2011 Cost Estimates of Producing High-Tunnel Tomatoes in Western Washington

WASHINGTON STATE UNIVERSITY EXTENSION FACT SHEET • FS090E

Preface

The information in this publication serves as a general guide for producing tomatoes in high tunnels in western Washington as of 2011. This guide can be used by new and existing high-tunnel tomato producers to help evaluate production decisions, determine potential returns, and prepare budgets. Specific assumptions are included in this publication, but these assumptions may not fit every situation since production costs and returns are highly variable for any particular high-tunnel operation due to case-specific:

- High-tunnel system
- Capital, labor, and natural resources
- Crop yields
- Type and size of machinery
- Input prices
- Cultural practices
- Commodity prices
- Management skills

Cost estimation also varies with the intended use of the enterprise budget. To avoid drawing unwarranted conclusions for any particular farm, readers must closely examine the assumptions made in this guide, and then adjust the costs and/or returns as appropriate for their situation.

High-Tunnel Tomato Production in Washington

A high tunnel is a temporary agricultural field structure with arched or hoop-shaped frames. It is covered with one or more layers of clear plastic, is solar heated, and has no electricity (Figure 1). For a sturdy and durable high-tunnel structure, the hoops are made of steel and the plastic is greenhouse grade 6 mil (0.15 mm) with UV light protection. The plastic covering can be easily removed and replaced if it is damaged or if the structure is "rested" for a season. The structure can be disassembled and moved to other locations; however, if placed in a windy environment, the required wind reinforcement makes it cumbersome to move. High tunnels are generally 9-feet to 12-feet high, which allows for a small- to medium-sized tractor to be used inside it. High tunnels provide protection from seasonal rainfall and direct sunlight. In cooler climates, such as western Washington, high tunnels elevate the temperature inside the structure, especially under sunny conditions.

Figure 1. High-tunnel structure used for tomato production in Western Washington.

Tomatoes benefit most from high-tunnel production in spring, summer, and fall. High tunnels make it possible to plant early in the spring; facilitate fast plant growth, and early harvests in the summer; and extend harvest into the fall. Tomatoes are grown in the ground inside high tunnels (Figure 2), and can be transplanted into unheated high tunnels as early as mid-March, if average daily temperatures are above 50°F. For early maturing varieties (less than 70 days), fruit harvest will generally start in late June. In the fall, high tunnels protect the crop from rain and light frost, and extend harvest through October if plant health remains good. In general, tomatoes are harvested twice a week during peak harvest, which may extend from four to six weeks, depending on the first killing frost date.

Drip irrigation is essential in high tunnels. A low volume of water on a daily basis appears to reduce fruit cracking, thereby increasing the amount of marketable fruit. Fertilizer is incorporated into the bed prior to planting and is applied through the drip system during the growing season. Additional calcium fertilizer may be needed to reduce

Figure 2. Several varieties of tomatoes grown in a high tunnel in western Washington.

blossom-end rot, a physiological fruit disorder that tends to increase under high-tunnel growing conditions. The primary issue for high-tunnel tomato production is providing adequate ventilation to reduce relative humidity and prevent temperatures from exceeding 95°F. High relative humidity promotes foliar diseases and reduces fruit marketability. When the temperature exceeds 95°F, blossom drop occurs and new flower formation can be impeded for up to three weeks, resulting in reduced fruit production.

The number of acres in high-tunnel tomato production in Washington is limited, with approximately 50 acres in production in 2011. Although the potential for quality tomato production is high, the adoption rate for this production system is low. This is likely due to a lack of awareness of the benefits and potential returns when using high tunnels, as well as the capital investment needed to begin production.

Objectives

The objectives of this publication are to: (1) provide an estimate of the capital requirements and production costs of growing tomatoes in high tunnels in western Washington, (2) provide growers with a procedure and a tool for analyzing the profitability of high-tunnel tomato production, and (3) develop an Excel workbook that allows the user to estimate production costs and examine different scenarios by changing input assumptions, yield, and price.

The primary uses for this publication are to identify inputs, costs, and yields of producing tomatoes based on assumptions described below. This publication does not represent any particular farm and is not intended to be a definitive guide to production practices. However, it can be helpful in estimating the physical and financial requirements of comparable plantings.

Sources of Information

The data used in this study were gathered from a group of experienced growers in western Washington who use a high-tunnel system to produce tomatoes. Their production practices and input requirements form the baseline assumptions of the enterprise budget. Additionally, the data represent what these growers anticipate if no unforeseen production failures occur. Given that many factors affect production costs and returns, individual growers can use the Excel Workbook provided to estimate their own costs and returns.

