University of California Cooperative Extension

PISTACHIO NOTES

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Jack Frost Nips Pistachio in Some Areas of Kern County

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Pistachio growers at high elevation in Arizona and in the Cuyama Valley uphill and southwest of Bakersfield are at increased risk of damage to their crops from late spring frosts compared to San Joaquin Valley (SJV) growers. Such damage was experienced by growers this spring in both of these high-elevation locations. However, occasionally, we see damage from late spring frosts on the floor of the SJV as well. A frost in early April this year appears to have damaged some pistachio leaves, and perhaps may reduce yields slightly in some low-elevation areas of Kern County. Applying oil in the mid-January to late February time-window to control scale insects or for the purposes of creating a more even bloom can increase the risk of being hit by a late frost by advancing bloom 7 to 10 days.

One of the most common symptoms of late-spring frost damage on leaves is a distinctive 'wavy' pattern of light and dark green areas (see picture on page 2). The light-green or necrotic areas are the result of mesophyll cell collapse as a result of freeze damage. This damage frequently occurs when the leaves are still bound within or just existing the vegetative bud. Freeze damage may also destroy the germ cells of the reproductive (i.e. flowering) buds, which may result in reduced yield or no yield, depending upon the temperature. In a frozen orchard, the result on the rachis will be tiny dark nutlets that don't grow larger than BB size and eventually fall from the tree. These nuts will act similarly to nutlets that the tree sheds early in the season during the course of crop-load adjustment in more normal years. Generally, if the orchard exhibits the "frozen leaf" symptom, but nuts continue to expand and grow on the rachis, the growing nuts will fill and produce a kernel and marketable nut.

So how cold will it have to be to cause damage to the flower bud in the spring? The following text in italics is an abstract from a Turkish paper by S. Arpaci, H.S. Atli, H. Tekin, and M. Burak in an article entitled, Studies on spring frost resistance of some pistachio (*Pistacia vera*) cultivars:

> **"This study was carried out between 1999 and 2001, in order to determine spring frost resistance of Siirt, Ohadi, Uzun and Uygur pistachio (*Pistacia vera*) cultivars. In the flowering time, the fruit buds were exposed to artificial freezing tests for 1, 3 and 5 hours at -1ºC (30.2ºF.), -3ºC (26.6ºF.). The plant materials (cuttings) were put into refrigerator for 24 hours prior to exposure to freezing tests. The freezing tests were done in a temperature controlled freezer unit. After the exposures to different freezing temperatures, the plant samples were taken out from the unit and put in a refrigerator for 1-2 hours then they were put in the jars with full with water at ambient air temperature for 24 hours. Then, the buds were cut along the longitude by a sharp blade, and those that showed brown-black colors were determined as dead (injured) buds. In the flowering stage, -3ºC for 2 hours caused more than 85% injury in all cultivars, -1ºC for 2 hours caused more than 60% injury, and in the same regime 1 hour application resulted in less than 40% mortality rate. In small fruit stage, -2ºC for 2 hours caused a mortality rate more than 66%, whereas 1 hour application resulted in 35% injuries in Uzun cultivar, 25% in Siirt, 41% in Ohadi and 45% in Uygur cultivars, respectively."**

Even though this study did not include 'Kerman' the cultivars they used were all *P. vera* and it is not likely that Kerman's performance would be much different. The important thing to note is that the temperature does not have to be very cold during bloom time to do some significant damage to the developing crop.

Freeze-damaged pistachio leaf

Update on Gill's Mealybug Management in Pistachios

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Key contents:

1) Gill's mealybug has been reported in Kern County
2) Treatment timing is approaching but likely delayed this year
3) New insecticide options available

DISTRIBUTION

Gill's mealybug is a relatively new pest of pistachios in California. It was first found in California in the late 1990s near the town of Tulare. Currently it is most commonly found in pistachio orchards in Tulare County, but is also present in isolated orchards nearly all counties where pistachios are grown in California. In the spring of 2011, Gill's mealybug was found for the first time in Kern County in an orchard between McFarland and the Famoso Raceway.

