2024 Cost and Return Estimates of Establishing, Producing, and Packing Granny Smith Apples in Washington

Preface

The results presented in this WSU publication serve as a general guide for evaluating the feasibility of producing Granny Smith apples grown on two training systems—angled V and vertical spindle—in Washington State as of 2024. 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 and return estimates 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.

Granny Smith Production in Washington State

From the 2012–2013 to the 2022–2023 season, shipments of Granny Smith fresh apples from Washington State have remained relatively stable. In 2012–2013, the volume was approximately 13.8 million 40 lb boxes, while in 2022–2023 it was 13.5 million boxes. As of the 2022–2023 season, Granny Smith was the fourth most shipped cultivar in Washington, only after Gala, Red Delicious, and Fuji, as shown in Figure 1 (WSTFA [Washington State Tree Fruit Association] 2024).

Comparing to prices from the past decade (2012–2013 to 2022–2023), the average price for Granny Smith apples was $25.48 per 40 lb box (Figure 2). Granny Smith prices showed more volatility (standard deviation $3.76) than the prices for Gala and Red Delicious but less volatility than Honeycrisp. The average packinghouse door price for Honeycrisp has been $56.20 per 40 lb box with a standard deviation of $5.78, while Red Delicious averaged $17.70 (standard deviation $2.29), Gala averaged $25.70 (standard deviation $2.82), and Fuji averaged $26.30 (standard deviation $3.15) (WSTFA 2024).

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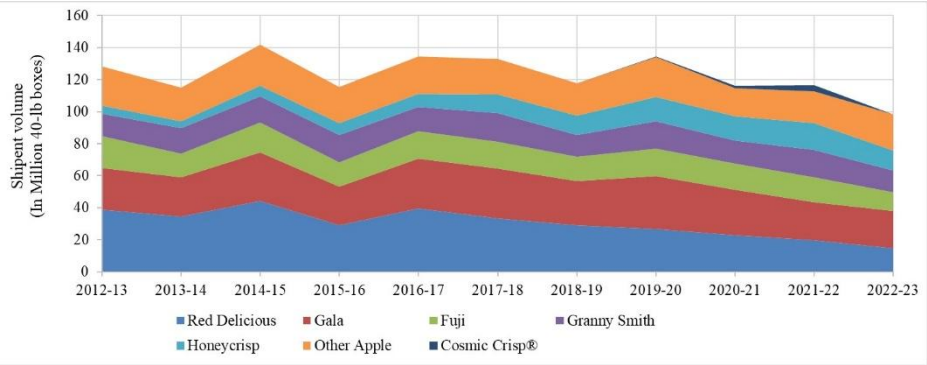

Figure 1. Shipment volume of Washington-grown apple cultivars from 2013–2014 to 2022–2023. *Source*: WSTFA (2024).

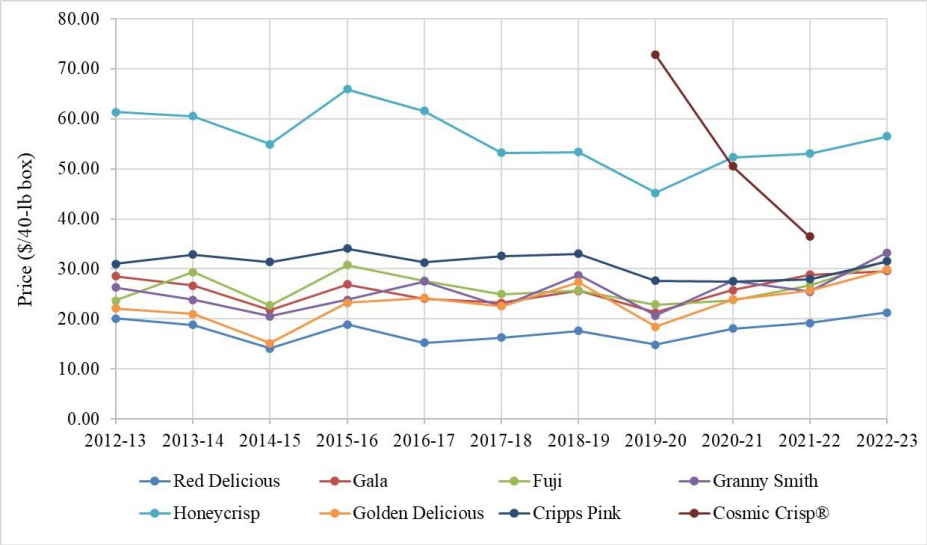

Figure 2. Packinghouse door prices for different fresh apple cultivars grown in Washington State, 2012–2013 to 2022–2023. *Source*: WSTFA (2024).

