AgWest FARM CREDIT

Industry Perspectives

Apples

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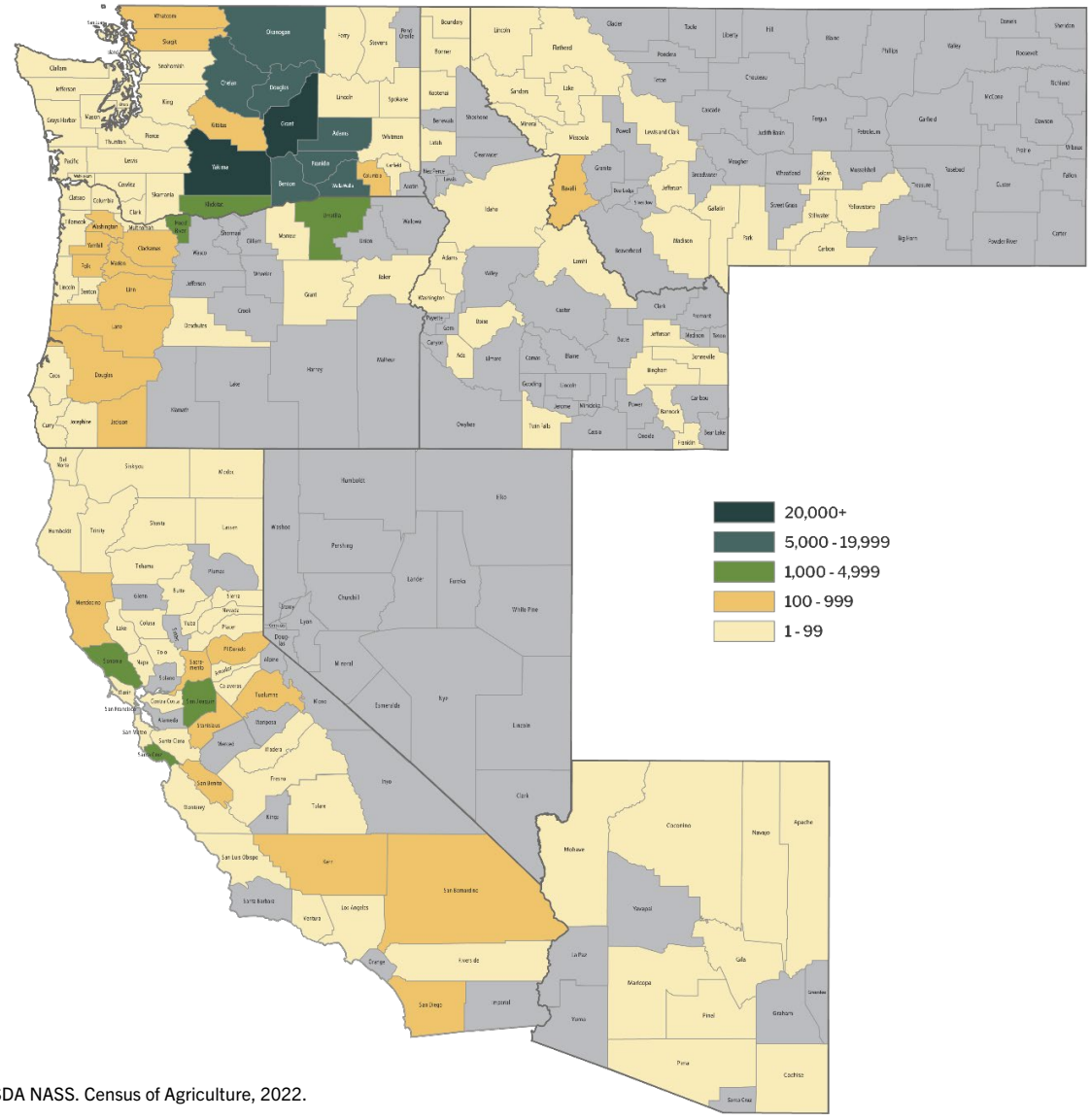
Industry overview

Apples are among the most popular specialty crops in the United States and perhaps the world, driven largely by its status as a stable food item among consumers. An array of varietals provide a range of flavor experiences, including crisp, sweet, tangy and/or tart. Researchers are continuously experimenting with new varieties, and growers will bring those that respond well in the marketplace to production. The value chain is robust, with nurseries that grow rootstocks and starter plants, producers who increasingly implement advanced planting techniques to increase yields, packers that sort fruit using sophisticated optical and robotic systems, and established marketing desks that have the size and scope to efficiently sell and ship to the largest retailers. Despite this level of sophistication, apples remain entirely harvested by hand using labor most often sourced from Mexico. Global markets, while only taking an average of 10% - 20% of U.S. production, are important outlets during large crop years and for more traditional varieties such as Red Delicious. All in all, the apple industry is complex, dynamic and is continuously adjusting to the times.

