



Economic Considerations for Apple Production in Kentucky

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Introduction

Apples are the most widely planted tree fruit in Kentucky. The 2017 Census of Agriculture reported Kentucky's apple production at 1,106 acres, of which 784 acres were bearing. However, Kentucky's apple acreage has declined by more than half since the 1980s primarily due to aging orchard operators and orchard removal; since then, Kentucky apple producers have shifted from larger orchards to smaller orchards focused on selling apples locally. Direct marketing to consumers, through community farmers markets and on-farm stands, and production of value-added products, such as baked goods and cider, are emphasized by Kentucky apple producers today.

Mirroring the broad trend in farm and food crop production efficiency, U.S. apple yields per acre have increased as apple acreage has declined. The U.S. Department of Agriculture reported an average yield of 33,967 pounds per acre from 2013 to 2018, a significant increase from the average yield of 27,567 pounds per acre from 2007 to 2012. Many factors account for yield increases; the adoption of higher-density planting methods is one contributing factor.

Apple orchards can produce more apples per acre of land using high-density plantings; high-density plantings also require more intense management and higher establishment costs. High-density dwarf apple orchards are managed for a first harvest within two to three years after planting. This produces apple sales sooner than traditional semi-dwarf plantings, in which first harvest occurs three to four years after planting. This earlier harvest



TALL SPINDLE SYSTEM



is vital to offsetting the comparatively higher financial cost of establishing a high-density apple orchard. Higher yield potential, compared to semi-dwarf orchards, is also a possible long-term eco-

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conomic benefit for high-density plantings.

This publication summarizes some of the key economic concerns for comparing different apple production systems in Kentucky. Estimated establishment costs and production costs, based on an average Kentucky production scenario for 2019, are summarized in the table at the end of this publication. Estimates of economic returns for each system are not provided here as actual establishment and production costs vary considerably between locations based on site selection, land preparation costs and producer expertise. A more detailed cost and return estimate is provided in the Center for Crop Diversification (CCD) apple crop profile referenced at the end of this publication; however, those estimates are only representative of an average production situation in Kentucky for a given year.

Producers considering establishing apple orchards should develop their own cost and return estimates based on their actual production scenario and expected expenses, yields and prices. Tree fruit budget spreadsheets that allow producers to input actual cost estimates for their situation are available from several universities, listed in the “resources” section.

Production Systems

Three apple production systems are suited for establishment in Kentucky. A standard system is the semi-dwarf orchard using M.7 or a comparably sized rootstock, such as G.210. Higher-density systems are the conventional dwarf orchard and tall spindle orchard, both using high yield efficient rootstocks such as G.41 or G.202. Spacing, tree population and likely yields per acre in Kentucky are listed below:

Potential Apple Planting Populations for Kentucky, 2019

Semi-Dwarf	14x20'	155 trees/acre	300-350 bushels per acre
Conventional Dwarf	8x16'	340 trees/acre	550 bushels per acre
Tall Spindle Dwarf	4x12'	907 trees/acre	1,000 bushels per acre

Preplanting and Planting Costs: Key Categories for Comparison

Land Preparation

Orchard land preparation costs will vary according to the site. The budget estimates in the CCD apple profile assume costs for tilling and planting land for a cover crop in the summer prior to planting. These costs include machinery and equipment fuel, oil and repairs; seed; fertilizer and lime.

There can be additional land preparation costs for an orchard. A new orchard site may require earthmoving equipment to bulldoze and grade the land. Replanting an old apple orchard with new rootstock requires tree, stump and root removal.

Depending on the extent of site preparation, a 2016 estimate by Penn State University calculated more than \$5,000 per acre could be needed just to prepare a tree fruit site for planting. Based on custom hired earthmoving equipment rates in Kentucky for 2019, these costs are realistic “higher-end” estimates of potential per-acre soil preparation costs.

Wildlife Control

Wildlife, particularly deer, can cause significant economic loss to specialty crop plantings in Kentucky. Orchardists can maintain perimeter barriers, such as electric fences, to prevent deer from damaging trees. Tree guards will provide protection from voles and rabbits for newly planted trees. Purchasing tree guards in higher quantities can decrease the cost per guard. Deer repellants are also sometimes used to discourage deer from approaching the trees if deer populations in the area are low.

