AgWest FARM CREDIT

Industry Perspectives

Pistachios

This Industry Perspective was prepared by AgWest Farm Credit's Almonds and Pistachios Industry Team.
Please direct questions and comments to CustomerFeedback@agwestfc.com.

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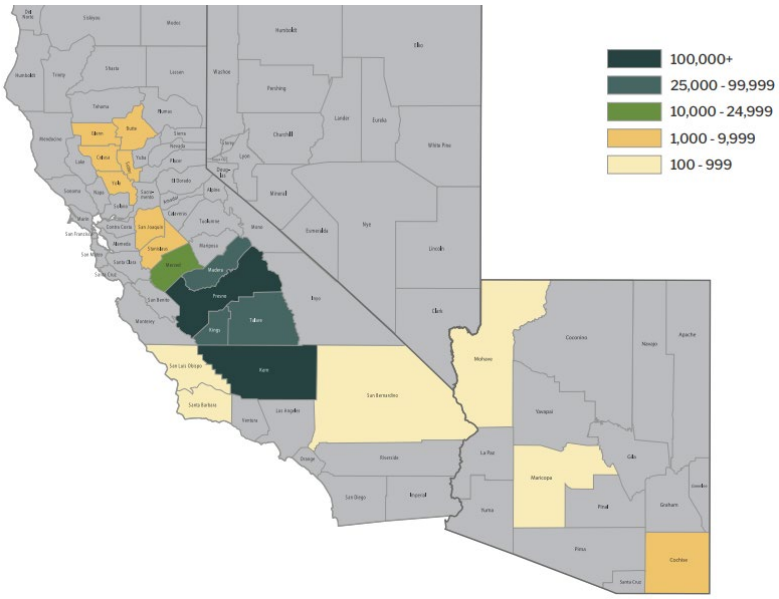
Introduction

Pistachios grow in Mediterranean climates, which feature temperate weather with hot, dry summers and cool, wet winters. The U.S. is the world's largest producer of pistachios with 61% of global production. Iran and Turkey follow at 16% of global production each, Syria 4% and Europe at 3%. Nearly all U.S. production occurs in California, and to a much lesser extent, Arizona and New Mexico. Pistachios are California's third largest agricultural export by value. Production is concentrated in the Central Valley, primarily from Kern County to Merced County.

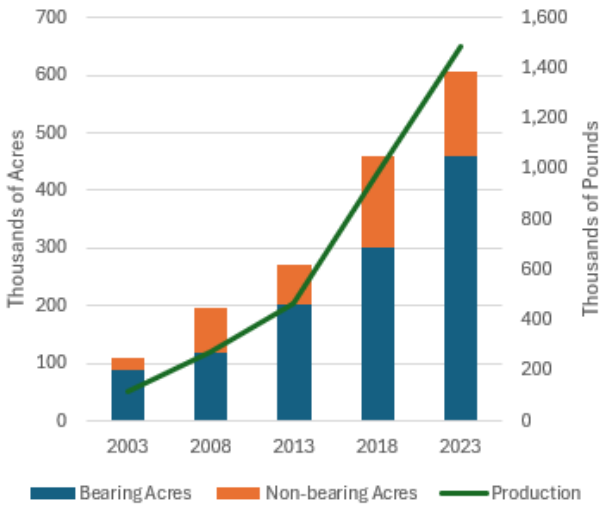
West Coast pistachio acres by county, planted acres in AgWest territory



Source: USDA NASS. Census of Agriculture, 2022.

Pistachio acres in California have increased from just over 100,000 acres to 600,000 acres over the last 20 years, with production levels increasing at about the same ratio. Increased plantings are occurring in the Sacramento Valley. While planted acres are likely going to level out in the near future, the percentage of those that are non-bearing is about 25%. As non-bearing acres come into production, the supply of pistachios will increase.

Pistachio acres and production in California



Source: Administrative Committee of Pistachios.