Production trends

Global apple production has trended up since USDA's Foreign Agricultural Service (FAS) started recording data in 1970. China is by far the largest producer, followed by Europe, the U.S. and Turkey. Within the U.S., Washington produces about two-thirds of the nation's total, followed by New York and Michigan. Washington benefits from rich soil, near-ideal fruit-growing climate – warm days and cool nights with dry summers – and sophisticated storage, packing and marketing infrastructure.

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



Source: USDA NASS. Census of Agriculture, 2022.

Varieties

Washington produces several apple varieties, each with their own color, flavor and growing characteristics (see chart below). Club varieties such as Envy, Rockit, Opal and others differ from traditional in that they are licensed to growers and marketers by a plant breeder. They come with certain requirements, including royalties, how many acres can be planted and/or at what point during the season they can be shipped to retailers. Of these varieties, Cosmic Crisp has seen unprecedented acreage growth and production could reach as high as 25 million boxes by 2028 (about 15% to 20% of the total crop).

Primary apple varieties

Variety	Color	Character	Use	Harvest time	Percentage of Northwest crop
Gala	Red to pinkish-orange over yellow background	Very crisp, sweet, tart	Fresh, sliced	July to September	19%
Red Delicious	Red, stripe or blush	Crisp, mildly sweet, stores well	Fresh	September to October	15%
Granny Smith	Green, green blush	Very firm, crisp, very tart	Fresh, cooking	October	14%
Honeycrisp	Bright red over pale green background	Crisp, juicy, tangy-sweet flavor	Fresh, cooking	September to October	15%
Fuji	Red blush with yellow to green background	Very firm, crisp, sweet, stores very well	Fresh, cooking	October/ November	11%
Cripps Pink	Reddish-pink with orange background	Firm, crisp, tangy-tart, sweet	Fresh, sliced, cooking	October/ November	6%
Cosmic Crisp	Dark red scattered with brigtht lenticels	Crunchy, juicy, sweet, a bit of tang	Fresh, cooking	September to October	5%

Source: Washington State Tree Fruit Association. Bestapples.com.

Value and supply chain

Growth and harvest

Apple trees grow from rootstocks that are selected based on dwarfing, anchorage and pest resistance characteristics. Most rootstocks are established in nurseries where they develop in the field for a year before being grafted with an apple tree shoot and raised until ready for replanting. Some producers use a plant in place method where rootstocks and apple shoots are planted / grafted directly in the orchard. Once established, an apple tree is considered pre-productive for the first three to four years. Trees enter their economic lifecycle, where production is sufficient to cover costs, between years four and five. Full production happens around five to seven years depending on variety, soil and growing methods.

While traditional orchards consisted of free-standing trees, modern orchards utilize trellis systems to improve efficiency and yields. In these systems, trees are planted at designated spacings and limbs are trained on wires to maximize space utilization. Wire densities can range, with tighter spacing often allowing producers to better control fruit loads, canopy management and marketable fruit. This has allowed for greater adoption of mechanized platforms, which help to transport workers during harvest, pruning, training and thinning activities. The two main trellis systems include:

- **V-trellises** are typically built with wood or metal posts. Post and wire spacing vary based on the planting density (trees per acre), variety and grower preference.
- **Vertical trellises** are typically built with wood posts and wires. As with V-trellises, post and wire spacing vary based on the planting density, variety and grower preference.

Trellis systems and dwarfing rootstock have enabled high-density orchards, or those with significantly higher trees per acre than traditional orchards. A free-standing orchard with about 500 trees per acre can produce about 40 bins per acre (there are 900 pounds per bin on average), while a high-density orchard with 2,000 trees per acre can produce upwards of 80 bins per acre. The widespread adoption of these practices over the last several decades has increased total apple production.

