Pistachio Cultivar Options for the Sacramento Valley: Why Don't My Nuts Split?

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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:

Red Aleppo
Joley
Kalehghouchi
Aria
Pete I

Large nuts of Pete 1

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 and 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 one 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 would apply 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.

There is no such thing as a perfect cultivar!

From my discussions with Katherine Jarvis-Shean, your UC Farm Advisor, a major problem for pistachio growers in this area, is achieving adequate nut-split, even when boron is not deficient and irrigation during the “nut fill” period is optimal.

If most growers in a geographical area are struggling with nut split, boron and irrigation are not likely the problem.

So, first off, assuming an adequate growing season, of these U.C. cultivars and Kerman, which has the best split-nut percentage?

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

What if we don’t have enough heat to mature a pistachio crop?

What if the growing season is not long enough?

How do we know if the growing season is warm enough and long enough?

How much heat does it take to grow a crop of pistachios?

Lu Zhang, in some recent research conducted with Dr. Louise Ferguson and others, suggests we need about 4500 °F GDDs (also called Heat Units (HU)) to mature pistachio through shell split.

It is critical in making comparisons that we use the same formula to calculate and compare heat units (the 4500 GDD value comes from using a base of 44.6 °F, with no upper temperature cutoff –beginning about Feb. 15 through harvest)

We need enough GDD to finish growing the kernel. Current evidence suggests that it is the force generated by the growth of the kernel that splits the shell.

Is the growing season sufficient for growing pistachio in Yolo County and environs?

Heat Units (base 44.6 ° F from 3/1 to 9/30) and Chill hours (< 45° F from 11/1 to 2/28) available for pistachio at selected weather stations in the Delta. For comparison: GDD requirement for pistachio ~ 4500 ° F, Chill hours ~ 900 (hrs < 45° F; Nov 1 to Feb. 28)) Kern County west side SJV 1987 – 2015 three locations ~ 5485 GDD available from 3/1 to 9/30.
RED = probably deficient, Blue = probably borderline

Location - City	County	Heat unit accumulation, ° F (mean 2017 – 2019)	Chill hour accumulation, hrs (mean 2017-18 and 2018-2019)
Winters	Yolo	**5119**	**886**
Davis	Yolo	**4843**	**787**
Bryte (experimental)	Yolo	**4875**	**717**
Woodland	Yolo	**5145**	**740**
Dixon	Solano	**4350**	**1169**
Marago	Contra Costa	**3476**	**994**
Manteca	San Joaquin	**4848**	**994**

So in the delta it appears we have the ‘double whammy’ of first, low chill getting the tree off to a slow start in the spring, which means we are not using early heat units effectively for growth,

and,

Secondly, to compound the problem, we are disadvantaged further with only a borderline number of GDD necessary to mature the crop.

The net effect of a ‘double whammy’ is difficult to predict.

Nut shell development in pistachio, pollination to harvest

April May June July August September

Shell expansion (STAGE 1)
Kerman and Lost Hills (755 GDD)
Golden Hills (710)

Shell hardening (STAGE II)
Kerman (2583 GDD)
Golden Hills (2830 GDD)
Lost Hills (3157 GDD)

GDD calculated using Fahrenheit degrees with a base of 44.6 ° F.
(adapted from Lu Zhang, personal communication)

Kernel growth (STAGE III)
Kerman (2111 GDD)
Golden Hills (1904 GDD)
Lost Hills (2021 GDD)

NOTE: There is a normal range, depending on cultivar, of individual nut maturity on the tree of about 2 weeks.

Current evidence suggests that it is the force generated by the growth of the kernel that splits the shell. If the kernel does not grow enough the shell does not split.

So, for the sake of argument, let’s we decide to plant pistachios anyway, instead of almonds or walnuts, the latter two crops which, historically, appear to be better adapted to Yolo County and have a proven record of making money.

So, from our earlier discussion, that a better adapted pistachio cultivar for Yolo County would be “short season” and have a low “winter rest” (i.e. low chilling requirement), which should give us a better chance for the nuts to reach harvest maturity, all else being equal.

Dr. Lou Zhang's data, personal communication, suggests that the cultivar Golden Hills, may have a lesser GDD requirement than Kerman or Lost Hills.

Is this supported by actual observations in Kern County in our test trials?

Dr. Zhang did not include the very short-season cultivar "Gumdrop" in her evaluations, we will include it in ours.

Order of full bloom (1 is earliest, 3 is latest)	
Kerman	3
Golden Hills	2
Gumdrop	1
Lost Hills	2

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.

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	2-3
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 harvest about 24 days after Gumdrop.

So, let's look at Golden Hills and Gumdrop, compared to Kerman, for GDDs required for nut maturation

Length of growing season (full bloom to harvest) compared to Kerman for Gumdrop and Golden Hills:

Gumdrop:
Full bloom is 11 days earlier and harvest is 24 days earlier – Net 13 days shorter season.

Golden Hills

Full bloom is 6 days earlier and harvest is 14 days earlier – Net 8 days shorter season.

However, there are less GDD accumulated per day earlier in the season (about 6 in March compared to 22 in September in Kern County). If we do the math, above, adjusting for daily differences in daily GDD accumulation between spring and fall, the GDD requirement (base 44.6 °F, no upper cut off) is as follows:

Length of season in GDD °F equivalents on average in Kern County

Gumdrop – requires 462 GDD less than Kerman (about 10% less)

Golden Hills – requires 340 GDD less than Kerman

What about the requirement for a long winter rest period requirement for pistachio?

<u>Low chill (poor winter rest) symptoms in pistachio include the following:</u>

- delayed bloom,
- extended bloom (differences between north and south side of trees – north bloom first),
- flagging of shoots,
- early nutlet drop and nut blanking/poor yield
- Longer juvenility period. More years before first nut production.

