

2019 COST ESTIMATES OF ESTABLISHING, PRODUCING, AND PACKING HONEYCRISP APPLES IN WASHINGTON



Preface

The results presented in this WSU publication serve as a general guide for evaluating the feasibility of producing Honeycrisp apples in Washington State as of 2019. This publication is not intended to be a definitive guide to production practices, but it is helpful in estimating the physical and financial requirements of comparable plantings. Specific budget assumptions were adopted for this study, but these assumptions may not fit every situation since production costs and returns vary across orchard operations, depending on the following factors:

- Capital, labor, and natural resources
- Crop yields
- Type and size of machinery, irrigation, and frost control systems
- Input prices
- Production and management practices
- Apple prices
- Orchard size
- Management skills

Cost estimations in the enterprise budget also vary depending on its intended use. To avoid drawing unwarranted conclusions for any particular orchard, readers must closely examine the assumptions made in this guide, and then adjust the costs, returns, or both as appropriate for their own orchard operation.

Honeycrisp Production in Washington State

During 2006–2017, bearing acres of Honeycrisp in Washington State have witnessed a dramatic increase of 425%, from 4,307 acres planted in 2006 to 22,616 total bearing acres in 2017. In 2017, Honeycrisp was the fourth largest cultivar in acreage with 13% of Washington State’s total apple acreage, only after Red Delicious, Gala, and Fuji. Across the state, 42% of the Washington Honeycrisp acreage are in the Yakima district, 35% in the Columbia Basin, 18% in the Wenatchee district, and 5% in other areas (USDA NASS 2017).

As of 2018, the total U.S. production of Honeycrisp was 24.74 million 40 lb boxes, while Honeycrisp production in Washington was 12.13 million 40 lb boxes; therefore, Washington represents 49% of all U.S. production of Honeycrisp apples (U.S. Apple Association 2018; WSTFA 2020). As of 2018–2019, in terms of fresh apple shipments, Honeycrisp is the fifth largest cultivar grown in Washington State, with 10% of total shipments, following the traditional cultivars, Red Delicious, Gala, Fuji, and Granny Smith. Between 2008 and 2018, Honeycrisp shipments have increased by 673%. On average, shipments have grown annually by 24% during the last ten years (WSTFA 2020). The graph in Figure 1 illustrates the increase of Honeycrisp shipments.

Honeycrisp enjoys a price premium above the more traditional apple cultivars grown in Washington. For example, during 2018–2019, the average FOB (free on board) price of Honeycrisp was at \$53/40 lb box, compared with Red Delicious at \$17.7/40 lb box, Gala at \$25.6/40 lb box, Fuji at \$25.7/40 lb box, and Granny Smith at \$28.8/40 lb box (WSTFA 2020).

Study Objectives

This publication is designed to enable owner-operators to estimate: (1) the costs of equipment, materials, supplies, and labor required to establish and produce a Honeycrisp orchard and (2) the ranges of price and yield at which Honeycrisp production would be a profitable enterprise.

The primary use of this report is to identify inputs, costs, and yields considered to be typical of well-managed Honeycrisp orchards. This publication does not necessarily represent any particular orchard operation and is not intended to be a definitive guide to production and management practices. However, it describes current industry trends and, as such, can be helpful in estimating the physical and financial requirements of comparable plantings.

Information Sources

The data used in this study were gathered from a group of experienced Honeycrisp owner-operators in Washington State. Their production practices and input requirements form the baseline assumptions that were used to develop the enterprise budget. Additionally, the data represent what these owner-operators anticipate over an orchard's life if no unforeseen failures occur. Given that many factors affect production costs, pack-out, and returns, individual owner-operators can refer to the Excel Workbook section to estimate their own costs and returns.

Budget Assumptions

1. The area of the total farm operation is 300 acres. Bearing acres include 225 acres of apples (75% of total area), 48 acres of sweet cherries (16%), and 27 acres of pears (9%).
2. This budget is based on a 22-acre Honeycrisp block within a 300-acre orchard. It is assumed that 5% of this block is

dedicated to roads, pond, loading area, buildings, etc., rather than to fruit production. Therefore, the total productive area for this block is 21 acres. Table 1 shows the assumed Honeycrisp block specifications.

