

Rose Rosette Disease Webinar Questions originally broadcast on February 13, 2013

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Answered by Jim Amrine

Crops Affected

Q: Is *Rosa accicularis* resistant?

No. I have found this plant in Preston Co., WV, and it was susceptible to RRD.

Q: Have existing hybrid classes of RRD resistant roses like hybrid blandas been tested?

We did not test *Rosa blanda*. It may be a good candidate for research.

Q: If it affects multiflora roses and many of these modern varieties are grafted, why would the canes be more vulnerable to RRD than the root system?

The virus takes time to move from the end of the cane down into the crown; so if you see symptoms early and prune that cane at the crown, then you may be able to prevent infection of the entire plant. How much time? Probably one or two months to reach the crown, but this is a guess at this point. Research needs to be done to determine the rate of movement from the tip of a cane down into the crown.

Q: If you find *R. multiflora* adjacent to your growing area, how should you get rid of it? Bush hog? Remove from roots and burn it? Other means? Herbicides? Multiflora rose can be large and unruly.

I know. I have photos of myself and my students with scratches all over as if in a cat fight. Get rid of them any way you can. If the land is level, use a brush hog. Most herbicide controls I have seen end up with plants coming back from the roots in about three years; you have to be persistent. If you are in West Virginia with steep hills, use goats. Fenced goats do a marvelous job. Andorra goats do very well on multiflora rose; and you get a nice crop of valuable hair as well.

Q: Are certain cultivars more susceptible than others?

Multiflora rose is the most susceptible of all; many of the Chinese roses are very susceptible as well.

Q: I recently heard from a gardener at the USBG that there's a theory that RRD is transmitted by *Rosa virginiana*. Is this true, or were they perhaps referring to *Rosa multiflora*?

The transmission of RRD is by the eriophyid mite, *Phyllocoptes fructiphilus*. Probably any infected rose can be a reservoir or a source of the virus. *Rosa virginiana* is present in pastures at higher elevations in the mountains; I do not recall ever seeing RRD in *Rosa virginiana*. The gardener probably meant *Rosa multiflora*, which we regard as the major reservoir in eastern North America.

Q: *R. multiflora* is used as a rootstock. Does this make the scion more susceptible to this disease?

If the scion is resistant, it will stay resistant. If the scion is lost, the multiflora that develops is as susceptible as all other multifloras. If the rootstock is able to send up a separate cane, then it can be infected.



Q: With the extensive number of Knock Out roses in the landscape is it possible that the Knock Out is becoming a secondary host for the mite?

Yes, it is possible. Unfortunately, I have seen a few reports of RRD-infected Knockout Roses.

Q: Is there a difference between double or single knockouts being more resistant to RRD?

I do not know.

Q: How many generations of eriophyid mites per year in PA?

Too many! In warmer weather 60°F and above, there is about one generation every seven to 10 days, virtually one per week from mid May until cold weather in the fall. They even develop slowly when temperatures are in the mid 40s, F to about 60°F.

Q: Does RRD kill the multiflora roses?

Always, in every single case. Sometimes as quick as a few months, for large plants as long as 4 or 5 years. *Rosa woodsii* is the only rose that is not killed to our knowledge, for roses that can be infected. Individual canes die, but the RRD does not spread to other canes. We need to find out why; there may be a key factor here that can be used to develop resistance.

Q: Any work done with the resistance of different varieties of roses that we grow against the mite?

Rosa bracteata shows greatest promise; see comments on the same question above.

Q: Among the resistant species roses are there specific cultivars that breeders should be using or is the resistance generalized such that any cultivar can be expected to be resistant?

I collected the species roses from the field; I am not aware of any cultivars of these species. If the cultivars are hybrids with susceptible roses, the resistance may be lost.

Q: How do roses grafted onto multiflora rootstock play into rose rosette virus? Can they become a host plant based on the rootstock?

Both the graft and the rootstock may become infected (there are very few cultivars or species immune to the virus); the root stock would become susceptible if the graft is lost, and growth comes from the rootstock. In that case, most roses would be destroyed anyway.

Q: What kind of thread of spread of RRD exists within the rose production industry? Is there much production of roses in the areas of high multiflora numbers?

A rosarian or horticulturist should answer this one.

Q: I have read that *Rosa bracteata* is immune to RRD. Is this true? Or has RRD been seen on bracteata?

Phyllocoptes fructiphilus will not develop on *Rosa bracteata* [there is something in the foliage that repels the mites], so yes it is immune, since there is no other vector. However, *bracteata* can be grafted with RRD and it develops symptoms similar to that seen in other roses. WV farmers made me promise to destroy my six plants; they were afraid of another pest like multiflora rose. A couple plants left uncontrolled died that winter, so it cannot survive in WV. It is subtropical and a severe weed in pastures near the Gulf of Mexico.

