

# Commercial Chestnut Cost of Production and Comparative Analysis with Tart Cherry Production

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Dr. Roy Black<sup>1</sup>, Roger Betz<sup>2</sup>, Erin Lizotte<sup>2</sup>, Dr. Dennis Fulbright<sup>3</sup>

1. Dept. of Agricultural, Food, and Resource Economics Michigan State University, 2. Michigan State University Extension, 3. Dept. of Plant, Soil and Microbial Science, Michigan State University.

## Executive Summary

The estimated cost of producing grafted, French-style (European/Japanese parentage) chestnuts at a commercial scale (>10 acres) on is \$0.81/lbs based on a full production yield of 3,500 lbs/acre and a minimum planting size of 10 acres. The cost of production calculation is based on estimates of operating costs, harvest costs, management, interest and tax costs. It also includes an amortized cost of establishing an orchard and employing the land in production (in this case the defender crop is tart cherry but the spreadsheet can be altered to represent any desired challenger cash return or rate of return). This report was developed through interviews with chestnut growers and other experts in 2013. The tables below are a summary of the costs to establish and produce chestnuts and will be more clearly defined in the "Calculating Cost of Production" section of this document.

<b>Chestnut Orchard Establishment Cost</b>	
<b>Site preparation prior to year 1</b>	<b>Cost/Acre (\$)</b>
Plowing and permanent seeding	\$300.00
PH adjustment	\$60.00
Fence	\$1,187.50
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$1,777.50</b>
<b>Planting year (year 1)</b>	
Ground preparation	\$27.22
Marking and surveying	\$13.24
Trees 1/2 to 3/4	\$2,000.00
Tree Planting (Fall)	\$61.20
Mulch application	\$102.00
Mouse control	\$10.22
Water Well	\$1,100.00
Irrigation Drip	\$250.00
Management	\$67.54
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$3,861.42</b>
<b>Growing cost (year 2)</b>	
Pruning	\$14.09
Tree Replacement	\$200.00
Pest control spray 1/3 of est.	\$5.00
Herbicide spray same minus material =1/2	\$1.50
Mowing same as mature	\$56.75
Irrigation Energy	\$10.00
Hand Fertilizer 10% of mature	\$18.68
Mouse control	\$10.22

Management	\$50.66
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$596.89</b>
<b>Growing cost (year 3)</b>	<b>Cost/Acre (\$)</b>
Pruning	\$28.18
Tree Replacement	\$20.00
Irrigation Energy	\$10.00
Pest control spray	\$5.00
Herbicide spray	\$1.50
Mowing	\$56.75
Fertilizer	\$18.68
Mouse control	\$10.22
Management	\$50.66
Real Estate Tax	\$30.00
Land Opportunity Cost	\$400.00
<b>Total</b>	<b>\$630.98</b>
<b>Growing cost (year 4)</b>	
Pruning	\$42.27
Irrigation Energy	\$10.00
Pest control spray	\$5.00
Herbicide spray	\$1.50
Mowing	\$56.75
Fertilizer 20%	\$37.35
Mouse control	\$10.22
Management	\$50.66
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$443.75</b>
<b>Growing cost (year 5)</b>	
Irrigation Energy	\$10.00
Pruning	\$56.36
Pest control spray	\$5.00
Herbicide spray	\$1.50
Mowing	\$56.75
Fertilizer 30%	\$56.03
Management	\$67.54
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$473.18</b>
<b>Total Establishment Cost</b>	<b>\$7,783.72</b>

Annual Chestnut Orchard Cost Per Acre at Production (>5years)	
	<b>Total</b>

	Cash (\$/Acre)	Non-Cash (\$/Acre)
Pruning	\$283.30	\$176.35
Mowing	\$56.75	\$34.42
Crop Protection	\$252.49	\$74.50
Herbicide	\$23.86	\$3.48
Fertilizer	\$186.77	\$4.03
Harvest	\$657.54	\$678.75
Management and Labor Supervision	\$135.08	\$0.00
Interest on operating capital @ 8%	\$51.60	\$0.00
Real Estate Taxes	\$30.00	\$0.00
Land Opportunity Cost	\$0.00	\$200.00
<b>Total Costs/Acre</b>	<b>\$1,647.40</b>	<b>\$1,171.52</b>
<b>Total Cash and Non-Cash Costs/Acre</b>	<b>\$2,819.92</b>	

## Objectives

The objectives of this report are to:

- Calculate the cost/lb of producing grafted, French-style (European/Japanese parentage) chestnuts at a commercial scale (>10 acres) and utilizing a commercial harvester.
- Describe how these values were calculated.
- Determine the annual cash requirements for each stage of the chestnut production cycle.
- Compare the economics of French-style chestnuts to tart cherry production in Michigan.