3. The total value of bare agricultural land (including water rights) is \$18,000 per acre with annual property taxes of \$170 per acre.
4. The investment in infrastructure, cultural practices, and harvest activities aim to capture state-of-the-art practices in apple production across Washington. However, consider that not all investments are representative for the majority of apple operations. For example, the use of netting is becoming widespread; yet, sunburn protectant sprays or overhead cooling are still the predominant sunburn protection methods.
5. The irrigation system consists of overhead cooling and under-tree drip sprinklers with two separate sub-main lines. Water is provided through a public irrigation district.
6. The pond is installed in Year 1.
7. Cultural practices and harvest activities are done by using a combination of ladders and labor-enhancing equipment. The hourly labor rate for 2019 is calculated using the Washington adverse wage rate for 2019 at \$15.03/hour (U.S. Department of Labor 2019a). We add 25% to this hourly rate to reflect medical leave, payroll taxes, and all administrative costs for H2A employees, including housing, amounting to \$18.79/hour. Activities such as chemical application, irrigation, and frost protection are assumed to cost \$16.03/hour, plus 25% totals of \$20.04/hour. Harvest labor rates follow the Department of Labor prevailing wage rates for 2019 (U.S. Department of Labor 2019b), and we add 4% to these harvest labor rates to account for mandated paid rest breaks.
8. Warehouse packing charges assume a 690 lb bin.
9. The gross return is assumed at \$741/690 lb bin; equivalent to \$57/40 lb box.
10. Average pack-out for Honeycrisp is 75% of a 690 lb bin, equivalent to thirteen 40 lb boxes per 690 lb bin.
11. Management is valued at \$700 per acre.
12. Interest on investment represents a 5% opportunity cost to the enterprise. These are forgone earnings from investing money in orchard, equipment, and buildings rather than in an alternative activity. This also represents interest on funds borrowed to finance orchard, equipment, and building purchases.