Difference in leaf out of a Kerman canopy during a spring following a year of very inadequate rest (2014-15) in Kern County. The canopy on the right side of the picture is the south side of the tree.

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

There is some evidence that earlier blooming fruit and nut cultivars have a lower chilling requirement.

Heat Units (base 44.6 ° F from 3/1 to 9/30) and Chill hours (< 45° F from 11/1 to 2/28) available for pistachio at selected weather stations in the Delta. For comparison: GDD requirement for pistachio ~ 4500 ° F, Chill hours ~ 900 (hrs < 45° F; Nov 1 to Feb. 28)) Kern County west side SJV 1987 – 2015 three locations ~ 5485 GDD available from 3/1 to 9/30.
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So, these comparisons suggest that if pistachios are still the crop of choice for our Yolo County orchard, it would appear that Golden Hills or Gumdrop would be the better choice based solely on seasonal heat accumulation, winter rest period requirement and harvest uniformity.

However, a cultivar has many characteristics having nothing to do with the temperature. I have learned there is not such things as a perfect cultivar.

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**

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. What about if the heat unit requirement cannot be met?

Lost Hills, across trials, has had about 3% 'lost shells and kernels'; Kerman/Golden Hills less than 0.5%

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:

1. 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.
2, Personal observations (C. Kallsen) in Madera 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**

No difference in sodium or chloride exclusion among cultivars.

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

My “conventional” advice

<u>Dormant Season Tree Training</u>

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

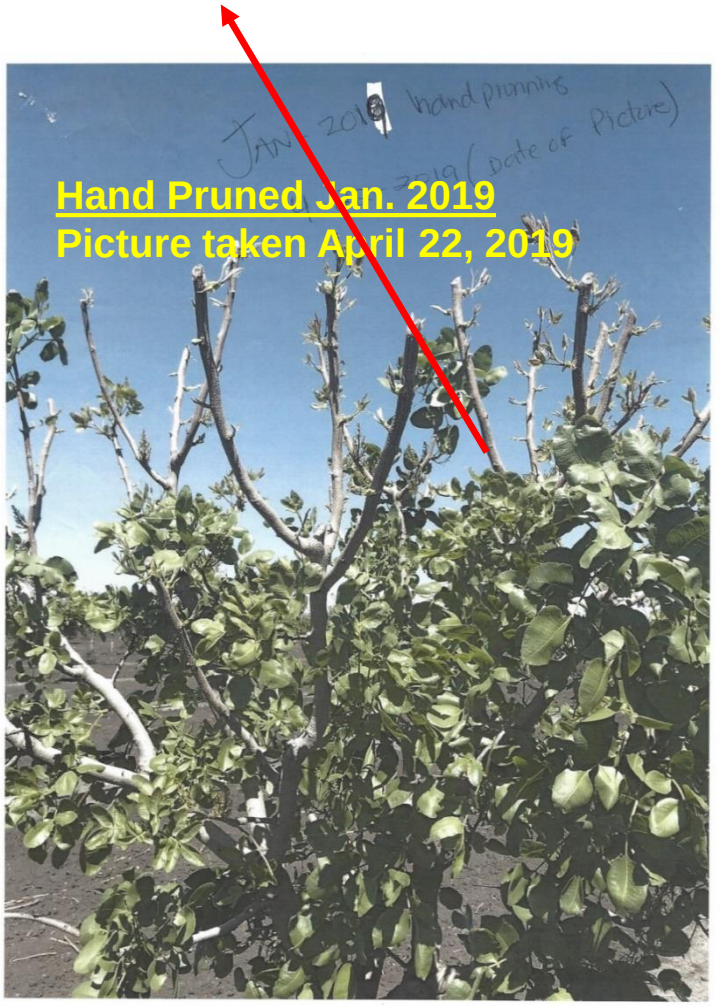
Apical buds begin producing auxins in the spring, which prevents buds lower on the branch from pushing. Tip the apical buds <u>before</u> they come out of dormancy.

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.

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.

Are we pruning Golden Hills too late? Pictures taken April 22, 2019.



Also, ensure good scion girth before dormant training cut with Golden Hills. Observations suggest scion girth should be 3/8th inch or more before cutting.

The wood of Golden Hills is more “brittle” than that of Kerman and more prone to breakage at the ‘crotch’ of the tree. 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 <u>minimum necessary</u> 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.

Reviewing Gumdrop

Gumdrop - Gumdrop was released to the industry in July, 2016.

1. ‘Gumdrop’, currently, is ready for harvest before the commercial nut processing plants are ready to accept nuts. ‘Gumdrop’ should only 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.


GUMDROP
KERMAN
GOLDEN HILLS
WESTCOTT
RULER

I see the best fit for Gumdrop as a cultivar planted by large, well capitalized companies that can harvest the Gumdrop trees quickly, and 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.

BLOOM SYNCHRONY in the San Joaquin Valley (SJV)

Below is a list of female cultivars with the names and relative apportionment of suggested pollinizers (applicable to those that believe the SJV is going to get warmer and drier in the future).

Female cultivars with suggested (by Kallsen) percentages of male pollinizers			
Female	Early male	Standard male	Adjunct male
Gumdrop	Zarand (25-50%)	Tejon (50 - 75%)	
Golden Hills	Tejon (≤ 20%)	Randy (≥ 80%)	
Lost Hills	Tejon (≤ 20%)	Randy (≥ 80%)	
Kerman	Randy (25%)	Famoso (50%)	Peters (25%)

If you believe the 2014 and 2015 low-chill, drought years were a rare, random weather anomaly choose 100% with the listed standard male except for Kerman, in which case choose 50% Famoso and 50% Peters as the male pollinizers.

Thank you for your attention.

Is there time for questions?