Other developments include:

- Adoption of technologies supporting high-precision agriculture, including geospatial systems, variable-rate and digital fertilizer / water application technologies and drones for advanced data collection. Together, these should reduce input costs and improve ecological outcomes.
- Shade cloth and hail netting have become increasingly prevalent among apple producers despite their high capital requirements. While their use may impact photosynthesis and subsequently lead to smaller and less colorful fruit, benefits include reduced heat stress, sunburn, weather damage, water demand and risk of microbial contamination from overhead / cooling irrigation water.
- Automated picking technology has been in development for many years but is not yet commercially viable.

Despite these advancements, orchard management remains a labor-intensive process and this can create challenges, particularly during harvest. Compressed harvest seasons, where fruit is picked within a tighter-than-normal timeframe, can result in labor demand exceeding supply. (Compressed harvests occur due to weather and/or fruit maturation conditions.) In heavy crop years, growers have to be more selective with harvest, choosing blocks with more marketable fruit (relating to yield and/or quality). 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 impact fruit quality, resulting in greater field sorting or selective picking.

Packing warehouses

After harvest, apples are sent to a packing warehouse, which acts as an intermediary between growers and retailers (growers own their fruit until it reaches retailers). Fruit is washed, sorted, waxed, boxed, stored and shipped. The Northwest's two main packing hubs are in Yakima and Wenatchee, Washington.

Pre-size and commit-to-pack lines are two traditional approaches to a packing line:

- Pre-size lines sort by size and grade, after which point apples are placed back into bins for storage. These apples will either be sent directly to packing or kept in storage until a later date as dictated by the market and will then be sent to a dedicated packing line.
- Commit-to-pack lines sort, size and pack apples directly into retail packages, after which point they're placed into storage until markets are ready to take them. Commit-to-pack systems are the industry standard today as they allow fruit to be handled once, thereby reducing external damage and internal bruising.

Packing warehouses have adopted new technologies over the last decade to reduce labor demand and increase the value returned per fruit. (Labor cost and availability is a significant challenge.) Cameras and sophisticated software programs sort for size, color, shape, grade, external defects and internal condition – characteristics that determine an apple's market value. Robotic palletizing, as well as automated bagging and storage systems, have also become commonplace. While these technologies can reduce labor demand, they require significant capital investments and thus a relatively high amount of throughput is needed to be profitable. As a result, individual industry producers have generally been seeking economies of scale with each successive packing automation upgrade.

The most desirable size and color of apples go to fresh markets where premiums are highest, while lower quality fruit goes to processed markets such as slicers/peelers, juice and applesauce. The Washington apple industry is focused on fresh pack, and processor apples are a by-product.

Apples will be stored in cold storage (CS) and controlled atmosphere storage (CA) depending on when they go to market. Washington has the largest concentration of CS and CA facilities in the world. CS is traditional refrigeration and can hold apples for up to 90 days before quality is jeopardized. CA storage maintains precise levels of temperature, humidity, oxygen and carbon dioxide, reducing an apple's metabolic rate and enabling storage for about a year.

Large-scale fruit-packing warehouses tend to also own orchards and/or maintain production-packing agreements with large, independent fruit growers. Vertically integrated producers have been around since the beginning of the industry. Several packing warehouses sell their own fruit, but more commonly multiple packers share a common fruit marketing company/sales desk that allows smaller packers to serve the needs of the largest retailers.

Marketing-sales desks

Marketing-sales desks also act as intermediaries between packing warehouses and retail stores, serving to align supply with demand. The U.S. apple market is dominated by large retail grocery chains that not only specify the size profile and quality of fruit desired, but maintain large volume requirements (see Retailers section below). Marketing desks allow the apple industry to collectively meet their needs. The Northwest tree-fruit industry is consolidated down to approximately 20 marketing-sales desks, with the 10 largest moving the bulk of the fruit produced.

Retailers

Apples command a considerable amount of shelf space, particularly given the large number of varieties available. Marketing-sales desks enter into multi-year agreements to supply retailers, who then market and sell fruit to consumers. Large grocery stores typically prefer fruit in the 72- to 88-size range (as measured by the number of apples that can fit into a 40-pound box) and are responsive to consumer trends.