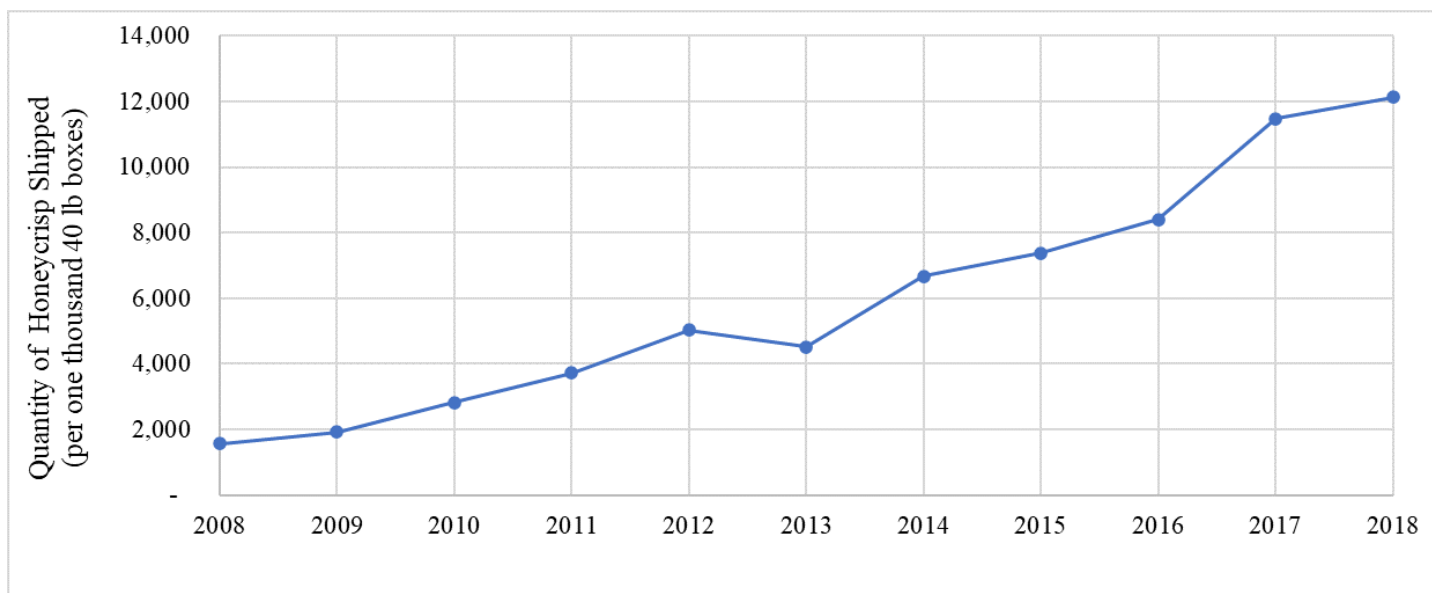


Figure 1. Shipments of Washington-grown Honeycrisp apples from 2008 to 2018 (per one thousand 40 lb boxes). Source: WSTFA (2020).

Table 1. Honeycrisp block specifications.

Architecture	Randomly trained with 18-inch radius from tree center.
In-row Spacing	3 feet
Between-row Spacing	10 feet
Rootstock	Dwarf - 9 series
Productive Block Size	21 acres
Life of Planting	15 years
Tree Density	1,452 trees per acre
Trellis System	Vertical trellis system

Summary of Study Results

Table 2 shows the estimated annual cost and returns for a 21-acre block of Honeycrisp apples in Washington State. Production costs are classified into variable costs and fixed costs. Variable costs comprise orchard operations, harvest activities, materials, maintenance and repairs, and packing costs. Fixed costs are incurred whether or not apples are produced. The fixed costs include interest, taxes, insurance, management, amortized establishment costs, and depreciation on capital. Fixed capital includes land, irrigation system, netting for sunburn protection, machinery, equipment and building, mainline and pump, pond, trellis, and wind machine. Management is treated as a fixed rather than a variable cost because, like land, management has been committed to the production cycle of the crop. Total fixed costs are increasing every year due to the interest cost of establishment that is incurred beginning the second year of production, and interest and depreciation costs of the wind machine that are incurred starting the third year of production, when the units are installed.

This study assumed that a Honeycrisp orchard could achieve full production in the sixth year. Based on the assumptions listed above, the total production costs for Honeycrisp during full production are estimated at \$41,087.18 per acre. The break-even price for Honeycrisp apples as of 2019 is estimated at \$730.44 per 690 lb bin or \$56.19 per 40 lb box (considering 75% of a 690 lb bin, equivalent to thirteen 40 lb boxes per bin).

Table 3 shows the sensitivity of net returns to different combinations of price and yields. For this analysis, the FOB prices range from \$591 to \$791 per 690 lb bin (\$45.46 to \$60.85 per 40 lb box), and the net yields range from \$48.75 to \$63.75 bins per acre. At \$741 per 690 lb bin (\$57 per 40 lb box) and higher, any yield in the range would result in positive returns. At the price of \$691 per 690 lb bin, only yields higher than 56.25 bins per acre would result in a positive return. At the price \$641 per 690 lb bin, only yields higher than 63.75 bins per acre would result in a positive return. At the price \$591 per 690 lb bin, none of the yields in the range considered in this study (from \$48.75 to \$63.75 per 690 lb bin per acre) would result in a positive return.

Table 2. Cost and returns per acre of establishing, producing, and packing Honeycrisp on a 21-acre orchard block.