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 Granny Smith orchard on two training systems—angled V and vertical spindle—and packing costs; and (2) the ranges of price and yield at which Granny Smith production would be a profitable enterprise.

The primary use of this report is to identify inputs, costs, and yields considered to be typical of a well-managed Granny Smith orchard. This publication does not necessarily represent any particular orchard operation and is not intended to be a definitive guide to production and management practices. Additionally, this publication 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 Granny Smith owner-operators in Washington State, crop consultants, and Extension specialists. The owner-operators' production practices and input requirements form the baseline assumptions that are used to develop the enterprise budget. The data represent what they anticipate over an orchard's life if no unforeseen conditions occur. Additional insights on pest, disease, and nutrient management programs are obtained from crop consultants and Extension specialists. 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 of mixed conventional tree fruits. 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 29-acre Granny Smith block within a 300-acre orchard. It is assumed that 1 acre 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 28 acres. Table 1.1 presents the Granny Smith block specifications for the angled V, while Table 1.2 outlines the specifications for the vertical spindle training system. The differences are in the architecture and spacing of planted trees and, thus, the tree density. On the angled V, the tree density is 1,815

trees per acre, while on the vertical spindle, it is 1,452 trees per acre.
3. Given the differences in the number of trees and per-acre bearing surface, the gross yield, cost of trellis system, and labor requirements for pruning, training, and thinning are higher for angled V.
4. The total value of bare agricultural land (including senior water rights) is $20,000 per acre with annual property taxes of $200 per acre.
5. The irrigation system consists of under-tree double drip lines and a sprinkler system for under-tree cover crop or overhead cooling, 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 manual labor, ladders, and labor-enhancing equipment. The hourly manual labor rate for 2024 was $23.75 per hour, calculated using the base Washington adverse wage rate for 2024 of $19.25 per hour (U.S. Department of Labor 2024), plus H2A fixed cost of $4.50 per hour. For fertilizer application and frost protection, the labor rate was $24.75 per hour, a dollar more than the manual labor rate. For chemical application and irrigation, the labor rate was $27.79 per hour, including overtime and H2A fixed cost. Harvest labor rates follow the Agricultural Wage and Practices Employer Survey, plus mandated paid rest breaks and paid overtime. These labor rates are assumed to be the same for all years of production.
8. The gross return is $26 per 40 lb box or $455 per 875 lb bin.
9. Average pack-out for Granny Smith is 80%.
10. Warehouse packing charges assume an 875 lb bin.
11. Management salary is valued at $750 per acre.
12. Interest on investment represents a 5% opportunity cost to the enterprise. These are forgone earnings for investing money in orchard, equipment, and buildings rather than in an alternative activity. This also represents interest on funds borrowed to finance the orchard, equipment, and building purchases.

Summary of Study Results

A detailed budget is presented for the establishment and production costs of Granny Smith apple trees trained on an angled V system and vertical spindle system. Production costs are classified into variable costs and fixed costs. Variable costs comprise orchard operations, harvest activities, materials, maintenance and repairs, and packing costs (Tables 2.1 and 2.2). Fixed costs are incurred whether apples are produced Tables 3.1 and 3.2). These costs will generally be calculated for the whole farm enterprise and are allocated on a per-acre basis. 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, main line 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.

This study assumes that a Granny Smith apple orchard in either system could achieve full production in the sixth year of operation. Based on the above assumptions, the total production costs for an angled V trellis system are estimated at $51,672 per acre (Table 4.1) and $43,522 per acre with a vertical spindle system (Table 4.2) during full production. The returns over variable costs are negative

Table 1.1. Granny Smith block specifications for angled V trellis system.

