AgWest FARM CREDIT

Industry Perspectives

# Lemons and Oranges

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

Industry Perspectives

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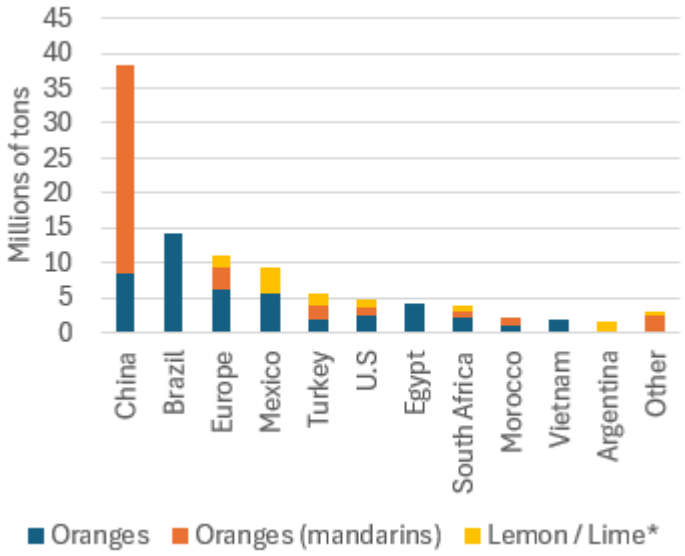
## Introduction

Lemons and oranges are used in fresh, processed and industrial by-product markets, and are among the most popular citrus fruits in the world. Global production is led by China, Brazil, Europe and Mexico, with the U.S. at about 4 million tons of production in 2024 (see chart below). Over the last few years, demand for oranges has held relatively constant while lemons have seen a sharp drop-off in demand.

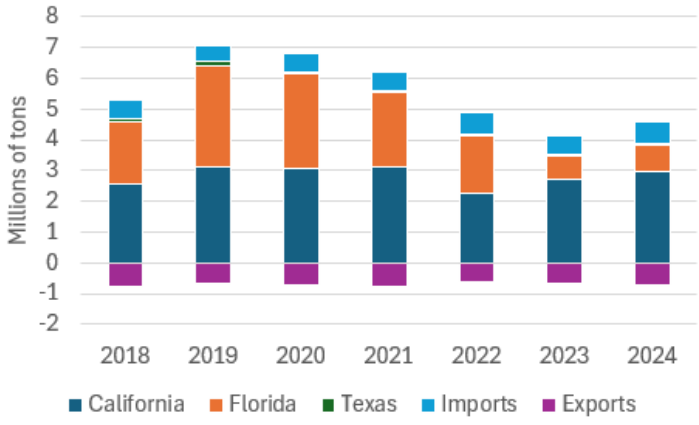
*Global production*




Source: U.S. Department of Agriculture, Foreign Ag Service.
*Lemon and lime data is aggregated.

Historically, Florida was the largest orange producer in the U.S., growing primarily the Valencia variety for juice markets. A combination of hurricanes and Citrus Greening (a bacterial disease that severely damages orchards) reduced Florida's production by over 90% over the last twenty years. Juice production in, and imports from, Brazil has largely offset these declines. Lemon production ranges from about 880,000 to 1.1 million tons per year, nearly all of which takes place in California.

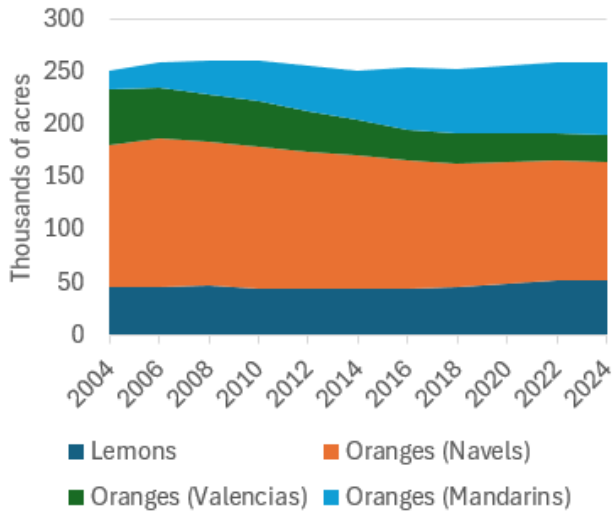
*US orange supply (imports, exports and production by state)*




Source. U.S. Department of Agriculture.
Oranges include Valencia, navel, tangerines, and clementines.

