University of California Cooperative Extension

PISTACHIO NOTES

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Salmonella and How to Eliminate Them

The following article was copied directly, with a few minor changes, from Agribusiness Week at www.agribusinessweek.com. This article was posted on the Agribusiness Week website on April 18th, 2009 under Special Report.

Salmonellae are widely distributed in our food chain and environment. The bacteria can be found in raw meats, poultry, eggs, unpasteurized milk, and daily products. People may also become exposed to Salmonella bacteria through contact with animals such as, pet chicks, dogs, cats, and reptiles.

Salmonella is a genus of rod-shaped gram-negative Enterobacteria that causes typhoid fever, paratyphoid fever, and the foodborne illness salmonellosis. Most Salmonella species are motile and produce hydrogen sulfide. There are approximately 40,000 cases of Salmonella infection reported in the United States each year.

SEROTYPES

There are over 2,000 salmonella serotypes and these can be divided arbitrarily into three unequally sized groups. These include the species specific serotypes such as S. dublin (cattle); the invasive serotypes which cause septicemia disease in several animal species (e.g. S. enteritidis and S. typhimurium); and the non-invasive serotypes which tend not to result in septicemia.

Members of the first group are not recognized as foodborne pathogens (disease-producing microorganisms). The third group is by far the largest and may be associated with sub-clinical infection in farm livestock. They can cause disease on occasion and are associated with food poisoning in humans. The principal manifestation of human salmonellosis is gastroenteritis. Septicemia occurs in some patients.

SOURCES OF CONTAMINATION

Salmonellae are vegetative bacteria and have a relatively low temperature tolerance. The most resistant serotypes are unable to withstand temperatures of 70°C for more than a few minutes, provided wet heat is used. In dry conditions, salmonellae can survive for extended periods.

The main reservoir of Salmonella is the intestinal tract of vertebrates, and members of the genus are widely spread in nature. Animals and humans may be carriers at some stage in their lives. There are many potential sources of contamination. The most likely are the following:

- Raw material which is contaminated with microorganisms. If raw material handling and conveyors are located near finished product areas, there is a risk of direct contamination by splashing or spillage. It is often difficult in existing plants to separate these areas, but nevertheless it is essential that cross contamination must be prevented.

- Aerosols from raw material blow lines. These contain large numbers of bacteria. Together with dust accumulations around the plant, air currents can spread contaminants.
- Personnel and equipment. These should be clearly separated between raw material and heat-treated product areas and barriers provided to prevent passage between the two. Equipment that provides the right conditions for Salmonella growth (water, temperature. nutrients) can be a source of recontamination of product.
- Birds, insects and vermin, and their fecal deposits. These may be the vector for transmission from raw material harvested in the field through heat treatments in the processing plant.
- Rework, spillages, and floor sweepings. These are all more likely to be contaminated and should be returned to the raw material area and not allowed to continue in the processing line.

BACTERIAL "HOT SPOTS"

The greatest risks of contamination on a continuous basis are various hot spots where product accumulates moisture, and warm conditions are prevalent. Salmonellae multiply rapidly given the right conditions, doubling their population every 20 minutes! The most effective management is by using a hygiene program and if possible, re-engineering to remove the problem.

Maintaining Mature Pistachio Tree Height Without Severe Impacts on Yield

So, once trees have reached the mature height we want for efficient cultural operations, productivity and efficient harvest, how do we keep them there?

In pistachio, during dormant pruning, shoots produced the previous season are generally those that are pruned. Because of the less selective nature of mechanical pruning, one-year old and two-year old wood is commonly cut. The presence of large visible buds is a clue to the age of the shoot. Large, very visible buds, generally fall from wood that grew earlier than the current season (see drawing on page 3). All that remain on older wood are bud scars or very small vegetative buds. Older wood may also contain adventitious buds that may sprout if an older branch is cut, but these adventitious buds are not visible with the naked eye.

New Research has implications for topping

University of California researchers have recently published a scientific paper that sheds light on the way Kerman pistachio trees respond to pruning by topping. (Spann, T.M., Beede, R.H., and Dejong, T.M., 2008. Neoformed growth responses to dormant pruning in mature and immature trees grown on different rootstocks. Journal of Horticultural Science and Biotechnology 83:137-142).