Varieties

Pistachio plantings require male and female varieties to produce and are historically alternate bearing, where trees produce a large crop one year and a small one the next. This may change as the newer varieties being adopted by the industry seem to show less alternate bearing characteristics. However, pistachio trees can take 10 or more years to reach full production, meaning the industry is still learning about how new varieties change with age and respond to variations in weather patterns.

Common pollinator (male) varieties include Peters, Randy, Famoso, Tejon and Zarand. There are four primary female varieties in the U.S.:

- **Kerman** is the oldest variety and has been the industry standard in California. It has a good flavor profile and attractive green color. While Kerman trees are good producers, they are more prone to alternate bearing than other varieties. They also have a tight harvest window with a higher blanking percentage. Blanking is when hulls develop without kernels.
- **Golden Hill** is a relatively new variety (released in 2005) that is higher yielding and harvested 1-2 weeks earlier than Kerman trees. The earlier harvest helps to mitigate the impacts of the pest, Navel Orangeworm. It also has fewer blanks and a greater percentage of naturally split hulls (hulls open while still on the tree), which makes this variety better suited for fresh markets.
- **Lost Hill** is a relatively new variety (released in 2005) that is very similar to Golden Hill, except with larger kernel sizes and a higher shelling tendency (process of removing the outer shell of a pistachio) during handling.
- **Gum Drop** is the newest variety (released in 2016) that is harvested up to 12 days before Golden Hill. It has good yield potential and excellent quality characteristics, but has not been widely planted.

Value chain

Growth and harvest

It takes trees 5-6 years to produce nuts, roughly 10 years to break even, and 10 or more to reach full production. Pistachio orchards have a long economic life, or the amount of time in which it is financially viable, that can reach as high as 70 or more years depending on site conditions and management practices.

The lifecycle of a pistachio tree depends on tree and rootstock variety, soil and cultural management practices (irrigation, fertilization, pest control and pruning). Rootstocks are grown in a nursery for a year and transplanted to the orchard from late spring to early summer at a spacing based on variety and site conditions. A young pistachio rootstock is budded to the preferred scion (a shoot or twig). Some producers use pre-budded trees, where rootstocks are budded in the nursery prior to planting. The process of grafting/budding specific pistachio cultivars onto rootstocks maximizes and/or ensures uniformity of crop characteristics, nutrient uptake, vigor, branching, anchorage, timing for crop maturity and bloom, and pest control.

Trees are dormant between November and February, start to bud in late March, reach bloom and pollination in April, develop shells and grow the kernel between May and August, and are ready for harvest from late August to early October when nuts mature. A high percentage of nuts split naturally while still on the tree.

- **Dormancy**: Trees lose their leaves and store nutrients. Growers remove remaining nuts to minimize pest presence. Buds begin to swell towards the end of this period.
- **Bloom and Pollination**: Pistachio trees are wind pollinated, and this can create challenges. Lower yields can result from a misalignment in bloom between male trees and their female counterparts. Excessive cool, heat and/or wet weather can delay bloom, damage flowers and/or slow pollination.
- **Growth**: Kernels grow, shells harden and proper irrigation is important. Younger trees generally require less water than their older counterparts. Excessive heat during the summer can increase water requirements and/or stunt nut fill.
- **Shell split**: Pistachios are ready for harvest when their shells begin to split. Naturally split shells receive a premium in the marketplace. At this stage, trees become susceptible to a common pest called the Navel Orangeworm.
- **Harvest**: Pistachios are mechanically harvested using a shaker and immediately shipped for processing. Shell staining can become problematic if nuts remain on the tree for too long or hulls remain in contact with the shells for an extended period after harvest. Rain during harvest can lead to fungal growth and shell staining, which leads to lower prices.

