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UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

Pistachio Cultivars in California

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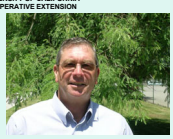

Many thanks to the large number of University of California researchers who are currently or have been involved in this project in a number of capacities. A special thanks to all of the many grower and processor cooperators (and the California Pistachio Commission and the Pistachio Research Board) without whose help over the past two decades none of this research would have been possible. Many thanks.

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Partial List of Female and Male Pistachio Cultivars Grown in California with very approximate acreage (bearing and non-bearing) in 2019.

Cultivar	Sex	Approx. Acreage
Kerman	Female	320,000
Golden Hills	Female	70,000
Lost Hills	Female	< 8,000
Kalehghouchi	Female	< 2000
Pete 1	Female	?
Red Aleppo	Female	<1000
Joley	Female	<1000
Aria	Female	<1000
Gumdrop	Female	<100
Peters	Male*	320,000
Randy	Male	75,000
Pete 1 male	Male	?

* Male trees compose approximately 4 to 11 % of the trees on an acre of orchard. These figures represent acres that have at least 1 male tree.

This presentation focuses on cultivars released by the University of California (Golden Hills, Lost Hills and Gumdrop) in comparison to Kerman.

However, other cultivars exist in commercial orchards in California. I have varying amounts of data on the following:

Large nuts of Pete 1

- Red Aleppo
- Sirora
- Joley
- Kalehghouchi
- Aria
- Pete 1

High yielding experimental selection KB25-78

Aria is a more almond-shaped nut

Kalehghouchi in 2007

Statistically in 2005, Aria was the longest, Kerman the widest, and Kalehghouchi the tallest nut.

Cautionary Note on 'Red Aleppo' and relatives

In the "Jasmine Cultivar and Breeding Selection Trial" located in an area with high winter heating (also moderate winter chilling) the following cultivars are being evaluated (among many others):

1. 'Red Aleppo'
2. a patented (expired) sport of Red Aleppo called 'Ruehle',
3. and a variety that is purported to be 'Sirora' and, if so, has 'Red Aleppo' parentage.

This trial was planted in 2010, and as late as 2019 none of these three cultivars listed above have produced any yield. Kerman, Golden Hills and Lost Hills began producing harvestable yield in 2016, and as of 2019, Golden Hills and Lost Hills had over 10,000 lbs/acre of payable yield from 2016-2019.

Information in the presentation has been amalgamated from a number of small randomized and replicated U.C. trials conducted within larger blocks of Kerman pistachio, largely in Kern County with one trial in Madera County.

The four cultivars (short for cultivated varieties) compared here, have not all been in all trials. Kerman, as the industry standard, has been in all the trials acting as a control, or basis of comparison. The other three cultivars being compared, Golden Hills, Lost Hills, and Gumdrop, have been in many, some or only two of the trials. Thus, evaluations are based on limited information.

The comparisons among these 4 varieties are the best "estimate" of the presenter based on the 18 years, or so, of evaluating yield of pistachio cultivars.

Your results may vary.

Evaluations presented here from all of our trials are applicable to trees of equal age, growing in the same location and at the same tree spacing.

Younger trees tend to be ready for harvest later than mature trees of the same cultivar (as much as two weeks).

A given cultivar in one area of the Central Valley compared to the same cultivar of the same age in another area of the Central Valley can differ in harvest readiness by as much as a month.

Getting ready to harvest experimental trees at sunrise.

The objective of this presentation is not to determine which is the best pistachio variety for California but to present comparative information on the relative strengths and weaknesses of 4 cultivars currently grown in the SJV.

This information should assist growers in determining which, if any of these four might be most suitable for their individual farming and marketing conditions.

There is no such thing as a perfect cultivar.

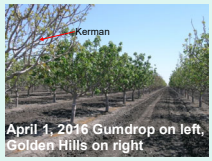
Cultivar Performance Comparisons

Historical Production Record in California (1 is the longest)	
Kerman (1960s)	1
Golden Hills (2002)	2
Gumdrop (2012)	3
Lost Hills (2002)	2

Commercially and until very recently, the California industry has been using Kerman almost exclusively since the 1960s, Golden Hills and Lost Hills since 2005, and Gumdrop was just released in 2016. We know what Kerman will do over 60 years, less so for the others. The more you know about a cultivar, the less the risk of unknowns.