Tree Support Systems

The per acre costs for planting conventional dwarf and tall spindle apple orchards are higher than semi-dwarf



CONVENTIONAL DWARF SYSTEM

Source: John Strang, UK Department of Horticulture

Planting Cost Considerations Per Acre

	Semi-Dwarf	Conventional Dwarf	Tall Spindle Dwarf
Trees/Rootstock	155 trees	340 trees	907 trees
Tree Guards	155 guards	340 guards	907 guards
Wildlife Control	Deer repellent, fencing (possible)	Deer repellent, fencing (possible)	Deer repellent, fencing (possible)
Tree Stakes		340 stakes	907 stakes
Posts & Wire			150 posts; ~15,000 feet wire
Tree Clips		680 clips	2,425 clips
Ground Anchors			2 per row
Miscellaneous Spindle System Supplies			Gripples, gripple tool, splicer, staples (Totaling ~\$40 to \$100)
Seasonal Labor	20-30 hours hired for planting, plus 10 hours owner labor	30-40 hired hours for planting, plus 20 hours owner labor	80-90 hours for planting, plus 30 hours owner labor

orchards. The higher number of trees increases the total cost of establishment even as cost per tree declines with larger orders. More labor is also needed to plant higher populations. Tree support systems must also be constructed, and these include higher material and labor costs than semi-dwarf orchards.

The table above lists common material and equipment cost categories for each system. Remember: Although the dwarf systems have higher establishment costs, they will produce sooner, bring the orchard up to full production years earlier and will produce higher yields of higher quality fruit over the life of the orchard. This can help offset the higher establishment and planting costs and generate higher returns per acre than traditional semi-dwarf plantings. Dwarf and tall spindle orchards usually remain productive for 20 to 25 years, while semi-dwarf orchards may last longer with good care. At the same time, dwarf plantings require more intensive management. This can create more production risk, especially for inexperienced producers.

Labor

Farm producers often underestimate their time investment when planning and preparing for a new crop. Successful orchard establishment requires some thoughtful time spent in research and planning. Some producers, especially larger-scale operations involving relatively higher capital investments, will hire experienced consultants to plan the site.

Another potential cost, relative to time, is that the desired rootstocks and cultivars are usually not immediately available. Commercial quantities may need to be ordered one to two years in advance. These are potential

areas of delay for planting a productive orchard.

There is an obvious labor difference for each system, as indicated in the per acre planting labor hour estimates in the table above. Cost approximations for hired labor, based on the median time estimate and a \$12.50 wage rate, are as follows:

Semi-Dwarf	25 hours, \$312.50
Conventional Dwarf	35 hours, \$437.50
Tall Spindle Dwarf	85 hours, \$1,062.50

The higher labor cost for tall spindle systems, similar to the higher materials costs, mean that earlier and higher production is essential for this system to generate a similar or greater return on investment as the semi-dwarf and conventional dwarf systems in Kentucky.

Irrigation

Irrigation is recommended for new tree fruit plantings in Kentucky. Irrigation is crucial for higher density plantings, where trickle irrigation systems are used to provide moisture and nutrients through fertigation. Producers without existing irrigation systems (pumps, filters, pipelines, etc.) will incur additional startup expenses.

Production Costs: Key Categories for Consideration

Next to labor, discussed below, managing diseases and pests usually rank as the highest cost category for tree fruit production in Kentucky. Disease and pest management costs will usually be similar between production systems, as these costs do not greatly vary based upon planting density.

Labor – Pruning

Greater ease of pruning, because of smaller tree size, is one of the benefits for dwarf plantings. Producers and hired workers with pruning experience should be able to complete pruning with less time per tree for dwarf orchards, compared to semi-dwarf orchards. Tree training labor and fruit thinning costs are considerably higher for conventional dwarf and tall spindle dwarf orchards. These labor hours will result in higher labor costs, compared to semi-dwarf systems, in the years after planting dwarf systems.

Labor - Harvest

An experienced apple picker can harvest about 12½ bushels of apples per hour. This results in about 36 hours of hired harvest labor required for a yield of 450 bushels per acre. On-farm packing and grading will require additional labor (15 to 25 hours per 450 bushels), depending on the kind of packaging used.

Marketing Costs

Marketing costs are frequently underestimated when developing budget estimates for specialty crops. Part of the reason for underestimating marketing costs is the difficulty of estimating total time required to sell crops through direct markets, such as community farmers markets and community supported agriculture. Unanticipated marketing material costs, such as signage and website design or social media marketing campaign costs, can also surprise specialty crop producers.