Budget Assumptions

1. The enterprise budget is for tomato production in a high tunnel. The high tunnel is an add-on to an existing farm enterprise. The basic overhead costs of a farm, such as buildings, farm equipment and vehicles, fees, and other dues, are assumed to be covered by the farm business. Only new expenses associated with the high tunnel are included in the production scenario.
2. The high tunnel is 20-feet by 96-feet with end walls. It is a three-season structure that is set up in mid-April and taken down in November. Only tomatoes are being produced in the high tunnel.
3. The production specifications are shown in Table 1. Based on this, the growing area (i.e., row area multiplied by the number of rows in the high tunnel) for tomatoes is 480 sq. ft. The remaining space in the tunnel is devoted to utility areas (paths, handling stations, and the like).
4. The high tunnel uses a drip irrigation system. Installation includes a fixed cost of $50 for the system parts, and a $50 annual labor cost to roll up the irrigation line at the end of the growing season. The cost of installing an irrigation outlet outside the high tunnel is $815.
5. The growing season for tomatoes is from February 1st to October 1st, and the harvest season is from June/July to October 1st.
6. There are 480 tomato plants in the high tunnel with a marketable yield of 9 pounds of tomatoes per plant. It is assumed that 90% of the total tomato yield is marketable. Symmetry, a deep red color, firmness, and a lack of cracking are some of the qualities that growers look for in marketable tomato fruit. Tomatoes are sold at local farmers markets, co-ops, and CSAs, usually located within 20-50 miles of the farm. Farmers markets charge a vendor fee, which is generally fixed, but they may also include a percentage of daily sales. Return to the grower is $3 per pound.
7. Interest on investment is 5%.

Summary of Results

The detailed enterprise budget for high-tunnel tomatoes is presented in Table 2. Production costs are classified as variable and fixed costs. Variable costs comprise field operations, harvest and packing, marketing, labor, materials, maintenance, and repairs. Fixed costs (which are incurred whether the crop is grown or not) include depreciation on capital, interest, property tax, and management.

Given the above assumptions, the cost of producing high-tunnel tomatoes is estimated at $15.41/ft^2, compared to about $0.60/ft^2 for tomatoes grown in the open field (Galinato et al. 2012). Assuming a price received of $3 per pound, the net return for high-tunnel tomatoes would be approximately $11.59/ft^2. At the same price, the net return for field-grown tomatoes is much lower, at about $1.49/ft^2. Figures are expressed in square feet and are based on the estimated growing areas for tomatoes, which are 480 ft^2 and 43,560 ft^2 (equivalent to 1 acre) for high tunnel and open field, respectively.

The tomato yield per square foot throughout the growing season in a high-tunnel system is 9 lbs/ft^2, which is much higher than the yield for field-grown tomatoes, which is about 0.70 lb/ft^2. As a result, while high-tunnel production costs are higher, the increased yield boosts the net returns over that of open-field production in this budget scenario.

Two key factors affecting net returns are crop yields and received prices. Crop yield varies depending on the location (warm or cool climate), structure, features of the high tunnel, and cultural practices in the tunnel, among others. Also, retail prices for tomatoes vary and growers should be aware of the market prices as they examine their own budgets. Table 3 shows the sensitivity of net returns to different price and yield scenarios for tomatoes produced in a high-tunnel system. Fixed costs (Table 2) are based on underlying cost data shown in Tables 4 through 6. Table 4 presents the physical capital requirements. Interest costs and depreciation costs applied to the high-tunnel tomato enterprise are listed in Tables 5 and 6.

Interest costs represent required return on investments. These costs can be actual interest payments on loans used to finance high-tunnel tomato production and physical capital investments, or they can be opportunity cost, or a combination of the two.

WSU enterprise budgets are economic budgets (not financial/cash budgets), and to fully understand them, it is important to understand the concept of *opportunity cost*. Opportunity cost is defined as the revenue foregone by not investing in the next best alternative carrying similar financial risk. For example, if a producer invests $30,000 of equity capital in equipment, the producer gives up the alternative of investing that money in the stock market, or paying off an outstanding loan. Thus, if the producer is to realize an "economic" profit, the equipment investment must earn a return that is higher than the producer would earn from the next best alternative. If the next best alternative happens to be paying off an outstanding loan that carries an annual interest of 6%, economic profits are not realized until a net return greater than $1,800 is realized by the equipment investment. Thus, the high-tunnel enterprise budget reflects an interest cost on owned or borrowed capital.