Order of full bloom
(1 is earliest, 3 is latest)

Kerman	3
Golden Hills	2
Gumdrop	1
Lost Hills	2



April 1, 2016 Gumdrop on left, Golden Hills on right


Gumdrop after bloom

FULL BLOOM DATES

Average full bloom date for the four cultivars in a maximum of 6 separate trials for each cultivar in the southern SJV beginning as early as 2002 until the present (2019) were as follows:

Gumdrop – March 28
Golden Hills and Lost Hills – April 7
Kerman – April 12

At a given location, and for similar aged trees, Gumdrop will be at full bloom about 11 days before Kerman.

CULTIVAR BLOOM SYNCHRONY in the San Joaquin Valley (SJV)

Below is a list of female cultivars with the names of suggested male pollinizers under various climate-change scenarios for the next 40 years (the life of the orchard) in the SJV.

Predicted adequacy of winter rest period	Female cultivar	Early male	Standard male	Late male
Low (such as in 2014 and 2015)	Gumdrop	Zarand*	Tejon	
	Golden Hills Lost Hills	Tejon	Randy	
	Kerman	Randy	Famoso	
Moderate (our 'normal' situation)	Gumdrop	Zarand	Tejon	
	Golden Hills Lost Hills		Randy	
	Kerman	Famoso	Peters	
High (occasionally occurs in SJV)	Gumdrop		Tejon	
	Golden Hills Lost Hills		Randy	Famoso
	Kerman		Peters	O2-18*

* These males are not UC-released cultivars.

Upright scaffold and branch growth (1 is most upright)	
Kerman	3
Golden Hills	1
Gumdrop	1-2
Lost Hills	2

Upright branch growth is a useful trait in that it reduces sagging branches in high yield years, reduces pruning requirements and allows for closer tree spacing.

Smooth Graft Union Scion and rootstock grow at same rate (1 is smoothest)	
Kerman	1
Golden Hills	3
Gumdrop	4
Lost Hills	2

Note: This evaluation is based on rootstock that is all *P. integerrima* or hybrids between *P. atlantica* and *P. integerrima*. Graft unions of all cultivars tend to be smoother on P. atlantica x P. integerrima hybrids than on pure P. integerrima rootstocks.

Tree Vigor (1 is highest vigor)	
Kerman	1
Golden Hills	3
Gumdrop	3
Lost Hills	2

Pruning/Training Requirement (1 is least)	
Kerman	3
Golden Hills	1
Gumdrop	1
Lost Hills	2

Uniformity of Nut Maturation Across the Tree (1 is most uniform)	
Kerman	**2**
Golden Hills	**1**
Gumdrop	**3**
Lost Hills	**3**

Order of Need for Two Equal Harvest Shakes (1 is least, 3 is most)	
Kerman	1-2
Golden Hills	1
Gumdrop	3
Lost Hills	1-2

Order of harvest timing (based on a single shake harvest) (1 is earliest, 3 is latest)	
Kerman	3
Golden Hills	2
Gumdrop	1
Lost Hills	2-3

Approximate harvest readiness date for the four pistachio cultivars at 6 trial locations in the SJV, from 2002 to 2019 are as follows:

Kerman	September 15
Lost Hills	September 4
Golden Hills	September 1
Gumdrop	August 20

Kerman, at a given location for similar-aged trees, will be through with harvest about 24 days after Gumdrop.

Payable early-yield from 6th through 9th leaf (1 is highest)	
Kerman	2
Golden Hills	1
Gumdrop	1
Lost Hills	1

Payable Yield from Mature Trees (1 is highest)	
Kerman	1
Golden Hills	1
Gumdrop	?
Lost Hills	1

No consistent differences among Kerman, Golden Hills and Lost Hills.

