Cedar Apple Rust in Bonsai

Steven D. Ittel
Brandywine Bonsai Society
Wilmington, DE 19807

In the Brandywine Valley of Delaware or the mid-Atlantic area, cedar apple rust and related diseases can be destructive or disfiguring diseases on crabapple, quince and hawthorn bonsai if you do not use adequate controls. Its most effective cohost in the mid-Atlantic area is Eastern red cedar (*Juniperus virginiana*) where it causes unsightly galls. Damage to the coniferous cohost is usually minimal but can be significant on small bonsai. Cedar apple rust is caused by the fungi *Gymnosporangium globosum* or *G. juniperi-virginianae* that spend most of their life cycles on red cedars growing near orchards or bonsai collections.

Symptoms

On the apple, the infection is most visible on leaves but also occurs on fruit and young twigs. The brightly colored spots produced on the leaves make it easy to identify. Numerous small, pale yellow spots appear on the upper surfaces of the leaves, usually during late April or May (Figure 1). These spots gradually enlarge and turn orange. You can see orange drops of liquid in the spots. Later, darker, often brown, spots (called spermatia) appear in the spots on the upper leaf surface (Figure 2).

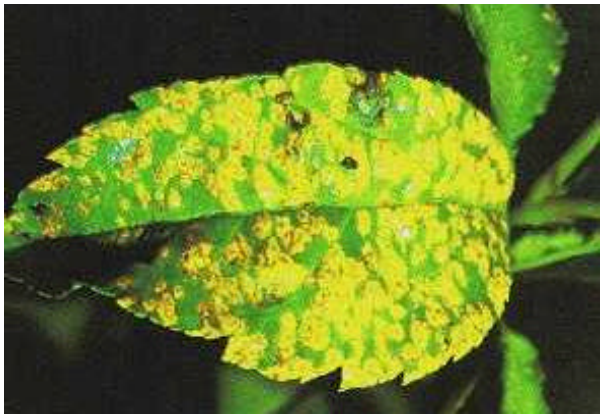

Figure 1. Severe cedar apple rust on a leaf early in season.

In late summer, tube-like structures called aecia develop on the undersides of leaves (Figure 3). These are the fruiting bodies of the rust as it is to be transmitted back to the conifer host. The infected leaves might drop prematurely during drought or other conditions that put the tree under additional stress. In exceptional circumstances, defoliation can be almost complete.

Fruit infections are usually near the calyx (blossom) end of the apple and are somewhat similar to the leaf lesions. Crab apple fruit seem to be a bit more resistant to infection than normal apples.

Figure 2. Moderate cedar apple rust on a leaf in mid-July.

Figure 3. Underside of leaf in mid-July showing the aecia. This leaf is in the process of sporing.

On the cedar, the fungus produces reddish-brown galls from 1/4 to 2 inches in diameter. These galls are frequently called "cedar apples," and can be mistaken by the uninitiated for cones. After reaching a diameter of about 1/2 inch, they show many small circular depressions (like golf balls). In the center of each depression is a small, pimple-like structure. In the spring these structures elongate into orange gelatinous protrusions known as telia horns (Figure 4). These spore-bearing horns swell during rainy periods in April and May (Figure 5). The wind carries the microscopic spores to infect apple leaves, fruit and young twigs on trees within a radius of several miles of the infected tree.

Figure 4. Mature cedar apple rust gall on a red cedar tree in the spring shown about life size.

Figure 5. During rain, the same cedar apple rust gall forms gelatinous orange spikes (telia horns), that produce spores.

A **B**

Figures 6A, B. Cedar apple rust shown on the poor cohost, San Jose Juniper, in early spring before (**A**) and after (**B**) the first warm rain. Shown to approximate scale for comparison.

Disease cycle

Understanding of the disease cycle of this rust fungus is helpful for proper identification and control. The disease cycle of cedar apple rust is complex. Two host plants — apple and cedar — are involved, and three fruiting structures are produced by the fungus: aecia, spermatia and telia. The fungus requires two years to complete the cycle (see Figure 6).