	Establishment Years					Full Production ^a	Your Costs
	Year 1	Year 2	Year 3	Year 4	Year 5		
Estimated Net Production (bins/acre) ^b			18.75	33.75	45.00	56.25	
Estimated FOB Price (\$/bin) ^c			741.00	741.00	741.00	741.00	
Total Returns (\$/acre)			13,893.75	25,008.75	33,345.00	41,681.25	
Variable Costs (\$/acre):							
<u>Establishment</u>							
Soil Preparation	1,271.44						
Trees (including labor)	14,412.26						
<u>Orchard Activities</u>							
Pruning & Training ^d	563.70	638.86	657.65	469.75	714.02	939.50	
Green Fruit Thinning ^d	281.85	281.85	563.70	657.65	845.55	1,127.40	
Irrigation Labor ^e	200.40	200.40	200.40	200.40	200.40	200.40	
Herbicide ^{e,f}	88.03	254.77	253.38	300.29	253.38	253.97	
Insecticide ^{e,f}	0.00	207.51	837.37	784.90	837.37	811.17	
Fungicide ^{e,f}	684.97	788.48	783.77	786.84	783.77	785.75	
Rodenticide ^{e,f}	39.62	51.80	51.24	51.60	51.24	51.48	
Sunburn Protection ^{e,f}	0.00	0.00	412.29	413.01	412.29	412.75	
Chemical Thinning ^{e,f}	0.00	0.00	340.19	341.82	340.19	341.24	
Growth Regulator ^{e,f}			350.48	350.66	350.48	350.60	
Ripening Regulator ^f			500.00	500.00	500.00	500.00	
Fertilizer ^{e,f}	0.00	96.36	136.44	136.44	136.44	136.44	
Sunburn Protection—Netting ^g			1,200.00	1,200.00	1,200.00	1,200.00	
Frost Protection (labor) ^e			8.02	8.02	8.02	8.02	
Beehives			55.00	55.00	55.00	55.00	
General Farm Labor ^h	100.00	100.00	100.00	100.00	100.00	100.00	
Irrigation Water & Electric Charge	350.00	350.00	350.00	365.00	365.00	365.00	
<u>Harvest Activitiesⁱ</u>							
Picking Labor			994.50	1,790.10	2,386.80	2,983.50	
Other Labor (checkers, tractor drivers, supervisors)			250.00	450.00	600.00	750.00	
Hauling Apples			175.00	315.00	420.00	525.00	
<u>Warehouse Packing Charges^j</u>			5,187.50	9,337.50	12,450.00	15,562.50	
<u>Maintenance and Repairs</u>							
Maintenance & Repair	300.00	300.00	300.00	315.00	315.00	340.00	
Fuel & Lube	300.00	300.00	300.00	300.00	300.00	300.00	

	Establishment Years					Full Production ^a	Your Costs
	Year 1	Year 2	Year 3	Year 4	Year 5		
<u>Other Variable Costs</u>							
Overhead (5% of Variable Costs) ^k	929.61	178.50	700.35	961.45	1,181.25	1,404.99	_____
Interest (5% of Variable Costs) ^l	976.09	187.43	735.36	1,009.52	1,240.31	1,106.43	_____
Total Variable Costs	20,497.97	3,935.96	15,442.64	21,199.95	26,046.51	30,611.12	_____
<u>Fixed Costs (\$/acre):</u>							
<u>Depreciation</u>							
Irrigation System	140.00	140.00	140.00	140.00	140.00	140.00	_____
Sunburn Protection—Netting	533.33	533.33	533.33	533.33	533.33	533.33	_____
Machinery, Equipment & Building	261.92	261.92	261.92	261.92	261.92	261.92	_____
Mainline & Pump	30.00	30.00	30.00	30.00	30.00	30.00	_____
Pond	48.00	48.00	48.00	48.00	48.00	48.00	_____
Trellis	466.67	466.67	466.67	466.67	466.67	466.67	_____
Wind Machine			111.54	111.54	111.54	111.54	_____
<u>Interest</u>							
Irrigation System	105.00	105.00	105.00	105.00	105.00	105.00	_____
Sunburn Protection—Netting	200.00	200.00	200.00	200.00	200.00	200.00	_____
Land ^m	900.00	900.00	900.00	900.00	900.00	900.00	_____
Machinery, Equipment & Building	92.04	92.04	92.04	92.04	92.04	92.04	_____
Mainline & Pump	22.50	22.50	22.50	22.50	22.50	22.50	_____
Pond	60.00	60.00	60.00	60.00	60.00	60.00	_____
Trellis	175.00	175.00	175.00	175.00	175.00	175.00	_____
Wind Machine			83.65	83.65	83.65	83.65	_____
Establishment Costs (5%)		1,233.62	1,700.82	2,098.29	2,247.75		_____
<u>Other Fixed Costs</u>							
Miscellaneous Supplies	150.00	150.00	300.00	300.00	300.00	300.00	_____
Land & Property Taxes	170.00	170.00	170.00	170.00	170.00	170.00	_____
Insurance Cost (all farm)	120.00	120.00	300.00	300.00	300.00	300.00	_____
Management Cost	700.00	700.00	700.00	700.00	700.00	700.00	_____
Amortized Establishment Costs ⁿ						5,776.41	_____
Total Fixed Costs	4,174.46	5,408.08	6,400.47	6,797.94	6,947.40	10,476.06	_____
TOTAL COSTS	24,672.43	9,344.04	21,843.11	27,997.89	32,993.91	41,087.18	_____
ESTIMATED NET RETURNS	(24,672.43)	(9,344.04)	(7,949.36)	(2,989.14)	351.09	594.07	_____
Accumulated Establishment Costs	24,672.43	34,016.46	41,965.83	44,954.97	44,603.88		_____