Individual Nut Size and weight (1 is largest)	
Kerman	2
Golden Hills	2
Gumdrop	2
Lost Hills	1

Inshell split-nut percentage (1 is highest)	
Kerman	2
Golden Hills	1
Gumdrop	1-2
Lost Hills	1

Shell Hinge Strength (1 is greatest)	
Kerman	1
Golden Hills	1
Gumdrop	2 - 3
Lost Hills	3

Weaker shell hinge strength means a higher percentage of kernels are lost in hulling but the nuts that survive processing are easier for consumers to open. Lost Hills may be good choice where full ET cannot be met.
Lost Hills, across trials, has had about 3% 'lost shells and kernels'; Kerman/Golden Hills less than 0.5%

Cleanest (whitest) Shell Exteriors (1 is cleanest)	
Kerman	1
Golden Hills	2
Gumdrop	3
Lost Hills	3

Harvested Blank Nut Percentage (1 is lowest)	
Kerman	3
Golden Hills	1
Gumdrop	2
Lost Hills	1

Degree of Alternate Bearing to 12th leaf (1 is least)	
Kerman	2
Golden Hills	2
Gumdrop	3
Lost Hills	1

Botryosphaeria Panicle and Shoot Blight (1 is most resistant)	
Kerman	1
Golden Hills	2
Gumdrop	no data
Lost Hills	1

Note: This information comes from the following reports/researchers:

American Pistachio Industry Annual Reports, Crop Years 2012-2013, 2013-2014. Research by Dr. Themis Michailides, et. al.

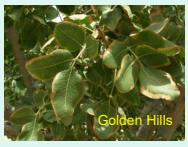
Information in these reports comes from average disease resistance ratings. Frequently, differences were not statistically significant.

Alternaria Late Blight (1 is most resistant)	
Kerman	1
Golden Hills	2
Gumdrop	no data
Lost Hills	1

Note: This information comes from the following reports/researchers:

* American Pistachio Industry Annual Reports, Crop Years 2012-2013, 2013-2014. Research by Dr. Themis Michailides, et. al. Information in these reports comes from average disease resistance ratings. Frequently, differences were not statistically significant.
* Personal observations (C. Kallsen) in Madera and elsewhere suggest Golden Hills is more susceptible to Alternaria than the other listed cultivars.

Exclusion of Boron in Leaf Tissue (1 is less boron in leaf tissue, less chance of early defoliation)	
Kerman	1
Golden Hills	2
Gumdrop	no data
Lost Hills	1



If salts, especially boron are high in the irrigation water do not plant Golden Hills.

No difference in sodium or chloride leaf exclusion among cultivars.

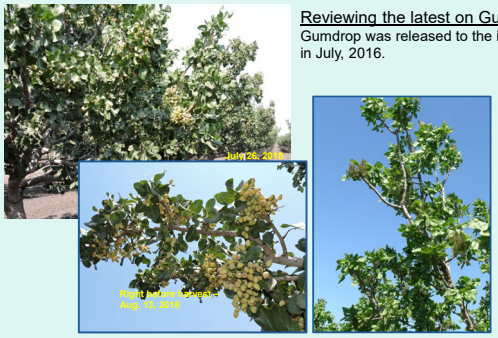
Low-Chill Symptoms on Tree (1 is fewest)	
Kerman	3
Golden Hills	2
Gumdrop	1
Lost Hills	2

Low chill (poor winter rest) symptoms include the following: delayed bloom, extended bloom (differences between north and south side of trees), flagging of shoots, early nutlet drop and nut blanking/poor yield. Juvenile trees tend to remain juvenile in low-chill years, delaying the first year of harvest.

More detailed results from the U.C. breeding evaluation trials from 2002 through 2018 can be found in the following publication:

Kallsen, C.E., D.E. Parfitt and J. Maranto. 2020. UC pistachios show improved nut quality and are ready for harvest earlier than 'Kerman'. Calif. Ag. 74(2)86-93.

http://calag.ucanr.edu/archive/?article=ca.2020a0011



Reviewing the latest on Gumdrop
Gumdrop was released to the industry in July, 2016.