## The Cost of Production Calculation

Farmers considering investing in a new block or replanting an existing block of chestnuts want to know if the block will be profitable over the block's lifespan. They recognize the chestnut industry is risky with highly variable yields, and revenues but farmers want revenues that, on the average, cover costs, including a return for profit over the lifetime of the block.

A starting point is establishing a projected cost of production per lb of chestnuts. The cost must include: (1) cash required for getting the block into production; (2) the land control costs for the time period of getting the block into production; (3) crop protection expenditures, fertilizer, labor, machinery, building and equipment costs, and harvest and handling costs during the bearing years; (4) land control costs during the bearing years; and (5) management and supervision costs. These costs include a rate of return on equity capital and a charge for unpaid family labor and management. The final component is projected average yield/acre during the bearing years.

Chestnuts, like other perennial tree crops, have a lifecycle which includes an establishment stage, a ramping up to maturity stage, a maturity stage, and a declining production stage (though at this time we are unsure of the declining stage for chestnuts in Michigan). Several years of cash outflows occur prior to any revenue generation. As production ramps up, cash inflows begin to exceed cash requirements resulting in a positive annual net cash flow.

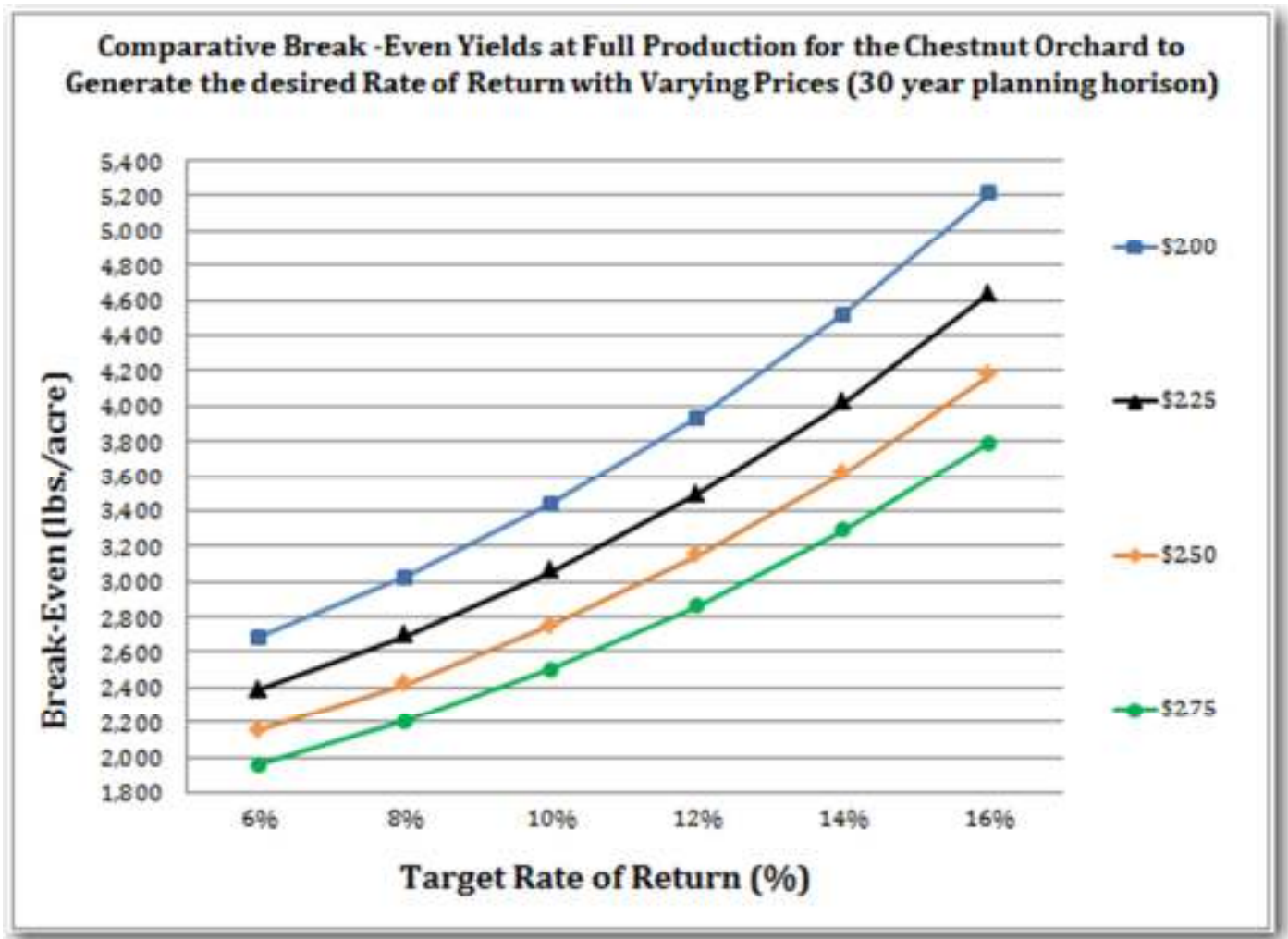
The average annual costs per pound of marketable nuts over the entire life-cycle of the tree must be assessed – the life cycle cost. Budgeting procedures employed must standardize cash flows to account for the timing and risk involved during the chestnut tree life-cycle.