Block Specification	Description
Architecture	Train each level's branches straight down to the wire
In-Row Spacing	2 feet
Between-Row Spacing	12 feet
Rootstock	G-41
Productive Block Size	28 acres
Life of Planting	20 years
Tree Density	1,815 trees per acre
Trellis System	Angled V (30 degrees from the vertical line, with 7 wires per side; top wire is 11.5 feet off the ground; metal post every 30 ft)

Table 1.2. Granny Smith block specifications for vertical spindle trellis system.

Block Specification	Description
Architecture	Train each level's branches straight down to the wire
In-Row Spacing	3 feet
Between-Row Spacing	10 feet
Rootstock	G-41
Productive Block Size	28 acres

Block Specification	Description
Life of Planting	20 years
Tree Density	1,452 trees per acre
Trellis System	Vertical spindle (height 11.5 feet, 7 wires, metal post every 30 ft)

(-$3,227 per acre and -$3,472 per acre, respectively), meaning that the farm income is insufficient to cover the costs needed to continue operations in either trellis system.

Most of the budget values given in Tables 2.1–4.1 and Tables 2.2–4.2 are based on more comprehensive underlying cost data, which are provided in the Excel Workbook described in the next section. Interest costs represent the required return on investments. They can be actual interest payments on funds borrowed to finance farm operations and physical capital investments, an opportunity cost, or a combination of the two. Opportunity costs are the returns on investment that would have been received if the investment had been in the next-best-alternative activity. In Table 3.1 and Table 3.2, the opportunity costs are accounted for by interest costs and management costs, where the latter may represent the unpaid time and labor of the owner-operator. Depreciation costs are annual, noncash 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 5.1 and Table 5.2 show the sensitivity of net returns to different combinations of price and yields given the different trellis systems. For this analysis, the free on board (FOB) prices considered are the minimum, average, and maximum average annual FOB prices between 2019 and 2024 (WSTFA 2024), plus a couple additional price scenarios. The net yields are about 59–83 bins per acre, given an 80% pack-out. A gross yield-price combination of 84 bins per acre or greater (angled V) and 79 bins per acre or greater (spindle) and $695 per bin or higher (both angled V and spindle) would result in positive net returns for the owner-operator, based on the study's production and cost assumptions.

Table 6.1 and Table 6.2 show the break-even return (BE) given different yield levels during full production in the different trellis systems. As of 2024, the first break-even returns of Granny Smith are about $496 per bin and $510 per bin for the angled V or spindle systems, respectively. These values represent the minimum return needed for the owner-operator to cover the operation's variable costs in the two scenarios. Returns lower than these figures suggest that it is more profitable not to operate (shutdown price) than to produce Granny Smith for the fresh market. The second break-even returns are about $508 per bin (angled V) and $526 per bin (spindle), which is needed to cover the total cash costs and to be economically viable in the short run. The third break-even returns are $525 per bin (angled V) and $543 per bin (spindle), which is needed to cover the cash costs plus depreciation of machinery and buildings. This return must be realized for the operation to be financially viable in the long run. The fourth break-even returns are about $652 per bin (angled V) and $689 per bin (spindle). When this return is received, the owner-operator would recover all out-of-pocket expenses plus realize a competitive return on equity capital invested in land, apple orchard, 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.

The key results of the 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 is provided to enable individual owner-operators to estimate their returns based on the costs of their production.

Table 2.1. Variable costs ($ per acre) of establishing, producing, and packing Granny Smith on angled V trellis system in a 28-acre orchard block.

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Soil Preparation	1,520	0	0	0	0	0
Trees (including labor)	19,938	0	0	0	0	0
Pruning and Training [a]	1,734	1,568	1,283	689	1,021	1,306
Thinning [b]	0	0	0	0	0	0
Chemicals [c,d]	278	748	1,875	1,875	1,875	1,875
Fertilizer [c,d]	90	90	276	276	276	276

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Irrigation Water and Electric Charge	350	350	350	365	365	365
Irrigation Labor [d]	361	361	361	361	361	361
Sunburn Protection [e]	0	0	0	0	0	0
Frost Protection (labor) [d]	10	10	10	10	10	10
Beehives	0	0	65	65	65	65
General Farm Labor [f]	300	300	300	300	300	300
Picking Labor [g]	0	0	1,591	2,294	2,997	3,663
Other Labor (checkers, tractor drivers, supervisors) [g]	0	0	473	682	891	1,089
Hauling Apples [g]	0	0	473	682	891	1,089
Warehouse Packing Charges [h]	0	0	10,836	15,624	20,412	24,948
Maintenance and Repair	360	360	360	425	425	425
Fuel and Lube	270	270	270	270	270	270
Overhead [i]	1,261	203	926	1,196	1,508	1,802
Interest (5% of Variable Costs) [j]	1,324	213	972	1,256	1,583	1,419
Total Variable Costs	**27,795**	**4,473**	**20,420**	**26,369**	**33,250**	**39,263**

Note: Numbers are rounded to the nearest whole number.

