

2024 Cost and Return Estimates of Establishing, Producing, and Packing Cosmic Crisp® Apples in Washington



Preface

The results presented in this WSU publication serve as a general guide for evaluating the feasibility of producing Cosmic Crisp® 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.

Cosmic Crisp® Production in Washington State

Cosmic Crisp® apples, developed by the Washington State University apple breeding program, are a cultivar known for their exceptional crispness, juiciness, and long shelf life. A cross between Honeycrisp and Enterprise apples, Cosmic Crisp® was officially released for commercial production in December 2019, with WSU holding the patent for this cultivar. Proprietary Variety Management (PVM) was enlisted by WSU to assist in managing and promoting the commercialization of Cosmic Crisp® (Musacchi et al. 2024). The cultivar quickly gained popularity within the Washington State apple industry, with over 20 million trees sold by 2023 (Paterson 2023).

As of 2022–2023, there were 5.5 million 40 lb boxes of Cosmic Crisp®, which makes this cultivar the eighth largest in shipment volume, only after Gala, Red Delicious, Granny Smith, Honeycrisp, Fuji, and Cripps Pink. As shown in Figure 1, the cultivar's shipment volume has been steadily increasing since 2019–2020 (WSTFA [Washington State Tree Fruit Association] 2024).

In relation to prices, in 2019–2020 Cosmic Crisp® sold at a record average price of \$72.8 per 40 lb box. This price has steadily decrease since then. In 2020–2021, the average price was \$50.50; in 2021–2022 the price was \$36.40; and in 2022–2023 the price was \$35.20. At this price level, Cosmic Crisp® exhibits the second highest price, only after Honeycrisp, as shown in Figure 2 (WSTFA 2024).



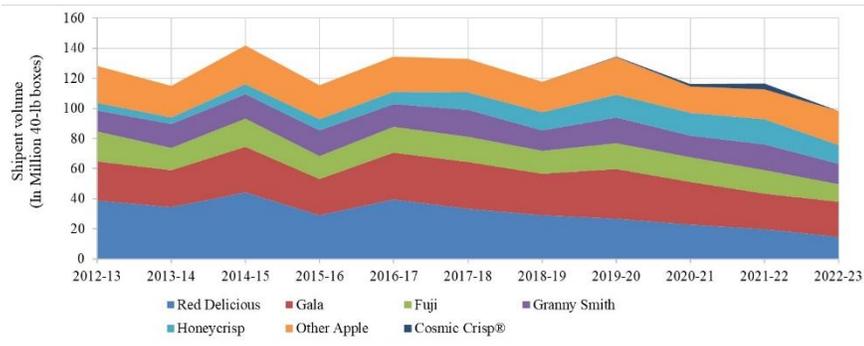


Figure 1. Shipment volume of Washington-grown apple cultivars from 2013 to 2014 and to 2022 to 2023. Source: WSTFA (2024).

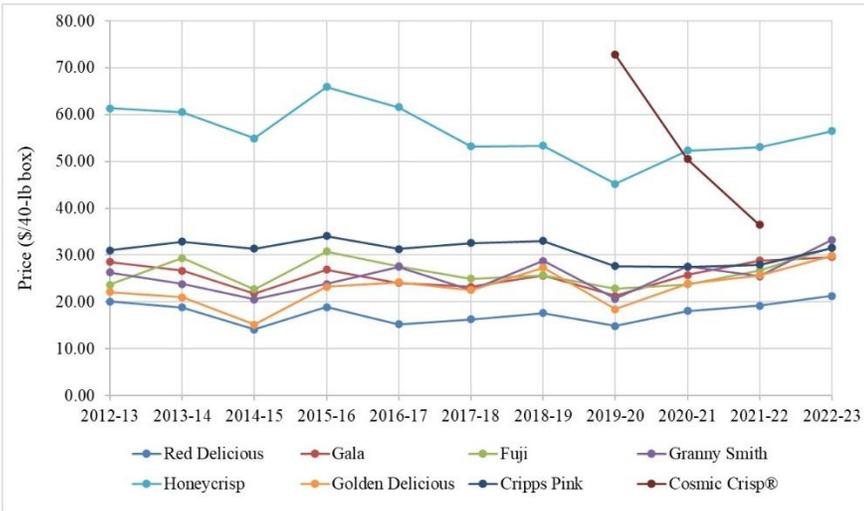


Figure 2. Packinghouse door prices for different fresh apple cultivars grown in Washington State, 2012–2013 and 2022–2023. Source: WSTFA (2024).