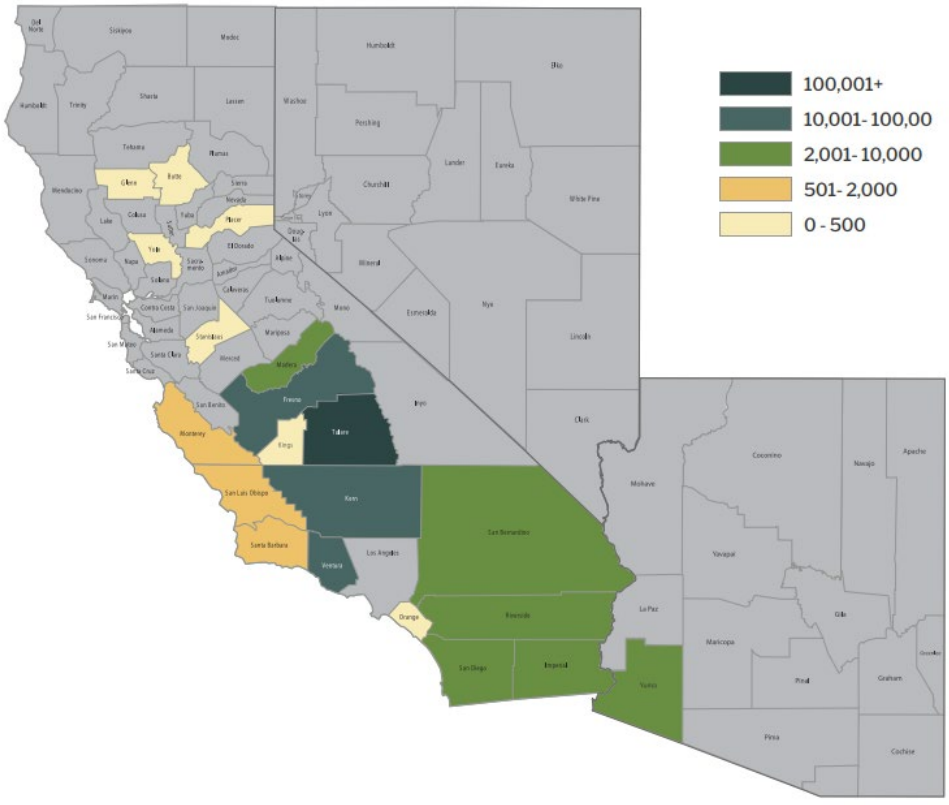
In California, orange acres are concentrated in Tulare and Kern counties and have shifted away from Valencia and navel varieties toward mandarins. Lemon production is concentrated in Ventura and Tulare counties. While total acreage has remained relatively constant, there are anecdotal reports of producers switching them out with other crops such as avocados due to unfavorable markets.

*Planted acres in California*




Source: California Citrus Acreage Reports, 2004 – 2024.

*West Coast lemon and orange acres by county, planted acres in AgWest territory*




Source: 2024 California Citrus Acreage Report. USDA NASS, Census of Agriculture, 2022.

## Varieties

Navels are the most common variety of oranges grown in California, followed by Valencias and Mandarins. Navels are used primarily in fresh markets, though smaller and/or lower quality fruit is often processed into juice. Valencias are primarily grown for juice markets, though can also be found in fresh markets. Mandarins include multiple varieties (Sumo, Satsuma, Clementine, Dancy, etc.) that are largely sold interchangeably in fresh markets. The Eureka and Lisbon varieties make up most of the lemon production in California and both are relatively interchangeable in terms of market uses. Meyer lemons, with its orange-like taste characteristics, are perhaps more versatile in terms of fresh market uses.

*Primary lemon and orange varieties*

| Variety | Physical attributes | Taste | Uses | % of Production and Top Growing Counties |
|---|---|---|---|---|
| **Eureka Lemon** | Medium to large (3–4 in), bright yellow; thick, slightly bumpy, juicy, seedless flesh | Sharp, acidic, tangy, classic lemon flavor | Fresh, juice, cooking (desserts, marinades) | ~40–50% (lemons); Ventura, San Diego, Riverside |
| **Lisbon Lemon** | Medium (2.5–3.5 in), bright yellow; smooth, thinner skin, juicy, few seeds | Tart, puckering, intense lemon flavor | Juice, fresh, baking, preserves | ~40–50% (lemons); Ventura, Riverside, Tulare |
| **Meyer Lemon** | Small to medium (2–3 in), golden yellow to orange; thin, smooth, tender flesh | Sweet-tart, less acidic, nuanced flavor | Fresh, desserts, roasting, sauces | ~5–10% (lemons); Ventura, Riverside, San Diego |
| **Mandarin Orange** | Small (2–2.5 in), bright orange, sometimes greenish; loose, thin, easy-to-peel, tender, few seeds | Very sweet, less acidic, bright flavor | Fresh, baking, preserves | ~3–5% (oranges); Tulare, Kern, Fresno |
| **Navel Orange** | Medium to large (3–4 in), bright orange, slight reddish blush; thick, pebbly, easy-to-peel, seedless flesh | Sweet, juicy, mildly tart, well-balanced | Fresh | ~60–65% (oranges); Tulare, Kern, Fresno |
| **Valencia Orange** | Medium (2.5–3 in), deep orange, thinner than navel; smooth, thin, juicy, few seeds | Sweet, tangy, high juice content | Juicing, fresh, cooking (marmalades, sauces) | ~30–35% (oranges); Tulare, Kern, San Diego, Ventura |

