMAL as seen here on this white pine.
- The powdery, dusty structures seen on this slide may cause some alarm but it is just the leaf hair on this variety on Rhododendron known as yakushmanum. If we looked at all of the leaves on this shrub and all of the shrubs in this planting, they would have similar characteristics. If we researched this particular cultivar of Rhododendron we would discover that this cultivar produces an abundance of these leaf hairs that cover the leaves and this is NORMAL.
- The powdery, dusty structures seen on this slide should cause alarm as it is a disease causing agent, a powdery mildew fungus. The powdery substance on the leaves in this case not on all the leaves and only on one or two of the shrubs in this planting. This is an ABNORMAL characteristic.
- Here are some strange looking white balls on a Pitch Pine. One might guess that some type of insect has infested this tree. However, if we know of these plants, we know that "pitching" is a NORMAL production of Pitch Pine. Pitching is an exudate produced by the plant.

- Again some strange looking white balls on a Douglas Fir this time. It is an **ABNORMAL** condition that consists of insects, the Cooley Spruce Gall Adelgid and Douglas Fir is the alternate host of this critter. We have the Cooley Spruce Gall Adelgid in our area but we see more of a close relative the Eastern Spruce Gall Adelgid. It produces these structures that resemble normal cones. Closer inspection is required to determine which is present, just cones or the adelgid.
- Normal structures on a twig, bud scars (useful in determining each year's growth, stressed plants may grow very little in certain years), lateral and terminal buds present, and lenticels.
- This Mimosa root system appears to have abnormal bumps and round protrusions on it. Again we need to know our plants because this is a **NORMAL** condition of this plant. The Mimosa belongs to the family Leguminosae, which produces characteristic nitrogen fixing nodules. This could easily be confused with Cyst or Root Knot nematode damage. Root Knot Nematode infects plants such as Swiss Chard, Beet, and Carrot. If viewed under a dissecting scope, the female body could be teased out of those bumpy areas. In contrast, the Mimosa nitrogen fixing nodules are just corky plant tissue. The Cyst nematode can also be confused with the nitrogen fixing nodules but again they can be removed from the root and dissected to find vermiform juveniles and eggs within the cysts.

Symptoms or Signs.

SYMPTOMS are changes in the appearance or growth of the plant in response to a damaging factor.

SIGNS are visual evidence of the damaging factor.

- An example of a **SYMPTOM** is the light, brown to black swellings of tissue in the black knot twig. Or the mass growth of mushroom-like tissue from the corn ear. The begonia plant has a discoloration of tissue on the plant's leaves. Also the wilting of a Rhododendron. Symptoms identical to ones described in the presentation could be caused by many different factors such as environmental extremes and/or root pathogens. Other damaging root factors such as chemical injury or mechanical breakage of roots and stems may also cause damage. At this stage we need to know more information to make an intelligent guess. We need to ask more questions.
- A **SIGN** is present in the Eutypella canker on this specimen. It produces a **MYCELIAL MAT** beneath the bark surface. If you cut into this area the mycelium of the fungus is quite distinct. Also the raspberry cane **SPORULATING** is a fine example of a **SIGN**. This may be a clue towards finding the culprit of the damage but more questions need to be asked. Often once plants are stressed; opportunistic, non-aggressive organisms take up residence on them. These secondary organisms are not the causal agent of the damage. Another **SIGN** of a fungal infection is the presence of **FRUITING BODIES**. The black dots all over the cones produced by infected trees are the characteristic fruiting bodies of Diplodia tip blight. Another possible **SIGN** of the damaging factor is the presence of an insect and eggs.

Investigate this organism and identification of it are necessary to ensure it is the damaging factor. Don't forget there are many beneficial insects out there that we want to keep around. Does this insect cause damage to this plant? If you see it chewing on the plant, it's probably a pretty good indication that it is. Another SIGN, cast skins of aphids on a Rhododendron leaf.

Step 2- Look for Patterns.

Look for patterns in the plant community, on individual plants, and on individual plant parts.

