Pistachio Cultivars

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Pistachio (P. vera) probably originated in central and/or eastern Asia

Distribution of 3 Pistacia species in Central Asia and Asia

Cultivated pistachio cultivars (varieties) are in the species P. vera

Slides courtesy of Dan Parfitt
Pinnately compound leaves of pistachio species

Slide Courtesy of Dan Parfitt
Seed from 4 pistachio species.
Commercial nut-producing varieties world wide are in the genus ‘Pistacia’ and the species ‘vera’.

Pistachio trees are dioecious, which means male and female flowers are born on different trees.
Probably 97% or more of the pistachio acreage in California is planted to the Pistacia vera female cultivar called ‘Kerman’ and a P. vera male called ‘Peters’.

(Note: there is no such thing as a Kerman male).
Short History of Kerman

- selected, in 1929, from seed imported from Rafsanjan, Iran
- named in 1952
- released for trial in 1957
- grown on 1700 acres in 1977
- grown on approximately 170,000 acres in California in 2008.
Kerman Traits in California (irrigated, fertilized)

**Yield**

- bears significant fruit in 6\textsuperscript{th} leaf (5-year old tree).
- alternate bearing (average yearly yield is 2200 - 3500 lbs/acre CPC yield per year over 2-year cycle)
Kerman Tree Characters in CA

- moderate vigor (trainable trees)
- trees have upright spreading growth habit
- begins bloom in late March or early April
- precocious (bears fruit early in life cycle)
- open nut clusters
- harvestability (nuts stay on tree until shaken)
- uniform nut maturity (nuts ripen uniformly)
- late nut maturity (September to mid-October)
- high chilling requirement
- growth rate of Kerman and P. integerrima rootstocks similar
Kerman Nut Quality Characters

- ‘round’ nut shape (dimensions similar)
- good hull strength demonstrating few early splits.
- clean, unstained shells
- firm, crisp, purple and yellowish-green kernel
- split-nut weight averages from 1.0 to 1.6 grams/nut annually
- good split percentage and strong shell-hinge strength
- high blank percentage some years
Kerman has a long (60 year) track record in California.
We know its strengths and weaknesses.
Peters Male

- found by A. B. Peters from Fresno, CA. (originally may have come from Armenia)
- good producer of durable pollen
- bloom period continues for three weeks
- initial spring bloom usually slightly ahead of Kerman. Bloom period coincides with Kerman very well most years.
Other males:

02-16  - from Azerbaijan, overlaps with early Kerman bloom
02-18  - from Azerbaijan, later than Peters and overlaps later Kerman bloom

‘EIL’, ‘Chico’, ‘Kaz’, ‘Randy’ – early males (some with P. integerrima heritage) – mostly too early for Kerman. Pollen viability, quantity and durability tested only for Randy in this list.

None of these are widely planted in California with Kerman
Other female varieties grown in California
(characteristics found in the literature or described to
me by growers)

Red Aleppo compared to Kerman:

• one of the first varieties planted in CA
• flowers earlier in the year
• equally alternate bearing
• earlier harvest
• more shell staining?
• lower percentage of clean, edible inshell split nuts
• smaller nut size, crisper kernel
• trees more difficult to train – hanging branches
Joley (released from California program in 1980) compared to Kerman:

- blooms earlier (one week)
- earlier harvest (one week)
- smaller, flatter and narrower nut
- similar percentage of clean, edible split nuts (fewer closed shell)
- tendency toward light stain (may be due to lack of huller availability early in season)
- comes into bearing earlier?
- similar tendency to alternate bear
Some other varieties from the Mediterranean or western Asia area that have been grown in California include:

Ibrahimim (Ebrahim Abadi), Ohadi, Safeed, Shasti, Wahedi, Bronte, Buenzle, Lassen, Minassian, Sfax and Trabonella.
Popular Cultivars in other countries:

Iran – Akbari, Ahmad Aghaii, and Kalehghouchi

Syria – Red Aleppo

Turkey – Uzun and Kirmizi

Sicily – Napoletana

Australia - Sirora

Other varieties grown in the Mediterranean and east-central Asia include but are not limited to:

Aegina, Ajamy, Alemi, Achoury, Avidon, Ayimi, Bayazi, Batoury, Bianca, Bianca Regina, Boundoky, Cappuccia, Cerasola, El Bataury, Ghermeza, Ghiandolara, Gialla, Insolia, Iraq, Larnaka, Latwhardy, Kastel, Marawhy, Mateur, Momtaz, Muntaz, Obiad, Ogah, Ouleimy, Pignatone, Pontikas, Rashti, Red Jalap, Shasti, Silvana, White Ouleimy
An Iranian variety called Damghan and a selection similar to Damghan from the USDA Clonal Germplasm Repository in Davis, were budded into a replicated, randomized trial with new selections from the U.C. breeding program, this year (2008) in the Buttonwillow area.

This variety has large nuts but is purported to have low yields. Time will tell.

Past experience suggests that varieties that do well in one country, even if environmental conditions appear to be the same, may not do well in another country.
Taste

Pistachio cultivars from some other countries are purported to have better taste than ‘Kerman’ grown in California (especially small-nutted varieties from Italy). Nut taste can be affected by:

- genetic differences in sugar, oils and other constituents of the nut
- by climate and cultural practices that influence nut size, for example.
- what a person is used to.

Few scientific tests have been made to determine taste preferences for pistachio.
Presenting ‘Golden Hills’ and ‘Lost Hills’ two new pistachio varieties from a U.C. Pistachio Breeding Program

The pistachio breeders -
Dr. Dan Parfitt and retired Farm Advisor Joe Maranto
The seedling test plot where selections were made. The seedling test plot was planted in 1990 and 1991, from seeds germinated in 1989 and 1990.
Golden Hills and Lost Hills were released by U.C. to the pistachio industry in July 2005.

These two varieties were chosen for release based on several performance characteristics in a test plot budded in 1997 on the west side of the San Joaquin Valley in Kern County.

The initial performance of ‘Golden Hills’ and ‘Lost Hills’ has been similarly acceptable in a second plot budded in 1999 located on the east side of the SJV in Madera County, and in its 6th leaf in two additional trials planted in Kern County in 2002.
In 2007, after 6 years of yield and nut quality evaluation on rootstock, the ‘Golden Hills’ variety appears to have excellent commercial potential.
Golden Hills

June, 2006
Lost Hills

Picture by Eric Mercure, 2004
Flowering of Golden Hills, Lost Hills and Kerman, 2005
Golden Hills, 2007

Kerman, 2007

Golden Hills, 2007
Randy early male

Variety released to industry in 2005

Winter, 2005

July, 2003

March 27, 2003

March 16, 2007

March 9, 2007
Randy versus Peters, 2005

Most advanced bloom, March 17

Average bloom, March 24
Randy early male

- first flowers appear 10 to 15 days before ‘Peters’
- provides good quantities of relatively durable and viable pollen.
- is more precocious than ‘Peters’ flowering one year before ‘Peters’.
- bloom period overlaps that of ‘Kalehghouchi.’
- Randy will provide adequate pollination for Golden Hills and Lost Hills. No other male is necessary.
Estimated date of full bloom for Kerman, Golden Hills, Peters and Randy in western Kern county (near Lost Hills) and near Madera in Madera county.