^a The full production year is representative of all the remaining years the orchard is in full production (Year 6 to Year 15).

^b Estimated net production considers an average pack-out of 75%; or 13 box/bin.

^c These prices reflect the return before any expenses are subtracted. Bin size is 690 lb.

^d Hand labor rate is \$18.79/hour and includes all applicable taxes and benefits.

^e Tractor/machinery, irrigation, and frost protection labor rate is \$20.04/hour and includes all applicable taxes and benefits.

^f Includes materials and labor. Detailed material costs and labor hours per year are provided in "App5. Data for tables" of the 2019 Honeycrisp Excel Workbook (download from Crop Enterprise Budgets).

^g Labor cost only.

^h General farm labor rate is a lump sum per acre and applied to miscellaneous/all other labor. Rate includes applicable taxes and benefits.

ⁱ Picking rate = \$28.11/bin; checkers and tractor drivers' rate = \$8/bin; hauling rate = \$7/bin. (Hauling refers to transportation cost from the orchard to the warehouse. It is assumed that warehouse will cover additional transportation expenses [if any] when the orchard is located in remote areas.) To derive the cost of each harvest activity, the aforementioned labor rates are multiplied by the gross production per acre (i.e., before packing): 25 bin/acre in Year 3, 45 bin/acre in Year 4, 60 bin/acre in Year 5, and 75 bin/acre during full production years (Year 6 to 15).

^j Packing charges include receiving charges per bin plus total box charges per bin. Pack-out number of boxes per bin is 13.

^k Captures indirect costs of operations in the orchard that fluctuate with the level of production but are not accounted by the variable costs already identified. Also captures unforeseeable expenses.

^l Interest expense on full year during establishment years and for three quarters of a year during full production.

^m Land cost is approximated by using the 5% interest rate multiplied by the land value of \$18,000 per acre.

ⁿ Represents the costs incurred during the establishment years (minus revenues during those years) that must be recaptured during the full production years. It is calculated as accumulated establishment costs in Year 5 amortized at 5% for ten years.

Table 3. Estimated net returns (\$) per acre at various prices and yields of Honeycrisp during full production^a.

Net Yield (bin/acre) ^b	FOB Price (\$/bin) ^c				
	\$591	\$641	\$691	\$741	\$791
48.75	-\$9,397	-\$6,959	-\$4,522	-\$2,084	\$353
52.5	-\$8,620	-\$5,995	-\$3,370	-\$745	\$1,880
56.25	-\$7,843	-\$5,031	-\$2,218	\$594	\$3,407
60	-\$7,067	-\$4,067	-\$1,067	\$1,933	\$4,933
63.75	-\$6,290	-\$3,102	\$85	\$3,273	\$6,460
Overhead cost	5%				
Interest cost	5%				

Notes: Shaded area denotes a positive profit based on the combination of yield and price.