[a] Hand labor rate is $23.75 per hour and includes all applicable taxes and benefits.

[b] There is neither hand thinning nor chemical thinning for Granny Smith.

[c] Includes materials and labor.

[d] Tractor or machinery labor for chemical application and irrigation is $27.79 per hour. Labor for fertilizer application and frost protection is $24.75 per hour and includes all applicable taxes and benefits.

[e] Netting for sunburn protection is not used for Granny Smith.

[f] General farm labor rate is a lump sum per acre and is applied to miscellaneous or all other labor. It includes applicable taxes and benefits.

[g] Picking rate = $37 per bin; checkers' and tractor drivers' rate = $11 per bin; hauling rate = $11 per bin. Hauling refers to transportation cost from the orchard to the warehouse. It is assumed that the warehouse will cover additional transportation expenses [if any] when the orchard is located in remote areas.

[h] Packing charges include receiving charges per bin plus total box charges per bin. Pack-out number of boxes per bin is 17.5.

[i] Overhead is calculated as five percent of variable costs. Captures indirect costs of operations in the orchard that fluctuate with the level of production but are not accounted for by the variable costs already identified. Also captures unforeseeable expenses.

[j] Interest of operating capital is calculated as five percent of the sum of variable costs and overhead. The interest expense is for a full year during establishment years and for three-quarters of a year during full production.

Table 2.2. Variable costs ($ per acre) of establishing, producing, and packing Granny Smith on vertical spindle trellis system in a 28-acre orchard block.

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Soil Preparation	0	0	0	0	0	0
Trees (including labor)	0	0	0	0	0	0
Pruning and Training [a]	1,235	1,211	1,235	594	879	1,069
Thinning [b]	0	0	0	0	0	0
Chemicals [c,d]	278	748	1,875	1,875	1,875	1,875
Fertilizer [c,d]	90	90	276	276	276	276
Irrigation Water and Electric Charge	350	350	350	365	365	365
Irrigation Labor [d]	361	361	361	361	361	361
Sunburn Protection [e]	0	0	0	0	0	0
Frost Protection (labor) [d]	10	10	10	10	10	10
Beehives	0	0	65	65	65	65
General Farm Labor [f]	300	300	300	300	300	300
Picking Labor [g]	0	0	1,295	1,850	2,405	2,923
Other Labor (checkers, tractor drivers, supervisors) [g]	0	0	385	550	715	869
Hauling Apples [g]	0	0	385	550	715	869
Warehouse Packing Charges [h]	0	0	8,820	12,600	16,380	19,908
Maintenance and Repair	360	360	360	425	425	425
Fuel and Lube	270	270	270	270	270	270

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Overhead [i]	1,036	185	799	1,005	1,252	1,479
Interest (5% of Variable Costs) [j]	1,088	194	839	1,055	1,315	1,165
Total Variable Costs	**22,848**	**4,080**	**17,625**	**22,149**	**27,607**	**32,228**

Note: Numbers are rounded to the nearest whole number.

[a] Hand labor rate is $23.75 per hour and includes all applicable taxes and benefits.

[b] There is neither hand thinning nor chemical thinning for Granny Smith.

[c] Includes materials and labor.

[d] Tractor or machinery labor for chemical application and irrigation is $27.79 per hour. Labor for fertilizer application and frost protection is $24.75 per hour and includes all applicable taxes and benefits.

[e] Netting for sunburn protection is not used for Granny Smith.

[f] General farm labor rate is a lump sum per acre and is applied to miscellaneous or all other labor. It includes applicable taxes and benefits.

[g] Picking rate = $37 per bin; checkers' and tractor drivers' rate = $11 per bin; hauling rate = $11 per bin. Hauling refers to transportation cost from the orchard to the warehouse. It is assumed that the warehouse will cover additional transportation expenses [if any] when the orchard is located in remote areas.