1. Currently, 'Gumdrop is not recommended for growers with little experience in growing pistachios or for growers with smaller acreages. 'Gumdrop', currently, is ready for harvest before the commercial nut processing plants are ready to accept nuts. 'Gumdrop' should be planted by grower operations having access to a plant that is capable of processing the nuts of this cultivar when they are ready for harvest. Air temperatures can be hot when 'Gumdrop' is ready for harvest and the nuts do not hold well on the tree.
2. 'Gumdrop' has shown more growth variability on UCB-1 seedling rootstock. Growth among 'Gumdrop' trees has been much more uniform on 'Platinum®' clonal rootstock in an observation trial planted in 2014.
3. 'Gumdrop' will perform best on well-drained soils where water 'ponding' does not occur.
4. In the San Joaquin Valley, a timely 'double shake' harvest is suggested for 'Gumdrop'. Depending on season and location, the first harvest will occur in early August with a second shake a week to ten days later.

Later in the season (mid-July) some to many nuts produce a drop of gum on the hull (hence its name). A 'Gumdrop' harvest is 'stickier' than a 'Kerman' harvest. 'Gumdrop' is very precocious and is an extreme alternate bearer.

I see the best fit for Gumdrop as a cultivar planted by large, well-capitalized companies that can harvest the Gumdrop trees quickly, efficiently transport the nuts to a processor that they control, so it will be open two weeks earlier than normal (probably in the first week of August in the southern SJV).

The advantage in having significant Gumdrop acreage is that the peak industry-wide harvest demand for harvesting, transporting and plant processing would be reduced, compared to what would have occurred had they planted cultivars that are ready for harvest in the existing harvest window.

The Golden Hills Cultivar

Since Golden Hills, by far, has gained the most acceptance by growers recently, some special notes on growing and producing nuts with Golden Hills follow.

As of this year, there are probably about 85,000 acres of Golden Hills and Lost Hills in the ground in California and Arizona.

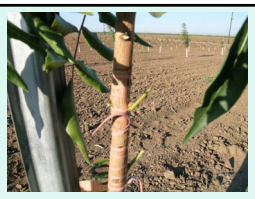
While data are limited, it is estimated that about 55,000 acres of Golden Hills pistachio were planted from 2009 through 2017. In the last couple of years, Golden Hills acreage, comprised more than 80% of the total new pistachio acreage planted.

Because of this increasing acreage, I have been getting a number of cultivar-specific questions on how to produce pistachios using the Golden Hills cultivar.

Budding the trees

Golden Hills has proven more difficult to bud than Kerman.

The reason is not clear. The area of the Golden Hill's branch that has flower buds, and which will eventually be the bud stick, tends to taper quickly.



Bud maturity is often quite variable along the bud stick, with the older buds being too large, and the smaller buds too green/immature.

Suggestion: Have a nursery licensed to distribute U.C. budwood and familiar with budding Golden Hills do the budding in a new planting. Another option is to plant trees that were pre-budded in the nursery.

The growth habit of the canopy of Golden Hills, compared to Kerman is:

1. Less vigorous
2. More upright

Tree spacing between trees within the row (having 19-20 feet between rows is desirable to accommodate large harvesting equipment)

Soil characteristics	Spacing within row
Deep, well-drained, loams to clay loams	17 to 18 feet
Less productive (saline, boric, shallow, impermeable)	14 to 16 feet

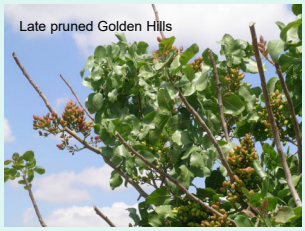
Dormant Season Tree Training

Do not tip Golden Hills late (i.e. tip by or before mid-February to be safe).

Apical buds begin producing auxins in the spring, which prevents buds lower on the branch from pushing. Tip the apical buds before they come out of dormancy.

Everything happens earlier with mature Golden Hills than Kerman – as much as 2 weeks earlier.

If you tip the terminal buds after the terminal buds come out of dormancy, buds a foot or more below that point will be extremely slow to push or won't push it all.