Processing

Once harvested, pistachios are immediately processed to avoid staining and damage. Processing facilities range in their capacities, but will typically pre-clean (remove dirt, twigs, pebbles, etc.), remove hulls, separate and remove blank shells (those without kernels), dry, sort by naturally split shells versus closed shells, mechanically split closed shells or extract

the kernels by crushing shells, and – finally – grade, package, store and transport the final products. Processing facilities may also roast, season and/or further process kernels into various products used for snacks, ingredients and/or beverages.

The equipment used is extensive and may include screw conveyers, bucket elevators, (vibrating) screens, abrasive peelers, float tanks, shelling knives/needles, hoppers, bolts, hulling cylinders, and optical sorters, among other types. Processing and packaging technology has made significant progress. Automated processes reduce labor demand and allow for more uniform products, as well as facilitate sorting by size, shape, color and defects. Due to their low water and high oil content, pistachios can store for up to two years in climate-controlled storage.

Manufacturers and retailers

Pistachios lend themselves to a vast array of products. Once packaged, pistachios can go straight to retailers where they are sold to consumers. Alternatively, these and other products can head to manufacturers who process/incorporate them into confectionery, snack, bakery and dairy goods, which are then sold by retailers. The diversity of products means that consumers can find pistachios throughout retailers' shelf space, including fresh produce, baking ingredients, snacks and beverages.

Drivers

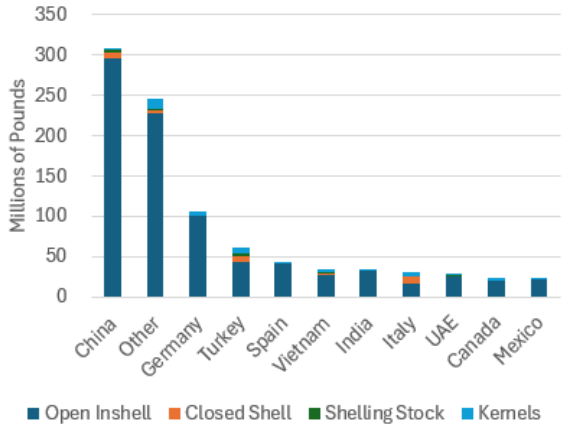
Nutritional content and product diversity

Perhaps the biggest advantage pistachios have is their high protein, mineral and monounsaturated fat content. Research over the years has demonstrated their benefits for heart health, weight management, blood sugar, exercise recovery and skin health. The industry leverages this research to appeal to health-conscious consumers both domestically and abroad. Further, their physical properties allow pistachios to be processed into a wide range of products including snacks, baking ingredients and beverages. They are often marketed as a vegetarian and/or healthier alternative to conventional food items and beverages.

International markets

California exports nearly 80% of its pistachio production to a wide array of countries. Most exports are split inshells (see chart below). Exports to China increased about 10-fold between 2013 and 2023, driven largely by changing consumer preferences among younger generations and an inability to increase domestic production. Europe has a long history of nut consumption and is the second largest market for U.S. producers.

Pistachio exports by destination country, 2023 crop



Source: Administrative Committee for Pistachios, August 2024 Shipment Report.

Technology

Technological advances in the pistachio industry are driven by the need to maximize labor, monetary and natural resources while increasing yields and productivity.

Producer

GPS and variable-rate technologies for fertilizer and water applications continue to gain acceptance among producers. Greater oversight over water management is leading to the increased adoption of digital irrigation systems.

Drone use continues to expand, improving the availability and quality of data for orchard managers. An array of camera and sensor options provide detailed analysis for soil, moisture, erosion and temperature conditions. Adoption of drone technology will likely increase in the coming years as producers increase focus on precision agriculture.

Processing facilities

Packing-line technology has expanded over the last several years to include sorting technology to detect internal defects, color and size, along with robotic palletizing and improved automated bagging machines. These technological advances serve as labor-management tools.

New sorting technology provides the ability to deliver high-quality products to the consumer while minimizing human error. Cameras and sophisticated software programs replace human defect sorting with machine defect sorting. Precise sorting technology allows processors to capture the highest possible returns for producers.