Source: U.S. Department of Agriculture. California Citrus Mutual. University of California Citrus Production Manual. UC Riverside Givaudan Citrus Variety Collection.

## Value chain

### Growth and harvest

Both lemon and orange trees take about 3-5 years to produce fruit and 7-10 years to reach full production. On average, navel and Valencia orchards produce about 600 – 700 40 lb boxes per acre and mandarins 620 – 800 boxes per acre. Lemon orchards yield 280 – 600 boxes per acre in Arizona and 900 – 1,000 boxes per acre in California.

The lifecycle of a citrus tree depends on tree and rootstock variety, soil and cultural management practices (irrigation, fertilization, pest control and pruning). **Rootstocks are generally 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 citrus shoot or twig is then budded or grafted on. Some producers use a plant-in-place method where rootstocks are planted in the orchard and subsequently grafted. The process of grafting/budding specific citrus 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. Multiple varieties are planted within an orchard to support pollination, and some growers use trellis systems for specialty fruits such as mandarins to increase planting density.

Lifecycle phases include:

- **Dormancy**: Trees lose their leaves and store nutrients. Growers remove remaining fruit to minimize pest presence. Buds begin to swell towards the end of this period.
- **Bloom and Pollination**: While lemon and orange trees are considered parthenocarpic (fruit develops without fertilization) or self-pollinating (trees produce both male and female parts), some growers use bees and interplant multiple varieties to improve fruit set and yields.
- **Growing**: Fruits grow, starting off green and then change to yellow (lemons) or orange (oranges) as sugar and acid content develops. Citrus fruits require ample irrigation and nutrients. Cool nights improve color and flavor.
- **Harvest**: Harvest, primarily done by hand, generally takes place when desired size and color requirements are met and/or juice content reaches 25-30% by weight. Valencia oranges are sometimes mechanically harvested when destined for juice markets. Eureka and Lisbon lemons are selectively harvested throughout the year.

*Lemon and orange lifecycle phases*

| Variety | Bloom | Fruit Set | Harvest | Dormancy |
|---|---|---|---|---|
| **Eureka Lemon** | Year-round (peaks March–May, August–September) | Year-round (peaks April–June, September–October) | Year-round (peaks February–August) | None |
| **Lisbon Lemon** | Year-round (peaks March–May, August–September) | Year-round (peaks April–June, September–October) | Year-round (peaks August–February) | None |
| **Meyer Lemon** | March–May (minor blooms year-round) | April–June (minor sets year-round) | November–March | Limited (December–February) |
| **Mandarin Orange** | March–April | April–May | November–March | Limited (December–February) |
| **Navel Orange** | March–April | April–May | November–April | December–February |
| **Valencia Orange** | March–April | April–May | March–October | December–February |

Source: California Citrus Mutual. University of California Citrus Production Manual. UC Riverside Givaudan Citrus Variety Collection. UC Davis Postharvest Technology Center.

Citrus orchards face several weather and disease risks throughout their lifecycles. Frost risk rises from December to January and can damage ripe fruit or young fruit sets. Excessive winter or spring rain can lead to fungus growth, damaged fruit and/or delayed harvest, while excessive summer heat can increase irrigation demand and costs, reduce yields and/or lead to sunburn, blemishes, or drying. Common diseases include Citrus Greening, Citrus Canker, Citrus Nematodes, various types of fruit and root rot, and Anthracnose, among others.