^a Includes amortized establishment costs. Net return is what the grower receives after all costs (for example, production expenses and packing costs) have been accounted.

^b Assumes a 690-pound bin. Takes into account an average pack-out equivalent to 75%.

^c Divide the prices in \$/bin by 13 to obtain equivalent prices in \$ per 40 lb box.

A further analysis of break-even returns is presented in Table 4. This analysis shows that the first break-even return is \$544.2 per 690 lb bin (\$41.9 per 40 lb box). This is the minimum return for the owner-operator to cover the operation's variable costs. Returns lower than this figure suggest that it is uneconomical to produce Honeycrisp apples. The second break-even return is at \$557.9 per 690 lb bin (\$42.9 per 40 lb box), needed to cover the total cash costs (the equivalent to total variable costs plus land and property taxes, insurance cost, and miscellaneous supplies). This second break-even return is needed for the operation to be financially viable in the short run. The third break-even return is at \$586.18 per 690 lb bin (\$45.09 per 40 lb box), needed for owner-operators to cover the cash costs plus depreciation of machinery and buildings. This third break-even return is needed for the operation to be financially viable in the long run. The fourth break-even return is at \$730.44 per 690 lb bin (\$56.19 per 40 lb box). If this return is realized, the owner-operator would recover all out-of-pocket expenses (cash costs), including a

competitive return on equity capital invested in land, trees, machinery, equipment, and buildings. Failure to obtain this break-even return level means that the owner-operator will not receive a return on capital contributions equal to what could be earned in alternative uses.

Most of the budget values given in Table 2 are based on more comprehensive underlying cost data, which are shown in Tables 5 through 8. Table 5 presents the annual capital requirements for a 21-acre Honeycrisp block only, while Table 6 describes the machinery, equipment, and building requirements for growing diverse crops in the 300-acre farm, including the Honeycrisp block. The costs of fixed capital listed in this table (e.g., housing for manager, machine shop, tractor, sprayer, mower) are allocated for the entire farm operation.

Table 4. Break-even return (\$/bin) for different levels of enterprise costs during full production of Honeycrisp.

	Cost (\$/acre)	Break-Even Return (\$/bin)^a	Your Cost (\$/acre)	Your Break- Even Return (\$/bin)
1. Total Variable Costs	30,611.12	544.20 ^b	_____	_____
2. Total Cash Costs ^c	31,381.12	557.89 ^d	_____	_____
= Total Variable Costs + Land & Property Taxes + Insurance Cost + Miscellaneous Supplies				
3. Total Cash Costs + Depreciation Costs	32,972.58	586.18 ^e	_____	_____
4. Total Cost				
= Total Cash Costs + Depreciation Costs + Interest Costs ^f + Management Cost				
	41,087.18	730.44 ^g	_____	_____

Net Yield (bin/acre) = 56.25

^a Break-even return is calculated as cost divided by net yield during full production.

^b If the return is below this level, Honeycrisp apples are uneconomical to produce.

^c If there are other cash costs on an individual's orchard, these costs must be identified and included in the cash cost break-even return calculation.

^d The second break-even return allows the producer to stay in business in the short run.

^e The third break-even return allows the producer to stay in business in the long run.

^f Interest costs include some actual cash interest payments.

^g The fourth break-even return is the total cost break-even return. Only when this break-even return is received can the grower recover all out-of-pocket expenses plus opportunity costs.

Table 5. Summary of annual capital requirements for a 21-acre Honeycrisp block.

	Establishment Years					Full Production^a
	Year 1	Year 2	Year 3	Year 4	Year 5	
Annual Requirements (\$)						
Land (22 acres)	396,000					
Trellis System	147,000					
Netting—Sunburn Protection ^b	168,000					
Irrigation System	88,200					
Mainline & Pump	18,900					
Pond	50,400					
Wind Machine			70,269			
Operating Expenses ^c	454,397	106,595	355,165	476,069	577,847	673,704
Total Requirements (\$)	1,322,897	106,595	425,435	476,069	577,847	673,704
Receipts (\$)						
	0	0	291,769	525,184	700,245	875,306
Net Requirements (\$)	1,322,897	106,595	133,666	(49,115)	(122,398)	(201,603)

^a The full production year is representative of all the remaining years the orchard is in full production (Year 6 to Year 20).