Uniform vs. random damage patterns.

Damage patterns in the PLANT COMMUNITY

- Lobolly pine killed by the Southern pine beetle. This is a NON-UNIFORM pattern of damage caused by a pest.
- Cotton field with chemical damage. Various patterns may be produced by chemical drift in a field. Chemical drift produces UNIFORM patterns that do not spread.
- *Phytophthora cinnamoni* damage on a Rhododendron. This is a NON-UNIFORM pattern. Symptoms are on one plant and the surrounding plants look fine. Also look for the junction point of damaged vs. non-damaged tissue. Remember don't ignore the roots.
- Round up (herbicide) spray drift damage patterns also cause UNIFORM damage as seen on Photinia, all the plants are damaged. Other herbicide injuries show movement in the rain storm runoff and a sprayer's foot prints from a grass herbicide application.
- A fairy ring pattern formed by a fungus grows in a circular pattern randomly in this lawn. An example of a NON-UNIFORM pattern of damage.

Damage patterns on an INDIVIDUAL PLANT

- What type of pattern damage would describe this plant's symptoms? This is a NON-UNIFORM (the entire tree is not browning) damage pattern on the American Elm infected with the Dutch Elm Disease, *Ophiostoma ulmi*.

Note the streaking pattern in the twig, this is very characteristic of the infection caused by this pathogen and the location where the diagnostician will take piece of tissue for culturing..

Bark beetle galleries are the location where the fungus is introduced into the tree and where infection takes place.

- Is this pattern UNIFORM or non-uniform? This uniform pattern was caused by overlapping application of a lawn fertilizer.

- Manganese deficiency on Spruce. Any available nutrients are mobilized into the new growth, therefore, symptomatic yellowing occurs in the older growth, UNIFORM damage pattern.
- Iron deficiency on Rhododendron. In this case the available nutrients are kept in the older growth leaving the new growth deficient and chlorotic and characteristic of an abiotic, UNIFORM damage pattern.

Damage on an INDIVIDUAL PLANT PART.

- Illustration of uniform vs. non-uniform damage patterns on leaves.
- Rhabdocline needle blight on Douglas Fir. Notice the random or NON-UNIFORM pattern of damage of the branches on this tree.
- In comparison, this evergreen's damage pattern is very UNIFORM, affecting the tips of the needles. This is an example of an abiotic damage event, freeze damage.
- Downy mildew of Buddleia caused by *Peronospora harotii*. Very random NON-UNIFORM damage pattern shown here is characteristic of a disease infection.
- Kalmia with a viral infection. The random NON-UNIFORM swirling damage pattern shown here is almost artistic in nature. A unique virus that affects Kalmia and Rhododendron. It has only been detected on certain cultivars and only on one or a few leaves of a plant.

Step 3, Development of Damage Over Time.

- *Aspergillus niger*, Black Mold, on onion slices. Development of the damage is seen at 1, 4, and 7 days after inoculation of the fungus. Notice the degradation of the bulb tissue.
- Fusarium Wilt on Cyclamen. One leaf at a time yellows and eventually dies. This continues until the whole plant succumbs to the fungus. Fusarium Wilt in the corm of Cyclamen. The red/brown discoloration is characteristic of this pathogen. The amount of discoloration increases over time.
- Elephant Hide on Potato. There is no change in the symptoms of this plant problem once it develops because it is not caused by a pathogen. These symptoms are produced due to environmental stresses. Elephant Hide on Potato. As you can see there is no penetration or rotting of the interior tissue.
- Foliar nematode on Creeping Phlox. The plants becoming progressively browned out and decline until the whole plant dies.

Step 4, ASK QUESTIONS!!

And even more questions. You can never ask too many questions. Often the people involved don't recall events as being associated. You need to probe their minds for information.