Packing technology comes at a significant cost. However, labor shortages are pressuring warehouses to adopt technology. The elimination of human sorters on the front end of the packing line often reduces labor needs by 30-40% at the warehouse. However, the savings from cutting labor costs are generally offset by increased fixed costs associated with building modifications to accommodate larger lines and increased depreciation costs.

Diversified production

Many pistachio growers opt to diversify production geographically as well as into almonds and walnuts.

Almonds

The U.S. produces about 77% of the world's almonds, with California responsible for nearly all of this amount. (Orchards are located as south as Kern County and as north as Tehama County.) Australia follows at 11%, Europe 9% and Turkey 2%. Similar to pistachios, almond trees thrive in Mediterranean climates.

There are 13 main varieties of almonds in California, the most prized of which are nonpareils. Known for their soft-shell, attractive and medium size kernel, uniform shape, smooth surface and light-colored skin, nonpareils receive a premium over other varieties. Many other varieties have been developed as nonpareil pollinizers, or plants that produce pollen which is then used to fertilize flowers. The value chain of almonds (planting, production, sorting, packing, storing and marketing) operates similarly to pistachios; however, peeling, drying, salting and roasting require different processes and equipment. Trees require a shorter pre-production period of about 3-4 years and full production happens around year seven. Orchards generally produce for 25 years. Almonds are considered very healthy, sold whole and inshell, and used for snacks, baking ingredients and beverages. About 70% of pistachios are exported, with top markets including India at 20%, Spain 10%, United Arab Emirates 8%, and the Netherlands, Germany, China and Turkey 5%.

Almond acreage has increased more rapidly than demand over the last decade, resulting in a sharp decline in prices and profitability over the last several years. Data suggests California is nearing peak production levels, which should support prices moving forward.

See our **Almonds Industry Perspective** for more information.

Walnuts

China produces 51% of the world's walnuts, most of which are consumed domestically. The U.S. follows at 28%, Chile 7%, Europe 5%, Ukraine 4% and Turkey 4%. In the U.S., most walnut production is north of the main pistachio growing areas. While walnuts are grown throughout the Central Valley in California, orchards are concentrated further north around Stockton and Yuba City. There are many varieties with distinct characteristics including Chandler, Hartley, Howard, Tulare, Serr and Vina.

The value chain of walnuts operates similarly to almonds, but with some differences in process and equipment required for harvesting and processing. In particular, walnuts require drying for up to 24 hours to remove moisture and prevent deterioration. Trees become productive between years five and seven and can last as long as 35 years. While walnuts are also considered a healthy food item, unlike almonds and pistachios they are generally not consumed whole but rather as ingredients in candies, cereals and baked goods. As such, the overall market is much smaller. About 70% of walnuts are exported, with top markets including Turkey at 29% of total, Germany 17%, Italy 12%, United Arab Emirates 9%, and Japan and Korea each at 8%.

Appendix A

Best practices

The following summarizes the best practices common among successful and progressive tree nut growers, packers/shippers and marketers. These primarily relate to issues of production and warehousing.

Orchard production best practices

Have a strategic plan.

- Successful businesses have defined goals and continuously develop and execute on business strategies, which may include diversification, replication, integration, networking, downsizing/rightsizing or intensifying (i.e., improving efficiency).

Increase gross revenue per acre.

- Growers increase gross revenue through a combination of reaping high yields, producing desirable nut varieties and peaking on a demanded size profile. A desirable varietal mix and high-yielding orchard structure will continue to be critical to competitive top-line revenues.

Contain expenses.

- Growers manage fixed expenses, which allows for lower break-even levels.
- Focusing on orchards of an economic size is key to long-term cost competitiveness.

Diversify varietal mix.

- Growing multiple varieties stretches out the harvest season and smooths out production levels.

Mitigate risk.