[h] Packing charges include receiving charges per bin plus total box charges per bin. Pack-out number of boxes per bin is 17.5.

[i] Overhead is calculated as five percent of variable costs. Captures indirect costs of operations in the orchard that fluctuate with the level of production but are not accounted for by the variable costs already identified. Also captures unforeseeable expenses.

[j] Interest of operating capital is calculated as five percent of the sum of variable costs and overhead. The interest expense is for a full year during establishment years and for three-quarters of a year during full production.

Table 3.1. Fixed cash and non-cash costs—depreciation, interest, and other fixed costs ($ per acre) of establishing, producing, and packing Granny Smith on angled V trellis system in a 28-acre orchard block.

Fixed Cash or Non-cash Cost		Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Cash:	Miscellaneous Supplies	190	190	190	190	190	190
Cash:	Land and Property Taxes	200	200	200	200	200	200
Cash:	Insurance Cost (crop and farm)	600	600	600	600	600	600
Depreciation:	Irrigation System	160	160	160	160	160	160
Depreciation:	Sunburn Protection—Netting	0	0	0	0	0	0
Depreciation:	Machinery, Equipment, and Building	307	307	307	307	307	307
Depreciation:	Main Line and Pump	30	30	30	30	30	30
Depreciation:	Pond	60	60	60	60	60	60
Depreciation:	Trellis	650	650	650	650	650	650
Depreciation:	Wind Machine	134	134	134	134	134	134
Interest:	Irrigation System	120	120	120	120	120	120
Interest:	Sunburn Protection—Netting	0	0	0	0	0	0
Interest:	Land [a]	1,000	1,000	1,000	1,000	1,000	1,000
Interest:	Machinery, Equipment, and Building	106	106	106	106	106	106
Interest:	Main Line and Pump	23	23	23	23	23	23
Interest:	Pond	75	75	75	75	75	75
Interest:	Trellis	325	325	325	325	325	325
Interest:	Wind Machine	100	100	100	100	100	100
Interest:	Establishment Cost	0	1,631	2,178	2,767	3,337	0
Other Fixed Cost:	Management Cost	750	750	750	750	750	750
Other Fixed Cost:	Amortized Establishment Costs [b]	0	0	0	0	0	7,579
Total Fixed Cost		**4,830**	**6,461**	**7,008**	**7,597**	**8,167**	**12,409**

Note: Numbers are rounded to the nearest whole number.

[a] Land cost is approximated by using the 5% interest rate multiplied by the land value of $20,000 per acre.

[b] 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 15 years.

Table 3.2. Fixed cash and non-cash costs—depreciation, interest, and other fixed costs ($ per acre) of establishing, producing, and packing Granny Smith on vertical spindle trellis system in a 28-acre orchard block.

Fixed Cash or Non-cash Cost		Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Cash:	Miscellaneous Supplies	190	190	190	190	190	190
Cash:	Land and Property Taxes	200	200	200	200	200	200
Cash:	Insurance Cost (crop and farm)	600	600	600	600	600	600
Depreciation:	Irrigation System	160	160	160	160	160	160
Depreciation:	Sunburn Protection—Netting	0	0	0	0	0	0
Depreciation:	Machinery, Equipment, and Building	307	307	307	307	307	307
Depreciation:	Main Line and Pump	30	30	30	30	30	30
Depreciation:	Pond	60	60	60	60	60	60
Depreciation:	Trellis	417	417	417	417	417	417
Depreciation:	Wind Machine	134	134	134	134	134	134
Interest:	Irrigation System	120	120	120	120	120	120
Interest:	Sunburn Protection—Netting	0	0	0	0	0	0
Interest:	Land [a]	1,000	1,000	1,000	1,000	1,000	1,000
Interest:	Machinery, Equipment, and Building	106	106	106	106	106	106
Interest:	Main Line and Pump	23	23	23	23	23	23
Interest:	Pond	75	75	75	75	75	75
Interest:	Trellis	208	208	208	208	208	208
Interest:	Wind Machine	100	100	100	100	100	100
Interest:	Establishment Cost	0	1,366	1,863	2,424	2,967	0
Other Fixed Cost:	Management Cost	750	750	750	750	750	750
Other Fixed Cost:	Amortized Establishment Costs [b]	0	0	0	0	0	6,814
Total Fixed Cost		**4,480**	**5,846**	**6,343**	**6,904**	**7,447**	**11,294**

Note: Numbers are rounded to the nearest whole number.