Q: Has RRD been confirmed on any native North American species roses?

Yes, *Rosa woodsii*. We tested many species of native North American roses, but not even half of them. So a lot more work needs to be done.

The Mite

Q: Does the eriophyid mite that vectors the rose rosette disease virus vector any other diseases to other ornamental or ag crops?

No. It is a vector of the RRD virus only. The mite will feed only on the genus *Rosa*, no other members of Rosaceae that we have tested. This includes all common crops and ornamentals in the family. Graft tests to other genera of Rosaceae have been negative; back grafts from these grafted plants to healthy multiflora have also been negative.

Q: Are there any other host plants for the mite?

The RRD vector mite, *Phyllocoptes fructiphilus* can only develop on plants in the genus *Rosa*. We applied live mites to many other general in Rosaceae, and even to other plants, but the mites either quickly depart or they lay a few eggs and the offspring die. They cannot develop on the McCartney Rose [the pest along the gulf coast], *Rosa bracteata*. This plant has very dark green glossy foliage and the mites depart as soon as you put them on the leaves; there must be a compound in the leaf that repels the mites. The plant is susceptible to graft transmission.

Q: Can the mites be seen with a hand lens? And are they primarily in leaf axils or in the very new growth like a broadmite? Are they similar in size to broadmites?

They are very hard to see in low-power hand lenses [5x or 10x]. Try to get a 20x hand lens; they are visible if you get the lens close enough to see them and look in the right place. They are found under leaf petioles, especially under the dissected stipules that often adhere to the stem, and in the folded young leaves at the tips of tender, growing shoots. They are a little smaller than broadmites, more elongate, and thin, resembling small bananas with four legs at the head end. Broad mites are more oval is shape, about 200 microns long and have eight visible legs – the last two may be somewhat reduced. Here is a site that has SEM images of broad mites: <http://entnemdept.ufl.edu/creatures/orn/tabmite.htm>

Q: When do the eriophyid mites become active in the spring?

Whenever temperatures go above 60 to 65°F. Mite populations may be very low in spring; it is often very hard to find any until June or so. They survive better when winters are more mild. But, they also depend on the condition and form of the overwintering roses; in some years, roses have more open buds and numerous small clusters of small leaves, which are ideal shelters that help the mites survive winter. In other years the buds are small and tight with no room for mites, and canes are bare with no clusters of vegetation. You may find a few mites in creases or cracks in the canes. In all cases, the mites must overwinter on green tissues. If they cannot feed occasionally, they will die.

Q: You do not get positive PCR assays from asymptomatic tissues from infected plants? So, you are saying that the virus is not systemic and only causes local infections so only symptomatic tissues carry the virus? If so, this is very different from other virus diseases.

It may be that the virus is not present in asymptomatic tissues at detectable levels. Backgrafts of these tissues to clean multiflora roses should prove whether they are viruliferous or not. It may be that the virus is spreading in the conductive tissues but these older, non-growing tissues [stems, leaves] do not have the right kind of cells for replication of the virus; thus the virus particles pass on through until they find the right kinds of cells in the crown, the roots or in the growing tips. It may also be possible that the virus moves downward only later in the season, or very slowly. A number of carefully constructed and carefully conducted experiments need to be done on test plants during initial phases of infection to discover the degree and rates of movement of the virus.

Q: What is the incubation period from infection to symptoms?

I have seen it happen in as quick as 17 days, and take as long as three months or until the next season. For the quick response, we dug up about 24 very large multiflora roses: we removed all canes above ground leaving about 6- to 12-inch stumps for each cane, and cut off nearly all roots, leaving 6- to 12-inch stumps on the roots. We put these 'amputated crowns' in large pots with peat vermiculite mix and placed them under a mist bed in early September. We soon had numerous new growth canes from each crown; we placed pieces of tender, red RRD-symptomatic tissues onto several new shoots of each crown, wrapping them with parafilm. After mite transfer the growing crowns were kept in the greenhouse; symptoms developed 17 days later in every single crown. Appearance of symptoms on already-developed canes took longer; up to 3 months or until the next season. We found that all grafts onto multiflora rose after about the 10th of June, were negative for transmission of the virus. Something happens to stem tissue that prevents grafts from being successful after mid-June.

Q: Does it get into the roots of own-root plants? This was pure observation, but a fellow rosarian mowed down quite a few own-root HT roses that were fully infected. Several have come back and to date (about one year) have been clean.

That is a very interesting observation. In these hybrid teas growing from their own root system, perhaps the virus does not go through the crown to the roots below. That would be important to determine. The experiments should be repeated.

Q: the presence of the virus has been demonstrated in symptomatic plants using PCR. Were pathogenicity tests performed as a proof of concept?