At the first warm rain of spring, each spore horn produces a large number of spores. The wind carries them to apple leaves just about the time when apple buds are in the pink to early blossom stage.

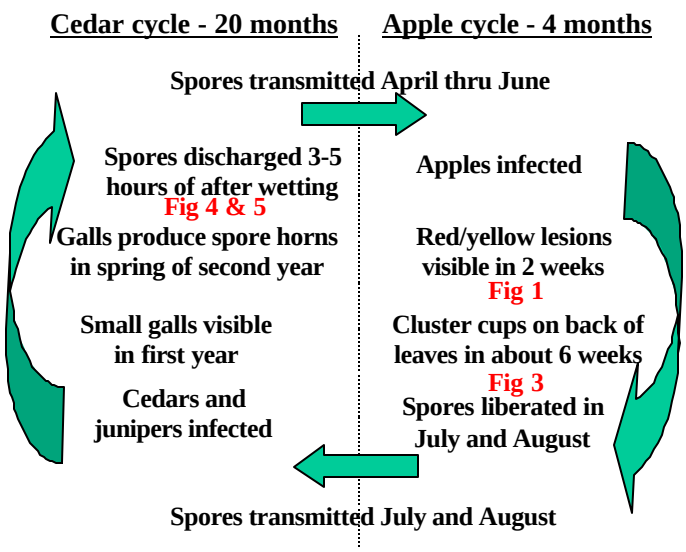

Figure 6. Disease cycle of cedar-apple rust.

Upon reaching apple leaves, the spores attach themselves, germinate and enter the leaf tissue. They infect within four hours under favorable conditions. Yellow lesions develop in one to three weeks.

In July and August, spores from the apple leaves (aeciospores) are produced. The wind carries them back to cedar trees, completing the cycle. The spores land on cedar needle bases or in cracks or crevices of twigs. There, they germinate and produce small, green-brown swellings about the size of a pea. Galls do not produce spores until the second spring. However, many mature galls usually are available every year.

Control

Control of the cedar apple rust disease involves interruption of the disease cycle. It would be nice if we could plant only resistant varieties of crabapples, hawthorn or quince when cedar trees are nearby. There are definite differences in the susceptibility of apple varieties. Crabapples are generally more susceptible than apples. Information on resistant crabapples or hawthorn is given in Table 1 below. The resistant varieties are less susceptible to attack, but that does not mean that they are free from an aggressive attack. In bonsai collections, collected crabapples are generally *malus unknownus* collected locally. In years of heavy infestation, locally collected trees can be very hard hit (heavy lesions on every leaf) while Indian Summer crabapple (listed as resistant) and suffered (a few lesions on about 25% of the leaves). One might think that local trees would have more resistance through years of natural selection in a region where cedar apple rust is endemic, but that is obviously not the case.

The recommended method of control is to "remove cedars located within a 2-mile radius" of the collection to interrupt the disease cycle. Unfortunately, neighbors might take a dim view of this approach. Even worse, we might have red cedar or other junipers in our

collections sitting on the same bonsai benches. Keeping the trees apart in the collection does no good because of the high mobility of the spores, so you might as well put them side-by-side if they look good together.

Fungicide sprays are highly effective against the rust diseases when applied properly, but they do not kill the active fungus. Rather, they inhibit the transmission cycle. Apply them four times at 7- to 10-day intervals starting with prebloom on hawthorn and quince and pink bud on crabapples if the disease is chronically a problem. Continue thru full bloom. These applications are to protect the plant from spores being disseminated from the cedar host in mid-spring. Fungicides such as Bayleton, Funginex, Rubigan EC and others listed below will protect the apple leaves from becoming infected.

Generally, orchardists do not spray local cedars or junipers, but because bonsai enthusiasts care about all of their plants, the same fungicides can be used in July and August on the red cedars and junipers to reduce infection. Of course, follow label directions.

