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THE SCOOP

on fruits and nuts in Stanislaus County

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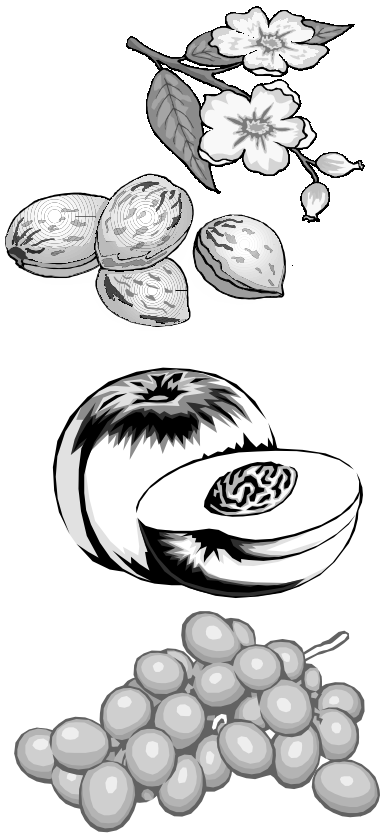

Fall Foliar Urea for Bacterial Canker Management

Bacterial canker (bc) is a complex disease that involves the bacterial pathogen *Pseudomonas syringae.* Why is it that some orchards are chronically plagued with bc while others are never affected? Plant pathologists use a "disease triangle" to explain this phenomenon. Three things must exist in order for a disease to occur. First, the disease organism, or pathogen, must be present. Second, environmental conditions conducive for disease development must exist. Third, you must have a susceptible host.

Pseudomonas syringae is a very common epiphyte. This means that it is probably present at some level on the surface of trees in all almond and stonefruit orchards in Stanislaus County. Also, temperature and moisture conditions for bacterial growth are generally present in all orchards every winter. So if the bacterium is probably present in every orchard and environmental conditions are pretty similar among orchards, what is it that makes the difference? It is the third part of the triangle - host susceptibility. IT IS THE CONDITION OF THE TREE THAT WILL DETERMINE WHETHER OR NOT BACTERIAL CANKER WILL OCCUR AND HOW SEVERE IT WILL BE IN YOUR ORCHARD. Therefore, our best means to manage bacterial canker is to keep the trees as resistant as possible.

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There are several factors that can influence a tree's resistance to bacterial canker. If a tree's tissue is damaged by frost, it is more susceptible to invasion and colonization by *Pseudomonas* bacteria. Ring nematode feeding on root tips also increases a tree's susceptibility to bacterial canker. In addition, recent trials have shown that low nitrogen status can increase the danger of this disease.

Pseudomonas syringae bacteria produce and release syringomycin, a substance toxic to tissues of almond and stonefruit trees. This is the reason why tissue colonized by the bacteria turns brown and dies. A tree that is able to suppress production of syringomycin will have at least partial resistance to the disease. A gene within the *Pseudomonas* bacteria is responsible for producing this toxin. It appears that higher nitrogen content within peach tree tissue reduces the expression of this gene. In other words, trees with higher nitrogen content don't allow the bacteria to produce as much toxin and are therefore more resistant to bacterial canker.

Fall foliar urea sprays can be an effective way to boost the nitrogen content of almond and stonefruit trees. This is especially true for orchards that have weakened root systems from nematode feeding or other soil problems. Scott Johnson, UC pomology specialist at the UC Kearney Ag Center, has shown that 80% or more of the urea-nitrogen from a fall foliar spray is absorbed into the leaf within 24 hours. It is then re-mobilized into the woody tissue within 4 – 6 days to be stored for use the following spring.

I tried the fall foliar urea sprays in our fumigation trial on Patterson Road to see if I could increase the trees' resistance to bacterial canker. This spray was in addition to the grower's normal (and very adequate) nutrition program. The trial is in a third generation peach orchard growing in very sandy ground. My application was October 29, 2002 when the orchard was at the end of its second-leaf. Using a commercial air blast sprayer, I added 100 lb. of low biuret urea per 100 gallons of water per acre. It took about 10 minutes of agitation for the urea to dissolve. I sprayed trees in fumigated and unfumigated areas of the orchard. Other trees were treated with calcium chloride foliar sprays (4 quarts per acre) periodically through the season. In December, a student working under UC Davis plant pathologist, Bruce Kirkpatrick, injected treated and untreated trees with the *Pseudomonas syringae* bacteria to determine if the fertilizer treatments made the trees more resistant to bacterial canker. After about two months, the inoculated shoots were collected and the severity of bacterial canker disease was assessed by measuring the lesions that grew in inoculated shoots.

We had some very clear results. From the table on the next page, you can see that trees growing in fumigated areas were much more resistant to the bacterial canker pathogen. Bacterial canker lesions in fumigated trees grew only about one inch during those two months. In contrast, lesions in unfumigated trees grew about one foot. However, when we treated unfumigated trees with a fall foliar urea spray, lesions only grew about an inch – about the same as in trees fumigated with methyl bromide! So it appears that a fall foliar urea spray may really help with resistance to bacterial canker. The calcium treatments helped also, but results were not as dramatic as the urea treatment. We plan to repeat this test this winter.