- Get a history of the problem.
Is this new?, Has it occurred on these plants before? How long have you noticed it? When did you first notice it?
- Get a record of all sprays and fertilizer treatments that have been applied to the plants.
- Find out a history of the site.
Was this always a garden space? What other types of plants have been grown in this site?
- Could environmental conditions be causing the problem?
Ask about weather conditions in the area? Have there been any extreme temperatures?
- Is there a pattern to the symptoms?
Within the community? on individual plant? On individual plant parts?
Are environmental conditions different in areas containing the affected plants? Are they in low areas of the field prone to flooding? Other microclimates?
- Is the pattern within the plant?
Is it wilting on one side?
Look for obvious symptoms and signs.
Are cankers present? Can you see fruiting bodies?
- Don't ignore the root system.
- Beware of secondary pathogens and insects.
- Be patient, don't jump to conclusions.
As experts we feel we have to give a quick answer, don't feel pressured to answer quickly.

Step 5: Reference:

Ball Field Guide to Diseases of Greenhouse Ornamentals. M. Daughtrey and A. Chase. 1992. Ball Publishing. Geneva, Illinois. 218 pp. (around \$60)

Brooklyn Botanic Gardens Handbooks. Brooklyn Botanic Garden, 1000 Washington Ave. Brooklyn, NY 11225 (around \$9.00)

Some of the titles available:

Hummingbird Gardens: Turning Your Yard Into Hummingbird Heaven

Wildflower Gardens: 60 Spectacular Plants and How to Grow Them in Your Garden

Bird Gardens: Welcoming Wild Birds to Your Yard

Going Native: Biodiversity in Our Own Backyards
Invasive Plants: Weeds of the Global Garden
The Natural Water Garden: Pools, Ponds, Marshes and Bogs for Backyards
Everywhere
Woodland Gardens: Shade Gets Chic
Gardening with Wildflowers and Native Plants
Natural Disease Control: A Common-sense Approach to Plant First Aid

Compendia are published by the American Phytopathological Society (APS), 3340 Pilot Knob Road, St. Paul, MN 55121-2097. They currently cost \$43 each including postage. Each compendium covers common diseases found on the various plants listed. The color photographs in the center of each publication are helpful although the language in the body of the text is somewhat technical. Here is a listing of the compendia available.

Compendium of Alfalfa Diseases.
Compendium of Apple and Pear Diseases.
Compendium of Barley Diseases.
Compendium of Bean Diseases.
Compendium of Beet Disease and Insects.
Compendium of Chrysanthemum Diseases.
Compendium of Citrus Disease.
Compendium of Conifers Diseases.
Compendium of Corn Diseases.
Compendium of Cotton Disease.
Compendium of Cucurbit Diseases.
Compendium of Elm Diseases.
Compendium of Flowering Potted Plant Diseases.
Compendium of Grape Diseases.
Compendium of Lettuce Diseases.
Compendium of Nut Crop Diseases in Temperate Zones.
Compendium of Onion and Garlic Diseases.
Compendium of Ornamental Foliage Plant Diseases.
Compendium of Pea Diseases.
Compendium of Peanut Diseases.
Compendium of Raspberry and Blackberry Diseases and Insects.
Compendium of Rhododendron and Azalea Diseases.
Compendium of Rice Diseases.
Compendium of Rose Diseases.
Compendium of Sorghum Diseases.
Compendium of Soybean Diseases.
Compendium of Stone Fruit Diseases.
Compendium of Strawberry Diseases.
Compendium of Sweet Potato Diseases.
Compendium of Tobacco Diseases.
Compendium of Tomato Diseases.
Compendium of Tropical Fruit Diseases.
Compendium of Turfgrass Diseases.
Compendium of Umbelliferous Crop Diseases.
Compendium of Wheat Diseases.

Cornell University Information Bulletins, Fact Sheets, and Tree Pest Leaflets.

Cornell Commercial Recommendations for Pest Control (available for Trees and Shrubs, Turf, Tree Fruits, Small Fruits, Vegetables and Potatoes, etc.)

Diseases and Pests of Ornamental Plants. 5th ed. P.P. Pirone. 1978. John Wiley & Sons, Inc., New York, New York. 566 pp.