<table>
<thead>
<tr>
<th>Year</th>
<th>Kerman</th>
<th>Golden Hills</th>
<th>Peters (male)</th>
<th>Randy (male)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>April 5</td>
<td>March 31</td>
<td>April 4</td>
<td>March 29</td>
</tr>
<tr>
<td>2004</td>
<td>April 2</td>
<td>March 29</td>
<td>March 31</td>
<td>March 23</td>
</tr>
<tr>
<td>2005</td>
<td>April 1</td>
<td>March 26</td>
<td>April 1</td>
<td>March 25</td>
</tr>
<tr>
<td>2006 Kern</td>
<td>May 1</td>
<td>April 24</td>
<td>April 30</td>
<td>April 28</td>
</tr>
<tr>
<td>2006 Mad.</td>
<td>April 24</td>
<td>April 24</td>
<td>April 28</td>
<td>April 27</td>
</tr>
<tr>
<td>2007 Kern</td>
<td>April 1</td>
<td>March 26</td>
<td>April 1</td>
<td>March 25</td>
</tr>
<tr>
<td>2007 Mad.</td>
<td>April 3</td>
<td>March 29</td>
<td>April 3</td>
<td>March 26</td>
</tr>
</tbody>
</table>

Note: Experimental site was accidentally treated with oil which advanced bloom in 2003. Bloom timing of ‘Lost Hills’ very similar to Golden Hills.
Probably the most important characteristic of Golden Hills compared to Kerman is its earlier harvest maturity.

Industry dependence on Kerman means entire San Joaquin Valley crop is ready for harvest at about the same time, resulting in extreme peak demand for labor, harvest machines and hulling/processing facilities. This situation will continue to worsen (especially during the “on” bearing year) as more acres of Kerman are planted.

By planting earlier maturing varieties, the harvest season would be extended and harvest could be completed with fewer trained laborers, fewer mechanical harvesters, and less hulling/processing capacity.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Kern County</th>
<th>Madera County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>Sept. 12</td>
<td>Sept. 17</td>
</tr>
<tr>
<td>Golden Hills</td>
<td>Aug. 29</td>
<td>Sept. 1</td>
</tr>
<tr>
<td>Lost Hills</td>
<td>Aug. 30</td>
<td>Sept. 4</td>
</tr>
</tbody>
</table>
The early harvest of Golden Hills has two additional advantages;

Navel orangeworm nut infestation can increase geometrically with time. The average two week earlier harvest can greatly reduce the need for chemical control of this pest since Golden Hills’ nuts may miss the third NOW flight almost entirely.
Harvest readiness is easier to predict for Golden Hills. Since it matures in the heat of August and since most of the nuts split relatively early in the season, maturity progresses quickly and evenly.

Often Kerman is difficult to predict because it matures in September, when cooler day and night temperatures begin. Cooling temperatures, in combination with the high percentage of closed shell nuts, makes predicting harvest readiness imprecise.
Differences in Yield and Alternate bearing among varieties in western Kern County
Average annual yield and selected nut quality characters of Kerman, Lost Hills and Golden Hills on PG1 rootstock from 6th leaf (2002) through 11th leaf (2007) from the west side of the San Joaquin Valley (near Lost Hills in northwest Kern County)

<table>
<thead>
<tr>
<th>Variety</th>
<th>CPC assessed yield, lbs/acre</th>
<th>Grower-paid yield, lbs/acre</th>
<th>Edible split inshell, lbs/acre</th>
<th>Split nuts, %</th>
<th>Individual nut weight, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>3036 a</td>
<td>2712 a</td>
<td>2389 a</td>
<td>67.8 a</td>
<td>1.24 a</td>
</tr>
<tr>
<td>Golden Hills</td>
<td>3849 b</td>
<td>3654 b</td>
<td>3460 b</td>
<td>84.6 b</td>
<td>1.26 a</td>
</tr>
<tr>
<td>Lost Hills</td>
<td>2895 a</td>
<td>2763 a</td>
<td>2631 a</td>
<td>85.5 b</td>
<td>1.47 b</td>
</tr>
</tbody>
</table>

Percentages based on percent of hulled, total dry load.
Values under the same column heading followed by different letters are significantly different at $P \leq 0.05$ by Fisher’s protected LSD test.
The issue of the ‘Split’ in pistachio nuts.

How split should a pistachio nut be?
Average annual percentage of loose shells and meats and total insect damage of Kerman, Golden Hills and Lost Hills in western Kern County (2002-2007).