The 1st step is calculation of the cash requirements for the establishment period. The cash required in each year plus the accumulated interest until the beginning bearing year is summed. Likewise, the accumulated annual cost of having land

tied up during the establishment period is calculated. These expenditures are amortized over the bearing years. Think of this step as acquiring a “ready to bear” block.

In the 2nd step, the annual production and harvesting cost during the bearing years, including land control cost is calculated. The amortized establishment cost is added to get the average annual total cost per acre during the bearing years. This cost is divided by the average yield across the bearing years to get the cost per lb.

The cost/lb of chestnuts is a “break-even” price. It is the price/lb the farm would have to receive, over the block’s life-cycle, to cover all of the annual cash requirements. This study calculates the chestnut price required to justify investing in a block of chestnuts to ensure getting a target rate of return on equity capital, covering the annual cost of using land, the opportunity cost of family labor and management, and other allocated costs. See the *Comparative Break-Even Yields* table below to compare difference rates of return, price levels and yield requirements.



### Estimation of Costs and Revenue

The projected costs were developed through focus group discussions with chestnut and also pulled data heavily from a tart cherry cost of production tool developed in 2010. Many of the costs associated with tart cherry production are comparable including land cost, labor and machinery. Although the initial assumptions are based on the data available for a chestnut orchard system, there is and should be some disagreement among stakeholders on the parameters assumed and results obtained. For this reason and others, this excel based decision support tool is flexible in that an individual grower may modify the assumptions described and determine for their own operation what the results need to be in order to obtain a comparative break-even and maintain profitability.

### Calculating Costs of Production

The following tables illustrate how the cost of production for chestnut was established and includes descriptions of how values were estimated. The first section includes a description of the costs to establish an orchard through year 5, the second section includes a description of the annual cost of production in an established orchard (year 6 and beyond).

*Cost of Establishment (0-5 years)*

Site preparation prior to year 1	Cost/Acre (\$)
Orchard removal & clean-up	\$0.00
Plowing and permanent seeding	\$300.00
PH adjustment	\$60.00
Fence	\$1,187.50
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$1,777.50</b>

Preplant costs were estimated with land reshaping and seeding estimated at \$300/acre, orchard removal was not included but can be added in the model. An estimated cost of \$60/acre is included for pH adjustment prior to planting. The cost of fencing to prevent deer damage was included and estimated using the cost for an 8' panel fence at a \$4.50/linear foot cost and distributed over a ten acre block (2,500 linear feet). Real estate tax was estimated at \$30 per acre. The land opportunity cost represents the potential income from the land if used for another purpose (for example tart cherry production).

Planting year (year 1)	
Ground preparation	\$27.22
Marking and surveying	\$13.24
Trees	\$2,000.00
Tree Planting	\$61.20
Mulch application	\$102.00
Pest control spray	\$0.00
Herbicide spray	\$0.00
Mouse control	\$10.22
Water Well	\$1,100.00
Irrigation Drip	\$250.00
Management	\$67.54
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$3,861.42</b>

Year 1 costs include an average ground preparation cost of \$27.22 per acre, management costs of \$67.54/acre and marking and surveying costs of \$13.24/acre are based on the tart cherry cost of establishment. Tree costs for grafted, Japanese/European hybrids (1/2-3/4") are estimated at \$25/tree and a density of 80 trees per acre totaling a plant cost of \$2,000/acre. Trees are planted in the fall in Michigan with an estimated cost of \$61.20/acre based on tart cherry estimates. No herbicides or pesticides are utilized in the planting year because the trees are not planted until fall. Mouse guards are estimated to cost \$10.22 per acre installed. Expenses associated with well installation (spread over 10 acres) and drip irrigation were also included. Real estate taxes were set at \$30/acre and the land opportunity cost remain at \$200/acre.