The same is true for calculating the opportunity costs of an operator's labor and owned land. In calculating labor costs, the operator's labor is valued at the amount he or she could earn if they were hired someplace else to do the same work, or at the amount it would cost to hire someone to do the work the operator currently does himself/herself. Likewise, in calculating the opportunity cost of a producer's owned land, this land would be valued at the amount that a producer could earn if the land was rented out rather than being used by the producer.

Depreciation costs include the annual replacement cost of equipment, which is the amount a producer would pay to replace equipment per year, on average. Although using replacement prices may overstate the costs growers are experiencing in the present, these prices do indicate the earnings that would be needed to replace depreciated assets in the future. When looking at the long-term viability of an enterprise, it is important to consider its ability to replace depreciable assets on a replacement-cost basis.

Excel Workbook

An Excel spreadsheet version of the enterprise budgets of high-tunnel grown tomatoes (Table 2), as well as associated data underlying the cost calculations (Tables 4 through 6), are available at the WSU School of Economic Science's Extension website: http://extecon.wsu.edu/pages/Enterprise_Budgets. Growers can modify select values and use the Excel Workbook to evaluate their own production costs and returns.

Reference

Galinato, S.P., C.A. Miles, and S.S. Ponnaluru. 2012. 2011 Cost Estimates of Producing Fresh Market Field-Grown Tomatoes in Western Washington. *Washington State University Extension Fact Sheet FS080E*.

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Table 1. Production Specifications of Tomatoes Grown in a High Tunnel

Variety	Intermediate
High tunnel size	20 ft by 96 ft
In-row spacing	1 ft
Between-row spacing	3.5 ft
Row width	1 ft
Row length	96 ft
Density	480 tomato plants
Number of rows	5 rows

Table 2. Estimated Cost and Returns of Producing Tomatoes in a High Tunnel ($/tunnel)

Total Returns	**Unit**	**Price/unit**	**Quantity**	**Total**	**Note**	**Your Return**
Tomato	pound	$3.00	4,320	$12,960.00	The marketable yield is 9 lbs/plant. There are 480 tomato plants grown in the high tunnel.	
Variable Costs	**Unit**	**Cost/unit**	**Quantity**	**Total**	**Note**	**Your Cost**
Soil preparation						
Spread compost						
Material	yard	$10.00	5.50	$55.00		
Labor	hour	$165.00	0.33	$54.45		
Till cover crop and compost	hour	$165.00	0.33	$54.45		
Chisel plow	hour	$165.00	0.33	$54.45		
Till beds	hour	$165.00	0.33	$54.45		
Fertilizer						
Material	gallon	$30.00	12.00	$360.00	Fertiligation liquid fertilizer; 1 gal/wk for 12 weeks	
Labor	hour	$14.75	3.30	$48.68		
Seeding and Transplanting						
Seeds	500-seed pack	$8.75	1.40	$12.25	20% over desired number of plants (i.e., about 691 seeds)	
Transplants						
Material	pot	$0.18	500.00	$90.00		
Labor	hour	$14.75	1.50	$22.13		
Planting	hour	$14.75	8.00	$118.00	2 people spending 4 hours each	
Production Costs						
Fungicide				$0.00		
Irrigation water				$0.00	Has own water source; not connected to irrigation district.	
Irrigation power				$0.00	Included in overhead cost	
Irrigation labor[3]				$50.00		
Trellis set up	hour	$14.75	5.00	$73.75	Done by one person	
Twine and pruning	hour	$14.75	20.00	$295.00	Done 4 different times during the growing season; 5 hours each time	
Plastic and stake removal	hour	$14.75	8.00	$118.00	Plastic over the tunnel	
Harvest and Post-harvest Costs						
Picking (per pound)	hour	$14.75	54.00	$796.50	Based on 80 lbs per hour	
Washing, grading and packing (per pound)	hour	$14.75	43.20	$637.20	GAP procedure is followed; grading, washing and packing 100 lbs per hour	
Boxes	10-lb box	$0.20	432.00	$86.40		
Marketing costs[1]				$1,400.00	Estimated cost related to high-tunnel grown tomatoes as a portion of total direct marketing costs of all agricultural produce	
Maintenance and Repairs						
Tunnel and equipment maintenance and repairs				$175.00	Maintaining the high tunnel including repairs due to wind damage, equipment, etc.	
Fueling and lubrication				$75.00		
Irrigation system maintenance and repair				$100.00		
Other Variable Costs						
Tunnel temperature management	hour	$14.75	50.00	$737.50	Over a 4-month period	
Irrigation and fertigation management	hour	$14.75	45.00	$663.75		
High tunnel set up and removal[2]	hour	$14.75	11	$162.25		
Overhead (5% of variable costs)				$314.71		
Interest on Variable Costs (5%)[4]				$220.30		
Total Variable Costs				**$6,829.21**		
Fixed Costs						
Depreciation						
High tunnel				$178.98		
Irrigation system				$139.00		
Trellis system				$30.00		
Equipment Annual replacement cost				$100.00		
Interest						
Equipment and supplies				$16.91		
High tunnel				$32.62		
Irrigation system				$21.63		
Land	acre	$466.50	0.04	$20.56	Estimated value of agricultural land is $9,330 per acre. Interest rate is 5%.	
Trellis system				$7.50		
Other Fixed Costs						
Land and property tax	acre	$108.00	0.04	$4.76		
Management	acre	$400.00	0.04	$17.63		
Permit				$0.00	No building permit necessary for high tunnel built in Washington.	
Total Fixed Costs				**$569.59**		
Total Cost				**$7,398.79**		
Estimated Net Returns				**$5,561.21**		