[a] Land cost is approximated by using the 5% interest rate multiplied by the land value of $20,000 per acre.

[b] 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 15 years.

Table 4.1. Summary of estimated costs and returns ($ per acre) of establishing, producing, and packing Granny Smith on angled V trellis system in a 28-acre orchard block.

Returns and Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Estimated Net Production (bins per acre) [a]	0	0	34.40	49.60	64.80	79.20
Estimated FOB Price in $ per bin [b]	455.00	455.00	455.00	455.00	455.00	455.00
Estimated FOB Price in $ per 40 lb box [b]	26	26	26	26	26	26
Total Returns	**0**	**0**	**15,652**	**22,568**	**29,484**	**36,036**
Total Variable Costs	27,795	4,473	20,420	26,369	33,250	39,263
Total Cash Costs	28,785	5,463	21,410	27,359	34,240	40,253
Total Cash Costs and Depreciation	30,125	6,803	22,751	28,700	35,581	41,594
Total Fixed Costs	4,830	6,461	7,008	7,597	8,167	12,409
Total Production Costs [c]	32,625	10,934	27,428	33,966	41,417	51,672
Returns over Variable Costs [d]	**-27,795**	**-4,473**	**-4,768**	**-3,801**	**-3,766**	**-3,227**
Returns over Cash Costs [d]	**-28,785**	**-5,463**	**-5,758**	**-4,791**	**-4,756**	**-4,217**
Returns over Cash Costs and Depreciation [d]	**-30,125**	**-6,803**	**-7,099**	**-6,132**	**-6,097**	**-5,558**
Net Returns [e]	**-32,625**	**-10,934**	**-11,776**	**-11,398**	**-11,933**	**-15,636**

Note: Numbers are rounded to the nearest whole number, except the net production and FOB price per bin.
[a] Estimated net production considers an average pack-out of 80% or 17.5 boxes per bin.
[b] FOB means freight on board. FOB prices are packinghouse door prices. They reflect the return before any expenses are subtracted. Bin size is 875 lb. Both the per-bin price and per-40 lb box price are provided for convenience, but the per-bin price is used to calculate the Total Returns.
[c] Total production costs are the sum of total variable costs and total fixed costs.
[d] The returns over variable costs, cash costs, and cash costs and depreciation are calculated as the difference between total returns and the respective costs. Numbers that are red and preceded by a minus symbol denote negative returns.
[e] Net returns are calculated as the difference between total returns and total production costs.

Table 4.2. Summary of estimated costs and returns ($ per acre) of establishing, producing, and packing Granny Smith on vertical spindle trellis system in a 28-acre orchard block.

Returns and Costs	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Years 6 to 20 (Full Production, Annual Average)**
Estimated Net Production (bins per acre) [a]	0.00	0.00	28.00	40.00	52.00	63.20
Estimated FOB Price in $ per bin [b]	455.00	455.00	455.00	455.00	455.00	455.00
Estimated FOB Price in $ per 40 lb box [b]	26	26	26	26	26	26
Total Returns	**0**	**0**	**12,740**	**18,200**	**23,660**	**28,756**
Total Variable Costs	22,848	4,080	17,625	22,149	27,607	32,228
Total Cash Costs	23,838	5,070	18,615	23,139	28,597	33,218
Total Cash Costs and Depreciation	24,946	6,177	19,722	24,247	29,704	34,326
Total Fixed Costs	4,480	5,846	6,343	6,904	7,447	11,294
Total Production Costs [c]	27,328	9,926	23,968	29,053	35,053	43,522
Returns over Variable Costs [d]	**-22,848**	**-4,080**	**-4,885**	**-3,949**	**-3,947**	**-3,472**
Returns over Cash Costs [d]	**-23,838**	**-5,070**	**-5,875**	**-4,939**	**-4,937**	**-4,462**
Returns over Cash Costs and Depreciation [d]	**-24,946**	**-6,177**	**-6,982**	**-6,047**	**-6,044**	**-5,570**
Net Returns [e]	**-27,328**	**-9,926**	**-11,228**	**-10,853**	**-11,393**	**-14,766**