Growing cost (year 2)	
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Pruning	\$14.09
Tree Replacement	\$200.00
Pest control spray	\$23.31
Herbicide spray same minus material	\$1.50
Mowing same as mature	\$91.18
Irrigation Energy	\$10.00
Hand Fertilizer	\$19.08
Mouse control	\$10.22
Deer control	\$0.00
Management	\$50.66
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$650.03</b>

Pruning cost during year 2 are estimated at \$14.09/acre as trees are small and require minimal pruning from the ground. Pruning costs do not include the cost of a pruning basket which is not necessary until trees are larger. Growing costs in year two include a 10% tree replacement cost (8 trees at \$25/tree). Pest control is estimated at 1/3 of the cost of an established stand based on tree row volume and the potential to spray alternate row middles. Herbicide sprays are estimated at 50% the cost of materials on established trees, mowing remains the same as in mature orchards. Irrigation energy costs are estimated at \$10/acre annually. Fertilizer rates are backed off to 10% of full production rates based on limited leaf area, mouse control remains at \$10.22/acre. Deer management is set at no cost because deer fencing was established. Management, taxes and the land opportunity cost remain the same. Real estate taxes were set at \$30/acre and the land opportunity cost remain at \$200/acre.

Growing cost (year 3)	Cost/Acre (\$)
Pruning	\$28.18
Tree Replacement	\$20.00
Irrigation Energy	\$10.00
Pest control spray	\$23.31
Herbicide spray	\$1.50
Mowing	\$91.18
Fertilizer	\$19.08
Mouse control	\$10.22
Deer control	\$0.00
Management	\$50.66
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$484.12</b>

Pruning cost during year 3 are estimated at \$28.18/acre as trees are still small and require minimal pruning from the ground. Pruning costs do not include the cost of a pruning basket which is not necessary until trees are larger. Growing costs in year three include a 1% tree replacement cost. Pest control is estimated at 1/3 of the cost of an established stand based on tree row volume and the potential to spray alternate row middles. Herbicide sprays are estimated at 50% the cost of materials on established trees, mowing remains the same as in mature orchards. Irrigation energy costs are estimated at \$10/acre annually. Fertilizer rates are backed off to 10% of full production rates based on limited leaf area, mouse control remains at \$10.22/acre. Deer management is set at no cost because deer fencing was established. Management, taxes and the land opportunity cost remain the same. Real estate taxes were set at \$30/acre and the land opportunity cost remain at \$200/acre.

<b>Growing cost (year 4)</b>	
Pruning	\$42.27
Tree Replacement	\$0.00
Irrigation Energy	\$10.00
Pest control spray	\$23.31
Herbicide spray	\$1.50
Mowing	\$91.18
Fertilizer 20%	\$38.16
Mouse control	\$10.22
Deer control	\$0.00
Management	\$50.66
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$497.29</b>

Pruning cost during year 4 are estimated at \$42.27/acre as trees are more substantial and will require some ladder or pole saw work and larger cuts. Pruning costs do not include the cost of a pruning basket which is not necessary until trees are larger. . Growing costs in year four include no tree replacement costs. Pest control is estimated at 1/3 of the cost of an established stand based on tree row volume and the potential to spray alternate row middles. Herbicide sprays are estimated at 50% the cost of materials on established trees, mowing remains the same as in mature orchards. Irrigation energy costs are estimated at \$10/acre annually. Fertilizer rates are increased to 20% of full production rates based on limited leaf area, mouse control remains at \$10.22/acre. Deer management is set at no cost because deer fencing was established. Management, taxes and the land opportunity cost remain the same.

<b>Growing cost (year 5)</b>	
Irrigation Energy	\$10.00
Pruning	\$56.36
Pest control spray	\$23.31
Herbicide spray	\$1.50
Mowing	\$91.18
Fertilizer 30%	\$57.24
Mouse control	\$0.00
Deer control	\$0.00
Management	\$67.54
Real Estate Tax	\$30.00
Land Opportunity Cost	\$200.00
<b>Total</b>	<b>\$527.13</b>
<b>Total Establishment Cost</b>	<b>\$7,997.48</b>

Pruning costs reach an all-time high during year 5 at \$56.36/acre based on tree size and lack of a pruning basket. As trees begin to fill the space there is less pruning required. Growing costs in year five include no tree replacement costs. Pest control is estimated at 1/3 of the cost of an established stand based on tree row volume and the potential to spray alternate row middles. Herbicide sprays are estimated at 50% the cost of materials on established trees, mowing remains the same as in mature orchards. Irrigation energy costs are estimated at \$10/acre annually. Fertilizer rates are increased to 30% of full production rates based on increasing leaf area. The costs of mouse control end after year four as trees are established and less susceptible to damage. Deer management is set at no cost because deer fencing was established. Management, taxes and the land opportunity cost remain the same.

*Established Orchard (6 years and older)*

*Pruning*

Pruning	Time	Labor	Equipment		Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Hour)	Non-Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
Pruning every year every tree	13.33	\$15.00	\$0.25		\$203.29	\$0.00
Brush Disposal--85 HP Tractor	0.50	\$15.00	\$21.08	\$12.18	\$18.04	\$6.09
Pruning Basket	13.33		\$4.65	\$12.77	\$61.96	\$170.26
	0.00	\$0.00	\$21.08	\$12.18	\$0.00	\$0.00
	0.00		\$5.60	\$10.08	\$0.00	\$0.00
<b>Total</b>					\$283.30	\$176.35

It was assumed that pruning would take place each year and would require 13.33 hours per acre with labor costs of \$15/hour. Brush disposal using an 85hp tractor was estimated to require 0.5 hours per acre using a flail chopper. A pruning basket is included because mature chestnut trees are large in size. Labor was estimated at \$15/hour.