I do not think we are at a point where we can evaluate or measure pathogenicity of the virus. We are lucky to measure its presence. There are many things potentially going on in the mites: does the virus increase in titre in the mite? Where in the mite can the virus be found? In what tissues does the virus develop or occur? Is the structure and nature of the virus in the mite the same as the virus in the plant? Does the mite extract a key component of the plant virus which then replicates and becomes able to reinfect other plants? Is the virus transmission by mites mechanical or biological? Why doesn't the mite saliva or digestive enzymes deactivate the virus? How long after feeding and acquiring the virus can the mite infect another plant? These mites are 180 microns long; how can we conduct experiments to answer these questions?

Q: How soon in the spring do the mites become active?

When temperatures become warmer than 60°F.

Q: Are there any entomologists who are currently screening roses for their susceptibility to the mite? This could be another way to find resistance to the disease.

I have recommended that this be done, especially with *Rosa bracteata*, which has foliage that repels the mite. Most entomologists are hard at work in areas that have proper funding.

Q: Question for the resistance done by Sali Barolli. Imperial Nurseries CT

I found work that she did on application of herbicides to container stock in hoop houses. Has she done anything with RRD and roses?

Q: Do you suspect there to be a mixed infection, on the basis of varying symptoms?

That is always a possibility; good health screening is needed to be sure roses are not infected with other diseases.

Spread Of RDD

Q: Is there any indication that cold temperatures have any effect on the movement and or population of the mite?

The mites are most mobile at temperatures above 70°F. They become inactive when temperatures go below about 50° F. So, most dispersal will occur on sunny days when temperatures are above about 70°F; more mites disperse on windy days

compared to calm days. Mites are not killed by cold weather; they survive movements in weather patterns where they go up into high clouds and live eriophyid mites have been recovered from snow.

Q: Within what radius of a nursery does multiflora rose need to be eliminated?

As Michael Dobres mentioned, the infestation of roses by airborne mites is a matter of chance. The more multiflora roses that there are in a neighborhood, the greater chance of infestation by the mite. Unfortunately, mites appear able to aerially disperse for at least 100 miles. Reduction of multiflora should be a goal of all farmers, growers and gardeners throughout the entire area.

Q: Can the virus be spread with pruners? Is disinfecting tools an effective way of preventing it? Won't pruning increase spread of virus?

No. Every attempt we have made to transmit the virus mechanically has failed. But, there is an outside chance that an infected mite may be riding on the pruners, in which case there is a remote possibility of the "pruner" spreading the disease when the mite crawls onto the next rose. Use an alcohol or a soapy water dip to remove mites before going to the next plant. Disinfecting will help to remove mites, but the virus cannot be transmitted on tools. Pruning tools will not spread it, and only very rarely spread the mites. Brush hogging can spread the virus; brush hogging grinds up the plants, without killing mites, and disperses infected mites onto all rose plants in a field. Soon new growth from cut canes afford a great opportunity for infected mites to spread the disease. Keep brush hogging and eventually, you will get all of the multiflora roses.

Q: What was the correlation percentage found in non-symptomatic foliage on infected plants? Was the virus ever present without symptoms?

We have seen about 20 percent of marked multiflora roses lose all symptoms for as long as two years, then blow up with full symptoms and die in a short time. We do not know why this happens. Do not be surprised if you see symptoms disappear then reappear later. This happens even more often in ornamental roses; this phenomenon has resulted in sale of assumed healthy plants that were really infected and later developed symptoms in complete absence of mites. It would be interesting to test a plant known to be infected but later symptom free with the DNA tests for RRD. The question is: Can the virus be detected in these plants?

Q: Is RRD sap-transmissible?

What do you mean by sap-transmissible? [Aphids and leafhoppers feed on sap of roses but they cannot transmit the RRD virus; we do not know why they are unsuccessful. One idea is that their saliva inactivates the virus.] The eriophyid mites pick up the virus at places where xylem and phloem are near the surface of the plant, as in the growing tips of shoots and lateral buds; xylem and phloem are conductive tissues that carry fluids or sap throughout the plant. When we do grafts, we have to do six per target plant to insure success; I think it is because we have to have at least one of the grafts make successful alignment of the elements or fibers of xylem and phloem. These are the theories we are working with. More careful research is needed to prove or disprove these ideas.

Q: Do you have info on confirmed cases in the last year or two in the Midwest?

Yes. I travel to western Ohio and Indiana five times per year; I always find RRD-infected roses everytime I go there. I have been to Illinois, Iowa, Missouri, Nebraska and Kansas several times the past six years — and many more before that — and I always find RRD-infected multiflora roses and *Phyllocoptes fructiphilus* when I go.

Q: How does this affect workers as far as developing fungus?