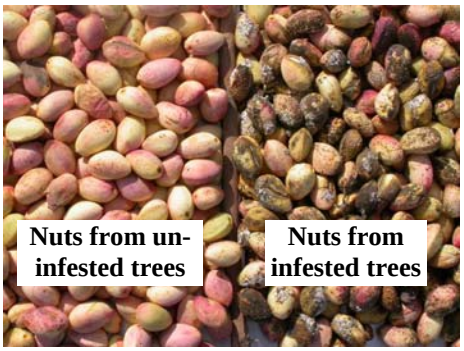
DESCRIPTION OF THE PEST

Adult female Gill's mealybugs are 2-5 mm in length, and are pinkish-grey in color. They are often covered with a white mealy wax and appear to have 2 stripes (darker areas) on their backs. Larger nymphs and mature females also produce a network of crystalline filaments (5-10mm) that protrude from the back of the insect. Adult mealybugs give live birth to crawlers, which commonly feed near their mother before venturing off to find their own feeding sites.

SEASONAL BIOLOGY

Gill's mealybug overwinter as crawlers in cracks and crevices of the trunk or below ground. In the spring they migrate to the new growth tips at the same time that buds begin to swell. By May these overwintering mealybugs become adult females that are primarily found on the rachis. In most years around the last week of May or first week of June they produce large numbers of crawlers that move to the hulls. This is the typical timing for insecticide treatments. If left untreated, these crawlers will develop into adults that produce the next generation of crawlers around mid- to late-July. These July crawlers mature and produce offspring around the time of harvest. The September crawlers overwinter and begin the cycle the following year.

DAMAGE



Mealybugs have a great affinity for feeding within the pistachio cluster where they intercept carbohydrates and other nutrients intended for nut development. This causes a decrease in nut quality due to increased shell staining and possibly smaller kernel size. Harvestability can also be affected when severe hull damage causes nuts to dry up and shrivel on the tree. Mealybug feeding also results in the production of large amounts of honeydew that acts as a substrate for black sooty mold. Thick layers of sooty mold on leaf surfaces can reduce photosynthesis.

MANAGEMENT

Chemical Control and Timing of Insecticides

Due to the frequency of applications of broad-spectrum insecticides for true bugs in pistachios, biological control organisms (that otherwise would be very effective) are not able to control Gill's mealybug. This has caused insecticides to be the primary means of control. The most effective product against Gill's mealybug is Centaur (buprofezin). This product is a growth regulator that is highly effective against crawlers. When used, applications should be made around the first week of June when crawlers are present. Due to the relatively cool spring in 2011 this timing may be moved back to mid-June. A second option is Assail (acetamiprid). This neonicotinoid can be effective in the June timing, but is probably the best option if the June timing is missed and an application is needed in mid-July during the second generation. The problem over the past few years is that Assail residues on fruit exceeded those allowed by certain export markets. PCAs and growers should follow up on this issue personally before using Assail, but I have been told that this issue is now resolved.

There are two newer options for chemical control. The first is Admire Pro and generic 2F formulations of imidacloprid. These products are applied via chemigation. While research has not fully documented, the best timing of Admire, data from similar crops suggests that applications in May would provide the best results in pistachios. The other new product to consider is Movento (very close to full registration at the time of writing this article). Movento is a foliar product that becomes systemic in the tree. It provides very little knock-down, but is highly effective within a few weeks once mealybugs ingest the active ingredient as they feed in the phloem. PCAs wanting to use this product should consult with their product representative regarding the status of the label as well as status of MRLs for exported fruit.

Monitoring and Treatment Decisions
Treatment decisions should be made in May by determining the number of mealybugs per cluster and their life stage. Though no concrete treatment thresholds have been established, one three-year research project showed that an average of 1 mealybug per cluster in May is sufficient to cause a 15% reduction in the value of the crop at harvest. Guidelines based on that work would suggest that mealybug populations of one mealybug per 10 to 15 clusters is treatable.

MORE INFORMATION
Additional information on Gill's mealybug can be found within the UC IPM Pest Management Guidelines for Pistachio (http://www.ipm.ucdavis.edu/PMG/selectnewpest.pistachios.html) and in ANR Publication 8207 *Ferrisia gilli*: A New Mealybug Pest of Pistachios and Other Deciduous Crops (http://anrcatalog.ucdavis.edu/InOrder/Shop/ItemDetails.asp?ItemNo=8207).