If you diagnose cedar rust disease on fruits and leaves it is far too late to spray for that year. The tree will not look good, but if the infection is light, just let it run its course. The leaf in Figure 2 is only lightly infected and should probably be left on the plant letting nature prevail and hoping for better control the next year. If the infection is heavy like in Figure 1, you should realize that by late season, there will be no green, just orange. The spots will grow to the size of those in Figure 2 and the entire leaf would be infected. If the tree is strong, you might want to consider a preemptive defoliation with the new leaves emerging after the infective season. A fully infected leaf won't make nutrients for the next year, so hoping for a new set of leaves is probably a better alternative. The next crop of leaves will be free of infection and the tree will look better for the rest of the summer.

Malus (Apple and Crabapple) listed as having resistance to rust diseases include Adams, Beverly, Candied Apple, Dolgo, Donald Wyman, Eleyi, Inglis, Indian Summer, Liset Mt. Arbor Narangasett, Periscifolia, Red Jewel, Robinson, Robusta, Royalty Sargent cv., Tina, Snowdrift, and Special Radiant. In regular apples, Jonathan, Rome Beauty, Wealthy and York Imperial are susceptible. Grimes Golden, Red Delicious, Winesap, Staymans, Redfree, Jonafree and Priscilla are resistant.

Juniperus listed as having resistance to rust diseases include J. ashei, J. chinesis (Fermina, Fortunei, Hetzii, Japonica, Keteleeri, Leeana, Mas, Oblonga, Pedula, Pfitzeriana, Pfitzeriana compacta, Pfitzeriana glauca, Plumosa aurea, Pyramidalis, Sargentii, Sargentii variegata, Sartentii watereri), J. communis (Aurea Aureo-spica, Cracovia, Depressa, Hibernica, Oblonga pendula, Pyramidalis, Saxatilis, Saxatilis pallas, Suecia, Suecia nana), J. conferta, J. formosana 'Hyata', J. horizontalis: (Admirabilis, Adpressa, Argenteus, Douglasii, Eximius, Filicinus, Glomerata, Lividus, Petraea, Plumosa), J. procumbens (J.chinensis var. procumbens, p nana), J. rigida, J. sabina: Broadmoor, Fastigiata, Knap Hill var. tamariscifolia, Skandia, J. squamata (Albo-variegata, Fargesii, Mereri, Wilsonii), and finally, J. virginiana(Aurea, Berg's Rust Resistant, Burkii, Globosa, Kosteri, Pseudocupressus, Pyramidalis, Skyrocket, Tripartita, Venusta).

Crataegus (Hawthorn) listed as having resistance to rust diseases include C. crus-galli, C. intricata, C. laevigata, Autumn Glory, C. phaenopyrum, C. pruinosa, C. viridis, and Winter King.

Table: Fungicides labeled for rust control. *This listing is for bonsai use only. The restrictions listed are for use on apple that will be harvested, but there may well be further restrictions.*

Fungicide	Rusts Controlled*	Fungicide restrictions
chlorothalonil (Bravo)	C	
fenarimol (Rubigan)	C, Q, H	Do not apply within 30 days of harvest.
ferbam	C, Q, H	Apply prebloom to bloom.
mancozeb	C, Q, H	
mycolobutanil (Nova)	C, Q, H	Do not apply within 14 days of harvest.
propiconazole (Banner)	C	Non-bearing trees only. Not for edible products.
sulfur, micronized	C, Q, H	
thiophanate-ethyl (Cleary's 3336 WP)	C, Q, H	Do not tank mix with copper fungicides or highly alkaline pesticides.
triadimefon (Bayleton)	C, Q, H	Do not apply within 45 days of harvest.
triforine (Funginex)	C, Q, H	Do not apply within 45 days of harvest.
zinc ion (Ziram 76)	C, Q	Do not apply within 14 days of harvest.

* C= crabapple, Q=quince, H=Hawthorn