RRD is caused by a virus. It cannot be acquired by humans, but do not inject it. I had a plant pathology professor who claimed bread mold can never infect humans. To prove his statement, he made a razor cut in his arm and inserted some bread mold. He has had an infection in his arm ever since; he cannot eliminate it. So, be careful how you prove or disprove ideas that you may have. RRD symptomatic roses are very susceptible to powdery mildew, a fungus. If you see a lot of powdery mildew on the

plants, take care and wear a face mask. You might be the person that proves that yes, it can, on rare occasions, infect humans. A fungal lung infection can be very serious.

Q: There had been MFR eradication programs for landowners in some states in past years/decades (a USDA-FSA and Soil & Water Conservation District program). I believe it is now a county-by-county program now (it is has been and is a huge problem for livestock and hay producers).

I have seen slow reduction in the number of multiflora roses in West Virginia and neighboring states. One of our major problems is the seed burden present in soils all over the region. Seeds can last as long as four decades in the soil. So, despite removal of the plant, new seedlings soon appear in many areas. Fortunately there is a seed predator that is helping to bring the plant under control. It is a seed chalcid, a small wasp in the family Torymidae (Hymenoptera), named *Megastigmus nigroflavus aculeatus*. It has the potential to infect an average of 95 percent of the seeds of a given rose plant. It is the reason that multiflora has developed such huge numbers of flowers and seeds per plant. These two species have been in an evolutionary war for at least a million years in East Asia. Multiflora in China, Korea and Japan is an occasional plant in the environment, not a noxious weed. And the reason is this small chalcid.

I did a study on the wasp in 1984 and found, on average, multiflora roses throughout West Virginia and neighboring states had a seed infestation of 50 percent. I repeated the study in 1994 and found this number had increased to about 80 percent. The seed chalcid is spread by songbirds, especially robins, mocking birds, red wing blackbirds, starlings and the like. Birds with powerful gizzards containing small stones, like doves [chickens, pigeons, ducks, geese, etc.], grind the seeds to a meal and the wasps are killed. The wasp was absent in Oklahoma, southern Missouri and Texas.

I have a presentation, which I gave to Michael that presents information on this seed chalcid. And, yes, you can collect hips in the fall and place them on target plants and get the chalcid's numbers to a higher level. I have done it several times. Collect the hips in late October; assay for the wasp by cutting seeds or a subsample of 20 hips with a straight edge razor, and if you find numbers higher than 70 percent infestation, just take other hips and scatter on the ground under the target plants. Snow cover and leaf cover will keep the wasps from being killed by temperatures below 10°F; hips exposed to cold temperatures will have only dead wasps. Birds often remove the hips by early December, so don't procrastinate. The chalcid, *Megastigmus aculeatus nigroflavus*, only attacks seeds of multiflora rose; other roses cannot be penetrated by the fine ovipositors.

Q: We have been picking up roses from vendors that haven't sold them and bringing them back to our nursery. In light of the more recent occurrences in our shipping areas, are we at risk to bring the disease back to our nursery?

The risk of moving roses around is no greater than just having the roses outside — unless you enter an area with an abundance of RRD-infected plants.

Q: Is the virus present in non-symptomatic tissue [on plants known to have been symptomatic]?

It can be. We have seen about 20 percent of newly symptomatic roses, lose all trace of symptoms. However, the symptoms always return and usually cover most of the plant. The plant then usually dies a few months later.

Q: It seems interesting that N.C. has fewer counties with green counties than the other surrounding states. Why do you think that is?

I presume you are talking about the RRD map. Or were you talking about the multiflora rose map? So, two possible answers. First, N.C. agencies, and boy scouts, et al., planted 21 million multiflora rose plants to help reduce erosion, for wildlife food and shelter, and sometimes as living fence for livestock. This is 7 million more than in W.Va. And Kentucky decided to let each county decide whether to plant, or not plant, multiflora roses; most counties elected to not plant them. The result is I can drive for miles in KY. and never see a single multiflora rose. Then, you find a county where they are plentiful. If I throw a dart at a map of W.Va., multiflora can be found within 100 yards of the point of impact; WVDA researchers actually did this as a part of field trials. Multiflora was everywhere in W.Va. Answer number 2: N.C. is on the line that marks the southern limit for multiflora rose. They are very scarce along the coast of N.C. where the climate is warmer and the plants seldom are exposed to cold winter temperatures; this reduces successful seed production and reduces successful seed germination.

Q: We have seen the RRV [RRD?] in blackberry plants, should that be a major concern?

I have seen strange symptoms in blackberry plants, lumps of deformed leaves and canes, that resemble RRD, but it is not RRD. Grafts from these symptomatic tissues back to multiflora rose were always negative. I am pretty certain that these are symptoms of aphids or leaf hoppers attacking the blackberry plants. It is definitely not RRD.

