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Kern Pistachio Notes

April 2014

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Rhodococcus fascians Associated with some UCB-1 Rootstocks

(Please note that Dr. J. Randall, Plant Pathologist at New Mexico State University/Las Cruces, reviewed and edited this article)

Rhodococcus fascians is a gram-positive yellow-orange bacteria that can cause disease in plants. Until 1984 it was called *Corynebacterium fascians*. The disease causes a range of symptoms such as flattened growth (known as fasciation) of stalks of plants with soft tissues such as squash; wrinkling of leaves; leafy galls, bud and shoot proliferation; reduced initiation and growth of lateral roots and delayed senescence in herbaceous annual plants. M.L. Putman, Oregon State University, describes leafy gall as a "mass of buds or short shoots tightly packed together and fused at the base." According to Putman, "plants affected by *R. fascians* often grow with less vigor, have an abnormally short stature, may produce fewer flowers, and may have less root growth." Putnam writes that *R. fascians* is known to infect over 60 species of herbaceous and woody plants including monocots (such as palms) and dicots. Field observations suggest that *R. fascians* may remain alive in the soil in which diseased plants were growing for up to two years. Potting soil can become infested and infect clean plants planted in it. *R. fascians* can move in water passively. Normally, these bacteria are limited to the surfaces of leaves, petioles and stems, although the bacteria can move into the plant and has been found inside plant cells and between plant cells. In nursery settings, the disease can be spread through propagative cuttings removed from diseased plants.

Disease development depends on the plant species, the age of the plant, and the particular strain of the bacteria. The bacteria must be present for initiation of the disease and for disease progression. According to Wikipedia, the effects of *R. fascians* infection is the result of excessive plant hormones – especially auxin and cytokinin. The bacteria can produce cytokinin and auxin, and can degrade cytokinin, to alter the normal ratio between these two hormones. *R. fascians* can also stimulate infected plant tissue to produce cytokinin and to block production of abscisic acid and giberelllic acid. Plants that are infected during development exhibit reduction of lateral root development. *R. fascians* is primarily a disease of meristematic (i.e. tissue in which the cells are reproducing) and it would appear that this bacterium has the ability to generate a mix of plant hormones designed to keep tissue meristematic.

In nursery settings, the primary control measures for *R. fascians* is sterilization of anything and everything used in propagating plants. Sterilization would certainly include the potting media, pots, benches, water and nutrient tanks, and implements; containers and materials used in clonal propagation and so on. All plants showing any symptoms of disease should be discarded in a manner that will not facilitate disease spread. Some form of plant testing should be done routinely to ensure clean material is present in the nursery and clean material is being sold to clientele.

In the last three years, in newly planted orchards in California and Arizona, some clonally-propagated 'UCB-1' rootstocks from a nursery in California exhibited symptoms that included shortened internodes, stunted growth, swollen lateral buds, bushy/bunchy growth pattern, a light-green color, and twisted roots with virtually no lateral branching. These trees were found to be more difficult to graft and, once grafted, many grew slowly.

During the second year of growth, some trees showed deformed growth around the graft union. In California, many of these trees that had been in the ground for over a year had stem galls. The percentage of these abnormal rootstocks within affected orchards varied, as did the degree of the symptoms manifested, but up to 65% of trees in some orchards showed some symptomology. Many growers are removing the trees with these symptoms from their orchards simply based on the poor growth of the rootstocks/grafted trees.

Dr. Jennifer Randall, a plant pathologist at New Mexico State University, recently found *Rhodococcus fascians* in association with symptomatic plants sampled in affected orchards. This is the first report of an association of *Rhodococcus sp*. with clonally propagated'UCB-1' (*Pistacia atlantica x P. integerrima*) rootstock. It is unknown whether the *Rhodococcus sp*. isolated from 'UCB-1' rootstock is responsible for any/all of the observed symptoms or if it is a part of a larger disease complex. Pathogenicity testing and Koch's postulates with the 'UCB-1' *Rhodococcus* cultures are in progress. A manuscript of Dr. Randall's findings has been submitted to the journal, 'Plant Disease'. The California Pistachio Research Board, the pistachio commodity group, recently funded a project designed to find pathogens in pistachio budwood and rootstocks. These U.C. researchers will be sampling plants in affected orchards in the San Joaquin Valley in late April to further define this problem.

Picture 1. Symptomatic ungrafted rootstock showing light-green color and bunchy growth.

Picture 2. Close up of the tree in Picture 1 showing 'witches' broom (i.e. proliferation of branches).