Foliar urea may advance defoliation (similar to zinc sulfate sprays) due to marginal leaf burn. The suggestion at this time is 100 pounds of low biuret urea (yes, I said 100 pounds) per acre. This will give you close to 50 pounds of N per acre. The time of application should be in October; September is too early to start defoliation and by November excessive senescence can be under way. I have not tested less than 100 lb. of low biuret urea per acre. I do not know if the same effects could be achieved with a lower rate. Regular urea is less expensive than low biuret urea and can probably be used safely in peaches for a fall spray. Apparently urea produced in some overseas plants can reach dangerously high biuret levels. High biuret can cause excessive shoot or bud burn. I have not yet tested this spray in almonds but plan to try various rates this fall.

Effects of Fumigation and Foliar Urea or Calcium on Bacterial Canker Lesion Length		
Foliar Fertilizer Spray	**Preplant Methyl Bromide Fumigation?**	**Lesion Length (mm)**
Grower's fertility program	No	301 a
Supplemental calcium sprays	No	78 b
Supplemental urea spray	No	27 c
Grower's fertility program	Yes	26 c
Supplemental calcium sprays	Yes	23 c
Supplemental urea spray	Yes	20 c

Results of Fumigation Trial

We have finished our fourth season comparing pre-plant fumigants in combination with various post-plant treatments in Norman Kline's peach orchard on Patterson Road. While we have not yet seen any bacterial canker in the plot, fumigation effects on tree growth, nematodes, yield and fruit quality are obvious. Across the board, trees in methyl bromide fumigated areas are much larger, have bigger fruit and more than twice the yields of unfumigated trees. Trees in Telone II fumigated ground are also much better than unfumigated trees but are not as large and yields are lower than methyl bromide treated areas. While Vapam-treated areas are better than the unfumigated areas, these trees are not uniform in size and many are beginning to struggle.

The table below shows fruit size, yield and calculated gross income for the four fumigant treatments in 2004. Average yield in the methyl bromide fumigated areas were more than double the yields in the unfumigated areas. At $280 per ton for Loadel cling peaches with less than 4% rejects, methyl bromide areas made $2268 per acre more in gross income than unfumigated areas this season (fourth-leaf). Telone II had a gross income of $1052 per acre more than the unfumigated areas.

Fumigation Effects on Yield and Gross Income of 4th-Leaf Loadel Cling Peach Trees Patterson Road, 2004

Fumigation Treatment	Avg. Fruit Diameter (mm)	Pounds of Fruit per Tree	Calculated Tons per Acre*	Gross Income per Acre	Increase in Income Over Unfumigated
Unfumigated	63.2	39.2	7.3	$2044	--
Vapam	63.7	56.5	10.5	$2945	$901
Telone II	66.4	59.4	11.1	$3096	$1052
Methyl bromide	67.1	82.9	15.4	$4312	$2268

* Per acre yield calculated by multiplying pounds of fruit per tree times 372 trees per acre.

When 2-year cumulative yields for each fumigation treatment are compared, differences are even more dramatic. During just the third and fourth-leaf harvests, gross income was more than $4000 higher per acre in methyl bromide fumigated areas than in unfumigated areas.

Cumulative Fumigation Effects on Yield and Gross Income Over Two Years (third and fourth-leaf)

Fumigation Treatment	2003 Tons per Acre	2004 Tons per Acre	Cumulative Yield	Cumulative Gross Income	Increase in Income Over Unfumigated
Unfumigated	4.1	7.3	11.4	$3140	--
Vapam	8.5	10.5	19.0	$5242	$2102
Telone II	6.9	11.1	18.0	$4946	$1806
Methyl bromide	11.0	15.4	26.4	$7267	$4127

All three fumigants initially eliminated more than 98% of the ring, root lesion and root knot nematodes from the top five feet of soil and kept them low for the first two years. However, nematodes are now higher in the fumigated areas than the unfumigated areas. This is because the few nematodes that survived fumigation were able to rapidly reproduce on healthy roots. Now the healthier, fumigated trees support more nematodes than the weak, unfumigated trees. The question now is whether regular applications of a nematicide can maintain lower nematode numbers and keep the fumigated trees healthy.

Post-plant treatments. We have applied several post-plant treatments over a four year period in fumigated and unfumigated areas. These treatments include nematicides (Enzone, Nemacur & DiTera), supplemental fertilizers (a blend of foliar micronutrients and foliar and drip-applied calcium and nitrogen), black plastic soil covering, compost, and microbiological and kelp-based soil additives. We have seen no effects of any post-plant treatment in fumigated areas. However, the foliar micronutrient sprays and the black plastic mulch increased tree size and yield in unfumigated areas. Nemacur and Enzone reduced nematodes initially after each application but nematode numbers always rebounded. Curiously, trees have not responded to the annual nematicide applications with more growth or higher yields. We have seen no effects on growth or yield from the microbiological soil treatments at all. In fact, soil tests showed that microbiological soil additives and kelp-based materials have not influenced the soil microbial community or increased microbial "activity" at all, despite multiple applications through the drip system each year.