Q: Has this been found in Mass. or the northeast.

Yes, I found RRD in New York State and in Massachusetts a few years ago. It will spread up along the coast into southern coastal Maine.

Q: Is it found in Wash. and Ore.?

Multiflora roses are planted along freeways in Ore. Someone needs to do a thorough survey to see if the multifloras have developed RRD anywhere in these states. I spent a few hours along I-5, not far from Corvallis, looking at thousands of multiflora roses in the median, back in about 2001. I did not see a single symptomatic rose. But, that does not mean the disease is not present. A few hours on one day is not enough searching.

Q: What is the time frame from initial infestation by mite and appearance of RRD?

As short as 17 days to as long as the next growing season; it depends a lot on the condition of the target rose.

Q: What is a typical distance from an infected plant that mites can be a likely danger to non-infested plants?

The closer you are to symptomatic multiflora roses or symptomatic rose plantings of any species, the higher the risk. It is a matter of statistical chance, depending on condition of the plants, mite populations, weather conditions, direction of the wind, wind barriers and a whole host of variable conditions. We had fields of rooted cuttings [rootstock for grafts] of multiflora roses near Tyler, Texas, that were showing frequent and abundant symptoms of RRD. No multiflora roses could be found within 20 miles of the location; we looked at aerial photos and drove miles and miles of roadsides. No multiflora and no native symptomatic roses. The nearest multiflora rose populations were at least 100 miles away in Okla. and Ark. So, the mite can frequently and routinely transport for at least 100 miles and probably a lot further. We got mites in every snowfall but one during the winter of 1994 and 1995. Many of the mites were still alive after melting the snow and sitting in buckets for three days until the water could be filtered. We assumed that the mites became airborne in a more mild climate and moved in with the weather system from the south, and the mites became embedded in the snow flakes when the moist air rose and froze at higher altitudes. Then the mites came down with the snow. We are talking about several mite specimens present in each snowfall. However, none of these were *Phyllocoptes fructiphilus*. If we were to repeat this experiment today, we may recover some fructiphilus, but maybe not.

Q: Is there any further information on the origin of RRD? Is the U.S. the only place where it is located? Are there any thoughts of how it came into roses? Is there a similar virus and host that people think this virus may have mutated and differentiated from in order to feed on roses?

The origin is *Rosa woodsii* in the Rocky Mountains above 8000 feet in Moab, Utah, and similar mountain ranges. In the mountains, along streams and in meadows in the high mountain valleys, *Rosa woodsii* is present in nearly every mountain range from Mexico north into Canada. RRD has been found in *Rosa woodsii* in Calif., Utah and Wyoming. The other states are not listed because no one has looked. I feel certain that careful surveys would find it and RRD in just about every range of mountains in the Rockies. *Phyllocoptes fructiphilus* was described from the cracked rose hips of *Rosa californica* in Clarksburg, near Sacramento, Calif. It has also been found in RRD tissues of *Rosa woodsii* in two or three locations in California and on *Rosa woodii* in the mountains near Moab, Utah. So both the mite and the virus are native to the Rocky Mountains of North America. We do not know of any other similar virus and mite relationship in any other plant. There are many eriophyids that transmit viruses to valuable crops and ornamentals, but the virus is very different from RRD in biology, structure and classification.

Q: Can the mites be transferred to other roses on gloves, clothing, etc.?

Yes.

Q: Why is RRD not seen south of I-20? Is it environmental reasons?

That is the southern range of multiflora rose. It is a cool temperate plant and needs sufficient cold exposure to insure adequate blooming, seed production and seed germination. It cannot survive and reproduce in margins close to subtropical conditions. Its ideal range is similar to that of apples.

Q: Do you recommend propagators randomly PCR screen stock plants or is simply looking for symptoms first enough?

We need to verify that new PCR methods truly detect all viruliferous plants. Then this technique can be applied to samples of the stock. Statistical tests can determine the best size and frequency of the sampling. As mentioned above, there is a significant population of plants that appear asymptomatic but have the virus present. So, close monitoring will always be required.

Q: Have you seen this disease in rose propagation beds?

Yes I have, in Tyler, Texas.

Treatment Of RDD

Q: When the diseased cane emerges from the crown of the plant, can one assume the plant is doomed?

If RRD infected canes develop from the crown, then in all likelihood, the plant is completely infected. There is one rose where individual canes can be infected and then die, but other canes from the crown remain virus free: it is *Rosa woodsii*. As far as I know, this is the only rose that does this.

Q: Is Spinosad effective against the mite?

We have not tested Spinosad. The spinosoids, belonging to the naturalyte class of pesticides, are primarily insecticides, and a general rule is that chemicals effective for insects are often ineffective against mites. They were tested against cattle ticks and found to cause 80 to 90 percent mortality. Tests should be conducted to see if they are effective against *Phyllocoptes fructiphilus*. The compounds are very toxic if ingested and have been found to be mutagenic.