^b The use of netting is becoming widespread; up-to-date, sunburn protectant sprays or overhead cooling are still the predominant sunburn protection methods.

^c Operating expenses include the sum of the total variable costs, miscellaneous supplies, land and property taxes, insurance cost, and management cost.

Table 6. Machinery, equipment, and building requirements for a 300-acre diverse cultivar orchard.

	Purchase Price (\$) ^a	Number of Units	Total Cost (\$)
Housing for Manager	135,000	1	135,000
Machine Shop/Shed ^b	150,000	1	150,000
Tractor-70HP, 4WD	45,000	5	225,000
Tractor-40HP, 4WD	25,000	2	50,000
4-Wheeler	7,500	3	22,500
Speed Sprayer	25,000	5	125,000
Weed Spray Boom & Tank	7,000	1	7,000
Mower—Rotary (7 ft)	5,000	1	5,000
Flail Mower	8,000	1	8,000
Fork Lift	25,000	2	50,000
Bin Trailer	7,500	3	22,500
Pickup Truck	35,000	1	35,000
Ladder (8 ft)	100	100	10,000
Platforms	40,000	3	120,000
Miscellaneous Equipment ^c	50,000	1	50,000
Shop Equipment ^d	15,000	1	15,000
Total Cost			1,030,000

Notes: Machinery, equipment, and building requirements are utilized in growing diverse crops in the 300-acre farm, which include Honeycrisp apples. The costs of fixed capital are allocated on the entire farm operation.

^a Purchase price corresponds to new machinery, equipment, or building.

^b Includes manager office, restroom, pesticide handling area and storage, dry storage, area for equipment cover, and shop bay for equipment work or repair.

^c Includes two mobile portable toilets, box blade, straight blade, quick connect loader, mechanical weeder, detachable bucket for loading fertilizer, gopher baiter, soil aerator, utility trailer, and two ladder trailers.

^d Includes compressor, welder, pressure washer, and miscellaneous tools.

Interest costs and depreciation of fixed capital (irrigation system, netting, machinery, etc.) are listed in Tables 7 and 8, respectively. Interest costs represent required return on investments. They can be actual interest payments on funds borrowed to finance farm operations and physical capital investments, an opportunity cost (a return that would have been received if the investment had been in an alternative activity), or a combination of the two. All interest and amortization costs assume a 5% interest rate. The amortized establishment costs

assume a total productive life of 15 years, which includes five years of establishment and ten years of full production. The amortized establishment costs must be recaptured during the full production years in order for an enterprise to be profitable. Depreciation costs are annual, non-cash expenses that are calculated over the asset's useful life. These expenses represent the loss in an asset's value due to use, age, and obsolescence.

Table 7. Annual interest costs per acre for a 21-acre Honeycrisp block (\$/acre).

	Total Purchase Price (\$)	Salvage Value (\$)^a	Number of Acres	Total Interest Cost (\$)	Interest Cost Per Acre (\$)^b
Irrigation System ^c	88,200	0	21	2,205	105.00
Sunburn Protection—Netting ^c	168,000	0	21	4,200	200.00
Land	396,000	N/A	22	19,800	900.00
Machinery, Equipment & Building ^{d,e}	1,030,000	74,500	300	27,613	92.04
Mainline & Pump ^c	18,900	0	21	473	22.50
Pond ^c	50,400	0	21	1,260	60.00
Trellis ^c	147,000	0	21	3,675	175.00
Wind Machine ^c	70,269	0	21	1,757	83.65
<i>Interest Rate</i>	<i>5.0%</i>				

^a Not applied to land because land is not a depreciable asset.

^b Interest cost is calculated as: (Total Purchase Price + Salvage Value)/2 × Interest Rate. For land, the calculation is: Total Purchase Price × Interest Rate, because there is no salvage value for land.