- Successful growers diversify, when possible, by cultivating crops in differing geographic areas to hedge against widespread weather-related adversity.
- Growers use available risk-management tools, such as crop insurance, to mitigate the risk of adverse and unforeseen events that could drastically affect the business. Crop insurance options include three variations of coverage: production based, revenue based and named peril. Most producers use some combination of these products to tailor a protection strategy that matches the specific safety needs of their business.

Align with fellow growers.

- Growers may also partner with other growers to leverage volume discounts for equipment, chemicals, fertilizers, fuel and other necessary inputs.

Align with a processor.

- Growers can commit or contract with certain processors and can generally receive a small bonus for doing so.

Have a labor-management strategy to secure and retain a skilled, adequate labor supply.

- Small and medium size growers often use custom harvesting companies given the high cost of specialized equipment.
- Producers have begun planting across different geographies to help alleviate labor shortages during peak harvest times.
- Larger producers are able to move labor forces from one orchard to another over larger geographic areas to ensure the labor force is retained.
- Many producers are successfully using the H-2A Temporary Agricultural Workers program. Although somewhat expensive, the program provides a feasible solution to labor needs.

Maintain accrual financial statements and use enterprise accounting.

- Successful operations use accrual-based reporting to assess true financial position and performance. These growers also use enterprise accounting to assess profitable and unprofitable business units, or orchard blocks.

Maintain a sound financial position.

- Orchardists with strong liquidity and lower leverage are able to absorb market down cycles and take advantage of strategic opportunities.
- A business should assess the adequacy of its financial position annually by using tools like financial ratios, peer financial benchmarks and historical trend analyses.
- Sensitivity analysis may also be used to give an accurate picture of the true financial position of the business given possible adverse scenarios.

Processing facility and warehouse best practices

Have a strategic plan.

- Successful businesses have defined goals and continuously develop and execute on business strategies, which may include diversification, replication, integration, networking, downsizing/rightsizing or intensifying (i.e., improving efficiency).

Maximize facility use.

- Maximize the use of fixed assets to lower per-unit costs, which enables warehouses to maintain competitive grower returns.

Contain expenses.

- Understand fixed and variable costs to maintain competitive processing and packing charges and maximize income levels.
- Cost containment allows facilities to reduce the level of throughput needed to break even in short crop years.
- Break-even analysis is valuable for understanding and predicting earnings based on various throughput levels at the warehouse.
- Sensitivity analysis may also be used to give an accurate picture of the true financial position of the business given possible adverse scenarios.

Embrace new technology.

- New technologies, which increase capital costs, help to reduce labor needs. This could lead to more consistent operations and lower per-unit costs.

Align with growers.

- Packing warehouses align with growers to ensure their targeted product throughput.
- Integrated operations typically grow a significant portion of the nuts they pack.

Provide new value-added processes.

- When working with retailers, value-added processes may prove to be a competitive differentiator. Such processes include inventory management, labeling, traceability programs, promotions and other value-enhancing activities.

Maintain a sound financial position.

- Warehouses with strong liquidity and lower leverage are able to weather adversity and take advantage of strategic opportunities.
- A business should assess the adequacy of its financial position annually by using tools such as financial ratios, peer financial benchmarks and historical trend analyses.
- Stress case scenarios may also be used to give an accurate picture of the true financial position of the business.

Appendix B

Glossary

Bloom. A period of time that starts with the pink set and ends with petal fall about 10 days later. 'Full bloom' is defined as the day that 60% of 'king blossoms' are open on the north (shady) side of the tree.

Bud. Found in the axils (the upper angle between a leaf stalk or branch and the stem or trunk from which it is growing), a bud is basically a dormant and compressed shoot, which given the right conditions will resume growth.

Cambium. The thin layer of tissue, often green or greenish yellow, between the bark and the wood on a tree. It is important to line up the cambium in grafting between rootstock and scion.

Central leader. A tree where the main branch goes straight up the center.