Late pruned Golden Hills

The same thing happens in Kerman, but the buds remain dormant for an additional 10 days to two weeks, giving you more time to prune a Kerman orchard in late winter.

Training/Pruning Suggestions:

Prune Golden Hills hard during training (i.e. non-bearing) to encourage more branching and greater outward spread of branches.

Reduce pruning, compared to Kerman, once it comes into bearing. Much of the yield is at the end of the branches but still within the canopy.

Training Golden Hills versus Kerman (spring/summer training first and/or second year)

Cutting main shoot or primary/secondary branches too early (or too close to the terminal bud) is more likely to result in insufficient or delayed bud push below training cut. Wait until you can see the developing buds in the axils of leaves below the proposed training cut before making it.

Golden Hills, particularly, appears to demonstrate poor bud push below the training cut if cut too early. You may end up with only one bud pushing.

Although little data exists, observations in 2020 strongly suggest that "big bug" populations (i.e. leaffooted and stink bugs) require closer monitoring and control as the shell hardens and after, than in Kerman. The 'Kerman' cultivar appears to 'drop' more nuts from the tree that have been pierced during feeding by the big bugs, while many more of the similarly affected nuts of 'Golden Hills' are retained on the tree and are harvested. The resulting damage is called 'epicarp lesion'. Affected nuts are difficult to separate out from unaffected nuts at the processing plant.

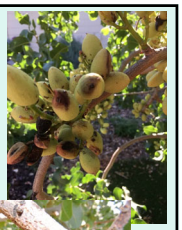

Photo by C. Kallsen, 2020

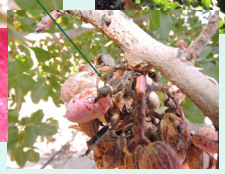

Photo courtesy of Dr. Michailides

Leaffooted bugs and hull damage on pistachio

(all unattributed photos by C. Kallsen)

LFB adults

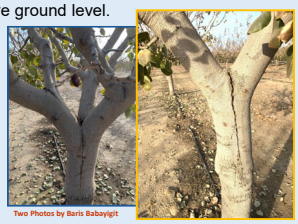




LFB nymphs

The wood of Golden Hills is more prone to breakage at the 'crotch' of the tree, especially when coming into first bearing. For this reason, it is especially important to form at least three primary scaffold branches when the initial training cut is made at 42 inches above ground level.

For trees with only two primary scaffolds, shaking force and duration at harvest should be adjusted to the minimum necessary to remove most of the nuts.



Two Photos by Baris Babayigit

Threaded rod with washers and bolts can help fix trees like these. I think Golden Hills may be a prime candidate for single-leader training.

Pre-harvest Dry Down?,

I have heard almond growers use the term 'dry down' to refer to the process of drying out the orchard, particular the orchard floor, prior to harvest.

Unless you have the soggiest, highest saturation-percentage soils in the SJV, if you want well-split nuts, the term 'dry down' should be deleted from the vocabulary of pistachio growers, particularly growers of Golden Hills.

It is hot when Golden Hills is ready for harvest. The trees will be transpiring at very high rates. For many blocks, if you can't get in and harvest the nuts within a few days of shutting the water off, you should find out why not.

If the orchard is too wet to get equipment in, fix the leaks in the irrigation system, correct the irrigation distribution inefficiencies, adjust your irrigation scheduling.

If the harvester do not show up when they are supposed to, have a serious talk with your harvest contractor. There is no reason to have a 'bone dry' root-zone prior to or immediately after harvest.

With Golden Hills, don't delay harvest until the hulls have tattered. Do not use hull tatter (i.e. splitting hulls) to gauge harvest with Golden Hills or Lost Hills.

The hull of Golden Hills nuts do not tatter as much as Kerman when ready for harvest.

Once a majority of the hulls slip harvest can begin. Greenish, 'tight' hulls are most likely blanks.

Most of the nuts will be split and ready for harvest even if many of the hulls remain intact.

Intact hulls at harvest may reduce navel orangeworm infestation compared to Kerman and Lost Hills.