Picture 3 and 4. Odd growth at the graft union, usually showing up at 2nd leaf.

Poor Chilling Affects Seen During Bloom 2014 in Kern County

By simply adding up hours below 45 º F we had plenty of chill hours in most Kern County locations during the winter of 2013-14. We even had a pretty substantial freeze. However, even during the winter, it was obvious that these cooler temperatures were punctuated by plenty of sunshine and much warmer temperatures during the daytime. Probably due to the drought, we had very little fog last winter. Fog is a great moderator of temperature as a result of the high heat capacity of water. When fog is present, cold fronts moving into the area do not result in as cold or in as rapidly descending temperatures. Additionally, temperatures are slower to warm in the morning. Without fog, solar radiation can quickly raise the temperature of tree branches in the winter, especially on the south side of the tree. This rapid warm up of leaf and flower buds appears to negate chill accumulation. So, not unlike last year, we, again, see some strange effects on our trees. In these low-chill years we commonly see the following:

- Leaves and flowers emerge first on the north, shaded side of trees where chill accumulation was less negated by solar warming.
- On long branch-shoots we see leaves emerge on the tips of branches with bare spots below with no leaves or late leaf emergence (this called flagging).
- For unknown reasons, especially in younger orchards, male trees bloom late and often have fewer flowers. This appears to hold true whether the male is ‘Peters’, ‘Randy’ or others.

Growers, understandably, find the last observation most alarming, since there is a concern that the late appearance of male pollen will result in reduced yield. Over the past years, I have made some observations that should help mitigate this concern.

Observation 1

As a result of the research that I have done for many years in evaluating new pistachio selections from the U.C. Breeding program, I have had some very early blooming genotypes in a number of test trials. In several instances, in some of those trials, I have not had an equally early blooming male. Often the flowers of these early-blooming females would appear to be totally open and flower length could be five or six inches long before any hint of the presence of an open male flower. However, in every case, I ended up with yields in these selections at the end of the season comparable to Kerman, Lost Hills, or other selections in the trial. I have discovered that pistachio has several strategies to assist it in getting enough pollen to set a crop. First, the flower is made up of many florets. The florets mature from the base of the flower up. If there is not pollen present at the start of bloom for that flower, the younger florets may be ready for pollination a little later.

Observation 2

Secondly, there is a range of flower age on the tree, especially in a low chill year. There may be some flowers at full bloom on the north side of the tree, while those on the south may have not yet opened. Even in a year with adequate chill, flower age varies on the tree.

Observation 3

The third reason, and the one which I think may play a much more important role and is critical in the example I discussed above about the 'early bloomers' is that the female flower appears to have the ability to 'wait' for pollen.

Again as part of my research with the U.C. breeding program, I cross a particular female tree with a particular male tree. Before the flowers open on the female tree of interest, I tie a bag over the flower (usually flowers) to prevent unwanted pollen from fertilizing it. Sometimes the bag stays on the flower quite a while. It is not uncommon, that by the time I have the desired male pollen available for my bagged flower, that the surrounding unbagged, naturally wind-pollinated flowers on the tree might already have developing nuts at the base of the flowers 3/8 inch wide. These flowers were pollinated ten or more days ago. There is not an unbagged flower on the tree that can still be pollinated. They are done. However, when I open the bagged flower, prior to putting in the pollen, I usually see a bag full of florets, from the bottom to the top of the flowers, ready for pollination. The florets have exposed, light-green sticky stigmas ready to receive pollen. Often I can harvest 20-40 nuts at the end of the season from a bag full of flowers like these. My only explanation is that the flowers continue to remain receptive, if unpollinated, and even continue to grow and expand until pollinated. I do not know how long they wait, but it appears to be of the order of a week or 10 days at least. It is this ability to wait, in addition to the two other mechanisms described above, that accounts for those 'early blooming' females to produce good yields of nuts, even when it seems that they have come out too early for adequate pollination. So, generally, when I hear growers express concern about poor synchronization between male and female trees, I suggest that most of that concern is unwarranted. I believe cutting male flowers from an early blooming orchard and placing them in an orchard with poor bloom synchronization is largely a waste of time. The females will wait for the males long enough.

The other thing about pistachio is that it is alternate bearing. What you don't get this year, you usually get next year. Unused carbohydrate seems to carry over. Several times with different sets of data, I have tried to correlate chill hours, determined by different methods, with yield. The correlations have always been poor and pistachio's tendency to alternate bear, really complicates the analyses. If poor chilling reduced yields, it ought to be easier to find in the data.

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