<table>
<thead>
<tr>
<th>Variety</th>
<th>Loose shells and meats, %</th>
<th>Total insect damage, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>0.6 a</td>
<td>1.84 b</td>
</tr>
<tr>
<td>Golden Hills</td>
<td>0.5 a</td>
<td>0.04 a</td>
</tr>
<tr>
<td>Lost Hills</td>
<td>3.4 b</td>
<td>0.17 a</td>
</tr>
</tbody>
</table>

Percentages based on percent of hulled, total dry load. Values under the same column heading followed by different letters are significantly different at $P \leq 0.05$ by Fisher’s protected LSD test.
Nut dimensions illustrated
Average nut dimensions (2002-2006) for Kerman, Golden Hills and Lost Hills nuts (shells) at the advanced selection trial near Lost Hills in western Kern County.

<table>
<thead>
<tr>
<th>variety</th>
<th>nut length, mm</th>
<th>nut width, mm</th>
<th>nut height, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>18.6 a</td>
<td>13.3 a</td>
<td>12.5 a</td>
</tr>
<tr>
<td>Golden Hills</td>
<td>19.5 a</td>
<td>13.5 a</td>
<td>13.1 b</td>
</tr>
<tr>
<td>Lost Hills</td>
<td>21.2 b</td>
<td>14.0 b</td>
<td>12.9 b</td>
</tr>
</tbody>
</table>

Nut length measured from 2004-06, nut height from 2005-06
PG1 vs UCB-1 rootstocks at Madera

No significant differences were found for yield, individual nut size or split nut percentage between PG1 and UCB-1 rootstocks when grafted to Kerman, Golden Hills or Lost Hills scions.
Average annual yield and nut quality characters of Kerman, Golden Hills and Lost Hills averaged over UCB-1 and PG1 rootstocks from 6\textsuperscript{th} leaf (2004) through 9\textsuperscript{th} leaf (2007) from the Madera site.

<table>
<thead>
<tr>
<th>Variety</th>
<th>CPC assessed yield, lbs/acre</th>
<th>Split nuts, %</th>
<th>Loose shells and meats, %</th>
<th>Total insect damage, %</th>
<th>Individual nut weight, g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>1438 a*</td>
<td>67.9 a</td>
<td>2.0 b</td>
<td>0.7 a</td>
<td>1.37 b</td>
</tr>
<tr>
<td>Golden Hills</td>
<td>1656 a</td>
<td>82.6 b</td>
<td>0.7 a</td>
<td>0.5 a</td>
<td>1.31 a</td>
</tr>
<tr>
<td>Lost Hills</td>
<td>1694 a</td>
<td>80.7 b</td>
<td>3.0 c</td>
<td>0.5 a</td>
<td>1.41 c</td>
</tr>
</tbody>
</table>

Percentages based on percent of hulled, total dry load.
* Values under the same column heading followed by different letters are significantly different at $P \leq 0.05$ by Fisher’s protected LSD test.
Bud trees at least 31 inches above ground.

Kerman on PG1

Kalehghouchi on PG1, 11th leaf

Golden Hills – 12th leaf on UCB1

Aria – 11th leaf on PG1
Don’t shake the bud union.

Graft trees at least 31 inches above ground level.
Differences in boron concentration in leaves of various pistachio varieties on the west side of Kern County
Short Summation of characteristics of Golden Hills compared to Kerman for Growers and Processors (from 6th through 11th leaf).

- Earlier harvest (two weeks on average)
- Similar, or greater, average annual CPC-assessed yield, edible split inshell yield, and grower paid weight.
- Similar nut size and shell-hinge strength
- Greater percentage of split nuts, less closed shell, and fewer blanks means less weight to haul to the huller, and less trash for the huller to dispose of.
- Has done well in limited taste tests.
- Greater ratio of scion to rootstock diameter.
- Earlier full bloom (by about 6 days on average). Randy male overlaps bloom well.
- May be more difficult to bud.