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 Cosmic Crisp® orchard on two training systems—angled V and vertical spindle—and packing costs; and (2) the ranges of price and yield at which Cosmic Crisp® 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 Cosmic Crisp® 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 Cosmic Crisp® 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 were 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 an 11-acre Cosmic Crisp® 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 10 acres. Table 1.1 presents the Cosmic Crisp® 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 \$35 per 40 lb box or \$647.50 per 925 lb bin.

9. Average pack-out for Cosmic Crisp® is 80%.
10. Warehouse packing charges assume a 925 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 of Cosmic Crisp® 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 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.

Table 1.1 Cosmic Crisp® block specifications, 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	10 feet
Rootstock	G-41
Productive Block Size	10 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 Cosmic Crisp® block specifications, 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	10 acres
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)

Table 2.1 Variable costs (\$ per acre) of establishing, producing, and packing Cosmic Crisp® on angled V trellis system in a 10-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)	21,753	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}	216	491	1,637	1,787	1,787	1,787
Fertilizer ^{c,d}	100	125	245	245	320	395
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	0	2,623	3,397	4,171
Other Labor (checkers, tractor drivers, supervisors) ^g	0	0	0	671	869	1,067
Hauling Apples ^g	0	0	0	671	869	1,067
Warehouse Packing Charges ^h	0	0.00	0.00	16,867	21,844	26,821
Maintenance and Repair	360	360	360	425	425	425
Fuel and Lube	270	270	270	270	270	270
Overhead ⁱ	1,349	192	244	1,275	1,603	1,928
Interest (5% of Variable Costs) ^j	1,416	201	256	1,339	1,683	1,518
Total Variable Costs	29,738	4,228	5,381	28,112	35,338	42,006

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 Cosmic Crisp®.

^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 Labor cost to deploy and pull back.

^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 = \$43 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 18.5.

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 Cosmic Crisp® on vertical spindle trellis system in a 10-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)	17,402	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}	216	491	1,637	1,787	1,787	1,787
Fertilizer ^{c,d}	100	125	245	245	320	395
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	150	150	150
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	0	2,064	2,709	3,354

Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Years 6 to 20 (Full Production, Annual Average)
Other Labor (checkers, tractor drivers, supervisors) ^g	0	0	0	528	693	858
Hauling Apples ^g	0	0	0	528	693	858
Warehouse Packing Charges ^h	0	0	0	13,272	17,420	21,567
Maintenance and Repair	360	360	360	425	425	425
Fuel and Lube	270	270	270	270	270	270
Overhead ⁱ	1,106	174	242	1,048	1,322	1,592
Interest (5% of Variable Costs) ^j	1,161	183	254	1,101	1,388	1,253
Total Variable Costs	24,391	3,835	5,329	23,113	29,157	34,679

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 Cosmic Crisp[®].

^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 Labor cost to deploy and pull back.

^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 = \$43 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 18.5.

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 Cosmic Crisp[®] on angled V trellis system in a 10-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	500	500	500	500	500	500
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	250	250	250	250	250	250
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	1,766	2,345	3,010	3,265	0
Other Fixed Cost: Management Cost	750	750	750	750	750	750
Other Fixed Cost: Amortized Establishment Costs ^b	0	0	0	0	0	6,606
Total Fixed Cost	5,580	7,346	7,925	8,590	8,845	12,186

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 Cosmic Crisp® on vertical spindle trellis system in a 10-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	500	500	500	500	500	500
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	250	250	250	250	250	250
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	1,481	2,008	2,637	2,942	0
Other Fixed Cost:	Management Cost	750	750	750	750	750	750
Other Fixed Cost:	Amortized Establishment Costs ^b	0	0	0	0	0	6,122
Total Fixed Cost		5,230	6,711	7,238	7,867	8,172	11,352

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.

This study assumes that a Cosmic Crisp® apple orchard in either system could achieve full production in the sixth year of operation. Based on the above assumptions, the total production costs on an angled V trellis system are estimated at \$54,192 per acre (Table 4.1) and \$46,031 per acre on a vertical spindle system (Table 4.2) during full production. The returns over cash cost and depreciation are positive (\$5,409 per acre and \$3,128 per acre, respectively), meaning that the farm income is sufficient to cover the costs needed to continue operations in either trellis system. However, the net returns are negative, implying that the producer is not able to cover total production costs, including opportunity costs. Opportunity costs are the returns on investment that would have been received if the investment had been in the next-best-alternative activity. In the enterprise budget, these costs are accounted for by interest costs and management costs, where the latter may represent the unpaid time and labor of the owner-operator.