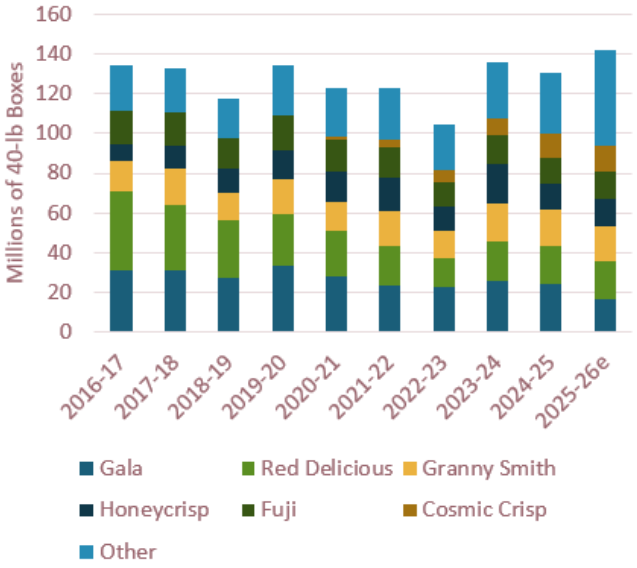
Drivers

U.S. consumer preferences

About 80% - 90% of the crop produced in the Northwest stays in the U.S., where consumer preferences are constantly evolving. Red and Golden Delicious apples were once cornerstones in the marketplace; with time however, these two, along with older Fuji and Gala strains, have lost favor to modern varieties such as Honeycrisp and Cosmic Crisp. New strains of Gala and Fuji with favorable coloring, texture and crispness have done a better job of maintaining market presence. Club varieties have seen a decline in sales and there is concern among some that they lack sufficient differentiation from traditional varieties to justify development costs. Demand for organic fruit has remained strong and this has led to stronger margins for producers diversified into this space. (Organic apples receive a price premium and make up about 11% - 12% of the Northwest crop.) Bagged fruit, which use smaller fruit sizes, gained in popularity during the pandemic. Marketing-desks typically have a harder time selling fruit with a larger size profile.

Producers face a trade-off between 1) investing in continued orchard development to stay aligned with consumer trends and 2) doing nothing and risking varietal obsolescence and compressed margins. Generally speaking, those who are more proactive in aligning their asset base with the marketplace have been rewarded with higher rates of return and greater resilience when prices decline during large crop years. Since orchard rejuvenation results in unproductive assets, it is recommended that growers stay ahead by perpetually keeping 15% to 20% of their acres in some stage of development at all times.

Northwest apple crops by variety



Source: Washington State Tree Fruit Commission. e: Estimate based on Aug 2026 crop forecast.

Labor cost and availability

Labor cost and availability are significant challenges for the apple industry. Fewer domestic workers than in the past are willing to do the manual labor necessary during harvest. Many employers are having to raise wages, work with labor contractors and keep well-maintained labor housings. The H-2A Temporary Agricultural Worker program provides an outlet for sourcing seasonal labor, though it's expensive and complicated due to transportation, housing and minimum guaranteed employment requirements. The Adverse Effective Wage Rate (AEWR) sets the base pay for H-2A workers. Among domestic apple producers, the rate is highest in Oregon and Washington at $19.82 (Michigan and New York are at $18.15 and $18.83, respectively).

Labor laws / regulations are becoming more complex and stringent. The Washington State Department of Labor and Industries issued a permanent heat rule in 2023, mandating employees allocate paid cool-down rest periods for outdoor workers. Both Washington and Oregon implemented new overtime rules for agriculture workers to be implemented in a

multi-year phase-in process, with Washington falling to 40 hours per week starting January 2024. Currently, overtime starts at 48 hours per week in Oregon, but this will fall to 40 hours in January 2027. As of August 2025, businesses must collect retail sales tax for temporary staffing services (providing workers to other business for limited periods of time). Additionally, gross income from these activities is subject to business and occupation tax under the Retailing classification (as opposed to it being activity based). Farm labor in the apple industry is largely provided on a temporary and contract basis due to the industry's seasonal nature.