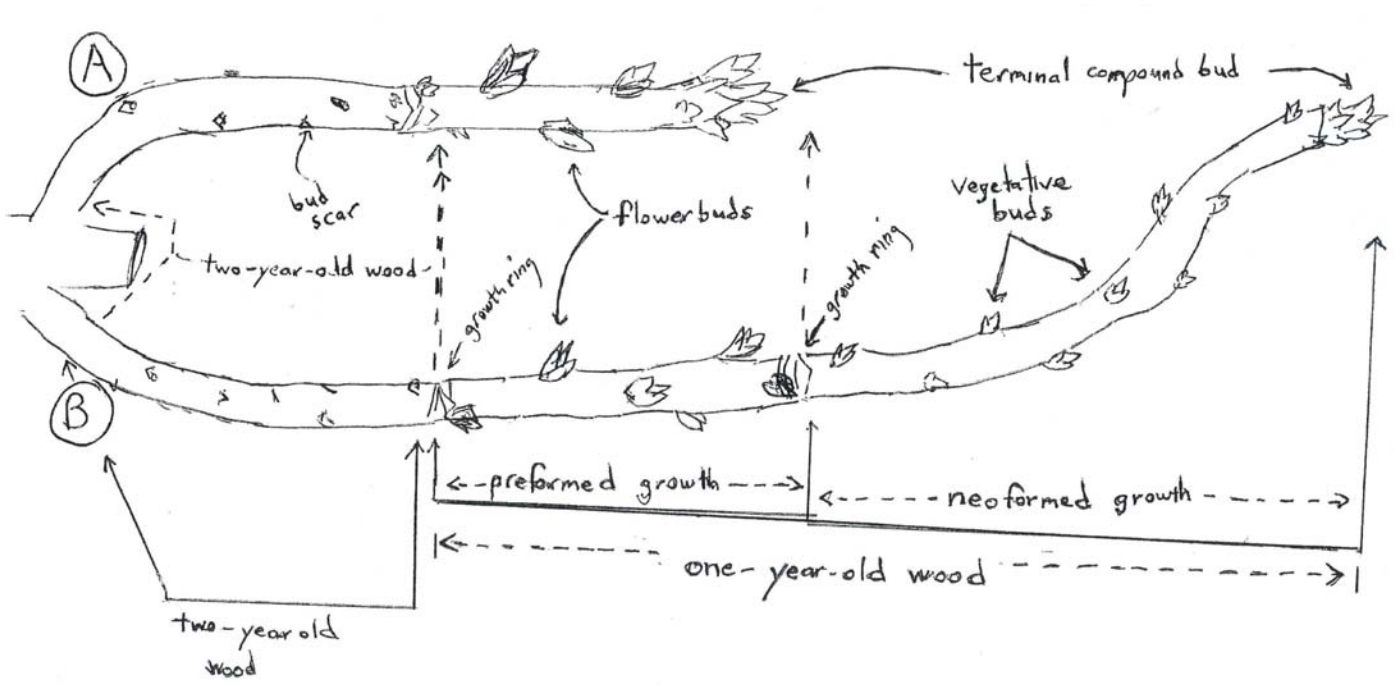
To understand the research, an understanding of the two types of shoots that pistachio trees produce, is necessary. An example may help to understand how pistachio shoots grow. For example, let's assume that the date is fast forwarded to December 20, 2009 (see box on page 3). For the sake of discussion, we have not yet pruned our dormant mature Kerman pistachio trees. The age of the youngest shoots produced in the season prior to dormancy are referred to as being one-year old. One-year-old branches may consist only of preformed growth (see page 3 for drawing branch-shoot labeled as "A") or both preformed and neoformed growth (see page 3 drawing branch-shoot labeled as "B"). In our example, although much of the growth may not yet truly be a year old in December, tissues that produce growth in 2009 originated and differentiated in the terminal shoot bud during the growing season of 2008.

Example: Pistachio Shoot Development and Identification

In this example we are assuming that we are looking at shoots in the dormant season (i.e. December) of 2009.

- The section of the branch labeled "preformed" grew during the spring of 2009 from meristimatic tissue in the terminal bud created during the growing season of 2008. The number of reproductive and vegetative buds which grew in 2009 in this section of the branch were largely predetermined by developments in the terminal bud in 2008.
- The section of the branch labeled "neoformed" grew during the late spring and summer of 2009, and the length of branch and number of buds produced were a product of environmental conditions during the growing season of 2009.

The terminal bud produced on the neoformed growth of 2009 will already contain the meristimatic tissues governing the number of buds that will be produced on the preformed section of branch which will begin pushing in April of 2010.