Clonal rootstocks. Clonal rootstocks are vegetatively propagated. Degree of size control and anchorage varies among dwarfing rootstocks.

Clone. A genetically identical group of plants derived and maintained from one individual by vegetative propagation.

Cold hardiness (**hardy**). The ability of plants to withstand cold injury (autumn-winter).

Cold storage. A form of refrigerated storage.

Cross pollination. Pollen moving from one flower to another, on the same plant or among flowers on different plants. Pollen moved between different plants often results in fruit that is different from either parent (i.e., a hybrid of the two).

Cultivar. A plant variety that has been produced in cultivation by selective breeding.

Dormant. The inactive or sleeping state in which a plant stops growing but is still alive.

Drip irrigation. Watering through soaker hoses or emitters placing water at plant bases on the soil surface; least wasteful method of watering.

Drip line. The rough circle that may be drawn on the ground around a tree where rain would drip off the outermost leaves. The most active roots are often located along this line.

Frost damage. Cold-temperature injury during a stage of the growing season. Parts affected are flower buds, flowers and young fruit (spring), or near-mature fruit or other tissues (fall).

GLOBALGAP. An internationally recognized set of farm standards dedicated to Good Agricultural Practices (GAP). Through certification, producers demonstrate their adherence to GLOBALGAP standards. For consumers and retailers, the GLOBALGAP certificate is reassurance that food reaches accepted levels of safety and quality, and has been produced sustainably respecting the health, safety and welfare of workers and the environment, and in consideration of animal welfare issues. Without such reassurance, farmers may be denied access to markets.

Grafting. A way to propagate a plant by inserting a section of one plant (the scion) into another plant (the stock).

Hardiness. Ability of a plant to withstand temperature extremes; usually refers to cold hardiness.

Internodes. A part of a plant stem between two of the nodes from which leaves emerge.

Organic certification. Verifies that a farm or handling facility complies with USDA organic regulations. This certification allows the holder to sell, label and represent products as organic. Farms all over the world may be certified to the USDA organic standards. Most farms and businesses that grow, handle or process organic products must be certified.

Pollination. The transfer of pollen from the male part of flowers (the anthers) to the female part (the stigma). Poor pollination results in a small nut crop.

Processing. Nuts that are not sold whole are processed (slices, flour, etc.) and sold into a variety of markets.

Pruning. The removal of living canes, shoots, leaves and other vegetative parts of the branch.

Rootstalk. Sometimes called "stock," this is the root system (plant) propagated from seed (seedling) or vegetatively as common in clonal rootstocks on which various cultivars are budded or grafted. Many rootstocks are used and possess traits that relate to anchorage, size control, tolerance of light and heavy soils, "wet feet," specific nematodes and other plants and diseases.

Scion. A detached stem, usually dormant, used in asexual propagation by grafting techniques. The scion is the actual nut variety, which is grafted onto root stock.

Set. The amount of blossoms or fruit/nuts held on the tree.

Shoot. Wood that is usually not over one or two years old and is longer than the short, stubby spur growth.

Spur. A short shoot with compressed internodes. Spurs grow from two-year or older branches and produce flowers.

Sucker. A cane that emerges from below the bud union, and therefore comes from the rootstock rather than from the variety grafted onto it. On other plants, a sucker is any unwanted, fast-growing, upright growth from roots, trunk, crown or main branches.

Sunburn. The damage caused by the hot summer sun on the branches, "cooking" and destroying the bark and tissues.

Thinning. Removal of flower clusters, immature clusters or part of immature clusters. (See also 'blossom thinning.')

Training. Certain practices that are supplementary to pruning and necessary for shaping the vine.

Variety. Variety and 'named variety' are commonly used to mean the same as 'cultivar.' Technically, variety means a naturally occurring variant of a species.

Vigor. Refers to the amount and rate of growth; relative among cultivars, climates and horticultural practices.

Whole. Nuts are minimally processed (hulled and shelled) and sold primarily into snack markets.