Note: Numbers are rounded to the nearest whole number, except the net production and FOB price per bin.
[a] Estimated net production considers an average pack-out of 80% or 17.5 boxes per bin.
[b] FOB means freight on board. FOB prices are packinghouse door prices. They reflect the return before any expenses are subtracted. Bin size is 875 lb. Both the per-bin price and per-40 lb box price are provided for convenience, but the per-bin price is used to calculate the Total Returns.
[c] Total production costs are the sum of total variable costs and total fixed costs.
[d] The returns over variable costs, cash costs, and cash costs and depreciation are calculated as the difference between total returns and the respective costs. Numbers that are red and preceded by a minus symbol denote negative returns.
[e] Net returns are calculated as the difference between total returns and total production costs.

Table 5.1. Estimated net returns[a] per acre at various prices and yields of Granny Smith during full production on an angled V trellis system.

Gross Yield (bins/acre) [b]	**Net Yield (bins/acre) [b]**	**Net Returns ($/acre) at $350/bin (or $20/box) [c,d]**	**Net Returns ($/acre) at $420/bin (or $24/box) [c,d]**	**Net Returns ($/acre) at $455/bin (or $26/box) [c,d]**	**Net Returns ($/acre) at $595/bin (or $34/box) [c,d]**	**Net Returns ($/acre) at $695/bin (or $40/box) [c,d]**	**Net Returns ($/acre) at $795/bin (or $45/box) [c,d]**
74	59	-22,482	-18,338	-16,266	-7,978	-2,058	3,862
79	63	-22,776	-18,352	-16,140	-7,292	-972	5,348
84	67	-23,070	-18,366	-16,014	-6,606	114	6,834
89	71	-23,364	-18,380	-15,888	-5,920	1,200	8,320
94	75	-23,658	-18,394	-15,762	-5,234	2,286	9,806
99	79	-23,952	-18,408	-15,636	-4,548	3,372	11,292
104	83	-24,246	-18,422	-15,510	-3,862	4,458	12,778

Note: Net yield and net returns are rounded to the nearest whole number. Shaded area denotes positive net returns based on the combination of net 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 for.
[b] Assumes an 875 lb bin. Considers an average pack-out of 80%.
[c] Number of 40 lb boxes per bin is 17.5.
[d] From left to right, the first four FOB prices are the minimum, median, average, and maximum annual FOB prices of Granny Smith between 2019 and 2024 (Source: WSTFA). The last two FOB prices assume scenarios of $100 and $200 higher than the maximum. Both prices in terms of bin and 40 lb box are provided for convenience, but the price per bin is used to calculate the net returns.

Table 5.2. Estimated net returns[a] per acre at various prices and yields of Granny Smith during full production on a vertical spindle system.

Gross Yield (bins/acre) [b]	Net Yield (bins/acre) [b]	Net Returns ($/acre) at $350/bin (or $20/box) [c,d]	Net Returns ($/acre) at $420/bin (or $24/box) [c,d]	Net Returns ($/acre) at $455/bin (or $26/box) [c,d]	Net Returns ($/acre) at $595/bin (or $34/box) [c,d]	Net Returns ($/acre) at $695/bin (or $40/box) [c,d]	Net Returns ($/acre) at $795/bin (or $45/box) [c,d]
74	59	-21,108	-16,964	-14,892	-6,604	-684	5,236
79	63	-21,402	-16,978	-14,766	-5,918	402	6,722
84	67	-21,696	-16,992	-14,640	-5,232	1,488	8,208
89	71	-21,990	-17,006	-14,514	-4,546	2,574	9,694
94	75	-22,284	-17,020	-14,388	-3,860	3,660	11,180
99	79	-22,578	-17,034	-14,262	-3,174	4,746	12,666
104	83	-22,872	-17,048	-14,136	-2,488	5,832	14,152

Note: Net yield and net returns are rounded to the nearest whole number. Shaded area denotes positive net returns based on the combination of net 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 for.
[b] Assumes an 875 lb bin. Considers an average pack-out of 80%.
[c] Number of 40 lb boxes per bin is 17.5.
[d] From left to right, the first four FOB prices are the minimum, median, average, and maximum annual FOB prices of Granny Smith between 2019 and 2024 (Source: WSTFA). The last two FOB prices assume scenarios of $100 and $200 higher than the maximum. Both prices in terms of bin and 40 lb box are provided for convenience, but the price per bin is used to calculate the net returns.