Disclaimer: *Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.*

Kalehghouchi, Aria and Kerman Cultivar Comparisons: Yield and Nut Quality Characteristics

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The Orandi family graciously donated budwood from their private selections from the 'Kalehghouchi' and 'Aria' cultivars for the establishment of a cultivar evaluation trial in 1998. From this budwood, two replicated and randomized cultivar-evaluation trials were established in Kern County on the property of cooperating growers. One trial was located on the east side of the San Joaquin Valley (SJV) and another on the west side to compare these selections of 'Kalehghouchi' and 'Aria' against 'Kerman' for yield and nut quality characteristics. The trees in both trials were grafted onto *P. integerrima* rootstock. The trial on the east side was located approximately 10 miles east of the city of Delano near the intersection of Highway 65 and Garces Highway and consisted of four replications of the three varieties with five trees of each variety in each replication. The trial on the west side was located northwest of the town of Lost Hills near the intersection of the California Aqueduct and Twisselman Road. These three varieties were replicated four times with 25 trees of each variety in each replication. Early flowering males were grafted into the orchard, since both 'Aria' and 'Kalehghouchi' flower earlier than 'Kerman'. The 'Randy' male pollination period overlaps the 'Kalehghouchi' bloom period well, although many growers of 'Kalehghouchi' have been using what is being called the "Kalehghouchi" male.

Both orchards are irrigated with low-volume systems (east side by fanjet, west side by drip). The replicates were randomized within the experimental area which was surrounded by a larger block of Kerman pistachio. Early harvests were conducted by using poles to knock nuts from the trees onto tarps and, in later years, trees were harvested with a commercial shaker and catching frame. At harvest green-weight yields were measured and 20-lb samples were collected from each replicate and evaluated at Paramount Farming Company and Primex Farms harvest processing facilities by individuals trained and certified to grade nuts using U.S.D.A official standards.

Results and Discussion.

The trees were planted and budded late and grew slowly as a result of the excessive rains of the El Niño year of 1998. In the west-side trial, trees began bearing nuts in 2002 (5th leaf) but in 2003 did not produce a harvestable yield.

Data collections from the cultivar 'Aria' were discontinued in 2007. While Aria possessed the useful characteristic of an earlier harvest date than 'Kerman' or 'Kalehghouchi' (see Table 1), evaluations to that

date also demonstrated that Aria nuts tended to have weaker shell-hinge strength than 'Kerman' or 'Kalehghouchi' and its habit of bearing nuts at the end of branches in the outer canopy predisposed them to severe sunburn, especially in the west-side trial were the trees were pruned to a shorter stature.

'Kalehghouchi' grew vigorously and as a young tree produces many low-hanging branches, which had to be pruned to allow access for the mechanical shaker. While not occurring in our trials, other blocks of 'Kalehghouchi' have produced more yield than Kerman in 5th leaf (four-year old trees) probably as a result of the more vigorous growth of this cultivar which produces a larger tree earlier. To keep the 'Kalehghouchi' tree in its space, this tree will require more pruning than 'Kerman,' especially when the tree is immature.

Aria had an attractive, larger and more almond-shaped nut than Kerman, while the nut shape of Kalehghouchi is blockier, more similar to the head of ram, from which it gets its name in the Persian language Farsi. 'Kalehghouchi' has the largest and heaviest nut (see Table 1). Compared to 'Kerman', 'Kalehghouchi' had a high edible, split inshell nut percentage, a lower blank nut percentage and nearly as strong shell-hinge strength as measured by the percentage of loose kernels and shells (see Table 1). 'Aria' typically bloomed first, followed by 'Kalehghouchi' and then 'Kerman'. In these trials, 'Aria' typically reached full bloom 2 to 5 days before 'Kalehghouchi', and 'Kalehghouchi' 5 to 8 days before 'Kerman' Both 'Kalehghouchi' and 'Kerman' were harvested about the same time. 'Aria' was ready for harvest first (see Table 1), especially on the west side of the SJV (note that harvest and other data for 'Aria' are only available from 2002 – 2007).