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. 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). The net yields are about 58–82 bins per acre, given an 80% pack-out. A gross yield-price combination of 73 bins per acre or greater and \$795.50 per bin or higher in both systems 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 (BE) return given different yield levels during full production in the different trellis systems. As of 2024, the first break-even

returns of Cosmic Crisp® are about \$541 per bin and \$556 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 Cosmic Crisp® for the fresh market. The second break-even returns are about \$554 per bin (angled V) and \$572 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 \$578 per bin (angled V) and \$597 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 \$698 per bin (angled V) and \$738 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 all apple operations in Washington State, as well as those outside of 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 4.1 Summary of estimated costs and returns (\$ per acre) of establishing, producing, and packing Cosmic Crisp® on angled V trellis system in a 10-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/acre) ^a	0	0	0	48.80	63.20	77.60
Estimated FOB Price in \$/bin ^b	647.50	647.50	647.50	647.50	647.50	647.50
Estimated FOB Price in \$/40 lb box ^b	35	35	35	35	35	35
Total Returns	0	0	0	31,598	40,922	50,246
Total Variable Costs	29,738	4,228	5,381	28,112	35,338	42,006
Total Cash Costs	30,728	5,218	6,371	29,102	36,328	42,996
Total Cash Costs and Depreciation	32,569	7,058	8,212	30,943	38,169	44,837
Total Fixed Costs	5,580	7,346	7,925	8,590	8,845	12,186
Total Production Costs ^c	35,318	11,574	13,306	36,702	44,184	54,192
Returns over Variable Costs ^d	-29,738	-4,228	-5,381	3,486	5,584	8,240
Returns over Cash Costs ^d	-30,728	-5,218	-6,371	2,496	4,594	7,250
Returns over Cash Costs and Depreciation ^d	-32,569	-7,058	-8,212	655	2,753	5,409
Net Returns ^e	-35,318	-11,574	-13,306	-5,104	-3,262	-3,946

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 18.5 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 925 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 Cosmic Crisp® on vertical spindle trellis system in a 10-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/acre) ^a	0	0	0	38.40	50.40	62.40
Estimated FOB Price in \$/bin ^b	647.50	647.50	647.50	647.50	647.50	647.50
Estimated FOB Price in \$/40 lb box ^b	35	35	35	35	35	35
Total Returns	0	0	0	24,864	32,634	40,404
Total Variable Costs	24,391	3,835	5,329	23,113	29,157	34,679
Total Cash Costs	25,381	4,825	6,319	24,103	30,147	35,669
Total Cash Costs and Depreciation	26,989	6,432	7,926	25,710	31,755	37,276
Total Fixed Costs	5,230	6,711	7,238	7,867	8,172	11,352
Total Production Costs ^c	29,621	10,546	12,567	30,979	37,330	46,031
Returns over Variable Costs ^d	-24,391	-3,835	-5,329	1,751	3,477	5,725
Returns over Cash Costs ^d	-25,381	-4,825	-6,319	761	2,487	4,735
Returns over Cash Costs and Depreciation ^d	-26,989	-6,432	-7,926	-846	879	3,128
Net Returns ^e	-29,621	-10,546	-12,567	-6,115	-4,696	-5,627

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 18.5 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 925 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 Cosmic Crisp® during full production on angled V trellis system.

Gross Yield (bins/acre) ^b	Net Yield (bins/acre) ^b	Net Returns (\$/acre) at \$518/Bin (or \$28/box) ^{c,d}	Net Returns (\$/acre) at \$647.50/Bin (or \$35/box) ^{c,d}	Net Returns (\$/acre) at \$795.50/Bin (or \$43/box) ^{c,d}
73	58	-15,012	-7,449	1,194
78	62	-14,800	-6,719	2,516
83	66	-14,588	-5,990	3,838
88	70	-14,376	-5,260	5,160
93	74	-14,165	-4,530	6,481
97	78	-13,995	-3,946	7,539

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.

^b Assumes a 925 lb bin. Considers an average pack-out of 80%.

^c The number of 40 lb boxes per bin is 18.5.

^d From left to right, the assumed FOB prices are the minimum, average, and maximum annual FOB prices of Cosmic Crisp® between 2019 and 2024 (Source: WSTFA 2024). 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 Cosmic Crisp® during full production on vertical spindle trellis system.