*Mowing*

Mowing	Time	Labor	Equipment		Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Hour)	Non-Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
60 HP Tractor	1.67	\$15.00	\$15.18	\$8.03	\$50.25	\$13.37
Rotary Mower 10 ft pull behind 3mph	1.67		\$3.91	\$12.65	\$6.51	\$21.06
<b>Total</b>					\$56.75	\$34.42

It was estimated that growers would mow five times during the season with mowing taking 0.33 hours per acre for each mowing and totaling 1.67 hours/acre annually utilizing a 10ft mower at 3 mph. Labor was estimated at \$15/hour.

*Crop protection*

Crop Protection	Time	Labor	Material	Equipment		Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Acre)	Cash (\$/Hour)	Non-Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
85 HP Tractor	3.00	\$30.00		\$21.08	\$12.18	\$153.25	\$36.55
Orchard Sprayer	3.00			\$9.75	\$12.65	\$29.24	\$37.95
Total Insecticide Various	0.00	\$15.00	\$70.00			\$70.00	\$0.00
<b>Total</b>						\$252.49	\$74.50



It was estimated that growers would spray insecticides to protect against potato leafhopper, Japanese beetle, rose chafer and mites on average 3.5 times annually with an estimated material cost of \$20/acre and total application time of 3 hours per acre annually using an orchard sprayer and 85hp tractor and labor and labor at a \$30/hour rate.

#### *Herbicide application*

Herbicide	Time	Labor	Material	Equipment		Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Acre)	Cash (\$/Hour)	Non-Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
60 HP Used Tractor	0.40	\$30.00		\$21.27	\$2.54	\$20.51	\$1.02
Weed Sprayer	0.40			\$0.89	\$6.15	\$0.36	\$2.46
Total Herbicide			\$3.00			\$3.00	\$0.00
<b>Total</b>						\$23.86	\$3.48

It was estimated that glyphosate applications would be made twice annually over approximately 1/3 or the land area with a \$3/acre total cost of material (\$1.50/acre per application) and would require 0.40 hours annually if using a 60hp tractor traveling at 3mph with a 5ft weed spray strip under the tree and labor at a cost of \$30/hour.

#### *Fertilizer*

Fertilizer	Time	Labor	Material	Equipment		Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Acre)	Cash (\$/Hour)	Non-Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
60 HP Tractor (Nitrogen Application)	0.15	\$30.00		\$15.18	\$8.03	\$6.78	\$1.20
Spin Spreader 2x application	0.30			\$0.92	\$3.73	\$0.28	\$1.12
60 HP Tractor (Potash Application)	0.15	\$30.00		\$15.18	\$8.03	\$6.78	\$1.20
Spin Spreader	0.15			\$0.92	\$3.32	\$0.14	\$0.50
Total Nitrogen N 100lbs			\$60.00			\$60.00	\$0.00
Phos p205 84lbs			\$58.80			\$58.80	\$0.00
Total Potash k20 =108lbs			\$54.00			\$54.00	\$0.00
60 HP Tractor (Lime Application)	0.00	\$30.00		\$15.18	\$8.03	\$0.00	\$0.00
Spin Spreader	0.00			\$0.92	\$3.32	\$0.00	\$0.00
			\$0.00			\$0.00	\$0.00
<b>Total</b>						\$186.77	\$4.03

Fertilizer costs were estimated on a split application, twice annual basis. Total fertilizer material costs were estimated at \$60/acre for 100lbs total nitrogen, phosphorus at \$58.80/acre at an 84 pound application rate and potash at \$54.00/acre at a 108lb/acre application rate. Equipment costs were estimated using a 60hp tractor for each application with an estimated 0.15 hours/acre per application for a total annual equipment use of 0.3 hours per acre and labor costs of \$30/hour. Additional parameters are available for including the cost of pH adjustment if necessary but these costs were not included in the current tool as the quantity and frequency of application needed is highly site specific.