Table 1. Cumulative yield and average nut quality characteristics of Aria[1], Kalehghouchi[1] and Kerman[1] pistachio at two trial locations in Kern County, California, 2002 – 2010. The trials were grafted in 1998.

Characteristic	West side San Joaquin Valley[2]			East side San Joaquin Valley[2]		
	Aria	Kalehghouchi	Kerman	Aria	Kalehghouchi	Kerman
Cumulative edible yield, lbs/acre	10129	18975 b[3]	22167 a	3892	15870 a	17537 a
Edible, inshell split nuts, %	77.2 b	83.8 a	73.6 b	54.4 c	84.3 a	76.8 b
Shelling stock nut, %	11.4 a	5.7 b	3.0 c	16.0 a	4.3 b	2.7 b
Closed shell nut, %	9.6 b	9.8 b	21.5 b	20.4 a	10.8 b	19.6 a
Blank nut, %[4]	5.9 b	2.8 c	8.7 a	4.1 a	2.1 c	3.4 b
Loose kernel and shell, %[5]	5.2 a	1.2 b	0.4 b	9.6 a	1.5 b	0.6 c
Adhering hull nut, %[5]	3.5 a	1.2 b	0.7 c	not calculated		
Insect damaged nut, %	0.4 b	1.0 a	0.7 a	0.5 a	0.3 a	0.3 a
Weight of one nut, g	1.35 b	1.44 a	1.26 c	1.39 b	1.42 a	1.33 c
Harvest readiness date	Sept. 1	Sept 15	Sept. 17	Sept. 20	Sept. 25	Sept. 23

[1] Data for Aria is from 2002 – 2007 and Kalehghouchi and Kerman from 2002 – 2010.
[2] West side plot located near the intersection of the CA aqueduct and Twisselman Rd, East side plot located near the intersection of Highway 65 and Highway 155.
[3] Values in the same cell followed by different letters are significantly different by Fisher's protected LSD test at $P \leq 0.05$. Aria not included in the significance tests for cumulative edible yield since Aria harvests ceased in 2007.
[4] Blank nut percentage is part of the 'closed shell" category.
[5] These characteristics are part of the 'shelling stock' category.

'Kerman' yielded better than 'Kalehghouchi' over the course of the experiment on the west-side of the SJV, but not significantly so at the east-side site. All three cultivars demonstrated alternate bearing at both sites (See Figures 1 and 2). When 'Kalehghouchi' had an off-bearing year, many trees in the orchard did not have a single flower at bloom time.