Evaluations are based only on trees that are, at most, 10-years old (11th leaf). Any initial plantings should be conservative in nature.
Short Summation of characteristics of Lost Hills compared to Kerman for Growers and Processors (from 6th through 11th leaf).

- Earlier harvest (two weeks on average)
- Similar, or greater, average annual CPC-assessed yield, edible split inshell yield, and grower paid weight.
- Greater nut size but weaker shell-hinge strength
- Greater percentage of split nuts, less closed shell, and fewer blanks means less weight to haul to the huller, and less trash for the huller to dispose of.
- So far, including harvest in 2008 (12th leaf), has not demonstrated alternate bearing.
- Greater ratio of scion to rootstock diameter.
- Earlier full bloom (by about 6 days on average). Randy male overlaps bloom well.

Evaluations are based only on trees that are, at most, 10-years old (11th leaf). Any initial plantings should be conservative in nature.
UCCE Iranian Variety Evaluation in California

Two sites: Each planted in 1998, randomized complete block exp. design, with 4 reps. Contain Kerman, Kalehghouchi, and Aria varieties

**Site 1** - Northwestern Kern County

- 25 trees per rep, PG1 rootstock, boric and calcareous soil

**Site 2** - Highway 65 near Tulare County line in Kern County (i.e. east side of San Joaquin Valley).

- 5 trees per replication, Kresha rootstock, clay loam soil in citrus belt.
Some blocks of Kalehghouchi and Aria in California are 20 years old or more.

However, to my knowledge, the first replicated trials comparing Kalehghouchi and Aria to Kerman were established in 1998 in Kern County.
ARIA

Early split nuts in Aria

Sun burned nuts

Big floppy leaves

Early bloom and leaf out
Loose kernels and shells from normal handling in sample bags after harvest.

Not good.
Kalehghouchi (Kale Goochi)

Kalehghouchi, 8th leaf
Kalehghouchi

Kalehghouchi – Many nuts borne inside the canopy close to trunk.
Vigorous vegetative growth results in low hanging branches which may need to be removed before harvest.

Kaleghouchi was made for topping, hedging, cross-hedging and probably skirting.

Frequent, light mechanical pruning appears to work for this variety.
<table>
<thead>
<tr>
<th>Year</th>
<th>Kerman (male)</th>
<th>Peters (male)</th>
<th>Kalehghouchi</th>
<th>Randy (male)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003*</td>
<td>April 4</td>
<td>April 2</td>
<td>March 31</td>
<td>March 29</td>
</tr>
<tr>
<td>2004</td>
<td>April 1</td>
<td>April 1</td>
<td>March 24</td>
<td>March 23</td>
</tr>
<tr>
<td>2005</td>
<td>April 2</td>
<td>April 1</td>
<td>March 24</td>
<td>March 24</td>
</tr>
<tr>
<td>2006</td>
<td>May 1</td>
<td>May 1</td>
<td>April 28</td>
<td>April 28</td>
</tr>
<tr>
<td>2007</td>
<td>April 1</td>
<td>April 1</td>
<td>March 23</td>
<td>March 26</td>
</tr>
</tbody>
</table>

*Note: Experimental site was treated with oil to advance bloom in 2003.*
Most advanced flower buds for varieties or selections shown on March 17, 2005.
Average harvest date for Kerman and Kalehghouchi on the west side and east side of the San Joaquin Valley in Kern County, 2002-2007.