Gross Yield (bins/acre) ^b	Net Yield (bins/acre) ^b	Net Returns (\$/acre) at \$518/Bin (or \$28/box) ^{c,d}	Net Returns (\$/acre) at \$647.50/Bin (or \$35/box) ^{c,d}	Net Returns (\$/acre) at \$795.50/Bin (or \$43/box) ^{c,d}
73	58	-13,920	-6,357	2,286
78	62	-13,708	-5,627	3,608
83	66	-13,496	-4,897	4,930

Gross Yield (bins/acre) ^b	Net Yield (bins/acre) ^b	Net Returns (\$/acre) at \$518/Bin (or \$28/box) ^{c,d}	Net Returns (\$/acre) at \$647.50/Bin (or \$35/box) ^{c,d}	Net Returns (\$/acre) at \$795.50/Bin (or \$43/box) ^{c,d}
88	70	-13,284	-4,167	6,252
93	74	-13,072	-3,437	7,574
97	78	-12,903	-2,853	8,631

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.

^b Assumes a 925 lb bin. Considers an average pack-out of 80%.

^c The number of 40 lb boxes per bin is 18.5.

^d From left to right, the assumed FOB prices are the minimum, average, and maximum annual FOB prices of Cosmic Crisp[®] between 2019 and 2024 (Source: WSTFA 2024). 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 Cosmic Crisp[®] 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	42,006.29	541.32	29.26 ^b
2. Total Cash Costs ^c	42,996.29	554.08	29.95 ^d
3. Total Cash Costs + Depreciation Costs	44,837.08	577.80	31.23 ^e
4. Total Costs ^f	54,191.88	698.35	37.75 ^g

Note: Number of boxes per bin is 18.5. Bin size is 925 lb.

^a Break-even (BE) return is calculated as BE Return = Cost divided by Net yield during full production (i.e., 77.60 bins per acre). The BE Return per 40 lb box is calculated as the per bin value divided by 18.5. 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, Cosmic Crisp[®] 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 Cosmic Crisp[®] 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	34,679.15	555.76	30.04 ^b
2. Total Cash Costs ^c	35,669.15	571.62	30.90 ^d
3. Total Cash Costs + Depreciation Costs	37,276.45	597.38	32.29 ^e
4. Total Costs ^f	46,031.04	737.68	39.87 ^g

Note: Number of boxes per bin is 18.5. Bin size is 925 lb.

^a Break-even (BE) return is calculated as BE Return = Cost divided by Net yield during full production (i.e., 62.40 bins per acre). The B E Return per 40 lb box is calculated as the per bin value divided by 18.5. 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, Cosmic Crisp[®] 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 Cosmic Crisp® on the two trellis systems can be found in the following Excel Workbooks: Appendix 1.1 Cosmic Crisp® Apples Grown on Angled V Trellis System and Appendix 1.2 Cosmic Crisp® 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.

Acknowledgments

The authors acknowledge the information provided by a group of anonymous Cosmic Crisp® orchard and packinghouse owners-operators, pesticide consultants, nursery representatives, financial institution representatives, and WSU Extension educators.

References

- Paterson, L. 2023. [Cosmic Crisp Boasts Big Sales for Washington, with New Apple Varieties on the Way](#). Northwest Public Broadcasting.
- U.S. Department of Labor. 2024. [Foreign Labor Certification, Agricultural Online Wage Library](#). Washington State Prevailing Wage Results.
- Musacchi, S., I. Hanrahan, K. Lewis, K. Evans, and T. DuPont. 2024. [WA 38 Characteristics and Horticulture](#). Washington State University Comprehensive Tree Fruit Site.
- WSTFA (Washington State Tree Fruit Association). 2024. Annual Crop Summary: 2012–2024 Production and Marketing Season.

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



WASHINGTON STATE UNIVERSITY
EXTENSION

Copyright © Washington State University

WSU Extension publications contain material written and produced for public distribution. Alternate formats of our educational materials are available upon request for persons with disabilities. Please contact Washington State University Extension for more information.

Issued by Washington State University Extension and the US Department of Agriculture in furtherance of the Acts of May 8 and June 30, 1914. Extension programs and policies are consistent with federal and state laws and regulations on nondiscrimination regarding race, sex, religion, age, color, creed, and national or ethnic origin; physical, mental, or sensory disability; marital status or sexual orientation; and status as a Vietnam-era or disabled veteran. Evidence of noncompliance may be reported through your local WSU Extension office. Trade names have been used to simplify information; no endorsement is intended. Published April 2025.