I think we have learned several things from this trial. First, even though fumigation is expensive, increased yields and reduced costs (reduced weed control, fertilizer, replants, etc.) can more than cover fumigation costs early in the life of an orchard. There is no substitute for pre-plant fumigation. DO NOT think you can skip fumigation and then fix things later with compost and microbiological soil additives. Also, we have shown that the replant problem is more than just nematodes. Even though we have applied effective nematicides to unfumigated trees (starting first-leaf) and we have reduced nematodes, the trees are still struggling. This means we really can't just take a simple nematode test prior to planting in a replant site and make an informed fumigation decision. I have seen several second generation orchards with poor growth because they were not fumigated, even though pre-plant nematode levels were low. In my experience, if you are replanting an orchard into sandy or sandy loam soil, it is a huge gamble not to fumigate prior to planting.

Want Free Fumigation?

Use of methyl bromide is scheduled to be phased out at the end of this year. Although almond and stonefruit growers may receive a special exemption for replanted orchards in 2005, we expect many growers to turn to Telone II for pre-plant fumigation. Telone II is a good nematicide but has limited activity against the fungal and bacterial portion of the replant problem. We would like to set up a trial this fall comparing commercial applications of proven fumigants, including iodomethane (formally called methyl iodide), a soon to be approved fumigant with activity very similar to methyl bromide.

If you are planning to plant an almond orchard this winter into a site recently occupied by an almond or peach orchard I would like to talk to you right away. We will cover all fumigation costs. We will also monitor nematode and microbiological soil populations during the establishment period of the orchard. The ideal location would fit the following criteria: an almond orchard planted in a location recently occupied by an almond or peach orchard, sandy or sandy loam soil, drip or microsprinkler irrigation, no till and maybe 20 acres or larger in size. If you are interested, call me at 525-6800.

Silverleaf Disease Management

Silverleaf disease is of relatively minor importance in California. However, those growers who have had serious problems with it may not agree that it is a minor disease. Silverleaf is a fungal disease that is spread during the rainy season. When spores of the fungus are released from infected trees and land on fresh pruning wounds, the fungus slowly invades the tree and eventually kills it. Toxins produced by the fungus cause leaves on infected limbs to have a slight silvery appearance.

There is no cure for an infected tree. Disease management should be directed at prevention. This includes removing and burning diseased trees (including roots) and preventing infection of new trees. One method of prevention is to prune almonds and peaches before the rains come. I know this is difficult to do in bearing orchards, but young trees can be pruned now. Tradition tells us young trees growing in bacterial canker sites should be pruned late (during or after bloom). However, if bacterial canker is not an issue, there is no reason to prune late.

For those few growers in our area who are having problems with this disease, there may be some help soon. New research by Dr. Jim Adaskaveg has shown that a foliar application of *Trichoderma* spp. (a biological control fungus) was very effective in preventing infection of pruning wounds and was much better than any "traditional" fungicide tested. Commercial formulations of *Trichoderma* are available from ag supply dealers, but are not yet registered for use on almonds and stonefruit in California.

Pruning First-Leaf Trees

It seems to me the quality of pruning first-leaf almond trees has declined in recent years. Although most growers space scaffold limbs fairly well around the tree, many do not allow enough space vertically between scaffolds. If possible, scaffold limbs should arise at least two inches apart in a vertical direction (up and down the trunk). If multiple scaffolds attach in the same vertical plane, it is more likely that they will split during the early bearing years. This is especially true for varieties like Padre and Aldrich that have a very upright growth pattern.

There is an increasing trend to leave more than three scaffolds in first-leaf almond trees. Although my opinion has softened a little in the last few years, I still prefer three scaffolds. After 15 – 18 years, most healthy trees on nemaguard rootstock become too large to trunk shake and it becomes necessary to shake individual scaffolds. When there are more than three scaffolds, it is difficult for shaker operators to grab one without damaging adjacent limbs. The result is an increase in bark damage and *Ceratocystis* infections, which leads to a premature decline of the orchard. Limb shaking may not be necessary for trees that will remain small. This would include trees on Marianna rootstock or possibly trees planted in hedgerows closer than 14 feet apart.

Tree & Vine Loss Calculator

Growers can calculate the value of a lost tree or vine using a simple spreadsheet now available on the Internet. The "Tree & Vine Loss Calculator", developed by the University of California Agricultural Economics department, can be accessed on our web page at http://cestanislaus.ucdavis.edu and then clicking on the agricultural links icon. The program uses our most recent cost studies to calculate the value for 20 tree and vine crops. So what is a mature almond tree worth at today's prices? About $225.

Inside The Scoop:

Future CE Seminars.

North San Joaquin Valley Cling Peach Seminar
December 14, 2004
Stanislaus County Ag Center, Modesto

North San Joaquin Valley Almond Day
January 26, 2005
Stanislaus County Ag Center, Modesto