[1]Assumes deliveries and sales of high-tunnel grown tomatoes (along with other agricultural produce) in 11 markets such as CSAs, farmers markets, etc.
[2]Takes 6 hours to set it up (3 people at 2 hours each); 3 hours to take it down (3 people at 1 hour each); and 2 hours additional to take out the twine, strings, etc.
[3]Roll up irrigation line at the end of growing season.
[4]Interest expense on 8 months based on growing season.

Table 3. Estimated Net Return at Various Prices and Yields of High-Tunnel Grown Tomatoes

Marketable Yield (pounds/tunnel)	Price ($ per pound)				
	$1.50	$2.00	$2.50	$3.00	$3.50
2,500	-$2,953.95	-$1,703.95	-$453.95	$796.05	$2,046.05
3,000	-$2,394.84	-$894.84	$605.16	$2,105.16	$3,605.16
3,500	-$1,835.73	-$85.73	$1,664.27	$3,414.27	$5,164.27
4,000	-$1,276.62	$723.38	$2,723.38	$4,723.38	$6,723.38
4,500	-$717.51	$1,532.49	$3,782.49	$6,032.49	$8,282.49

Table 4. Physical Capital Requirements of High-Tunnel Tomato Production

	Purchase Price*	Total Cost
High tunnel structure (20' x 96')		$1,186
Hoops (Steel ribs or tubes)	*$429*	
Stakes	*$234*	
Anchors (6)	*$24*	
Poly	*$344*	
Rope	*$50*	
End walls	*$55*	
*Reinforcements (additional pipes)***	*$50*	
Fertilizer injector		$475
Supplies (strings, hanger, tomato clips)		$140
Irrigation system—Drip (inside the high tunnel)		$50
Irrigation system—Outlet (outside the high tunnel)		$815
Irrigation pipe and risers	*$340*	
PVC unit and various PVC pieces, ball valves, pressure gauge	*$475*	
Trellis system		$300
Total Cost		**$2,966**

*Purchase price is approximate and corresponds to new high-tunnel structure, equipment, or supplies.
**To keep the high tunnel in place during windy conditions.

Table 5. Interest Costs ($/tunnel) of High-Tunnel Tomato Production

	Total Purchase Price	Salvage Value	Total Interest Cost
Equipment and supplies	$615	$62	$17
High tunnel—poly	$344	$34	$9
High tunnel—skeleton/metal parts	$842	$84	$23
Irrigation system	$865	$0	$22
Trellis system	$300	$0	$8
Interest Rate	*5.0%*		
Salvage Value	*10.0%*		

Notes:
Interest Cost is calculated as: (Total Purchase Price + Salvage Value)/2 x 5%.
Salvage Value refers to the estimated value of an asset at the end of its useful life. It is calculated as: Total Purchase Price x 10%.

Table 6. Depreciation Costs ($/tunnel) of High-Tunnel Tomato Production

	Total Purchase Price	Years of Use	Depreciation Cost
High tunnel—poly	$344	3	$103.20
High tunnel—skeleton/metal parts	$842	10	$75.78
Irrigation system			
Drip	$50	5	$10.00
Irrigation pipe & risers	$340	10	$34.00
PVC unit and other PVC pieces	$475	5	$95.00
Trellis system	$300	10	$30.00
Equipment replacement cost*			$100.00

Notes:
The depreciation cost (except for Equipment) is calculated as *straight line depreciation*: (Total Purchase Price – Salvage Value)/Years of Use.
*An estimate of average annual replacement costs, rather than depreciation costs, is used for equipment. Replacement prices may overstate growers' perceptions; however, they indicate the earnings needed to replace depreciable assets. When looking at long-term enterprise viability, it is important to consider the ability of the enterprise to replace depreciable assets.

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