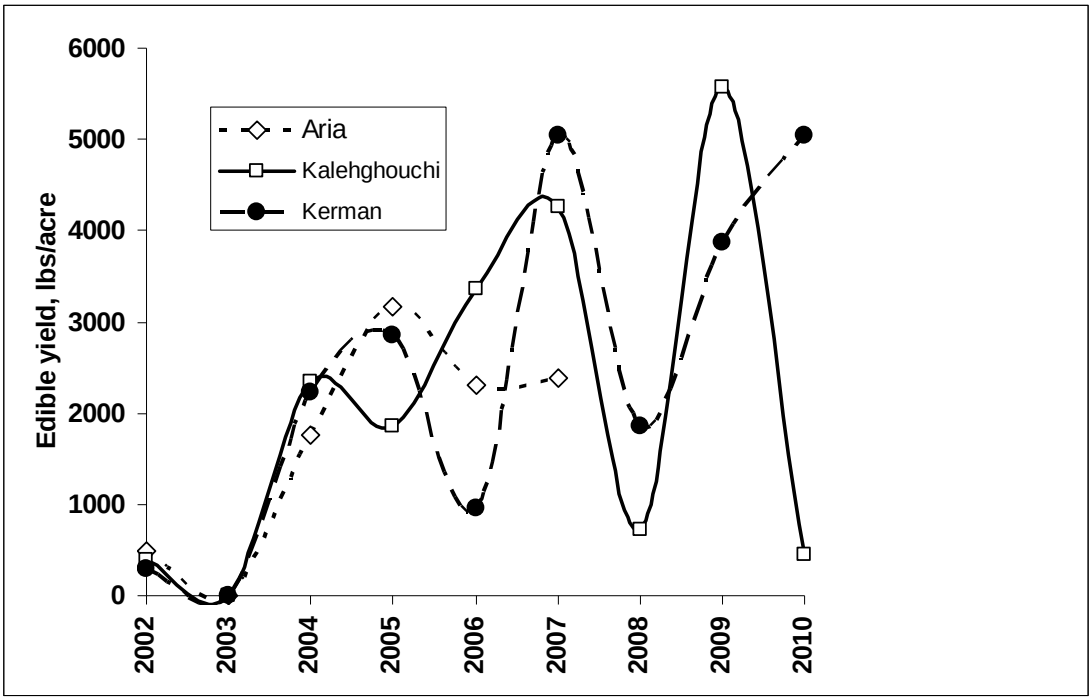

Figure 1. Edible yield by year at the west-side SJV cultivar evaluation trial. Aria, Kalehghouchi, and Kerman trees were grafted in 1998. Aria harvests ceased in 2007.

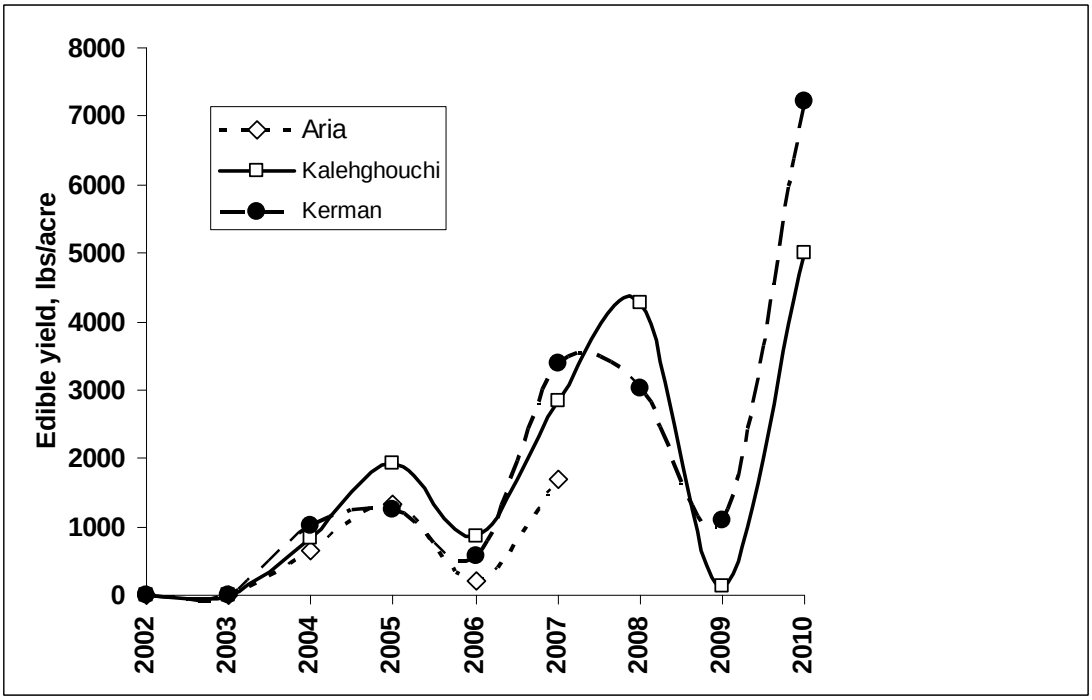

Figure 2. Edible yield by year at the east-side SJV cultivar evaluation trial. Aria, Kalehghouchi, and Kerman trees were grafted in 1998. Aria harvests ceased in 2007.