It is recommended that producers develop a marketing plan and a budget for how that plan will be accomplished. Several resources that can help producers develop their own marketing plans are highlighted in the resources section below.

Comparing Total Establishment Costs and Production Costs per Bushel

Higher establishment costs for dwarf systems are usu-

ally offset by a shorter period until full bearing age and the potential for higher overall yields of top quality apples early in the life of the planting and during full bearing years. The table below presents a hypothetical total cost summary for the semi-dwarf, conventional dwarf and tall spindle dwarf systems. While the higher establishment costs for the dwarf system creates comparatively more financial risks, the potential for faster-yielding dwarf trees creates a relatively similar cost of establishment between the conventional dwarf and semi-dwarf system. This is because the semi-dwarf trees must have one or more additional years to grow until they reach bearing age.

One very important economic concept to emphasize in the discussion of apple production systems is for the producers to know their cost per unit of production. The cost summary on the next page, while not intended to forecast any specific production situation, includes a comparison of the per bushel cost in full bearing years. This illustrates that the conventional and tall spindle dwarf systems have a lower cost per bushel, in this instance, because of total costs being spread out across a significantly higher total yield.

Cost estimates were developed for the 2019 season using average Kentucky conditions. These are provided only for comparison purposes and should not be interpreted as indicators of potential actual costs or profitability, as costs will vary considerably from orchard to orchard. These cost estimates do not include additional land preparation costs, such as grading and other site preparation costs, that may be more likely when establishing conventional dwarf and tall spindle dwarf systems.

Summary

Apples remain a viable and potentially profitable en-



SEMI-DWARF SYSTEM

Estimated Costs for Establishing One Acre of Apples, Kentucky, 2019

	Semi-Dwarf (155 trees)	Conventional Dwarf (340 trees)	Tall Spindle Dwarf (907 trees)
Preplanting Year	\$1,150	\$1,150	\$1,150
Planting Year	\$3,175	\$5,025	\$15,150
Growing Year	\$1,450	\$1,750	\$2,600
(Two years for semi-dwarf, one year for dwarf)	(\$2,900 over two growing years)		
Establishment Costs before first bearing year	\$7,225	\$7,925	\$18,900
Full Bearing	\$3,850	\$5,775	\$9,900
	(300 bu.)	(550 bu.)	(1,000 bu.)
Sample total cost per bushel in full-bearing year	\$12.84	\$10.50	\$9.90

Costs per acre are rounded to nearest \$25 and include both variable and fixed costs for each year.

terprise for Kentucky growers. Higher-density plantings may be an appropriate selection for orchardists with access to sites suitable for apple plantings, as well as access to the comparatively higher financial capital required for establishing conventional dwarf and tall spindle dwarf apple orchards. Higher-density plantings can produce significantly higher yields at potentially lower costs per bushel in full-bearing years, compared to semi-dwarf orchards. However, long-term profitability for apples is very sensitive to prices, yields and the total establishment costs for new plantings. Producers should carefully construct budget estimates, accounting for orchard site and their level of production expertise, to determine the potential for economic profitability in each specific situation.

Additional Resources

- Apples (Center for Crop Diversification resource page) <https://www.uky.edu/ccd/production/crop-resources/fruit/apples>
- Apple Trellis Construction for High Density Orchard Systems (Penn State University) <https://extension.psu.edu/apple-trellis-construction-for-high-density-orchard-systems>
- Tree Fruit Budgets (Penn State University) <https://agsci.psu.edu/research/extension-centers/frec/resources/tree-fruit-budgets>

- Apple Budget (The Ohio State University, 2000) <https://aede.osu.edu/research/osu-farm-management/enterprise-budgets/archived-budgets-2009-2001>

Note: Although the cost estimates in this budget are dated, the spreadsheet template is very functional for producers to use when developing their own estimates.

- Southern Appalachian Apples (North Carolina State University) <https://apples.ces.ncsu.edu/#>
- A General Guide to Pricing for Direct Farm Marketers and Value-Added Agricultural Entrepreneurs (University of Tennessee, 2011) <https://utextension.tennessee.edu/publications/Documents/PB1803.pdf>
- Choosing Direct Marketing Channels for Agricultural Products (University of Tennessee, 2010) <https://utextension.tennessee.edu/publications/Documents/PB1796.pdf>

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