Q: How do you spell Jim Amrine, RRD specialist, and where can you find his published research on the disease?

My full name is James W. Amrine, Jr. The i is long, and the name is derived from the Rhein River in Germany. Some of my work is available at www.wvu.edu/~agexten/varroa06. Much of my work has been shared with researchers using Dropbox.com. If Star Roses want to make these available on their website, then the work could be shared with anyone who is interested. You can eMail me at jamrine@wvu.edu.

Q: Are there any biological controls effective against the eriophyid mites?

Yes. There are several species of predaceous phytoseiid mites that can be found on roses and the young mites or starving adults will feed on the eriophyids. They often prefer the eggs over the mites. Small maggots of the family Cecidomyiidae (Diptera, gall midges) occur on leaves or in shoots of roses with mite colonies; and they attack and feed on the mites. However, they take about 40 minutes to feed on one mite, and in their lifetime of 10 days, they hardly eat more than 20 mites each. The most effective predator is a small yellow thrips that is now common on roses with large populations of *Phyllocoptes fructiphilus*. I have watched them feed on the mites, and they completely suck up the insides in about two seconds. They go from mite to mite with a voracious appetite. I have seen the thrips almost eliminate large populations of *Phyllocoptes fructiphilus*. If we could rear these thrips and release them, they may help to reduce mite populations. However, if they cannot find mites, they leave. Here are a few other predators that may feed on the mites: two or three species of small ladybird beetles; anthocorid bugs;

mites in the families Stigmaeidae and Bdellidae. Fungi, especially *Hirsutella thompsoni*, are able to kill large numbers of mites when they are crowded and temperatures and humidity are high.

Q: I know it isn't soil borne, but if there are any remaining roots from infected plants in the soil, are any other roses in danger?

Once, or if, these roots produce plants above ground, when mites get onto the infected tissues, they will be a threat to other plants nearby.

Q: Is there an ovicide available for dormant application?

The mites overwinter as dormant mites, not as eggs. The eggs hatch in about three days. It is more effective to use pesticides that kill the mites rather than ovicides. Many of the eggs are concealed and would be missed by a spray. If the mites cannot enter buds (the size of buds varies from one year to the next; all open one year, all closed up tight the next or two years later), or can not find a refuge on the plant (eg., clusters of small green leaves that grow in cool fall weather), they will die. RRD infected canes die in cold winters; all of the mites on the dead canes die in a few weeks, so it is possible to find symptomatic plants that have no mites at all.

Q: Are any organic measures available to prevent spread of mites?

Use very fine mesh to screen the plants, then spray frequently with pyrethrum or other similar plant-derived toxins to prevent the mites from passing through the holes in the screen. Presuming, of course, that pyrethrum is a pesticide approved for organic farming. Any mesh size larger than 30 microns will allow mites to pass through, but pyrethrum-treated mesh will repel or kill the mites. You have to use the spray weekly.

Q: Please clarify what recommendation I should give a homeowner with this problem. Seems to me the plant should be destroyed.

I always recommend that they destroy symptomatic plants. If the plants are of special value, I recommend they try to find healthy tissue and establish grafts on other roses or develop rooted cuttings in mist beds.

Q: If you kill with an herbicide, does the dead plant part still contain viable virus?

The virus does not survive in dead plant material, but most roses have extensive root systems. Some of these roots often survive the herbicide, and eventually they break ground, develop canes and then can be reinfected. RRD-infected crowns and roots will not survive the herbicide; they do not have enough reserves to survive. If you dig up an RRD-infected plant, take thin slices of the roots and test with iodine solution. You will see that there is no starch. The plants starve to death. Sections of RRD-infected canes are also devoid of starch.

Q: Does asymptomatic tissue have the virus in it? I was always under the impression that if any part of the plant is showing symptoms, the entire plant is a problem.

Yes, there is always a chance that asymptomatic tissues have the virus present; the way to prove it is to graft lateral buds of the suspect plant onto supposedly clean multiflora. I would do about six to 10 target plants. If the virus is present, it should appear in one of the targets. The virus may be present at such a low level that it does not reappear for two or three years, so repeat this test for a couple of seasons. I would only do this for a particularly valuable plant or to really find out if the virus resides in this suspect plant. You continue to have the problem that new mites carrying the virus may arrive at any time on your suspect plant, so you need to find a way to isolate it from airborne mites.

Q: I'm David Kinderdine. You used my picture in your presentation. I'm currently applying Lime Sulfur spray for my Tea roses. Is this effective for the eriophyid mite on Knock Outs?