#### *Harvest*

Harvest	Time	Labor	Material	Equipment		Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Acre)	Cash (\$/Hour)	Non-Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
<b>Harvest</b>							
Bin Rental			\$35.00			\$35.00	\$0.00
Transportation labor	1.56	\$15.00				\$23.33	\$0.00
Transportation to processor	56.00	\$1.00				\$56.00	\$0.00
Vacuum Harvester FACMA	4.9	\$30.00		\$44.59	\$135.98	\$365.49	\$666.28
60 HP Used Tractor Fork Lift	4.9	\$15.00		\$21.27	\$2.54	\$177.72	\$12.46
<b>Total</b>						\$657.54	\$678.75

All harvest estimates are calculated on a per acres cost and converted to a per acre cost assuming a minimum of a 10 acre planting. Bin rental fees were estimated at \$35/acre. The model assumes investment in a FACMA Vacuum harvester and no hand picking labor for harvest. The model assumes each acre will have to be harvested 3.5 times at a rate of 1.4 acres/hour. The model assumes the assistance of a forklift operator (\$15/hr) and a harvester operator (\$30/hr). Transportation costs were estimated by assuming 3.5 harvests, 200 miles round trip to processor, and \$0.80/mile—it is estimated that 10 acres of yield can be accommodated on a single flatbed load. Transportation labor was estimated at \$15/hr with a total of 4.4 hours per trip.

#### *Miscellaneous costs of production*

Miscellaneous costs of production	Time	Labor	Total	
	Cash (Hrs/Acre)	Cash (\$/Hour)	Cash (\$/Acre)	Non-Cash (\$/Acre)
Management and Labor Supervision	4	\$33.77	\$135.08	\$0.00
Interest on operating capital @ 8%			\$51.60	\$0.00
Real Estate Taxes			\$30.00	\$0.00
Land Opportunity Cost			\$0.00	\$200.00
<b>Total Miscellaneous costs</b>			\$216.68	\$200.00

Management and supervision labor was estimated to be comparable to tart cherry and so the established value of 4 hours/acre at \$33.77/hour were used.

## Machinery Costs

The following table lists machinery costs on an annual and hourly basis and may be used as a reference for growers utilizing equipment not listed or different from those listed in the model.

Annual Equipment Cost for the Chestnut Orchard System										
Description	Yr	Purchase Price in 2013 value	Yrs Life	Salvage Value	PV of Salvage in today's dollars	Interest Rate	Annual Machinery Cost	Insurance	Taxes	Total
85 HP 2WD Tractor	2013	\$65,653	7.0	\$9,848	\$6,999	5%	\$10,137	\$164	\$0	\$10,301
60 HP 2WD Tractor	2013	\$45,878	6.0	\$6,882	\$5,135	5%	\$8,027	\$115	\$0	\$8,142
60 HP 2WD Used Tractor	2013	\$11,628	6.0	\$1,744	\$1,302	5%	\$2,034	\$29	\$0	\$2,064
Vacuum Harvester FACMA	2013	\$85,000	15.0	\$30,000	\$14,431	5%	\$6,799	\$213	\$0	\$7,011
Orch. Sprayer 500 G	2013	\$79,100	12.5	\$23,976	\$13,029	5%	\$7,235	\$198	\$0	\$7,433
Weed Sprayer 100 G	2013	\$6,328	12.0	\$1,974	\$1,099	5%	\$590	\$16	\$0	\$606
Rotary mower	2013	\$14,000	15.0	\$3,451	\$1,660	5%	\$1,189	\$35	\$0	\$1,224
Pruning Basket	2013	\$20,000	15.0	\$4,930	\$2,372	5%	\$1,698	\$50	\$0	\$1,748
Spin/Spreader - 3PT	2013	\$5,600	12.0	\$1,747	\$973	5%	\$522	\$14	\$0	\$536
Sickle bar	2013	\$23,730	15.0	\$5,850	\$2,814	5%	\$2,015	\$59	\$0	\$2,074
Field Disc	2013	\$11,200	15.0	\$2,761	\$1,328	5%	\$951	\$28	\$0	\$979
TOTAL		\$368,117					\$41,198			\$42,118
Hourly Equipment Cost for the Chestnut Orchard System										
Description	Yr	Total Hours Used <sup>1</sup>	Hours for Chestnut	Capital Recovery <sup>2</sup>	Insurance	Taxes	Repairs <sup>3</sup>	Fuel & Lube <sup>4</sup>	Total. Oper.	Total Costs/hr
85 HP 2WD Tractor	2013	832	416	\$12.18	\$0.20	\$0.00	\$4.43	\$16.46	\$20.89	\$33.27
60 HP 2WD Tractor	2013	1000	500	\$8.03	\$0.11	\$0.00	\$3.45	\$11.62	\$15.06	\$23.20
60 HP 2WD Used Tractor	2013	800	400	\$2.54	\$0.04	\$0.00	\$9.62	\$11.62	\$21.23	\$23.81
Vacuum Harvester FACMA	2013	50	50	\$135.98	\$4.25	\$0.00	\$11.30	\$29.04	\$40.34	\$180.57
Orch. Sprayer 500 G	2013	572	286	\$12.65	\$0.35	\$0.00	\$9.40	\$0.00	\$9.40	\$22.40
Weed Sprayer 100 G	2013	96	48	\$6.15	\$0.16	\$0.00	\$0.72	\$0.00	\$0.72	\$7.03
Rotary mower	2013	94	47	\$12.65	\$0.37	\$0.00	\$3.54	\$0.00	\$3.54	\$16.56
Pruning Basket	2013	133	133	\$12.77	\$0.38	\$0.00	\$4.27	\$0.00	\$4.27	\$17.42
Spin/Spreader - 3PT	2013	140	70	\$3.73	\$0.10	\$0.00	\$0.82	\$0.00	\$0.82	\$4.65
Sickle bar	2013	200	100	\$10.08	\$0.30	\$0.00	\$5.30	\$0.00	\$5.30	\$15.67
Field Disc	2013	200	100	\$4.76	\$0.14	\$0.00	\$5.30	\$0.00	\$5.30	\$10.20
Total										\$354.77