Table 6.1. Break-even return for different levels of enterprise costs during full production of Granny Smith on angled V trellis system.

Levels of Enterprise Costs	Cost ($ per acre)	Break-Even Return ($ per bin) [a]	Break-Even Return ($ per 40 lb box) [a]
1. Total Variable Costs	39,262.95	495.74	28.33 [b]
2. Total Cash Costs [c]	40,252.95	508.24	29.04 [d]
3. Total Cash Costs + Depreciation Costs	41,593.74	525.17	30.01 [e]
4. Total Costs [f]	51,671.83	652.42	37.28 [g]

Note: Number of boxes per bin is 17.5. Bin size is 875 lb.
[a] Break-even (BE) return is calculated as BE Return = Cost divided by Net yield during full production (i.e., 79.20 bins per acre). The BE Return per 40 lb box is calculated as the per-bin value divided by 17.5. All variables in this equation are held constant, except for the "Cost," which takes the Total Variable Costs, Total Cash Costs, Total Cash Costs + Depreciation Costs, or Total Costs, depending on the level of enterprise cost that the break-even return is being calculated at.
[b] If the return is below this level, Granny Smith apples are uneconomical to produce.
[c] Total Cash Costs are the sum of total variable costs, land and property taxes, insurance cost, and miscellaneous supplies. 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] This refers to the total production costs, which are the sum of total cash costs, depreciation costs, interest costs, and management cost. 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 6.2. Break-even return for different levels of enterprise costs during full production of Granny Smith on vertical spindle trellis system.

Levels of Enterprise Costs	Cost ($ per acre)	Break-Even Return ($ per bin) [a]	Break-Even Return ($ per 40 lb box) [a]
1. Total Variable Costs	32,228.31	508.94	29.14 [b]
2. Total Cash Costs [c]	33,218.31	525.61	30.03 [d]
3. Total Cash Costs + Depreciation Costs	34,325.60	543.13	31.04 [e]
4. Total Costs [f]	43,522.32	688.64	39.35 [g]

Note: Number of boxes per bin is 17.5. Bin size is 875 lb.

[a] Break-even (BE) return is calculated as BE Return = Cost divided by Net yield during full production (i.e., 63.20 bins per acre). The BE Return per 40 lb box is calculated as the per bin value divided by 17.5. All variables in this equation are held constant, except for the "Cost," which takes the Total Variable Costs, Total Cash Costs, Total Cash Costs + Depreciation Costs, or Total Costs, depending on the level of enterprise cost that the break-even return is being calculated at.

[b] If the return is below this level, Granny Smith apples are uneconomical to produce.

[c] Total Cash Costs are the sum of total variable costs, land and property taxes, insurance cost, and miscellaneous supplies. 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] This refers to the total production costs, which are the sum of total cash costs, depreciation costs, interest costs, and management cost. 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.

Excel Workbook

The supporting data for Granny Smith on the two trellis systems can be found in the following Excel Workbooks: Appendix 1.1 Granny Smith Apples Grown on Angled V Trellis System and Appendix 1.2 Granny Smith Apples Grown on Vertical Spindle Trellis System. These workbooks are available for download on the WSU School of Economic Sciences Extension Crop Enterprise Budgets website. The workbooks include the enterprise budgets (Table 2.1 and Table 2.2), as well as associated data underlying the per-acre cost calculations (Appendix Tables 1 through 9 for capital requirements, calculation of interest cost, establishment costs, full production costs, calculation of salvage value and depreciation costs, amortization calculator, and production-related data).

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, Professor and Extension Specialist, School of Economic Sciences,
Puyallup Research and Extension Center, Center for Precision and Automated Agricultural Systems,
Washington State University
Suzette P. Galinato, Assistant Professor and Extension Specialist—Agricultural Economics,
Agriculture and National Resources, Washington State University Extension
Bernardita Sallato C., Associate Professor and Tree Fruit Extension Specialist,
Irrigated Agriculture Research and Extension Center, Washington State University

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