In the research conducted by Spann, Beede and Dejong, four treatments were applied across the top of experimental trees to simulate selective topping cuts. Some trees were left unpruned; in some trees all of the neoformed growth from the previous year was removed; in some trees all of the one-year-old wood was removed, both preformed and neoformed; and in some trees the pruning cut was made in the center of the two-year old shoots. Generally, the researchers found the following in regard to pruning one- and two-year-old wood on mature, bearing pistachio trees:

1. While some neoformed growth was inherent in mature trees, pruning increased the amount produced on each tree regardless of rootstock or crop load.
2. Overall, the number of neoformed shoots produced each year following the year of pruning, tended to decrease in the years following the year of pruning.
3. Regardless of rootstock (for UCB1, PG1 and Atlantica), pruning had no effect on the total length of preformed growth produced per tree. Also, the total number of shoots that grew per tree on all rootstocks was not affected by pruning treatment.

4. Pruning increased the number of shoots producing neoformed growth and the length of these shoots on trees on PG1 and UCB1 rootstocks, and not Atlantica. The more buds that were removed from a neoformed shoot by dormant pruning; the growth of the shoot pushing from each remaining bud would be longer than if fewer buds had been removed.
5. Pruning cuts made into two-year old wood were the most stimulatory while those made into one-year old wood produced growth similar to unpruned trees.
6. Trees pruned going into an "on" year in the alternate bearing cycle produced significantly more neoformed growth the first year after pruning than those going into an "off" year.
7. Yield did not vary in response to pruning treatment.

Generally, neoformed growth is more likely to be the kind of growth characterized by long whip-like shoots at the top of pistachio trees. Neoformed growth is composed of vegetative buds. The longer the shoot, generally, the more vegetative buds. If left unpruned, these shoots will produce branches without the structural integrity needed to transmit vibrations from the trunk and scaffold branches to the nuts for efficient removal. Leaving longs shoots at the top of pistachio trees going into the spring growing season is something that should be avoided if mechanical harvest is being contemplated.

Observations over many years in orchards on the west side of the San Joaquin Valley in Kern County, and in varietal test plots, have demonstrated that tall trees are not necessary for the annual average production of 3000 to 4000 pounds per acre of marketable yield, and an "on" year yield of 6000 pounds/acre is possible for 12 foot-tall 10th leaf trees spaced 17' by 19'. Allowing trees to become too tall results in poor light penetration into the canopy and difficulty in shaking and catching the nuts. Controlling tree height usually requires controlling neoformed growth. The research discussed in the article discussed above suggests that neoformed growth, the kind of growth that can produce very long shoots, is stimulated in pistachio trees on UCB1 and PG1 rootstocks by topping (see numbered findings above), whether accomplished by hand or mechanically. Furthermore, cutting into two-year old wood stimulates more neoformed growth than cutting one-year old wood. Since mechanical topping is less selective than hand pruning, more two-year old wood is probably cut during mechanical pruning with production of more neoformed growth. So how can we make the information in the article work for us? All the information we need isn't in the research, but it gives us additional information on which to base decisions. Before bringing in the topper, it may be useful to evaluate the following:

1. Is next year going to be an "on" or an "off" year?
2. How much neoformed growth is present from last season? How long is it?
3. Where are the preformed shoots located in the structure of the leaf canopy?

Information contained in the research article suggests that if most of the growth at the top of the mature tree is preformed growth, which usually has a shorter shoot length, there is little reason to top the trees. This observation is especially true if most of the growth is preformed and the trees are going into an "off" year. In some years, neoformed growth produced the previous year can be excessive. To assist in maintaining tree height in these years, perhaps the topper should be set for average removal of long neoformed portions of shoots produced the previous season, leaving as much of the preformed growth and reproductive potential inherent in the terminal buds intact.

Interestingly, in this research cumulative yield did not vary among topping treatments over the three years in which yield were measured, regardless of whether; 1) all of the one-year-old neoformed shoots were removed; 2) all of the one-year-old neoformed and preformed shoots were removed; and 3) all of the one-year-old shoots, both neoformed and preformed, and one-half of the length of all of the two-year-old shoots were removed. These results suggest that all of the one-year old growth at the top of a mature tree can be removed once every three years, without cumulative yield loss. This finding is further supported by U.C. Extension Specialist Louise Ferguson and others who found that trees that were severely topped (into three and four-year-old wood) prior to an "off" year in the alternate bearing cycle and again the following year and then no more for 5 years, had similar yields to hand-pruned control trees over the seven year cycle. Alternate bearing

was decreased in the topped trees as well. However, obviously, discontinuing topping treatments will again result in a gradual increase in tree height as the tree continues to grow higher in years without topping. One grower has reported to me that annual pruning of his mature pistachio trees at the same height every year has been effective in maintaining tree height, and that overall yield over a two-year alternate bearing cycle has been equal to yields produced before this program was initiated. However, this is an observation, and there are no experimental data to support or reject this practice, other than what may be inferred from the work of Dr. Spann. When trees are topped will also influence regrowth. U.C. Farm Advisor Bob Beede, found that mechanical topping approximately 50% of the length of one-year-old wood from vigorously growing shoots on August 1 did not result in significant differences in yield or nut quality from hand pruned trees at harvest. However, topping 100% of the one-year-old wood resulted in yield loss. Several growers have suggested to me that deficit irrigating from May through mid-June also reduces neoformed growth, but again, scientific data are not available to confirm this observation.