## Processing

Once harvested, lemons and oranges are sent to processing facilities that wash, sort, grade, process, and/or store fruit prior to shipping to markets. Packing lines are largely automated, cutting down on manual labor and improving consistency in high-quality products. Cameras are used to sort fruit based on size, color, grade, shape, external defects and internal condition. These characteristics determine whether an orange or lemon will be fresh packed or processed. Those with desirable external characteristics (size, color, firmness, shape, texture, etc.) and internal quality will go to fresh markets and fetch the highest premiums, while the remaining will be processed into various products, including juice - sorted fruit is fed into extractors that squeeze out juice, which is then pasteurized and packaged (additional processes such as evaporation and/or additional filtration can be used to produce concentrates or specialty products). From highest to lowest quality, ratings include Fancy, U.S. No 1, U.S. No 2, U.S. Combination and U.S. No 3 (juice/process grade). Citrus peels and pith can be further processed into essential oils, pectin, dried culinary products, dried animal feed and flavonoid extracts using several different processes, including cold-press, centrifugation, mechanical extractors/separators and water/acid extraction, among others.

## Cooperative and private firms

Cooperatives play a significant role in the citrus industry by pooling, processing, packing, marketing and distributing fruit, allowing growers to reduce costs and access more markets. Sunkist is the largest in the citrus industry and represents thousands of growers across California and Arizona. Regional based cooperatives provide localized support to growers who may be too small to access Sunkist. Private firms such as Wonderful Citrus and Sun Pacific compete with cooperatives for retail shelf-space and typically operate with a vertically integrated model (own/operate production, processing and/or distribution).

## Distributors, wholesalers and retailers

Distributors and wholesalers act as middleman between packing houses and end markets by purchasing, storing (using cold storage), and delivering fruit to retailers and restaurants. Fruit is perishable and in optimal conditions can be stored for up to three months for oranges and six months for lemons. Retailers include large supermarkets, club stores, specialty grocers and Direct-to-Consumer markets. Citrus fruits command a considerable amount of shelf space and packaging varies, ranging from loose fruit stored in bins/boxes to plastic/meshed bags.

# Drivers

## Consumer preferences

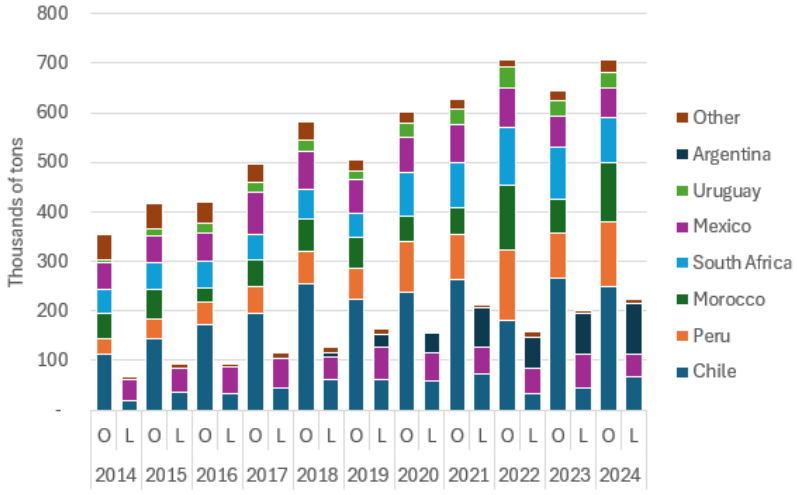
Several consumer trends impact demand, including:

- Shift toward different varieties – Mandarin oranges and Meyer lemons are increasingly preferred over more traditional varieties. Mandarins are desired for their easy-to-peel and portability attributes, while Meyers benefit from their sweeter and less-acidic taste profile. Specialty varieties such as Cara Cara and blood oranges have also gained in popularity.
- Declining juice consumption – Per capita orange juice consumption has fallen notably over the last twenty years. This may be due to health trends favoring whole fruit, concerns around high sugar content and competition from alternatives like almond milk.
- Seasonal peaks – Demand for fresh oranges increases during the winter and juice during the summer, aligning with California's navel and Valencia seasons, respectively.
- Falling lemon demand – Lemon demand has fallen over the last few years due in part to restaurant closures during the pandemic and declining use from a large fast food chain restaurant. There are increasing reports of growers switching to other crops such as avocados.
- Rising processed lemon product demand – Do-it-yourself, health and wellness trends have increased demand for lemon-derived products used as homemade cleaners, plant-based cooking and lemon oil diffusers.

## Imports

Increased plantings coupled with low labor costs and minimal trade barriers have enabled citrus growers in Central and South America to compete in U.S. markets. Fresh orange and lemon imports from major producing countries increased 98% and 235% over the last decade, respectively (see chart below). During this period, orange juice imports from Brazil increased 77% to 1.48 billion liters (391 million gallons).