^c The irrigation system, mainline and pump, pond, trellis system, and wind machine are used for the direct production of the fruit. Hence, their respective interest costs are divided by the production area (21 acres) to get the interest cost per acre.

^d Total area of the farm operation is 300 acres, and the machinery, equipment, and building are used in the entire, diverse cultivar farm. Thus, the corresponding interest costs are divided by the total area (300 acres) to derive the interest cost per acre.

^e See the Excel Workbook (Appendix 3) for a detailed calculation of the salvage value of the machinery, equipment, and building.

Table 8. Annual depreciation costs per acre for a 21-acre Honeycrisp block (\$/acre).

	Total Purchase Price (\$)	Number of Acres	Total Value per Acre (\$)	Years of Useful Life	Depreciation Cost per Acre (\$/yr)^a
Irrigation System	88,200	21	4,200.00	30	140.00
Sunburn Protection—Netting	168,000	21	8,000.00	15	533.33
Mainline & Pump	18,900	21	900.00	30	30.00
Pond	50,400	21	2,400.00	50	48.00
Trellis	147,000	21	7,000.00	15	466.67
Wind Machine	70,269	21	3,346.16	30	111.54
Machinery, Equipment & Building ^b					261.92

^a The depreciation cost is calculated as straight-line depreciation: (Total Purchase Price – Salvage Value)/Years of Use.

^b See the Excel Workbook (Appendix 3) for calculating the depreciation cost of the machinery, equipment, and building.

The net present value (NPV) of the \$1.3 million investment over 15 years is \$98,846 given a price of \$741 per 690 lb bin and a discount rate of 5% (Table 9). The estimated discounted payback period for the orchard investment can vary and ranges from 6.77 to 14.09 years, depending on the costs included in the calculation. If one includes total cash costs (which is the sum of total variable costs, miscellaneous supplies, land and property taxes, and farm insurance), the discounted payback period is 6.77 years. Whereas, if one includes all production costs (which is the sum of total cash cost, management cost, and fixed capital investment), the discounted payback period is 14.09 years. Table 9 also shows the sensitivity of the NPV calculations to different discount rates: 4%, 5%, and 6%, which represent the range of the average annual effective interest rates on non-real estate bank loans made to farmers from 2014 to 2018 (Federal

Reserve Bank of Kansas City 2019). The NPV and payback period calculations are shown in Appendix 6 of the Excel Workbook, described in more detail below.

The key results of this enterprise budget are formed by production-related assumptions established for the study. Production costs and returns for individual owner-operators may differ; thus, the results cannot be generalized to represent the population of apple operations in Washington State. An interactive Excel Workbook, described below, is provided to enable individual owner-operators to estimate their returns based on the costs of their production.

Table 9. NPV and payback period at different cost structures.

Discount Rate	NPV	Payback Period of Total Cash Cost ^a (years)	Payback Period of Total Cost ^b (years)
4.0%	\$228,689	6.65	13.17
5.0%	\$98,846	6.77	14.09
6.0%	-\$16,104	6.90	15.17

^a Cash cost is the sum of total variable cost, miscellaneous supplies, land and property taxes, and insurance cost. Excludes interest on operating capital.

^b Total cost is the sum of total cash cost, management cost, and fixed capital investment. Excludes interest on operating capital and interest on fixed capital.

Excel Workbook

An Excel spreadsheet version of this enterprise budget (Table 2) as well as associated data underlying the per-acre cost calculations (Tables 5 through 8 and Appendices 1 through 5 for establishment costs, full production costs, calculation of salvage value and depreciation costs, amortization calculator, and production-related data) are available at the WSU School of Economic Sciences Extension website for Crop Enterprise Budgets.

Owner-operators can modify select values and thus use the Excel Workbook to evaluate their own production costs and returns.

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By

R. Karina Gallardo, Associate Professor and Extension Specialist, School of Economic Sciences, Puyallup Research and Extension Center, Co-Director IMPACT Center, Center for Precision and Automated Agricultural Systems;

Suzette Galinato, Assistant Director IMPACT Center, and WSU School of Economic Sciences



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