Sulfur is very effective against exposed eriophyid mites. It prevents them from acquiring oxygen. Eriophyid mites do not have breathing apertures. They get oxygen through their skin. Sulfur blocks the passage of oxygen. So, I think your treatment may

work for eriophyids in the open. The mites under bud scales, at leaf petiole bases and concealed in foliage of tightly packed small developing leaves will not be treated and will survive the treatment. So, it needs to be repeated frequently.

Q: Any work with beneficial mites as a control?

We are not aware of any.

Q: Can remaining roots from removed roses infect a new rose planted in the same spot?

No. We proved that multiflora roses do not make root grafts. I have not heard of any roses that make root grafts. The threat is when the few living roots emerge from the soil and become full-sized plants, they can then become infected.

Q: Is Sevin effective to kill this mite?

Yes. We have tested it and it even kills mites in buds and growing shoots, which other pesticides cannot usually reach. Apparently, Sevin is somewhat systemic in buds and shoots of multiflora roses.

Q: Is there a quick test for this virus (e.g immunostrips)?

Perhaps one can be developed. At the moment, we do not know of one.

Q: Once discovered in a rose garden, what is the recommended treatment/response to hinder the virus from spreading to healthy roses?

Remove all symptomatic plants. Valuable plants should be isolated and an attempt made to recover grafts or rooted cuttings from them. If you live in an area with lots of nearby symptomatic multiflora roses, treat with a miticide on a weekly basis from April until late fall, when all growth ceases and leaves fall off.

Q: Our company uses predatory mites to control spider mites. Will they also control the mite that spreads rose rosette?

You will need to run a few tests to find out. In general, phytoseiids prefer larger mites as prey, often walking right over eriophyid mites. If they are desperate and very hungry, they will feed on them. They often prefer eggs to the mites; probably because of the resemblance to pollen grains, one of the major food sources for phytoseiids. Many phytoseiids get so large that they do not even recognize eriophyids as a potential food source.

Q: Is there anything we can do in spring to prevent RRD.

Eliminate all nearby infected multiflora or other roses. Spray valuable roses with effective pesticides.

Q: Any BCA's tried for control of eriophyid mites?

We have seen a number of potential candidates for biological control of *Phyllocoptes fructiphilus*. Perhaps the most promising are one or two species of small thrips that usually find larger colonies of mites. They are voracious predators. There are probably two or three species of phytoseiid mites that may be good predators. I am not a phytoseiid specialist, so I do not know their identity. But I have plenty of them on slides. There are predaceous gall midges that feed on *Phyllocoptes fructiphilus*. They are slow, taking about 40 minutes to eat one mite, and they do not eat very many. There are other mites, in the families Bdellidae and Stigmaeidae, that appear to be good predators, but they are rarely seen in samples. There are small coccinellids that are good predators. These are very small black or brown lady bird beetles (Coleoptera: Coccinellidae). And there are small black anthocorid bugs (Hemiptera: Anthocoridae) that feed on the mites; these are voracious predators as well, but they are not often seen in nature.

Q: I am a retailer. What criteria would I look for when receiving rose shipments from my growers, to determine if RRD is in a particular lot of container-grown roses?

Look for the visible symptoms described in Michael Dobre's pamphlet and in other pamphlets published about RRD. But remember, in our studies of hundreds of symptomatic multiflora roses, about 20 percent became asymptomatic. So be vigilant and always watch for symptoms; isolate or destroy symptomatic plants as soon as possible.

Q: If a rose is symptomatic for RRD, you mentioned pruning out this symptomatic portion of the rose can control the disease. How far below symptomatic growth should the pruning cuts be made?

I would remove the symptomatic cane all the way to the crown. But if you only have one cane and it is a graft, I would prune down to one or two leaves above the graft and hope for the best. Rosarians or horticulturists can probably give a better answer.

Q: You mentioned cutting out the infected canes at the base. I've had success with this. My question is how quickly does the disease travel from the top of the cane to the base?

We discussed this topic above; we do not know just how quickly the virus moves in the plant. We need to devise specific experiments that will provide the answer to this question.

Q: What are the major research efforts ongoing on RRD?

Our RRD and multiflora rose funding sources ended several years ago. Simultaneous to our work in the 1980s and 1990s was the work at Iowa State University [my alma mater] by Abe Epstein and John Hill. No other serious work was done. Their funding also came to an end. Recently, researchers at the University of Arkansas in Fayetteville, have been successful in discovering most of the attributes of the RRD virus. I am not aware of any other work being done at this time. Several Experiment Stations have developed pamphlets and websites on RRD and roses. More needs to be done.

Q: What about replanting after removal of infected roses?

There should be no problem in the soil or ground to your new roses. If large numbers of airborne mites are arriving, then you will always have a problem. If root remnants of previous roses survive, break ground and produce canes, they may be infected again when virus infecte *Phyllocoptes fructiphilus* arrive.