Golden Hills Nut Cluster – these nuts are ready for harvest. The hull may feel somewhat firm on a few, but even most of these will separate cleanly from the shell in the huller.

Getting the Most Out of a Golden Hills Harvest

Kallsen Definition for a 'Double Shake'

A double shake is when an orchard is harvested twice and roughly equal weights of nuts are harvested within each of the two shakes.

A double shake is composed of a light, initial bump shake [in which rachises (clusters) are not removed] and a 'hard' shake roughly 10 days or so later.

If more than 90% of the total nut load is removed during the first shake, the following shake is more of a "sanitation" shake and falls outside my definition of a double shake.

As discussed above due to the more brittle wood of Golden Hills, it is not advisable to use an extremely hard shake late in the season for mummy removal.

Bloom evaluation in randomized and replicated test trials have demonstrated that the relatively short bloom period for Golden Hills translates to more even nut maturity across the tree at harvest than is the case for Kerman or Lost Hills.

Because of the more even maturity of nuts across the tree, a double shake, unless the bloom period was extended due to poor chill, is unnecessary for Golden Hills. For mature trees, when the hulls of the most advanced nuts begin to slip and are ready for harvest, waiting an additional eight to ten days, will usually allow you get 95% or more of the nuts in a single shake. Don't rush to harvest.

If you shake the first nuts early for Golden Hills, when only 50% are ready, you will need to come back in a week or less to remove the remaining nuts in order to maintain nut quality. Most growers are not prepared to come back to the same orchard in a week or less for a double shake.

By waiting until 95% or more of the nuts are ready, you will get the majority of your crop off well before the first shake of Kerman, and suffer little loss in terms of nut quality that will occur if the second shake of Golden Hills is delayed.

Generally, in the southern San Joaquin Valley, shaking mature Golden Hills trees at the same time as Kerman, means something didn't go as well as it could have.

Even if a 2nd shake of mature Golden Hills is necessary, it can usually be completed before the first shake of Kerman.

High levels of adhering hull and dark stain at harvest, assuming the nuts were processed at the plant in a timely manner, means that the harvest was later than it should have been.

If only the percentage of adhering hull is high and stain % is low, it suggests that the harvest was too early.

Post-Harvest Irrigation

The yield and nut quality data for Golden Hills in our studies were obtained in small trials within larger blocks of Kerman. Golden Hills, after harvest, was irrigated based on the full irrigation requirements for Kerman, which had not yet been harvested.

Thus, Golden Hills, typically, received a generous post-harvest irrigation.

The pistachio tree has been shown to produce and store significant quantities of carbohydrate for future nut production in the fall. For optimal yields across the alternate bearing cycle, continue to meet water requirements of the mature trees after harvest (which may be an additional month or six weeks) if green leaves are present.

Attempting to institute post-harvest regulated deficit irrigation on Golden Hills, which are usually harvested by the end of August in Kern County, may produce yield and nut quality results quite different from the fully-irrigated post-harvest trees in our small experimental trials.

The leaf canopy of Golden Hill appears to be more sensitive to scorch and subsequent defoliation as harvest approaches than Kerman.

1. Ensure that adequate irrigation exists throughout the season, but especially, during the last three to four weeks before harvest. Minimize irrigation interruptions for crop pesticide spraying and avoid excessively long periods between shutting the water off and harvesting the orchard.
2. Until we learn more, avoid late season chemical sprays if possible, especially in the last two to three weeks before harvest. If late season sprays are necessary, such as for navel orangeworm (NOW) control, avoid using chemical adjuvants/spreaders that are known to have a higher risk of phytotoxicity and use lower rates of adjuvants in necessary pesticide applications, especially late in the season.

The U.C. cultivar 'Lost Hills' is becoming increasingly popular with some California growers.

It is not difficult or expensive to become a licensed producer of U.C. budwood.

Golden Hills, Lost Hills, Gumdrop, Randy, Tejon and Famoso are proprietary cultivars of the University of California.

Nursery, Budder (contractor) or Private-Grower licenses are available from the University of California to produce these cultivars. For licensing info contact the following person:

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