1. Assumes that the other half of the farm uses the equipment equally, except for the Vacuum, of which 100% is allocated to Chestnuts .
2. Annual Machinery Cost from table above divided by total hours used.
3. See formulas from ASAE, tractor functions rescaled to 6000 hours
4. Assumes diesel cost of \$4.00/gallon

## The Model

The model first calculates the sum of the future annual cash flows (gross revenues less cash outflow requirements) over the chestnut orchards economic life in terms of their present values. The future net cash flow values are discounted (converted) to their current values using an estimated target rate of return as a discount factor. Then the model transforms the sum of the discounted (converted) cash flows over the economic life into an average annual net return. Blue cells next to the calculation (Price, Target Rate of Return, and Yield at Full Production) may be modified to adjust the chestnut orchard model. Cells that are not blue contain formulas. Some of the non-blue cells may be modified by changing information in either the Chestnut Cost to establish, Chestnut Cost per Acre, or Chestnut Machinery Cost tabs.

The Chestnut orchard, over its economic life, must generate an annual cash flow that covers the annual net return of the defender orchard plus an annual dollar premium and/or land opportunity cost. These additional “costs” or penalties against revenue can help cover the uncertainty of certain parameters of the chestnut orchard system. The blue cell next to the calculation (Annual Dollar Premium) may be modified to a higher or lower dollar amount to account for the uncertainty of the Chestnut orchard system. The cell outlined in red (Yield at Full Production) is the value that you will SOLVE for in the analysis. Cells that are not blue contain formulas. Some of the non-blue cells may be modified by changing information in either the Defender Cost to Establish, Defender Cost per Acre, or defender Machinery Cost tabs.

To use the model:

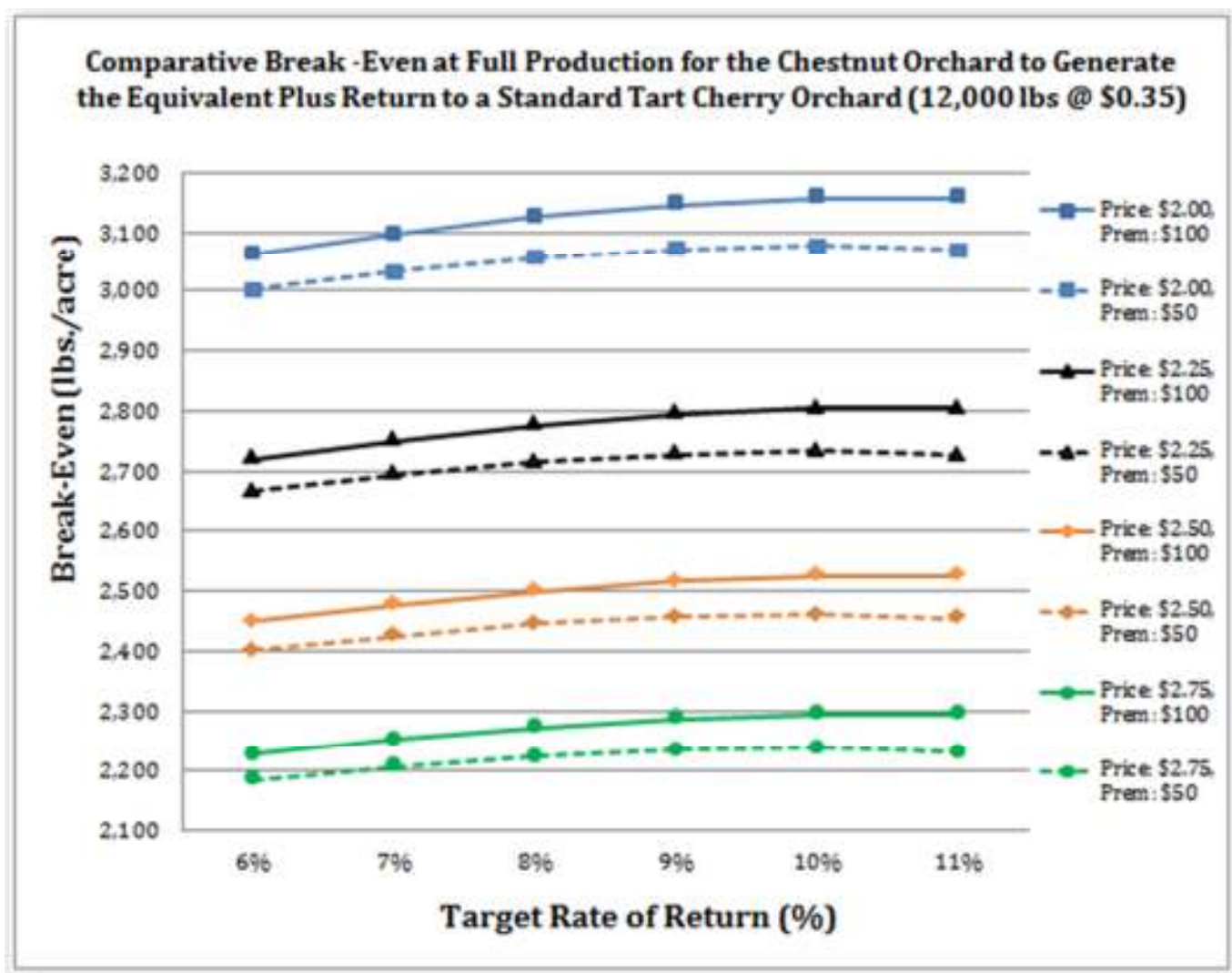
1. Review and update, if necessary, the cost of production tabs, Chestnut Cost to Establish, Chestnut Cost per Acre, Chestnut Machinery Cost, Defender Cost to Establish, Defender Cost per Acre, and Defender Machinery Cost to your operations effective costs. Do the costs you input, now reflect your existing defender orchard costs to establish and annual cost per acre? Do the cost for the Chestnut orchard system reflect your best estimate of the cost to establish and the annual cost per acre?
2. Review and update, if necessary, the blue cells (Price, Target Rate of Return, and Yield at Full Production) in the Chestnut Orchard Model tab. The values you input should reflect your expected average price per pound over the life of the orchard, your expected or desired percentage return rate, and your average yield during full production.
3. Review and update, if necessary, the blue cell (Annual Dollar Premium) in the Chestnut Orchard Model tab. If you are highly uncertain of the parameters of the Chestnut orchard system then increase the dollar value from its initial value of \$50/Acre. If you are less concerned over the uncertain parameters of the Chestnut orchard system, leave the \$50/Acre value in place or decrease the value.
4. To solve for comparative break-even yield at full production for the Chestnut orchard system, make sure you are within the Chestnut Orchard Model tab. Place your cursor on the yellow cell L28 and click the cursor once. Next click on the Data tab along the top of your screen. While you are still in the Data tab click on the drop down icon called "What-If Analysis". Within the drop down list of the "What-If Analysis", select the icon called "Goal Seek".
5. After you have click on the "Goal Seek" icon, a pop up table entitled "Goal Seek" should appear on your screen. If everything is working correctly, there should be three input boxes with the top one, "Set Cell", already filled in for you with L28. If the input box next to "Set Cell" is not filled in, place your cursor in the input box to the right of "Set Cell", click once and then move your cursor to the yellow cell L28 and click once. If the input box next to "Set Cell" is filled in with L28, place your cursor in the input box to the right of "To Value" and enter a 0. Then place you cursor in the input box to the right of "By Changing Cell" and click once. Then move your cursor to the cell outline in red, U5 and click once. The input box to the right of "By Changing Cell" should now have a U5 in it.
6. You are now ready to calculate the comparative break-even yield at full production for your Chestnut orchard system. Click "Okay" and within the "Goal Seek" pop up table and click "Okay" again when a second "Goal Seek"

icon appears. Now move to the Analysis & Interpretation Tab for a better understanding of what your results mean.

- You can also use this same process to solve for other parameters. You can choose different years, and choose either price or yield to solve for. "Rate of return" can be solved for given specific yields and prices. Be careful in changing cells that have formulas as you will affect the relationships between the chestnut orchard model and the defender orchard model.

### Comparative analysis

The table below illustrates the chestnut yield required to break-even and generate the equivalent income of a tart cherry orchard plus a defined rate of return based on price. We have already defined above how the chestnut production estimated were generated. The weighted average cost of producing the defender crop, tart cherry in Michigan on a representative farm is estimated at \$0.35/lbs and 12,000lbs/acre yield in the table below. The cherry cost of production was averaged across the three main production regions in Michigan and weighted by average per acre production for each region as published by the Michigan Agricultural Statistics Service. Users can utilize the spreadsheet to determine the chestnut yield or price needed to desire any level of return, tart cherry is simply provided for a comparison.



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