<table>
<thead>
<tr>
<th>Variety</th>
<th>West side SJV</th>
<th>East Side SJV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>Sept. 17</td>
<td>Sept. 23</td>
</tr>
<tr>
<td>Kalehghouchi</td>
<td>Sept. 14</td>
<td>Sept. 23</td>
</tr>
</tbody>
</table>

No harvests occurred on the west side in 2003 or on the east side in 2002 and 2003 due to lack of harvestable nuts.
Kalehghouchi nuts have shaken very well from the trees in both of our test plots. However, there are reports as the tree gets older, nuts are more difficult to remove.
CPC assessed yield by year for Kerman and Kalehghouchi pistachio varieties in the San Joaquin Valley (SJV) of California, 2002-2007.
Cumulative CPC-assessed yield and grower-paid yield of Kerman and Kalehghouchi from 5th leaf (2002) to 10th leaf (2007) east and west side of the San Joaquin Valley in Kern County

<table>
<thead>
<tr>
<th>Variety</th>
<th>CPC assessed yield, lbs/acre</th>
<th>Grower paid yield, lbs/acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>West SJV</td>
<td>East SJV</td>
</tr>
<tr>
<td>Kerman</td>
<td>12,348 a*</td>
<td>6,599 a</td>
</tr>
<tr>
<td>Kalehghouchi</td>
<td>12,696 a</td>
<td>6,751 a</td>
</tr>
</tbody>
</table>

Grower-paid yield is also known as total edible weight.
Crop was not harvested in 2003 on the west side and in 2002 and 2003 on the east side due to poor yields.

* Values followed by different letters located under the same underlined column heading are significantly different at P ≤ 0.05 by Fisher’s protected LSD test.
Comparison of selected nut quality characteristics between Kerman and Kalehghouchi from 5th leaf (2002) to 10\textsuperscript{th} leaf (2007) west and east sides of the San Joaquin Valley in Kern County.

<table>
<thead>
<tr>
<th>Variety</th>
<th>edible, split inshell, %</th>
<th>Split-nut shelling stock, %</th>
<th>closed shell, %</th>
<th>Loose shells and meats, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>West: 74 a 83 b</td>
<td>West: 3.1 a East: 6.0 b</td>
<td>West: 20.0 b</td>
<td>West: 0.5 a East: 0.6 a</td>
</tr>
<tr>
<td>Kalehghouchi</td>
<td>East: 76 a 86 b</td>
<td>East: 2.8 a</td>
<td>East: 22.3 b</td>
<td>East: 1.5 b 1.8 b</td>
</tr>
</tbody>
</table>

Percentages based on percent of hulled, total dry load. Crop was not harvested in 2003 on the west side and in 2002 and 2003 on the east side due to poor yields. Values under the same column heading followed by different letters are significantly different at $P \leq 0.05$ by Fisher’s protected LSD test.

<table>
<thead>
<tr>
<th>variety</th>
<th>weight of one nut, grams</th>
<th>nut length, mm</th>
<th>nut width, mm</th>
<th>nut height, mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerman</td>
<td>1.25 a</td>
<td>19.0 a</td>
<td>13.3 a</td>
<td>12.6 a</td>
</tr>
<tr>
<td>Kalehghouchi</td>
<td>1.45 b</td>
<td>19.8 b</td>
<td>13.6 b</td>
<td>13.7 b</td>
</tr>
</tbody>
</table>

Nut weight, length and width measured 2004-06, nut height 2005-06.

Average nut weights at the east side SJV trial from 2004-2007 were not statistically different with Kerman at 1.38 grams and Kalehghouchi at 1.42 grams per nut.
Short Summation of characteristics of Kalehghouchi compared to Kerman for Growers and Processors (so far).

- Earlier full bloom (about 1 week on average)
- Harvest earlier or slightly later (2-3 days earlier on average on west side of SJV).
- Larger nut size.
- Higher split percentage and slightly less shell-hinge strength.
- Similar cumulative CPC yields and grower paid weight.
- More difficult to train and prune trees.
- Ability to shake as trees get older?
- Greater ratio of scion to rootstock diameter.
- Randy male overlaps Kalehghouchi bloom very well.

Evaluations are based only on trees that are, at most, 9 years old (10th leaf). Any initial plantings should be conservative in nature.
Choose a variety in California with caution!

Unlike grapes,
- grafting an unsuccessful variety back to Kerman is a slow process