Diseases of Trees and Shrubs. W.A. Sinclair and H.H. Lyon. 2005. Cornell University Press. Ithaca, NY. 660 pp.

Diseases of Ornamental Plants. J.L. Forsberg. 1975. Special Publication No. 3. Revised, Univ. of Illinois at Urbana-Champaign, College of Agriculture. 220 pp.

Disease of Woody Ornamentals and Trees in Nurseries. Ronald K. Jones and D. Michael Benson. 2001. APS Press, St. Paul, Minn. 482pg.

Guide to Pest Management Around the Home, Parts I and II. 2000-2001. Misc. Bulletin 74. Cornell Cooperative Extension. 135 pp.

Identifying Diseases of Vegetables. A.A. MacNab, A.F. Sherf, and J.K. Springer. 1983. Pennsylvania State University, University Park, PA. 62 pp.

Magical Mushrooms, Mischievous Molds. George W. Hudler. 1998. Princeton University Press, Princeton, NJ.

Pests of the Garden and Small Farm: A Grower's guide to Using Less Pesticide. 1990. M.L. Flint. Statewide IPM Project, Univ. of California, Div. Of Agriculture and Natural Resources, Publication 3332, ISBN 0-931876-89-3. 276 pp.

Plant Diseases: Their biology and social impact. Gail Schumann. 1991. American Phytopathological Society (APS) Press, 397 pp.

Plant Pathology, 4th edition. George Agrios. 1997. Academic Press, San Diego, CA. 635 pp.

Shade Tree Wilt Diseases. Edited by Cynthia L. Ash. 2001. APS Press. St. Paul, Minn. 257 pp.

Scouting and Controlling Woody Ornamental Diseases in Landscapes and Nurseries. Prepared by Gary B. Moorman. 1992. Publications Distribution, Pennsylvania State University, 112 Agricultural Admin. Bldg., University Park, PA. 90 pp. (\$7.00, includes postage and handling).

The Garden Problem Solver: The Ultimate Troubleshooting Guide for Successful Gardening. Edited by Rosemary C. Rennie. 1999. The Readers Digest Association, Inc. Pleasantville, NY. 416pp.

The Healthy Indoor Plant: A Guide to Successful Indoor Gardening. C. Powell and R. Rossetti. 1992. Rosewell Publishing Inc., Columbus, Ohio. ISBN 0-9631767-6, 297 pp.

The Organic Gardener's Handbook of Natural Insect and Disease Control. Edited by Barbara W. Ellis and Fern Marshall Bradley. 1992. Rodale Garden Books. Emmaus, PA. 534 pp. (around \$27.00)

Turfgrass Problems, Picture Clues and Management Options. Eva Gussack and Frank S. Rossi, PhD. 2001, NRAES-125, Ithaca, NY.

Westcott's Plant Disease Handbook. 7th edition. R.K. Horst. 2008. Springer Verlag Berlin Heidelberg New York, 1317 pp.

Useful Web Sites:

Cornell University's Plant Disease Diagnostic Clinic, <http://PlantClinic.cornell.edu>

Northeast Plant Diagnostic Network, www.NEPDN.org

Cornell University's Home and Grounds Pest Fact Sheets, www.cce.cornell.edu/factsheets/home/pests

Cornell University's Gardening Program, <http://www.fvs.cornell.edu/Gardening/index.html>

Cornell University's EcoGardening Fact Sheets, <http://www.fvs.cornell.edu/extserv/MES/EcoGardFS.html>

Cornell University's Composting Home Page, <http://cfe.cornell.edu/wmi/#anchor9523120>

Ohio State Yard & Garden Fact Sheets, <http://www.ag.ohio-state.edu/~ohioline/lines/hygs.html>

Purdue University, http://www.ppdل.purdue.edu/ppdl/Reference_links.html#Gardening_Landscapes

Missouri Extension Service, <http://muextension.missouri.edu/xplor/agguides/hort/index.htm>

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