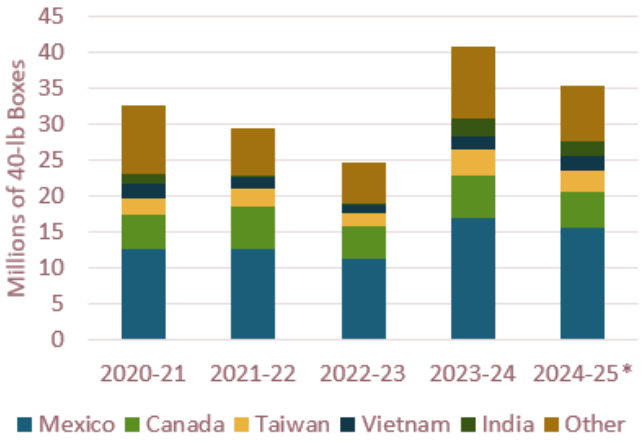
Adoption of new systems and technologies

Growers and packers continually look for ways to improve productivity. As mentioned above, much of the industry has invested in high-density orchards, mechanization platforms and technologies that support both precision agriculture and automated sorting / packing at warehouses. While efficiency gains often result in substantial benefits, their high capital costs have led to industry consolidation and can create financial stress during market downturns.

Export markets

While the vast majority of apples are sold domestically, export markets play an important role particularly as the crop has gotten larger. Key foreign markets include Mexico, Canada and Asia, and are particularly important for varieties that are not as desirable in the domestic market (i.e. Red and Golden Delicious). U.S. dollar strength and rising labor costs have weakened the competitiveness of domestic producers relative to their international peers, a trend that has reduced access to export markets. Reduced export levels can contribute to oversupply in domestic markets, particularly during large crop years.

Apple exports by country



Source: Washington State Tree Fruit Association. *Exports as of August 2025.

Trade disputes can greatly impact trade flows. In 2017, India surpassed Canada to become the second-largest importer of U.S. apples. In 2018, tariffs were implemented as part of the steel and aluminum dispute (Section 232) and this, along with the devaluation of the Indian rupee, resulted in a sharp drop in exports. In 2023, India reduced the tariff level down to the traditional level of 50% and while exports picked up, they remain significantly below pre-2019 levels.

Crop diversification

Many apple producers opt to diversify production into other fruits, particularly pears and cherries.

Pears

China, the European Union (EU) and the U.S. are the largest pear producers. China is responsible for around 76% of the world's pear crop, while the European Union (EU) and U.S only account for around 7% and 3% respectively. The Western U.S. is the nation's dominant player in pear production, accounting for approximately 80% of acres and production. Pears are primarily produced in the Yakima and Wenatchee areas of Washington, Hood River and Rogue River Valley areas of Oregon, and Mendocino, Lake, and Sacramento Counties of California. The top varieties include D'Anjou (56% of total production in the 2022-23 season), Bartlett (28%) and Bosc (12%).

Primary pear varieties

Variety	Color	Character	Use	Harvest time
Green Bartlett	Green	Short shelf life	Processing, fresh	August/September
Red Bartlett	Red	Difficult to grow, short shelf life	Fresh	August/September
D'Anjou	Green	Stores well, easy to grow	Fresh	September/October
Red D'Anjou	Red	Can be difficult to grow	Fresh	September/October
Bosc	Gold Russet	Must have quality finish	Fresh, cooking	September/October
Comice	Green	Low tonnage, delicate	Fresh	September/October
Starkcrimson	Red	Short shelf life	Fresh	August/September

Source: AgWest Farm Credit. Additional information about pear varieties is available at www.usapears.com.

The value chain of pears (production, sorting, packing, storing and marketing) is nearly identical to apples, albeit at a much smaller scale. Primary industry drivers include technological advancements, labor availability/cost, consumer demand and export markets. Orchards have a long pre-productive period (about eight years), which makes the barrier to entry for prospective producers higher than apples and cherries. Consumers increasingly view pears as staple food items, but for many, they remain novelty purchases. There has been a gradual decline in pear consumption since 2011, mainly driven by the canned market, whereas fresh fruit has held constant.

Cherries

The U.S. is the second largest producer of cherries behind Turkey. Washington leads the nation with around two-thirds of sweet cherry production, followed by California and Oregon. The Yakima Valley and Wenatchee Valley regions of Washington, and Willamette Valley and The Dalles/Hood River areas of Oregon dominate cherry production in the Pacific Northwest. In California, production occurs primarily within the San Joaquin Valley. The bulk of the Western U.S. red cherry production is comprised of Bing, Sweetheart, Skeena, Chelan, Tieton, Lapin and Lambert varieties. Californian cherries generally ripen two weeks to a month ahead of the Northwest. Similar to apples, there are new varieties being planted in the Pacific Northwest which have early harvest dates and/or large size capabilities.