The east-side trail was located in the rolling foothills of the citrus belt, where winter chilling-hour accumulation is frequently disturbed by clear, sunny days and temperatures above 60ºF. The cultivars produced less edible yield at the east-side SJV site compared to the west-side site for most of the early bearing years. (see Figure 3 for 'Kerman'). Harvestable yields were not produced until the 7th leaf. The differences in yield for a given year are noteworthy, and this lower yield of young pistachio trees in this part of the citrus belt has been observed in many other blocks in this citrus-growing area of Kern County. While soils and other factors may be to blame, the frequent occurrence of young blocks of pistachios not producing much yield until the 8th or 9th leaf suggests that the lack of chilling in the high-elevation citrus belt may be partially responsible. The trees in this east-side trial exhibited symptoms of lack of chilling such as uneven bloom on the south versus the north side of the tree. In some of the early years, the trees in the bottom of swales produced better yield than the trees on the hilltops. During the winter in this area, the sun frequently breaks through the winter haze/fog. Solar heating of the pistachio buds can be significant and reduce chill accumulation, and perhaps, even reverse winter chill accumulation. We saw similar delayed yield production in young blocks, over a wider area of Kern County in some of the low-chill years of the 1990s. Once the trees reach maturity, chill accumulation appears to be less important, and excellent yields are achievable in this area (see Figures 2 and 3).

There have been reports that Kalehghouchi nuts are more difficult to shake from the tree as it ages. Nut removal was not a problem in these trials, however the trees as of 2010, were only 12-years old (i.e.13th leaf).

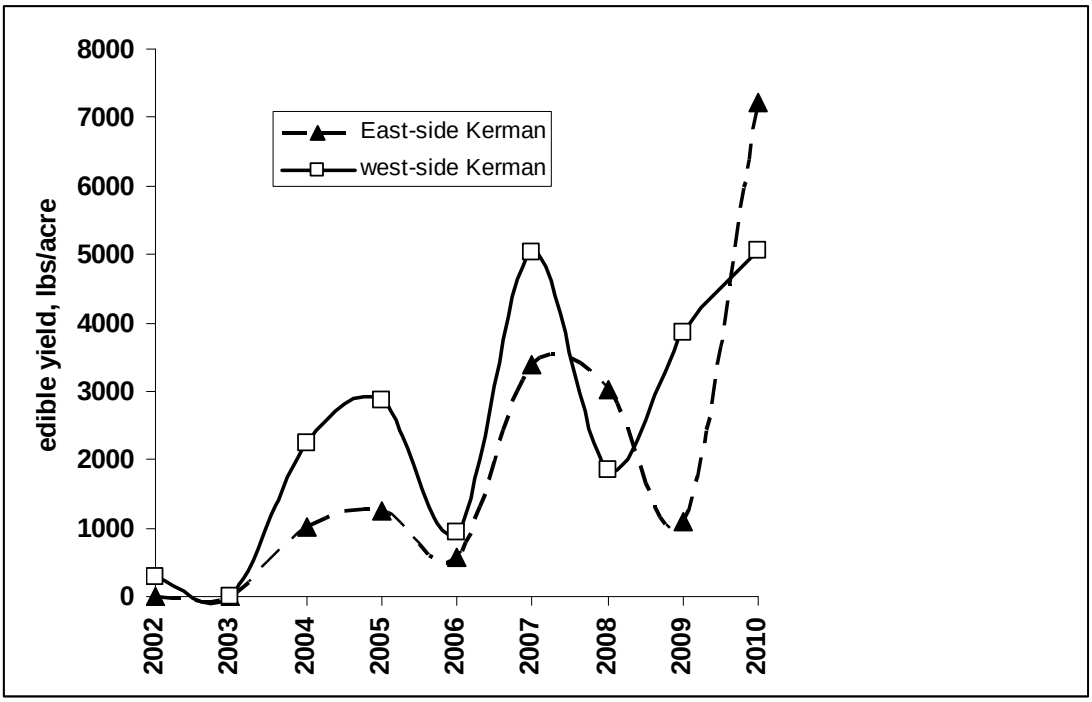

Figure 3. Comparing edible yield by year between 'Kerman' at the east-side and west-side SJV cultivar evaluation trials. Both trials were grafted in 1998.

Conclusions

'Kalehghouchi' appears to be useful cultivar for the California pistachio industry, especially for those interested in producing a larger-sized nut with good shell-hinge strength. The observation that it blooms earlier than 'Kerman' may put it at greater risk from late-spring frosts than 'Kerman'. Kalehghouchi will also likely require more pruning than Kerman, to maintain access to the tree by harvesting equipment and to keep the tree within its allotted space in the orchard.

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