

Root Rot and Its Control

by Zach Smith

(This article first appeared in *BONSAI: Journal of The American Bonsai Society, Fall 1990, Volume 24, Number 3, Pages 8 - 9.*)

Author's Note: I sent *Bonsai* editor Jack Wikle an article on Chinese privet which contained a reference to the control of root rot with Benomyl fungicide. Jack did what any good editor should - he rapped my knuckles (figuratively), and urged me not to make recommendations without having some basis for them. I strongly dislike being caught when I goof, and Jack refuses to let me get away with anything. The only revenge I could think of was this article.

Of all the scourges the bonsai literature warns about, root rot is perhaps the worst. It is fearsome because it occurs underground, out of sight, and invariable does it damage slyly. One day your bonsai is either simply dead, or its leaves have yellowed or wilted over a moist soil - this causing an inexplicable, rather hollow feeling in the gut. There are references in the literature to the use of Benomyl® systemic fungicide as a means to eliminate or prevent root rot - specifically, Paul Lesniewicz's book *Bonsai: The Complete Guide to Art and Technique* and at least one bonsai sales catalog. But how many of us have actual experience that it works? When Benomyl is used periodically as a preventive measure (soil drench), the absence of root rot does not necessarily mean the fungicide has done the trick. Few of us would brace conducting the only valid test, that being to take a sufficiently large population of bonsai and treat half of them with Benomyl while mistreating them all.

Following a good bit of reading and discussion with knowledgeable people, I have what I feel is a reasonably good understanding of just what root rot is and how the control measures work.

The fungus among us

There are many types of rot, most of them caused by fungi or bacteria. The ones we bonsaiists are most concerned with are caused by fungi of the family *Pythiaceae*, especially the genera *Pythium* and *Phytophthora*. Since these pathogens are fungi they produce spores, and in astounding numbers. We literally live in a sea of spores. Carried by water, air and other agents, widespread distribution is assured, so it's no exaggeration to say that root rot fungus spores are a component of soil in nature. Thus the potential for root rot is always with us.

How it occurs

Root-rot fungus spores require two things for proper germination - very high moisture levels and sufficient warmth. If moisture levels are not high enough the fungus cannot grow, or at least not well enough to complete its life cycle.

Once the root-rot spores have germinated, they produce threadlike, food-gathering structures called hyphae (the network of hyphae is known as the mycelium). Since fungi cannot produce their own food, the hyphae attack a tree's feeder roots out of simple necessity - what better place to find the rich source of carbohydrates the fungus needs than structures which gather and store food for an organism the size of a tree? Feeder root tissue is digested (rotted) by enzymes, for use by the fungus. When the root rot mycelium is sufficiently large and enough moisture is present, reproductive bodies are produced (sporulation) and the cycle repeats. (Mushrooms are the reproductive bodies for certain fungi, but not root rot.)

It is interesting to note that the mechanism by which root rot kills trees is exactly the same as that by which mycorrhiza benefits them. The difference is that mycorrhiza acts in a symbiotic fashion, providing certain nutrients (especially phosphorus) while it takes the carbohydrates it needs without causing excessive destruction of tissues.

Stopping the rot

The key to our first line of defense against root rot is to prevent germination of the spores. When we prepare our bonsai soil mixes, the first consideration is always, always excellent drainage. Without this we know our bonsai will, at the very least, grow poorly. They may choose not to grow at all, or they may die. Since trees do not require the excessive moisture that fungi do, a fast-draining soil is ideal to prevent the germination of spores. (Preventing germination of spores this way does not kill them - the most well-adapted of all reproductive bodies known, some spores can survive for literally thousands of years.)

How about sterilizing your soil? This will certainly kill any spores present, but there is nothing to prevent new spores from "re-infecting" the soil once your bonsai have been potted. Over the span of three to five years, the potential for root rot will surely have returned. Sterilization of a poor draining soil is therefore ineffectual. In addition, sterilization not only kills the root rot pathogens but also soil pathogens which attack root rot fungi (yes, they have their own enemies).

Chemical fumigation of soil with agents such as methyl bromide, besides being a hazardous practice not recommended for the home gardener, is of little use for the same reason as sterilization.

The use of fungicides

As noted, there are bonsai literature references recommending Benomyl fungicide, a product of the Du Pont company, to combat root rot. I contacted a plant pathologist at Du Pont to ask about this usage for their product.

Benomyl fungicide, sold under the tradename Benlate®, is primarily useful in controlling fungi on the exposed parts of a plant, particularly the leaves. In fact, the primary intended application for Benlate is in control of black spot on roses and other ornamentals (Zelkova is one bonsai species susceptible to black spot). Other applications include use to control brown spot on various types of fruit. Although it is called a systemic fungicide, Benomyl is more correctly thought of as a localized systemic; when applied to a plant's foliage, for example, it will absorb into the leaves' conducting tissues and provide internal protection there (and kill fungus which has invaded the leaves). Benlate product labels do not indicate any effectiveness for Benomyl in root rot control nor does Du Pont recommend such use.

There are other fungicides on the general gardening market, such as Captan, but none are recommended for use against root rot.

I spoke with Vaughn Banting about controlling root rot with fungicide. He indicated that there are products which can be used as soil drenches to kill root rot fungi, but they are not commonly available to the home gardener. Such brands as Banrot®, Trueban® and Subdue® are specifically targeted to kill fungi of the Pythium genus. These may be obtained by contacting a horticulturist or nurseryman, but should not be thought of as products for casual use in root rot prevention. They are your last defense (their high costs alone precludes frequent use).

If used against root rot fungi, these products will also kill any mycorrhiza present.

Summary

In bonsai there are always pests and diseases to contend with. Many can be avoided while others must simply be fought as best we can. Root rot is a particularly destructive disease, but it is also one of the most easily prevented. As Vaughn pointed out, root rot is most likely to occur when a plant is under stress. Poor soil drainage and the resulting wet conditions cause feeder roots to die, and allow root-rot spores to germinate and grow on the dead tissues. Or the bonsai gets too dry and feeder roots die, then you water and again the spores germinate and grow.

Particular attention should be paid to soil composition, as this is the best way to regulate moisture levels. Experience has shown that proper bonsai soils should be about 50% solid, 25% liquid and 25% gas. When this ratio is maintained, root rot is extremely unlikely to occur.

As part of a practical approach to root rot prevention, don't be afraid to adjust your repotting schedule if your bonsai are not draining properly after watering. Be careful to avoid over-watering.

In the end, the best way to control root rot is to keep it from occurring.