Q: Would a hard stream of water dislodge the mites and help in control early on?

You will probably remove a few, but many concealed mites in buds, tight new growth, under leaf petiole stipules and elsewhere will be missed and unaffected.

Q: Are you really suggesting that all rose branches be bagged and trashed? Seems like another solution would be appropriate, as it seems unlikely that the mite, if even present, would survive the composting process.

I would recommend placing them in closed composting containers for 30 days then the mites should all be dead by then. Then chip and compost.

Q: Can the mites be pretreated with a systemic spray such as Bayer for roses?

There may be pesticides that are residual and effective. Of course, they would not be present on new growth, and that is where the mites develop best.

Q: Are there any microorganisms that could be enlisted, much as we use BT against various beetles and their larvae?

There is a fungus, *Hirsutella thompsoni*, that has been cultured to help control eriophyid mites on citrus and other crops. It is most efficient in warm humid weather. It can completely eliminate eriophyid populations under special conditions [warm and humid, crowded mites]. I do not know if it is commercially available. It can be cultured and there are many publications on citrus rust mite and other mites that explain how to culture and produce the fungus for field trials. In the majority of tests, control approached 70 percent, so it is not a silver bullet.

Answered by Mike Dobres

Q: Do the PCR assays confirm that cutting off the infected branches will not cure the plant even if there are other canes that are seemingly unaffected or asymptomatic?

The PCR results simply say that virus was not detected in asymptomatic leaves. This can mean one of two things: a) the virus is indeed completely absent from the asymptomatic leaves tested, or b) the RRD virus is present at levels below the level of detection for PCR. Further studies are needed to better characterize the movement of the virus within the rose plant.

Q: Is there a way of inoculating segregating populations of seedlings for RRD?

None that I am aware of. The two methods of inoculations used in Jim Amrine's studies were grafting or mite mediated. Mechanical inoculation does not work for RRD. One could perhaps imagine germinating seeds in a chamber infested with RRD carrying mites, but this might get messy if not well contained or well designed. The difficulty in routine inoculation of roses with RRD is one of the biggest challenges for RRD researchers.

Answered by Conard-Pyle

Q: Is there a way/place we can send a sample to test for RRD?

Oklahoma State University's Plant Disease and Insect Diagnostic Laboratory offers RRD PCR testing for both in and out of state clients (US only, lower 48 states). The cost is \$25 per sample and checks can be made out to Oklahoma State University. They cannot accept credit card payments at this time.

Snip off two to three symptomatic canes/leaves and place inside two plastic bags (double bagged) if from outside Oklahoma and send for testing with the form in the following link. Symptomatic leaves are the preferred tissue for testing. The mailing address is at the top of the form.

<http://entopl.okstate.edu/pddl/pddl-form.pdf>

Results generally take two to three days depending on how busy the lab is (they will be very busy in mid-March to early April). Reports are sent directly back to the submitter and they prefer to send them by email (PDF) when possible.

Q: What about Drift roses?

Drift roses can also be affected with RRD.

Q: Having just said that most of the money supporting these results has come from the industry itself, wouldn't there be worry about biased results as per who is funding the research?

The coalition that has been assembled to work on this problem is bilateral, across many different agencies.

Q: Is it possible for the ornamentals industry to do anything to have the multiflora rose listed as an invasive plant or noxious weed in the states most impacted (i.e. Illinois, Indiana, Ohio, Pennsylvania, etc.)?

By working with ANLA on this issue we hope to address this with their help and drive it down to the state level.

Q: Would you recommend burning the diseased roses vs. throwing them in the garbage?

Yes, burning is an alternative. Be sure to bag the infected canes once removed to reduce risk of spreading the mite.

Q: It can be tricky in a larger public garden to deal with the sheer mass of rose debris from pruning in the spring and throughout the year. It's not practical or ecological to bag all the debris. Does anyone have a better way of dealing with this besides putting it in the dumpster?

David Kinderdine has a lot of experience in this (we referenced a slide of his bales of trimming debris).

Q: What chemicals are effective to control these mites?

Suffoil x 1 gallons plus Avid 4 ounces per 100 gallons

Akari 5SC 24 ounces per 100 gallons plus sticker

Judo 4 ounces per 100 gallons

Begin sprays at bud break and continue every seven days while plants are actively growing.

Q: Is there a particular place on the internet where you plan on posting any developments in RRD research... perhaps the Star website or Conard Pyle?

We are working on this and plan to have a centralized place online where information, updates and resources are posted. We will distribute the link when it is ready.

Q: Please show the full URL for the RRD brochure on the conard-pyle.com website once again.

<http://www.conard-pyle.com/index.cfm/fuseaction/home.showpage/pageID/143/index.htm>