Sweet cherry varieties, fresh market

Variety	Color	Character	Approximate harvest time
Chelan	Mahogany, red	Sweet, rich flavor; 16%-18% sugar; firm	Late-April to mid-June
Bing	Mahogany	Sweet, rich flavor; 17%-19% sugar; firm	May to early August
Rainier	Golden, red blush	Sweet delicate flavor; 17%-23% sugar	Late-May to early August
Lapin	Mahogany, red	Late variety; 17%-19%sugar	Early-July to mid-August
Skeena	Mahogany, red	Late variety; 19%-20% sugar	Mid-July to early August
Sweetheart	Dark red	Late variety; 16%-19% sugar	Late-July to mid-August

Source: AgWest Farm Credit. Additional information about cherry varieties is available via **www.nwcherries.com.**

The production, sorting and marketing aspects of the cherry value chain are similar to apples and pears; however, cherries do not store well for extended periods of time. Cherries are packed and sold similar to apples, though this occurs at a much more rapid pace (which can lead to an oversupply if/when there is a significant overlap among Western states). Primary industry drivers include technological advancements, labor availability/cost, consumer demand and export markets. Consumers view cherries as a luxury food item, suggesting this fruit is at greater risk of lower demand during economically difficult times than apples and pears.

Appendix A: Best practices

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

Orchard production

Have a strategic plan

- Successful businesses have defined goals and are continually in the process of executing specific strategies in their business. These strategies may include growth (e.g., 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 fruit 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.
- Growers with high-density plantings and/or highly demanded varietals may have a higher per-acre cost structure than the average grower, but the increased yields often result in the high-density planting having a per-bin cost advantage.
- Focusing on orchards of an economic size is key to long-term cost competitiveness.

Diversify varietal mix

- Growers achieve diversification by growing multiple types and varieties of fruit.

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 and shade cloth, 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.

Maintain a disciplined approach to orchard renovation

- New plantings and grafting scions onto existing rootstocks are two forms of regeneration. Grafting is more cost effective but is not always feasible. Top-performing growers place their operations on a renovation schedule. To maintain the competitiveness of the orchard as a whole, over 15% of total planted acres on average may be pre-productive at any one time. However, too many pre-productive acres, around 25%, can pressure orchard cash flow.
- Orchard renovation not only allows for updated orchard structure (e.g., denser plantings and/or trellis systems) but allows orchards to avoid varietal strain obsolescence.

Align with fellow growers

- When their operations lack critical mass, successful producers align with other growers to attract picking crews and assure them of a consistent supply of work that extends from the start of cherry through apple harvests. Access to a dependable labor force will continue to be an important piece of orchard production going forward.
- Growers may also partner with other growers to leverage volume discounts for equipment, chemicals, fertilizers, fuel and other necessary inputs.

Align with a warehouse

- Successful growers align with successful packing or storage warehouses that provide competitive services at reasonable costs. These warehouses need to have quality facilities and current fruit-handling and packing equipment. Growers who align with successful warehouses tend to perform with more consistent profitability.

Align with a marketing-sales desk

Successful growers place fruit with packing and storage warehouses aligned with a strong marketing-sales desk. This provides ready access to large domestic and international retail markets, which translates into the most competitive returns.

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

- Successful fruit growers have established and implemented a labor strategy for their business that will ensure their seasonal labor needs are met.
- Progressive tree-fruit growers need to be prepared to furnish housing and year-round employment as a means of retaining key employees.
- To help alleviate labor shortages during peak harvest times, producers have begun planting several varieties at different locations or elevations. This creates varied harvest times and a steadier labor-demand window.
- 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.
- Some producers have successfully used contractors who, for a fee, offer full-service labor. However, this practice has met some resistance, mostly because of timing and scheduling considerations.
- The development of labor-reducing or "picker-friendly" tree-planting styles is proving to be an advantage in terms of the ability to attract and retain an adequate labor supply.

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.