*Fresh lemon and orange imports*

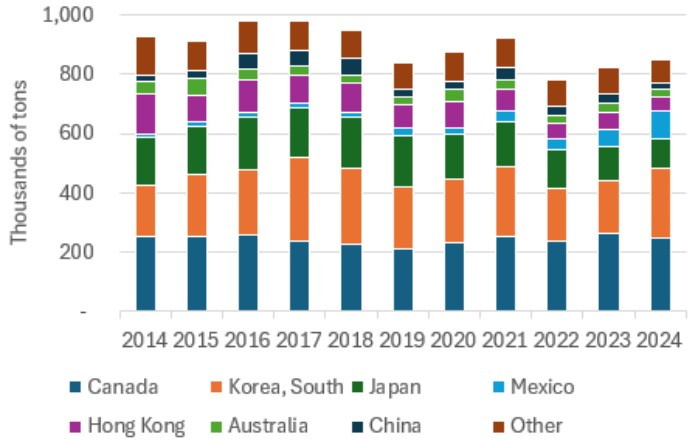



Source: U.S. Census Bureau Trade Database. O: Oranges. L: Lemons.

## International markets

Fresh orange exports make up about 18% of total U.S. production, ranging from about 620-780 thousand tons per year. Fresh lemon exports make up about 14% of total U.S. production, ranging from about 140-245 thousand tons per year. Top markets for each fruit include Canada, South Korea and Japan (see chart below). Over the last ten years, there has been a gradual decline to Japan, Hong Kong and Australia and increase to Mexico. Canada makes up about 80% of exports for both orange juice (346 million liters in total) and lemon juice (23 million liters in total).

***Fresh lemon and orange exports***




Source: U.S. Census Bureau Trade Database.

## Labor

Rising labor costs, largely the function of increasing competition and regulation, are pressuring citrus growers.

- Competition: There is a limited pool of domestic agriculture workers, forcing producers to increase wages, offer incentives and source foreign labor through the H2A Visa program (allows foreigners to temporarily work in agriculture during peak demand periods). Mechanization has had limited success in the citrus industry and has not been able to replace people.
- Regulation: California's minimum wage has more than doubled over the last decade, and relatively new overtime regulations require producers to pay workers 1.5 times regular pay between 8 – 12 hours / day, and double for anything after. California has strict guidelines related to heat illness, pesticide application, injury / illness prevention and sanitation. Regulations underpinning the H2A Visa program are complex and require producers to adhere to strict health guidelines, provide housing and pay wages based on the Adverse Effect Wage Rate (AEWR) established by the Department of Labor.

Compressed harvest windows for navel and Valencia oranges and to a lesser extent, Meyer lemons reduces supply and increases demand for labor. An extended bloom may lead to inconsistent fruit maturity, which can require additional harvest passes through the same acreage. Other adverse weather such as frost, excessive heat, wind, rain and hail can affect the quality of the fruit to be harvested, creating a need for intensified field sorting or selective picking.

## Technology

Technological advances in the citrus 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 facility*

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% to 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.

# Appendix A

## Best practices

The following summarizes the best practices common among successful and progressive citrus growers and processing facilities. 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 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 citrus varieties and peaking on a demanded size profile. A desirable varietal mix and high-yielding orchard structures 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 needs of their business.

*Align with fellow growers*

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

*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 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.

*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 can 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

**Bench Graft.** System where root stock and scion wood are grafted, shortly before the now grafted "tree" is planted in the orchard. This system eliminates the need for growing the trees in a nursery prior to planting in the orchard, however, the downside risk slower initial growth at the orchard site and potentially higher death loss.

**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.

**Blossom thinning.** Removing some of the blossoms that are turning to fruit.

**Boxes.** Fruit is hauled and stored in bins but packed for shipping in smaller cardboard boxes. A box of lemons and oranges is about 40 pounds.

**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).

**Culls.** Fruit that is discarded at the warehouse and will not go to market.

**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.

**Fresh.** Fruits (or vegetables) that are harvested and sold without the intention of further processing. Generally, fresh fruits will be consumed raw by the consumer.

**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).

**Fruiting wood.** The smaller wood or spurs on which the fruit is actually grown.

**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 form which leaves emerge.

**Marketing-sales desk.** Sells and markets fruit on behalf of packers.

**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.

**Pickers.** Workers who pick tree fruit by hand, and carefully handle the fruit to ensure good quality. The picker wears a bucket that has a canvas bottom, held shut with a drawstring. When the bucket is full, the worker empties it into a wooden bin by releasing the string.

**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 fruit crop. In most tree fruit, the transfer is accomplished by insects.

**Processing.** Fruit that is not sent to the fresh market and is typically canned, sliced or juiced.

**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 fruit variety, which is grafted onto root stock.

**Set.** The number of blossoms or fruit 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 2-year or older branches and produce flowers and fruit.

**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.