Mechanical hedging or hand-pruning the sides of the tree, in addition to topping, would be expected to further confound results. Research to date, certainly suggests that topping pistachio trees is a valid means of controlling tree height, and instituting the practice will be easier before trees have become excessively large and older wood has to be pruned.

Golden Hills Pistachio – No Need to Prune it Hard

Golden Hills was released to the industry as a new cultivar in 2005 and a few commercial orchards were planted with it that year. In these orchards, Golden Hills will be coming into 5th leaf, with increasing acreage coming into production in 2010 and beyond. The Golden Hills tree, at a given age compared to Kerman and the relatively new cultivar Lost Hills, is a smaller, more willowy tree, and, comparatively, appears to grow less vigorously. However, the size of the tree is not necessarily the major determinant of yield once a tree reaches maturity. Golden Hills, to date, appears to produce less neoformed growth than Kerman once it reaches maturity. In the oldest test plot now in its 13th leaf and the second oldest plot at 11th leaf, yields of Golden Hills have been superior or equal to those of Kerman and Lost Hills. A cultivar that produces less neoformed growth may be at an advantage in that less energy produced by the tree is spent producing shoots that will be rapidly removed by pruning and more energy is available to go into nut production. The less vigorous summer growth of Golden Hills could suggest that pruning costs will be less with this cultivar and that in-row tree spacing could be reduced, increasing the number of trees per acre and per acre yield. Based on the research of Dr. Spann and others, discussed above, growers should resist the temptation to prune Golden Hills hard to make it grow more like Kerman. Whether growing Kerman or some other variety, the emphasis should be on growing nuts and reducing costs were possible, not on growing more wood destined for the shredder.

Chilling Looks Good on Paper, But Not So Good on the Trees

While a review of pistachio chilling hour accumulations (hourly temperature accumulations below 45ºF during the period November 1 through February 28) show more than 1000 hours for many sites in the San Joaquin Valley on the http://fruitsandnuts.ucdavis.edu website, the trees appear to be telling a different story. Typically in low chill years, Kerman tends to flower earlier than its pollinating male Peters, the north side of a tree is well ahead of the south side during bloom, and young trees demonstrate a more uneven foliation than is normal. I see all of these characteristics this season. There appears to be plenty that we still do not know about how chill is accumulated in pistachio and how variations in temperature during the dormant season affect the pistachio rest period. However, Peters still appeared to bloom in time to catch the bulk of the Kerman bloom, especially on the south side of the trees, and the observations that parts of the tree leafed out later than other parts won't even be visible by the time this newsletter arrives.

The colder microclimates in the San Joaquin Valley may have dipped enough below freezing on the night of April 16 to nip some bloom, although I have not heard of any problems. Generally, the trees look like they are off to a great start this season.

Too Salty Means Less Toasty?

Observations made in a grower's field suggested that the worst salt-affected locations in the orchard appeared to be associated with increased incidence of late-fall frost damage on young pistachio trees. The observation begs the following question. "Does higher salinity predispose a young pistachio tree to frost damage?" A quick search of the literature was not very informative. Tolerance to salt is associated with increased tolerance to cold in some crops, but this is in no way the same as saying that a tree growing in higher concentrations of salt will be more cold tolerant than those growing in less saline conditions. I did turn up a paper from China, where researchers investigated the effect of soil salinity on the cold tolerance of a tree from a mangrove environment called Kandelia candel. Now a mangrove tree is probably as different from a pistachio tree as you can get, but for what it is worth, the researchers found the following: soil salinity can reduce cold tolerance of Kandelia candel leaves by increasing the negative effect of salt ions in cell membrane, adversely affecting cellular water relations and osmotic adjustment, and interfering with plant metabolism. If true, we could expect increasing incidences of frost damage on young trees with the increasing plantings of pistachio on salt-affected soils. The suggestion for pistachio growers is that pistachio growing in more saline soils may need additional hardening off in the fall prior to dormancy than those on less saline soils.

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