Warehousing best practices

Have a strategic plan

- Successful businesses have goals and are continually in the process of executing specific strategies in their business. These strategies may include growth (e.g., diversification, replication, integration, networking), downsizing/rightsizing, or intensifying (i.e., improving efficiency).

Maximize facility use

- Successful warehouses maximize the use of fixed assets.
- Improved use results in reduced per-unit costs, which enables warehouses to maintain competitive grower returns.

Contain expenses

- Warehouses, as packing entities, must understand fixed and variable costs to maintain competitive packing charges and maximize income levels.
- Cost containment allows a warehouse to reduce the level of throughput needed to break even in short crop years when fruit supplies are more scarce than usual.
- 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.

Align with other packing warehouses

Allied packing warehouses trade packing and storage capacity to use assets to their fullest potential. This situation is most often seen with warehouses using a common marketing-sales desk.

- Aligned warehouses can dedicate a specific line to a particular variety with fewer changeovers.
- Sharing and balancing storage needs, improving the variety and size profile of inventory for marketing-sales desks, and working together to realize increasingly efficient logistics and distribution are inherent advantages of partnership.

Partner with a proven and successful marketing-sales desk

- Successful packing warehouses align with marketing-sales desks that have steady access to a wide range of retail customers that use a broad portion of the total manifest, ultimately, to maximize fruit returns to the grower.
- Some integrated operations also own and operate a marketing-sales desk.
- Successful packing warehouses must closely monitor marketing-sales desk performance to ensure that competitive returns are realized on packed fruit.

Embrace new technology

- New technology, both in the field and in the warehouse, could reduce labor requirements substantially over the next five to ten years. Specifically, such technology could include the use of platforms and mechanical harvest methods in the orchards or the increased use of robotics and digital-imaging sorters within the warehouses.

Align with growers

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

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 is slower initial growth at the orchard site and potentially higher death loss.

Bin. A container that holds about 900 pounds of apples.

Bitter pit. A physiological problem with apples, seen as small, dark, rounded lesions on the skin. Caused by calcium deficiency.

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. If apple blossoms are not thinned and all fruit grows to maturity, apples are small in size, and the health of the tree is stressed.

Boxes. Apples are hauled and stored in bins but packed for shipping in smaller cardboard boxes. A box of apples is 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.

CA storage. Controlled atmospheric storage varies in size to hold from 10,000 boxes to 100,000 boxes. These rooms are sealed, and oxygen levels are reduced by the infusion of nitrogen gas to reduce the oxygen level from approximately 20% down to 1%-2%. The temperature of these rooms is kept between 32° and 36° Fahrenheit. This helps to keep the apples fresh tasting long after harvest because it slows the ripening process of stored apples.

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.

Club varieties. A relatively new trend in the industry. As new cultivars (varieties) become available from apple breeders, selective growers (clubs) through an exclusive license agreement commit to grow this new apple in the hopes of finding the next 'big seller.' A single packer and marketer focus efforts to control volumes and quality to capture high prices.

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

Cold storage (CS). 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.

Fireblight. A bacterial disease that causes the branches and fruit on apple trees to turn black and die. An apt name, the plant looks as if it has been scorched.

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

High density. An apple orchard with 1,000 or more trees planted per acre.

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

King blossom. The larger dominant blossom that is usually found in the center of the blossom cluster, surrounded by the yet unopened 'side blossoms.' The largest fruit will come from the king blossom.

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 USDA organic standards. Most farms and businesses that grow, handle or process organic products must be certified.

Packouts. The number of boxes of fruit that can be packed out of a bin.

Packer. The company that owns the warehouse where apples are packed, stored and shipped.

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. There are not enough wild bees to pollinate commercial orchards, so to ensure good pollination, growers place beehives throughout the orchard for 10 to 14 days during the bloom. Full bloom is when good pollination is essential.

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 amount 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.

Sleeping eye. Grown less than one year at the nursery. The rootstock is budded with the preferred variety in the fall. Before winter, the rootstock with its dormant bud is harvested, kept under optimal storage conditions, and then provided the next spring to the grower for establishment in the orchard. The grower is then responsible for training the tree resulting from growth of the bud, a step that is usually conducted at the nursery. This results in a lower outlay by the grower at this point in orchard establishment.

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.

Trellis.

V-trellis

Vertical trellis

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.